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SELECTED BIBLIOGRAPHY for the EXTRACTION of URANIUM from SEAWATER: CHEMICAL PROCESS and PLANT DESIGN FEASIBILITY STUDY, Volume II

OREGON STATE UNIVERSITY
1868

EXXON NUCLEAR COMPANY, Inc.

VITRO ENGINEERING CORPORATION

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XN-RT-15, Volume II
OSU-NE-7901, Volume II

SELECTED BIBLIOGRAPHY FOR THE EXTRACTION OF URANIUM FROM SEAWATER: CHEMICAL PROCESS AND PLANT DESIGN FEASIBILITY STUDY

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XN-RT-15

SELECTED BIBLIOGRAPHY FOR THE EXTRACTION OF URANIUM FROM SEAWATER:
CHEMICAL PROCESS AND PLANT DESIGN FEASIBILITY STUDY

VOLUME II

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ABSTRACT

A selected annotated bibliography of 521 references was prepared as a part of a feasibility study of the extraction of uranium from seawater. For the most part, these references are related to the chemical processes whereby the uranium is removed from the seawater. A companion document contains a similar bibliography of 471 references related to oceanographic and uranium extraction plant siting considerations, although some of the references are in common.

The bibliography was prepared by computer retrieval from Chemical Abstracts, Nuclear Science Abtracts, Energy Data Base, NTIS, and Oceanic Abstracts.

References are listed by author, country of author, and selected keywords.

SELECTED BIBLIOGRAPHY FOR THE EXTRACTION OF URANIUM FROM SEAWATER: CHEMICAL PROCESS AND PLANT DESIGN FEASIBILITY STUDY

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CHAPTER 1

INTRODUCTION

1.1 PURPOSE AND SCOPE

This document contains results obtained in a U. S. Department of Energy (DOE) project sponsored through Bendix Field Engineering Corporation (BFEC). The project was a joint effort between Exxon Nuclear Company, Inc. (ENC) and Oregon State University (OSU).

This document, the second of two volumes, contains selected bibliographic information used in the preparation of Volume I of XN-RT-15 and OSU-NE-7901, "Extraction of Uranium from Seawater: Chemical Process and Plant Design Feasibility Study." Both of these documents are closely related to two other documents, which were also an important part of the same study:

XN-RT-14, Volume I:

"Extraction of Uranium from Seawater: Evaluation of Uranium Resources and Plant Siting" by Michael R. Rodman, Louis I. Gordon, and Arthur C-T. Chen.

XN-RT-14, Volume II:

"Selected Bibliography for the Extraction of Uranium from Seawater: Evaluation of Uranium Resources and Plant Siting" by Arthur C-T. Chen, Louis I. Gordon, Michael R. Rodman, and Stephen E. Binney.

These documents constitute part of the low-level uranium resource study conducted by DOE/BFEC as part of the National Uranium Resource Evaluation (NURE) program.

1.2 COMPILATION METHODOLOGY

A total of 521 references from various countries are included in this bibliography. For the most part, these citations are related to the chemical processes which have been investigated to extract uranium from seawater.

The literature search for this project was performed mainly through the OSU Library Information Retrieval Service (LIRS) and the USDOE Technical Information Center RECON system at Oak Ridge, Tennessee.

LIRS provides on-line bibliographic searching through remote access terminals. These terminals connect with information retailers such as Lockheed Information Systems and Systems Development Corporation. LIRS directly retrieves information from a number of indices and directories specially programmed for retrieval by computer. These data bases cover agriculture, the biological sciences, business, chemistry, education, engineering, the earth science, physics, psychology, and the social sciences. Computer search has the advantages of specificity and comprehensiveness. Through text-searching and Boolean logic, the searcher may specify search parameters by coordinating subjects, authors, time periods to be covered, etc. Also, direct access to data bases allows the search to interact with the system to augment or alter the search strategy. Another advantage of this search is the immediate retrieval of information, typically from 10 to 20 minutes, as opposed to a number of days of equivalent manual searching. The printout consists of a computer-produced bibliography with citations which can be displayed in various formats on-line, or printed off-line.

The RECON system was accessed off-line to information in a similar fashion to that obtained from LIRS.

The search may be comprehensive or specific, and it may involve several data bases. Many of the data bases in LIRS cover only the last four to five years of the literature. The data bases considered most appropriate for the LIRS search were Chemical Abstracts, Oceanic Abstracts and the National Technical Information Service (NTIS). Chemical Abstracts were searched for three data bases arranged according to year, namely, 1970-71, 1972-76, 1977-78. The Oceanic Abstracts and NTIS searches included information from 1964 to 1977 and 1964 to 1978, respectively. In the RECON search, the data bases accessed were Nuclear Science Abstracts (1966-1976) and Energy Data Base, including Atomindex (1976-1978).

As mentioned above, text searching was done by Boolean logic. Search parameters were specified by combining keywords or descriptors that are related to the subject of interest. The computer searched through the title words, corporate sources, index terms and sometimes abstracts of the articles in the different data bases selected, retrieved and printed out according to the format chosen those articles containing the specified search parameters.

In the LIRS search, information was retrieved from Oceanic Abstracts and NTIS by using the following combinations of keywords:

> (uranium or titanium) and (seawater or ocean- or river water(s) or estuar- or algae or kelp or sewage or phytoplankton or plankton or marine organism(s)) and (234 or 235 or 238 or isotope(s) or reactor(s) or U234 or U235 or U238) but not (corrod- or corrosion).

The Chemical Astracts 1977-78 data base was searched using the same descriptors together with the Chemical Abstracts' sections on extractive metallurgy (CA054) or water [reviews (CA061000), source (CA061001), and analysis (CA061002)], but without (234 or 235 or 238 or U234 or U235 or U238 or reactor(s) or isotop- or corrod- or corrosion).

The keywords used to search the other two Chemical Abstracts data bases were limited to:

> (uranium or U or U308 or U02) and (seawater or ocean- or river water(s) or estuar- or algae or kelp or sewage or phytoplankton or plankton or marine organism(s) but without (234 or 235 or 238 or U234 or U235 or U238 or reactor(s) or isotop- or corrod- or corrosion or sediment(s)).

The word titanium was excluded to be more specific about the main subject of the literature search.

As bibliographic information and actual reprints and copies of articles were acquired, the appropriate bibliographic data were entered into the FAMULUS bibliographic data management system available through the Oregon State University Computer Center. This system provided the capacity for entry and storage of the bibliographic data, editing capability, listing and numbering after sorting (in this case by alphabetical order of authors), indexing according to keywords and other descriptors, and finally printing out in useable format the data list and indices which comprise Chapters 2 and 3 of this report. A sample of one bibliographic entry and listing by FAMULUS is shown and described in Section 1.3.

1.3 EXPLANATION OF FORMAT

Included below is a sample bibliographic entry found in Chapter 2:

```
107  AUTH  Davies,R.V.; Kennedy,J.; McIlroy,R.W.; Spence,R.; and
           Hill,K.M.
     DATE  1964
```

TITL Extraction of uranium from sea water.
CITA Nature 203: 1110-1115 (1964).
COUN UK
AREA Menai Straits, Portland Harbour
ABST A summary of the program to separate uranium from sea water by continuous counter-current extraction is presented.
KEY extraction, uranium, seawater, plant design, concentration, chemical species

Each reference has an identification number (107 in the example above) internal to this bibliography. Each reference is further identified by eight field descriptors as follows:

AUTH The authors of the reference are listed as cited (in this example, Davies, Kennedy, McIlroy, Spence, and Hill). Section 3.1 contains an index which sorts all of the bibliographic entries alphabetically by the last name of all the authors of each of the references.

DATE This field descriptor refers to the year in which the reference was published (1964, for this citation).

TITL This refers to the title of the bibliographic entry as published.

CITA Listed in this entry is the journal or technical report citation. For example, the article entitled "Extraction of Uranium from Sea Water" was published in Nature, volume 203, pages 1110 to 1115, in 1964. If the citation was in a language other than English, it is so indicated.

COUN The country listed refers to the country of the authors. This entry was included because so much of the work on the extraction of uranium from seawater has been performed in countries other than the United States. Section 3.2 contains a sorting of the bibliographic entries by country of the author.

AREA The geographical area in which the work was performed is included, if it pertains specifically to a certain oceanic region. In the example shown, reference was made to studies in the Menai Straits of Wales and Portland Harbour, England.

ABST An annotation is included for each reference. Often this is the abstract as found in the particular abstracting source from which the citation was obtained.

KEY Keywords are included in order to provide sortings of the bibliographic entries according to subject material. If not already listed in the abstracting source, keywords were added to represent the important topics covered in the reference. A sorting of the bibliographic entries according to keyword is included in Section 3.3.

1.4 ACKNOWLEDGEMENTS

This work was performed for DOE/BFEC with Mr. Owen Kingman, BFEC, serving as Contract Manager and providing many helpful suggestions during the course of this work.

The authors would also like to extend special thanks for the valuable assistance given them by the following individuals: Mr. Paul Oman and Mr. Robert Baker, for their assistance in running the FAMULUS program; Ms. Kris Brooks, for performing the computerized literature searches at OSU; Dr. Arthur Chen and Dr. Louis Gordon, for their overall collaboration on this project as consulting investigators; and Ms. Mary Knower, for her assistance in entering the bibliographic data into FAMULUS.

1.5 REFERENCE

[1] Pacific Southwest Forest and Range Experiment Station, "FAMULUS: A Personal Documentation System - Users' Manual", Forest Service, U. S. Department of Agriculture (1969).

CHAPTER 2

BIBLIOGRAPHIC LISTING

The selected bibliography for this portion of the project is listed in this section in alphabetical order according to the last name of the first author of each entry. A sample format is shown in Section 1.3.

1 AUTH Abrao,A.; Franca,J.M.Jr.
DATE 1970
TITL Pilot plant for purification of uranium by ion exchange in IEA operations.
CITA Instituto de Energia Atomica Report IEA-219: 94p (1970). (Portuguese).
COUN Brazil
ABST The installation and operation of a pilot plant for uranium purification based on an ion-exchange process are described. The preparation of uranyl nitrate solution, used to feed the ion-exchanger columns, is performed by fractional dissolution of raw sodium diuranate. The decontamination of thorium plus rare earth elements is achieved by oxalic acid precipitation directly in the bulk of uranyl nitrate. The decontamination of various impurities is enhanced by an EDTA-complex formation before the uranyl load on the strong cationic resin bed. The uranyl sulfate obtained by eluting the resin column with ammonium sulfate is reverse precipitated to avoid sulfate coprecipitation in the nuclear grade ammonium diuranate obtained.
KEY uranium, ion exchange, trace metals, elution, plant design, extraction

2 AUTH Acker,E.G.; Winyall,M.E.
DATE 1972
TITL Silica of high pore volume.
CITA Ger. Offen. 2,145,090 (Cl. C 01b, B 01j, C 09c), US Appl. 71,966, 14 Sep 1970: 26p (1972).
COUN W Germany
ABST SiO_2 of pore vol. 1.2-3.0 cm^3/g and particle size ≤ 0.1 or 1-20 μ, useful as thickening or delustering agents, resp., was manufd. from Na silicate soln. by adding NH_3 as coacervating agent for redn. of the soly. of the silicic acid and acidification to pH 10.6-11.2 for pptn. The ppt. was aged and washed. Thus, aq. H_2SO_4 was added to a soln. of 2500 ml Na silicate (28% SiO_2, 8.7% Na_2O), 3250 ml H_2O, and 1750 ml 30% NH_4OH. Gelation began at pH 10.95 and H_2SO_4 was slowly added to form a slurry at pH 10.4, which was filtered. The residue was washed with H_2SO_4, suspended again, and the mixt. passed through a jet pulverizer at 232° and 10.5 atm gage. The formed product was dried at 200° to give SiO_2 of surface area 449 m^2/g, H_2O pore vol. 2.4 cm^3/g, particle size 50-75 nm, and bulk d. 0.06. A mineral oil thickened with 2, 3, and 4% of this SiO_2 had a viscosity of 2250, 4500, and >10,000 cP, resp.
KEY adsorbent, chemistry, temperature

3 AUTH Adam,J.; Stulikova,M.
DATE 1974
TITL Selective extraction and determination of uranium using

(CONT.)
diphenyl acetic acid.

CITA Collect. Czech. Chem. Commun. 39(9): 2576-2580 (1974).

COUN Czech

ABST A benzene solution of diphenyl acetic acid is suitable for the extraction of uranyl ions from alkaline aqueous solutions. Addition of nitrilotriacetic acid to the aqueous phase renders the extraction selective for uranium in the presence of iron(III), nickel(II), lead(II), zinc(II), cobalt(II), cadmium(II), manganese(II), copper(II), chromium(IV), and molybdenum(VI) by selective masking of these ions. Gold(III) and platinum(IV) were found to interfere slightly. Transfer of the uranium into the organic phase is virtually quantitative after two extractions. Polarographic and spectrophotometric determinations were studied; in the latter case, dibenzoylmethane is added to the organic extraction phase as a colorimetric reagent. The polarographic determination is preferably performed after re-extraction of the uranium into aqueous solution (0.5M-KCl-0.5M-HCl). The former method provides a wider useful concentration range (10^{-5} to 5.10^{-3}M-U(VI) in the extract) than the latter (10^{-5} to 2.10^{-4}M-U(VI) in the extract); however, the latter has greater accuracy (±3%) than the former (±5%) as well as being more simple.

KEY extraction, uranium, trace metals, analysis, water, concentration

4 AUTH Adams,W.H.; Buchholz,J.R.; Christenson,C.W.; Johnson,G.L.; Fowler,E.B.

DATE 1975

TITL Studies of plutonium, americium, and uranium in environmental matrices.

CITA Report by Los Alamos Scientific Lab, LA 5661: 26p (1975).

COUN USA

ABST A nitric acid-hydrofluoric acid treatment for dissolution of plutonium oxides in soils has been developed; its adaptation to other biological matrices is discussed. Plutonium recoveries of 94 to 99% from 1-g samples of spiked and heated soils are reported. Adaptation of the acid solution to subsequent anion exchange separation of plutonium, followed by coupling to known electroplating techniques, is described. The uptake of plutonium, americium, and uranium from spiked soils by alfalfa, beans, radishes, lettuce, tomatoes, and barley is reported. The "apparent" solubility of Pu(238)O_2 in tap water was measured, and the deposition of plutonium in fish, algae, and snails in aquaria containing Pu(238)O_2 microspheres is reported.

KEY ion exchange, uranium, environmental impact, extraction, marine organisms, organics

(CONT.)

5 AUTH Agrawal,Y.K.
DATE 1975
TITL Extraction and photometric determination of uranium (VI) with N-p-tolylbenzohydroxamic acid (p-TBHA).
CITA Anal. Lett. 8(4): 257-267 (1975).
COUN India
ABST A rapid method for the simultaneous solvent extraction and spectrophotometric determination of hexavalent uranium with N-p-tolylbenzohydroxamic acid is described. The intense red complex with uranium can be extracted by chloroform at pH approx. 4.3. The red colored complex obeys Beer's law at 515 nm. A satisfactory separation from many commonly occurring metal ions is easily accomplished. Effects of acidity, reagent concentration and diverse ions on the visible absorption spectrum of the extracted complex have also been investigated.
KEY extraction, uranium, analysis, chemistry

6 AUTH Agrawal,Y.K.
DATE 1975
TITL Solvent extraction of uranium (VI) by N-m-tolyl-o-methoxybenzohydroxamic acid.
CITA Sep. Sci. 10(2): 167-173 (1975).
COUN India
ABST A simple and rapid spectrophotometric determination of uranium (VI) is described. The uranium (VI) N-m-tolyl-o-methoxybenzohydroxamic acid complex is extracted with chloroform at pH 5.3 to 5.5 from aqueous solution. Maximum absorption of orange-red extract occurs at 510 nm. The colored complex obeys Beer's law over the range 0.3 to 20 ppm of uranium. The effect of acidity, reagent concentration, and diverse ions on the visible absorption of extracted complex has been studied.
KEY extraction, uranium, chemistry, water, concentration

7 AUTH Ahrland,S.
DATE 1949
TITL On the complex chemistry of the uranyl ion. I. The hydrolysis of the six-valent uranium in aqueous solutions.
CITA Acta Chemica Scand. 3: 374-400 (1949).
COUN Sweden
ABST It has been shown by extinctiometric measurements that the uranyl ion UO_2^{2+} is the only existing complex of six-valent uranium in aqueous solution from $p[H^+] = 0.1$ (the lowest investigated) up to $p[H^+] = 2$. Over that $p[H^+]$ further hydrolysis complexes are gradually formed. So UO_2^{2+} may be regarded as a complex forming central group, and formulas for its complex formation have been developed in a manner analogous to other metal ions. The extinction curve of UO_2^{2+} has been determined; from

(CONT.)
this curve, the data of the literature have been found to be erroneous. Further investigation has been done for the hydrolysis of UO_2^{2+}.
KEY uranium, water, chemistry, analysis, concentration, trace metals, chemical species, extraction

8 AUTH Ahrland,S.; Hietanen,S.; Sillen,L.G.
DATE 1954
TITL Studies on the hydrolysis of metal ions. X. The hydrolysis of the uranyl ion, UO_2^{2+}.
CITA Acta Chemica Scand. 8: 1907-1916 (1954).
COUN Sweden
ABST All complexes from the hydrolysis of UO_2^{2+} which formed in appreciable amounts can be written in the form: $UO_2((OH)_2UO_2)_n^{2+}$, or, which is equivalent, $UO_2(OUO_2)^2{}_n^{2+}$. A direct analysis of the Y(X) curve (Y=1/2 Z) showed that several complexes with different n are formed. In view of X-ray evidence on the structure of compounds that may be precipitated from uranyl solutions, it seems reasonable that the complexes are sheet-like, probably with double OH bridges. The most correct formula would thus be $UO_2((OH)_2UO_2)_n^{2+}$.
KEY uramium, water, chemistry, analysis, concentration, chemical species, extraction

9 AUTH Akatsu,E.
DATE 1977
TITL Data of ion exchange.
CITA Japan Atomic Energy Research Inst. Report JAERI-M-7168: 45p (1977).
COUN Japan
ABST Behavior of ion exchange of several elements are compiled as 30 figures in the sequence of periodic system. Exchangers are Dowex, Diaion and inorganic ion exchangers. Data of adsorption on charcoal and silica gel are also given.
KEY ion exchange, adsorbent, trace metals

10 AUTH Alder,J.F.; Das,B.C.
DATE 1978
TITL Determination of low-levels of uranium by an indirect flame and electrothermal AAS procedure after ion-exchange preconcentration.
CITA At. Absorpt. Newsl. 17(3): 63-64 (1978).
COUN UK
ABST Low levels of U in water are concd. by passage through an ion exchange column followed by an elution with 3M H_2SO_4. The U is detd. by both flame and graphite furnace at. absorption spectrophotometry (AAS) using an indirect method based on the redn. of Cu(II) by U(IV) followed by complexation of the Cu(I) with 2,9-dimethyl-1,10-phenanthroline and finally, detn. of

(CONT.)
the Cu by conventional AAS. Solns. contg. $\geq$25 ppb U can be detd. by flame AAS and 2 ppb by the nonflame method. Various interferences have been studied; only Fe(III) presented a problem which can be overcome by complexation of the Fe with citrate.
KEY uranium, analysis, ion exchange, extraction, elution

11 AUTH Almagro Huertas,V.
DATE 1974
TITL Comparative study of some electrochemical methods used in the determination of U.
CITA Energ. Nucl. (Madrid) 19(88): 103-108 (1974). (Spanish).
COUN Spain
ABST An experimental study was made of the various methods for the evaluation of U using electroanalytical techniques. The values obtained in routine use of these methods were compared. The techniques used were amperometric, coulometric, and classical and automated potentiometric methods. A study on the final results obtained in the polarography of U was included.
KEY uranium, analysis

12 AUTH Alovitdinov,A.B.; Kochkarova,Kh.Y.; Kuchkarov,A.B.
DATE 1974
TITL Sorption of uranyl ions by the cation exchanger KAAF-0.40.
CITA Russ. J. Phys. Chem. 48(6): 915-916 (1974).
COUN USSR
ABST The sorption of uranyl ions from organic and inorganic acid solutions and from buffer solutions by the KAAF-0.40 cation exchanger was investigated. A high affinity of the uranyl ion for this exchanger has been observed.
KEY ion exchange, uranium, adsorbent

13 AUTH Amphlett,C.B.; McDonald,L.A.; Redman,M.J.
DATE 1958
TITL Synthetic inorganic ion-exchange materials-II. Hydrous zirconium oxide and other oxides.
CITA J. Inorg. Nucl. Chem. 6: 236-245 (1958).
COUN UK
ABST The oxides ZrO_2, ThO_2, and TiO_2 behave as anion exchangers in acid and neutral solution and cation exchangers in alkaline solution, the pH at which their behavior changes depending upon the oxide itself and possibly also upon the nature of the exchanging ion. The oxides have been prepared in granular form and their reversible reactions with ions in solution have been studied; they are monofunctional exchangers, with appreciable rates of exchange, and display the expected affinity towards ions in solution. Owing to their weakly basic nature, exchanged ions are readily removed

(CONT.)

by treatment of water. When ZrO_2 is treated with phosphoric acid it is converted into zirconium phosphate having properties qualitatively similar to the material described in Part I; the reaction cannot be solely one of anion exchange, but must involve breakdown of the oxide and introduction of further acid phosphate groups by neutralization. WO_3 is a cation exchanger in acid solution, but dissolves in alkalinic solution.

KEY ion exchange, titanium, chemistry

14 AUTH Andreine,R.J.; Lower,G.W.; DeMull,T.J.Jr.

DATE 1976

TITL Solvent extraction of uranium for dilute solutions using a gas-bubble mixed extraction column.

CITA Metall. Trans. B. 156(7B): 253-258 (1976).

COUN USA

ABST A modified solvent extraction process for recovering uranium from very dilute solutions, such as mine waters or copper dump liquors, has been developed and tested on a laboratory scale. The system utilizes a column in which the aqueous feed flows downward through a liquid organic extractant. A countercurrent flow of gas is used to achieve mixing and enhance mass transfer. Acid sulfate solutions at pH 1.5 containing either 0.010 or 0.015 g/l U_3O_8 comprised the feed. The extractant used was Alamine 336 dissolved in fuel oil. Critical parameters of the system, such as length to diameter ratio of the organic phase, volume ratio of aqueous to organic in the column, and flow rates of aqueous feed and gas are examined.

KEY extraction, uranium, water, chemistry

15 AUTH Andrianov,A.M.; Koryukova,V.P.; Il'inskaya,E.P.; Koval'chuk,L.I.

DATE 1977

TITL Sorption of uranium by an industrial sample of titanium hydroxide.

CITA Sov. Radiochem. 19(6): 653-655 (1977).

COUN USSR

ABST The conditions of extraction of uranium from solutions with an industrial sample of titanium hydroxide were investigated. The advantages of the proposed sorbent are noted: high sorption activity, chemical and mechanical stability, simplicity of regeneration, and availability.

KEY titanium, adsorbent, uranium, extraction, water, temperature, chemistry, concentration, capacity, seawater, elution

16 AUTH Anonymous

DATE 1964

TITL The extraction of uranium from seawater.

(CONT.)
CITA Comit. Nazl. Energia Nucl., Notiziario 10(12): 62-68 (1964). (Italian).
COUN Italy
ABST The possibility of recovering uranium from natural water, including seawater, by means of ion-exchange resins is considered.
KEY extraction, uranium, water, seawater, ion exchange

17 AUTH Anonymous
DATE 1966
TITL Extraction of metal anions.
CITA American Metal Climax, Inc. Neth. Appl. 6,511,360 (Cl. B 01d), U.S. Appl. Aug 31, 1964: 21p (1966).
COUN The Netherlands
ABST Anions or complex anions of metals such as Mo, Se, U, and W are extd. from aq. solns. with anion-exchange resins. A weakly basic anion exchanger contg. active primary and secondary amine groups is brought into contact with a dil. aq. soln. at pH 2-8 contg. small amts. of the metal anions and regenerated with a soln. contg. acid anions. An app. for performing the extn. is described. In an example, a neutral soln. contg. 15-18 ppm. Mo is passed over 5 columns, contg. 42 g. Amberlite IR-4B. At first, the resin is conditioned and converted into the acid sulfate form with a soln. contg. H_2SO_4 50 g./l. The resin is regenerated with H_2SO_4 15 g./l. The resin absorbs about 90% of the Mo present until a concn. of 90 g. Mo/dm.^{3} resin is obtained. The resin is eluted with a soln. of 20 g./l. NH_4OH and 5 g./l. NaOH. A Mo concn. of 25 g./l. eluate may be attained.
KEY extraction, ion exchange, trace metals, water, chemistry, capacity, elution, uranium

18 AUTH Anonymous
DATE 1967
TITL National conference on the technology of the sea and sea bed.
CITA Atom (127): 111-122 (1967).
COUN UK
ABST The papers presented at the Conference held at the Atomic Energy Research Establishment, Harwell, England, on April 5 to 7, 1967 are reviewed. These include the following: The use of nuclear explosives for sea-bed mining; extraction of uranium and other inorganic materials from sea water; unconventional nuclear reactors for underwater power; application of radioisotope tracers to spoil ground selection; and Harwell oil pollution work.
KEY extraction, uranium, seawater

19 AUTH Anonymous
DATE 1967

(CONT.)
TITL National conference on the technology of the sea and sea-bed.
CITA Atom (123): 113-116 (1967).
COUN UK
ABST Exploitation of the resources of the sea and sea-bed was the theme of a conference organized by the United Kingdom Atomic Energy Authority on behalf of the Ministry of Technology. Among the subjects covered were the technology of gaining food from the sea; movement and control of the sea-bed; sea rigs and platforms; information handling for oceanography and for meteorology over the oceans. Abstracts of the conference papers are published here. The full proceedings will be made available through H.M.S.O.
KEY seawater, sediments, trace metals, extraction

20 AUTH Anonymous
DATE 1967
TITL Uranium resources; revised estimates.
CITA A Joint Report by the European Nuclear Energy Agency and the International Atomic Energy Agency. (December): 26p (1967).
ABST This report is a summary and update of the known and estimated uranium resources in the world. Also included are comments on the reliability of the estimates and a short summary on uranium from the sea. In all, the reserves of 20 countries are presented.
KEY uranium, extraction

21 AUTH Anonymous
DATE 1972
TITL Quality of surface waters of the United States, 1968. 1. North Atlantic slope basins.
CITA U.S. Geol. Surv., Water-Supply Pap. (2091): 373p (1972).
COUN USA
AREA North Atlantic
ABST The water data collected by the U.S. Geol. Survey is presented and discussed.
KEY n atlantic, water, analysis

22 AUTH Anonymous
DATE 1974
TITL Quality of surface waters of the United States, 1969. 3. U.S. Geological Survey.
CITA U.S. Geol. Surv., Water-Supply Pap. (2143): 371p (1974).
COUN USA
ABST The compn. and properties of water of rivers in Alabama, Georgia, Illinois, Indiana, Kentucky, Maryland, New York, Ohio, Pennsylvania, Tennesse, Virginia, and West Virginia are given.
KEY water, river, analysis

(CONT.)

23 AUTH Anonymous
DATE 1975
TITL Apparatus and method for extracting uranium from sea water.
CITA Fr. Demande 2,243,264 (Cl. C22B, A01H), Ger. Appl. P 23 45 430.0, 08 Sep 1973: 7p (1975).
COUN W Germany
ABST A mutant strain of unicellular green algae is prepd. from a sea water culture to which $UO_2(NO_3)_2$ is progressively added until the culture contains 250 mg/l. U [7440-61-1]. These algae can tolerate high concns. of U and are capable of concg. U in sea water from 6 to 6000 ppm. A cage filter in which the opposite walls are made of sieves with 50-100 μ openings is used to allow sea water to be circulated through the mutant algae.
KEY uranium, seawater, extraction, capacity, concentration, marine organisms

24 AUTH Anonymous
DATE 1975
TITL Better U from sea process.
CITA Nuclear Engineering International: 462 (1975).
COUN Japan
ABST Japan has developed a new absorber, a granulated composite of active carbon and metallic bases of zinc, aluminum, and titanium as the absorber, which reportedly will extract uranium 2 to 3 times as effectively as the method using titanium hydroxide or lead glance. It will be tested this summer.
KEY adsorbent, titanium, uranium, capacity, extraction

25 AUTH Anonymous
DATE 1975
TITL Uranium from seawater.
CITA Meerestechnik 6(3): 92 (1975). (German).
COUN W Germany
ABST A report is given on the plans of the Japanese Ministry for International Trade and Industry (MITI) for the extraction of uranium in series (coupling with heat or nuclear power plant) or tidal methods, from seawater.
KEY extraction, uranium, seawater, tidal system, multi-purpose process

26 AUTH Anonymous
DATE 1975
TITL Uranium from seawater. Practical Japanese plants can operate in 1985 - other minerals may also be extracted.
CITA Ingenider-NYTT 11(34): 15,40 (1975). (Norwegian).
COUN Japan
ABST The principles of two processes developed in Japan for the extraction of uranium from seawater are described. Both systems use adsorbent filters, one being supplied

(CONT.)

with warm seawater from power plant condenser cooling water, the other utilizing tidal flow. Project planning is to be carried out in the period until 1980 and the first type is planned to be completed in 1985. Due to the extensive dam building, the tidal type could not be operable before 1990. Strontium, vanadium and phosphorus could be valuable by-products, while the tidal type could be combined with a tidal power station.

KEY extraction, uranium, seawater, filtration, adsorbent, tidal system, plant design, multi-purpose process, trace metals

27 AUTH Anonymous
DATE 1976
TITL Is there enough uranium.
CITA S. Afr. J. Sci. 72(4): 101 (1976).
COUN S Africa
ABST Published in summary form only.
KEY uranium, economics, existing plants

28 AUTH Anonymous
DATE 1976
TITL Uranium ore processing. Panel proceedings series. Proceedings of an advisory group meeting.
CITA International Atomic Energy Agency (Vienna, Austria) Report STI/PUB-453: 244p (1976).
COUN Austria
ABST The U ore processing conference had sessions on: anticipated future demand for U and need for increase in milling capacity; U ore milling practice; known and partially engineered techniques which have not reached fuel application in milling of U ores; process problems and developments for some new U ore occurrences; processing of low-grade resources; U as by-product and by-products from U ores; in-situ leaching; and recovery of U from seawater.
KEY uranium, seawater, extraction

29 AUTH Anonymous
DATE 1976
TITL Uranium-from-sea plant begins operation in Japan.
CITA Nuclear News (January): 66 (1976).
ABST Reports from Japan indicate that the Ministry of International Trade and Industry recently began operation of an experimental plant to recover uranium from seawater. Located on Shikoku island, the first-of-a-kind plant circulates 40 tons of water per day over an adsorber made of activated carbon and titanic acid. The seawater is circulated several hundred times while being stirred by an electric rotor. Uranyl carbonate extracted from the seawater is trapped by the adsorber and treated chemically. Reports

(CONT.)
indicate the experimental plant is expected to extract only about 10 grams of uranium a year. Earlier estimates of similar processes concluded that uranium produced from seawater would have to cost several hundred dollars per kilogram. The Japanese plant is designed to obtain basic technical information for a larger facility planned by the Resources and Energy Agency.
KEY uranium, seawater, adsorbent, extraction, economics

30 AUTH Anonymous
DATE 1977
TITL Hot plankton.
CITA Newsweek (Dec. 12): (1977).
COUN USA
ABST A deposit of uranium covering more than 100,000 square miles was discovered in the Black Sea. The uranium is bound up in the proteins and sugars of free-floating coccolith plankton (species Umbilicosphaera), and the uranium is concentrated ten thousand fold. The plankton die and sink to the bottom, where the uranium is deposited. Recovery might be accomplished with a vacuum system, and possible isolation and synthesis of the binding sugars is being examined.
KEY uranium, marine organisms, sediments

31 AUTH Anonymous
DATE 1977
TITL New absorbent for low-grade uranium success.
CITA S. Afr. Min. Eng. J. 88(4133): 82 (1977).
COUN S Africa
ABST Published in summary form only.
KEY ion exchange, uranium, adsorbent, extraction

32 AUTH Anonymous
DATE 1977
TITL New extraction methods for use in Southvaal uranium plant.
CITA S. Afr. Min. Eng. J. 88(4133): 19 (1977).
COUN S Africa
ABST Published in summary form only.
KEY extraction, uranium, ion exchange, economics

33 AUTH Anonymous
DATE 1978
TITL Microorganism cultures for extracting uranium from seawater.
CITA Brit. 1,507,003 (Cl. A01H13/00), Ger. Appl. 2,509,943, 07 Mar 1975: 3p (1978).
ABST U was extd. from sea water using mutants of the blue-green algae Oscillatoria or the fungus Aspergillus niger capable of absorbing U from sea water to a greater

(CONT.)

extent than the naturally occurring organisms. Thus, U-absorbing mutants of A. niger were selected following x-irradn. and adapted to sea water. Cultivation of the mutant strain on artificial sea water contg. 0.006 ppm U gave dry fungal mass after 24 h contg. 10-40 mg U/kg.

KEY marine organisms, extraction, uranium, seawater, capacity, concentration

34 AUTH Anonymous
DATE 1978
TITL Titanium: mineral commodity profiles.
CITA Bureau of Mines, U.S. Dept. of Interior, MCP-18: 19p (1978).
COUN USA
AREA North America, South America, Europe, Africa, Asia, Oceana
ABST Production of titanium dioxide pigment in the U.S. in 1977 amounted to about 680,000 tons, valued at about $580 million. Calculated production of titanium sponge metal was around 14,000 tons, worth about $77 million. These two major uses account for over 96% of domestic consumption of titanium. Other uses of titanium-bearing raw materials are for manufacturing welding rod-coatings, titanium carbides, ceramics, chemicals, and various other products. Total U.S. primary demand for titanium in 1977 was about 30% of world primary demand. The mineral sources of titanium products are rutile and ilmenite. Rutile is far less common than ilmenite. World production is predominantly from deposits on Australia's east coast. U.S. demand for rutile, however, has risen from 12,000 tons in 1950 to 180,000 tons in 1977; demand in the rest of the world, while not increasing as sharply, is nevertheless rising. Present technology requires ilmenite for making titanium pigment by the sulfate-process, either directly or through a high-titania slag as an intermediate form. Rutile is more versatile; its foremost use is to make pigment via the chloride process. In 1977 demand for titanium metal was divided between military hardware (mostly aircraft), commercial aircraft, and industrial uses. The amount of titanium consumed in industrial uses, such as for reaction vessels, condensers, heat exchangers, and other chemical processing equipment, and in steel and other alloys, is generally increasing.
KEY titanium, economics

35 AUTH Anonymous
DATE 1978
TITL Uranium extraction.
CITA Holz, P. (ed.), Chronicle of achievement 1953-1978, 26(3): 51,53 (1978).
COUN S Africa

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ABST Published in summary form only. A special supplement to Coal, Gold Base Miner. South Afr. (Mar 1978) v. 26(3).
KEY uranium, extraction

36 AUTH Antal,P.S.
DATE 1964
TITL Complexing of uranium in sea water.
CITA I. Geochemical Evidence for Stabilization in the Oceans. II. UO_2^{2+} Hydrolysis. (University of Miami, Institute of Marine Science, Technical Report, 64-5, October): 23p (1964).
COUN USA
ABST I. The relatively high uranium concentration of sea water is discussed in terms of a supply-removal steady state. The comparison of average abundances of uranium and other elements indicates that complexation by sea water constituents makes uranium (VI) difficult to remove from solution. II. Hydrolytic quotients of uranium (VI) complexes $(UO_2)_q(OH)_m^{2q-m}$ are critically reviewed; for computation in sea water medium the following values are recommended: $K_{0-1} = 6 \pm 4x10^{-9}$, $K_{0-2/2} = 1.0 \pm 0.2x10^{-11}$, $K_{0-4/3} = 2.3 \pm 0.2x10^{-15}$, $K_{0-5/3} = 1.8 \pm 0.2x10^{-18}$. The concept of reduced instability quotients, $B = K - pB_{mq}/m$, is introduced as a measure of hydroxyl bonding strength. B decreases (logarithmic scale) from 11.02 in the 2-2 complex, to 10.50, 10.43, 10.05, in the 4-3, 5-3, 6-3 complexes, respectively. Further substitution reduces it to 9.68 in the 7-3 compound, and to 8.64 in $[(OH_8(UO_2)_3]^{=}$. Computation of complex concentrations in sea water indicates that only UO_2OH^+ adds significantly to the species distribution. Hydrolysis reduces the average charge of uranium species, but condensation does not proceed in the presence of complexing anions: the net effect is stabilization of uranium in sea water.
KEY uranium, seawater, concentration, chemical species

37 AUTH Aravamuthan,V.
DATE 1978
TITL Some thoughts on the recovery of freshwater and marine chemicals from seawater.
CITA Indian Chem. J. 12(9): 19-34 (1978).
COUN India
ABST The review, with 4 refs., covers unified schemes for desalting water, recovering Br, I, B, and U, producing NPK fertilizer, alkali metals, and Mg sulfates and using tidal and thermal energy.
KEY seawater, extraction, existing system, trace metals, uranium, tidal system

38 AUTH Armitage,B.; Zeitlin,H.
DATE 1971

(CONT.)

TITL Preconcentration of various trace elements in sea water by solvent extraction and the ring oven.

CITA Anal. Chim. Acta 53(1): 47-53 (1971).

COUN USA

ABST A procedure is described for the preconcn. from sea water without pretreatment of 6 trace elements U, Cu, Ni, Co, Fe, Mn through solvent extn. with an 8-hydroxyquinoline-$CHCl_3$ mixt. Extd. samples are deposited on filter-paper disks with the aid of a kinetic clamp pump and a ring oven, and the 6 elements are detd. nondestructively by x-ray fluorescence. Evaluation of the procedure with distd. water and sea water samples spiked with the metal ions shows that extn. of the trace metals is essentially quant.

KEY extraction, seawater, uranium, water, trace metals, analysis

39 AUTH Assmann,E.; Diekers,G.; Opitz,K.

DATE 1972

TITL Silica gel production with the aid of ion exchangers.

CITA Ger. (East) 93,539 (Cl. C 01b), Appl. 159,224, 26 Nov 1971: 2p (1972).

COUN E Germany

ABST SiO_2 gel of large internal surface and high porosity is prepd. by forming a sol at 0-15°, at low pH, and at a concn. $\leq$ 20%, by treatment with acid and a cation exchange resin warming to 30-90° to form a gel, and drying. Thus, 700 l. of regenerated and washed cation exchange resin, 100 l. of aq. H_2SO_4, and 100 kg. of ice were well stirred to form a suspension at 1-5°, with liq. having a pH of 2.5. The 200 l. of aq. Na silicate soln. contg. 350 g SiO_2/l. was added to the stirred suspension in 30 min, the temp. increasing to 10-15°, and the soln. attaining a pH of 2.0-2.5 and a d. of 1.09 g/ml. The sol. was then sepd. from the resin and warmed to 70°, causing it to gel rapidly. After the removal of exuded H_2O, the hydrogel was dried to form the xerogel product.

KEY ion exchange, adsorbent, temperature, chemistry

40 AUTH Astheimer,L.; Schenk,H.J.; Schwochau,K.

DATE 1977

TITL Uranium enrichment from sea water by adsorption on brown coal.

CITA Chem.-Ztg. 101(12): 544-546 (1977). (German).

COUN W Germany

ABST Brown coal absorbed $\leq$ 3 ppm U from sea water in batch and column procedures. U in coal was detd. fluorimetrically after ashing, heating with HNO_3, and extn. with Me iso-Bu ketone. The presence of Ca^{2+} and Mg^{2+} (sea water) reduced adsorption of U.

KEY uranium, seawater, adsorbent, analysis, trace metals,

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		concentration
41	AUTH	Aumento,F.; Hyndman,R.D.
	DATE	1971
	TITL	Uranium content of the oceanic upper mantle.
	CITA	Earth Planet. Sci. Lett. 12(4): 373-384 (1971).
	COUN	Canada
	AREA	Mid-Atlantic Ridge
	ABST	Fission track detns. of both the whole rock contents and the distribution of U in individual phases were made on 20 serpentinized ultramafic rocks from the Mid-Atlantic Ridge at 45 °N (Hudson Geotraverse) and 52° N (Gibbs Fracture Zone). The rocks are thought to represent uppermost oceanic upper mantle material. Whole rock U concns. varying from 0.19 to 0.70 ppm were found. Most of the U is homogeneously distributed in primary orthopyroxenes (1 ppm), and to a lesser extent (0.2 ppm) in primary clinopyroxenes. Primary olivine is relatively depleted in U (0.03 ppm), as is primary chrome spinel (0.09 ppm).
	KEY	uranium, analysis, concentration, m atlantic, m atlantic
42	AUTH	Babinets,A.E.; Zhorov,V.A.; Bezborodov,A.A.; Kobylyanskaya,A.G.; Solov'eva,L.V.; Urdenko,V.A.
	DATE	1975
	TITL	Uranium in the Black Sea.
	CITA	Geol. Zh. 6: 16-26 (1975). (Russian).
	COUN	USSR
	AREA	Black Sea
	ABST	Water samples for uranium analysis have been collected over the entire Black Sea, from the surface to the sea floor. As distinct from the previously known facts, it has been established that the uranium content in different parts of the sea appears to vary both in extent and with depth. The behavior of uranium is governed by redox conditions of the environment. A decrease in pH value of water to 7.5 and a change of Eh value from +0.4 to -0.2 V lead to reduction of $U^{6+} \rightarrow U^{4+}$ and ensure higher sorption properties of the solid phases. The reducing reaction is proved possible through the calculated data. It is shown that the rate of uranium isolation is increasing with depth and its content is going down. Using optical properties of water, a hydrogeochemical behaviour of organic matter and uranium in water depths is explained. Role of organic matter and mineral components in the uranium deposition is described. Sorption of U ions on twelve components, which constitute a base of suspensions and floor sediments, has been also studied.
	KEY	uranium, analysis, chemistry, organics, sediments, seawater

(CONT.)

43 AUTH Babko,A.K.; Kodenskaya,V.S.
DATE 1960
TITL Equilibria in solutions of uranyl carbonate complexes.
CITA Russ. J. Inorg. Chem. 5(11): 1241-1244 (1960).
COUN USSR
ABST Stability constants of $UO_2(CO_3)_2^{-2}$ and $UO_2(CO_3)_2^{-4}$ have been measured in the aqueous solution. It is concluded that uranyl ions in carbonate solutions will form these two complexes when the carbonate ion is present in excess and the pH is greater than 7.
KEY uranium, chemistry

44 AUTH Bals,H.G.
DATE 1976
TITL Uranium extraction from seawater.
CITA INIS-mf-3844: 149p (1976).
COUN W Germany
ABST After an introduction to the physics and chemistry of the sea and an estimation of the chances for the absorption of uranium from rivers, the material-specific characteristics of the adsorber technology are decribed in detail. Then, the methods used for gaining uranium from seawater are described with special regard to the tidal and the so-called serial (sequency) method. Whether all methods described can be realised is an economic problem since very high quantities of water are necessary because of the low contents of uranium. A positive energy balance (gained energy/lost energy) is not definitely ensured yet for the production methods used. The development measures to be taken to obtain a positive energy balance are briefly described, and the research programme of the UEBG is mentioned.
KEY uranium, seawater, economics, river, adsorbent, tidal system, extraction

45 AUTH Bals,H.G.
DATE 1977
TITL Method and equipment to extract dissolved, suspended or chemically bonded substances from a liquid.
CITA German (F.R.) patent document 2550751/A/. Int. Cl. B01J 1/22: 20p (1977). (German).
COUN W Germany
ABST A process and an app. is provided for the recovery of U from seawater, by using multiple beds of adsorber located in a specially constructed ship. The seawater flows in an upward, essentially vertical direction through the beds at a rate which allows the adsorber particles to float in the liq. without being carried out. In order to obtain a uniform and stabilized flow of the liq. through the beds, grids or screens are provided as stream diffusers at the liq. entry points at the bottom of the beds. The app. allows continuous

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treatment of large vols. and the exhausted adsorber can also be continuously replenished. The exhausted adsorber is regenerated in another ship and after recovery of the metal values, the regenerated adsorber is returned to the bed. The process allows economical treatment of very dil. streams, since it operates offshore at the source of the metal-contg. material.
KEY uranium, seawater, offshore, adsorbent, shipboard systems, economics, extraction

46 AUTH Bals,H.G.
DATE 1978
TITL Uranium extraction from seawater.
CITA Contribution to WG 1B of INFCE by the Delegation of the Federal Republic of Germany: 10p (1978).
COUN W Germany
ABST In view of the order of magnitude of the total uranium requirement to be expected the Federal Republic of Germany has made great efforts in the field of uranium prospection. The following study delineates a new process (UEB process) for the extraction of uranium from seawater which in our view is particularly promising. This process does no longer work with immobile adsorber granules packed in a solid bed through which seawater flows, but rather with mobile particles in a fluidized bed. There the adsorber granules are almost kept suspended by the deflected sea current, at the same time migrating from the feeding to the discharge station at right angles to the current. Thus allowance is made for the fact that mobile adsorber particles are more likely to come into contact with uranium molecules than fixed ones. The special advantage offered by this working principle is that it permits the conception of adsorber units which, installed at greater depths, take the entire process energy required for adsorption from the sea current.
KEY economics, extraction, uranium, seawater, adsorbent, current, concentration, river, trace metals, environmental impact, plant productivity, capacity, titanium, tidal system, pumped system, shipboard systems, plant design

47 AUTH Barannik,V.P.; Zhorov,V.A.; Bezborodov,A.A.; Kobylyanskaya,A.G.; Abakumova,T.M.
DATE 1975
TITL Sorption of molybdenum(VI) and uranium(VI) ions by titanium(IV) hydroxide from sea water.
CITA Dopov. Akad. Nauk Ukr. RSR, Ser. B (9): 771-774 (1975). (Ukrain).
COUN USSR
ABST Attempts were made to recover U [7440-61-1] from sea water by using anion-exchangers, hydroxides, and a mixed

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sorbent consisting of exchanger AN-2F and $Ti(OH)_4$ [12651-23-9]. The effect of pH, amt. of sorbent, contact time, and presence of surfactants on U and Mo [7439-98-7] recovery was investigated. U was sorbed more efficiently than Mo. The sorption was influenced by surfactants. The complete recovery of U and Mo from sea water requirs 2.2 mg Ti/l.

KEY uranium, seawater, extraction, ion exchange, titanium, chemistry, capacity, trace metals

48 AUTH Barannik,V.P.; Zhorov,V.A.; Lyashenko,S.V.; Kirchanova,A.I.; Kobylyanskaya,A.G.
DATE 1976
TITL Use of ampholytes for removing trace elements from sea water by a froth flotation method.
CITA Izv. Vyssh. Uchebn. Zaved., Tsvetn. Metall. 5: 8-12 (1976). (Russian).
COUN USSR
ABST Trace concns. (~ 10 μ g/L) of Cu and U were sepd. from water, NaCl soln., and sea water by froth flotation with the use of collectors contg. ethylene oxide groups, viz. Stearox 6 [9004-99-3] and Stearox 920 [9004-99-3], which are ampholytes of the formula $Me(CH_2)_{16}CO_2(CH_2OCH_2)_n.CH_2CH_2OH$ with n = 6 and a mixt. of n = 9 and n = 20, resp. Mo is not extd. In distd. H_2O, the degree of recovery, ε , of Cu increases at pH 4-9 and ε of U attains a max. at pH ~6. The ε = f (pH) curves for the flotation of Cu and U from sea water have a max. and are shifted towards the acid region with respect to the flotation in distd. H_2O. The value of ε and the consistency of the froth increase with the concn. of the collectors, a suitable concn. being ~ 0.01 g/L. The addn. of 50 mg/L of stearic acid results in an increased recovery of U and decreased recovery of Cu.
KEY uranium, water, seawater, trace metals, extraction, concentration, chemistry

49 AUTH Baranov,V.I.; Khristianova,L.A.
DATE 1959
TITL Radioactivity of the waters on the Indian Ocean.
CITA Geochemistry: 765-769 (1959).
COUN USSR
AREA Indian Ocean
ABST A direct determination of uranium content in some tens of water samples of the Indian Ocean has been carried out. It is found that the uranium content in the central areas of the ocean averages 1.8×10^{-6} g/l. In the south-western part the content is somewhat higher (1.0×10^{-8} g/l). By calculation the concentrations of thorium (1.0×10^{-8}g/l) and of ionium (6×10^{-13}g/l) have been estimated for water in the central part of the ocean where a distinct disturbance of the radioactive

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equilibrium is established in the uranium family towards a considerable ionium deficiency compared to uranium.
KEY seawater, concentration, uranium, analysis, temperature, salinity

50 AUTH Barbano,P.G.; Rigali,L.
DATE 1978
TITL Spectrophotometric determination of uranium in sea water after extraction with Aliquat-336.
CITA Anal. Chim. Acta 96(1): 199-201 (1978).
COUN Italy
ABST A 5% (wt./vol.) soln. of monomethyltricaprylammonium chloride was satisfactory for extg. U from seawater contg. 3.5M LiCl prior to concn. The detn. was made spectrometrically.
KEY uranium, seawater, analysis, extraction

51 AUTH Baturin,G.N.; Kochenov,A.V.
DATE 1969
TITL Migration of uranium in rivers and the time of its presence in waters of the world ocean, of seas and lakes.
CITA Geokhimiya 6: 715-723 (1969). (Russian).
COUN USSR
AREA Russia
ABST The average uranium content in the total amount of dissolved and suspended materials of river run-off is similar to its average content in rocks of the earth crust. The rivers of the earth every year supply the world's oceans with approximately 20,000 tons of dissolved uranium and approximately as much of suspended uranium; the ratio between the first and the second is 1:1. In final run-off basins the prevailing part of dissolved uranium is precipitated together with terrigenous material on shelfs and continental slopes. The time dissolved uranium stays in waters of the basins varies from tens of years to hundreds of thousands of years and depends on their depth.
KEY river, concentration, water, uranium

52 AUTH Baturin,G.N.; Kochenov,A.V.
DATE 1973
TITL Uranium in interstitial waters of marine and oceanic sediments.
CITA Geokhimiya (10): 1529-1536 (1973). (Russian).
COUN USSR
AREA Atlantic Ocean, Pacific Ocean, Black Sea
ABST Uranium content in interstitial waters from sediments of the Atlantic and Pacific Oceans and the Black Sea varies from 1.3 to 650 x 10^{-6} g/l, which confirms the relative diagenetic uranium mobility. To the factors determining uranium content in interstitial waters belong: pH, Eh,

(CONT.)
the U and C_{org} content in sediments, the content of dissolved organic matters, and CO_2 in interstitial waters. The dependence of uranium content in interstitial waters upon C_{org} in sediments permits the assumption that some of the dissolved uranium is present in the form of metalloorganic complexes.

KEY uranium, interstitial water, concentration, sediments, chemistry, chemical species, organics

53 AUTH Bayer,E.

DATE 1962

TITL Structure and specificity of the organic complexing agents. Syntheses, properties and applications of the macromolecular complexing agents.

CITA Ionenaustauscher Einzeldarstell 1: 305-329 (1962).

COUN W Germany

ABST The properties and structure of the chelates from glyoxal bis(2-hydroxyanil) (I) or glyoxal bis(2-mercaptoanil) (II) with Cu^{++}, Ni^{++}, UO_2^{++}, Co^{+++} or Au^{+++}, Hg^{++}, and Ag^{+}, resp., are studied as low-mol. analogs of the cross-linked macromol. products prepd. from glyoxal and $(H_2N)_3C_6H_2OH$. Ion exchangers of this type are useful for obtaining metals (e.g. U or Cu) from sea water. $2\text{-}H_2NC_6H_4OH$ and glyoxal yielded bis(benzoxazolyl) (III), which does not have complexing properties and in weak alk. conditions cannot form I. In acidic conditions, I cyclizes back to III, which is a valuable property for an ion exchanger. The structures and properties of the chelate rings are detd. from their chem. reactions and infrared spectra.

KEY uranium, seawater, ion exchange, trace metals, extraction

54 AUTH Belinskaya,F.A.; Makarova,E.D.

DATE 1976

TITL Structure and ion exchange properties of titanium hydroxide. 2. Physicochemical study of the structure of titanium hydroxide samples produced by alkaline hydrolysis in the titanium(4) chloride-hydrochloric acid-water system.

CITA Ionnyi Obmen Ionometriya 1: 21-33 (1976). (Russian).

COUN USSR

ABST X-ray diffraction data indicate that the structure of Ti hydroxide depends strongly on the condition for prepg. the samples in the $TiCl_4\text{-}HCl\text{-}H_2O$ system during alk. hydrolysis. From solns. of $TiCl_4$, Ti hydroxide samples can have a rutile or anatase structure depending on hydrolysis conditions. Increasing the temp. of calcination of the air-dried samples led to an increase in the crystallinity. The samples were characterized by DTA and IR spectra.

KEY ion exchange, titanium, temperature, adsorbent, analysis

(CONT.)

55 AUTH Belinskaya,F.A.; Makarova,E.D.
DATE 1976
TITL Structure and ion exchange properties of titanium hydroxide. 4. Determination of the content of hydroxyl groups in titanium hydroxide samples by fluorination using a fluorine-selective electrode.
CITA Ionnyi Obmen Ionometriya 1: 40-43 (1976). (Russian).
COUN USSR
ABST The decrease in F^- concn. was followed using an F^--sensitive ($LaCl_3$ contg. Eu) electrode and soln. pH, by a glass electrode. Na^+ concn. in NaF solns. was also detd. using an Na^+-sensitive electrode. Max. F^- sorption occurs at pH 7-8 while at higher pH, sorption decreases due to increased OH concn. in soln. Na^+ sorption is also highest at pH 7-8 and decreased at higher or lower pH. Fluoride exchange titanium hydroxide.
KEY ion exchange, titanium, chemistry, adsorbent, trace metals

56 AUTH Belyakova,L.A.; Il'in,V.G.
DATE 1976
TITL Ion-exchange properties of crystalline modifications of silica.
CITA Adsorbtsiya Adsorbenty 4: 49-53 (1976). (Russian).
COUN USSR
ABST The cation-exchange properties were studied of cryst. polysilicic acids from Li silicate, Li and K polysilicates, and mixed Li K Na polysilicates. The sorption of Li^+,K^+, Na^+, and Cs^+ was studied at pH 2-10 by potentiometric and radiometric methods. The cation-exchange sorption on all cryst. polysilicic acids in acidic solns. increased with increase in the crystallog. radius in the series $Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$ and $Ca^{2+} < Sr^{2+} < Ba^{2+}$. In alk. solns., this series of sorptive selectivity had the inverse sequence. This character of adsorption of cations resulted from d_{π}-p_{π}-conjugation in siloxane and SiO-M^+ bonds. The cation-exchange capacity (esp. in acidic medium) was compared with that of silica gel, quartz, cristobalite, and tridymite. Adsorption of Na^+ on quartz was anomalously high. Adsorption of Na^+ on polysilicate in their Na form was also higher than that of other alkali cations. There was a memory effect in cation exchange with preferential sorption of those alkali cations (Na^+ and K^+) in the presence of which the hydrothermal crystn. of SiO_2 took place.
KEY ion exchange, adsorbent, trace metals, chemistry

57 AUTH Bertine,K.K.; Chan,L.H.; Turekian,K.K.
DATE 1970
TITL Uranium determinations in deep-sea sediments and natural

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waters using fission tracks.

CITA Geochim. Cosmochim. Acta 34: 641-648 (1970).

COUN USA

ABST Uranium determinations by induced fission track analysis were done rapidly utilizing a discharge counter instead of visual counting. Sediments, rocks, freeze-dried river salts (with Na_2CO_3 carrier) and one freeze-dried sea salt were analyzed by this technique. Comparisons with samples whose uranium concentrations were determined independently indicate that the method is accurate. The uranium concentration in deep-sea sediments varies widely with oceanic depth and depth in the core ranging from 0.5-40 ppm U on a calcium carbonate-free basis. Seventeen river water samples range between <0.01 and 1.2 μ U/l with an average value of 0.27 μ U/l.

KEY uranium, concentration, water, sediments, analysis, river, seawater

58 AUTH Bettinali,C.; Pantanetti,F.

DATE 1976

TITL Uranium from sea-water. Possibilities of recovery, exploiting slow coastal currents.

CITA Uranium ore processing. Proceedings of an advisory group meeting organized by the IAEA and held in Washington, D.C., 24-26 November 1975. ISBN-92-0-041176-2. IAEA, Vienna: 213-229 (1976).

COUN Italy

AREA Mediterranean Sea

ABST The authors analyze the interest in uranium recovery from sea-water within the framework of uranium world supply problems. The most reliable methods proposed for recovery are summarized and discussed, both from the chemical and the plant project points of view. Tides as a source of energy for water movement cannot be used in the Mediterranean and therefore only currents can be taken into account. The acceptable cost of an exchanger, in relation to the uranium price, is considered and related to known exchangers. The characteristics of exchanging elements are examined and the influence of the speed of sea currents discussed. The extractable uranium is a function of the exchange rate and of the speed of the flow inside the exchanging system; therefore it is quite clear that the current speed is not a prerequisite and that coastal currents around Italy are suitable. Exchanging elements built with sheets parallel to the flow, exchanging pans containing granular or fibrous exchangers have been considered. The main characteristics of a 1000 t/a plant are discussed considering possibilities. The most acceptable seems to be the continuous extraction system. The parameters needed to calculate the dimensions of

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such a plant are given and the relation between the length and speed of the moving chain discussed. A rough economic evaluation of the plant cost - starting from known technologies - and of the final cost of the uranium oxide produced is made.

KEY uranium, seawater, plant design, tide, current, ion exchange, adsorbent, economics

59 AUTH Betts,R.H.; Michels,R.K.

DATE 1949

TITL Ionic association in aqueous solutions of uranyl sulphate and uranyl nitrate.

CITA J. Chem. Society, Suppl. No 2 : 286-294 (1949)

ABST Spectrophotometric methods have been used to study ionic association in aqueous solutions of uranyl nitrate and uranyl sulphate. The stoichiometric association constants for the equilibria $UO_2^{++} + HSO_4^- \rightleftarrows UO_2SO_4 + H^+$ and $UO_2^{++} + NO_3^- \rightleftarrows UO_2NO_3^+$ were found to be 5.0 ± 0.34 and 0.21 ± 0.01, respectively. These values were obtained for solutions 2.00 M. in hydrogen ion. Results for concentrations of nitrate greater than 3 M. could not be interpreted unequivocally. In this region, either small amounts of $UO_2(NO_3)_2$ are formed, or, more probably, the value of the association constant changes slightly with the ionic environment.

KEY chemical species, uranium

60 AUTH Bhattacharyya,D.K.; Basu,S.

DATE 1978

TITL Separation of carrier-free bismuth-210 and UX_1 from lead-210 and U, respectively, using silica gel as ion exchanger.

CITA J. Radioanal. Chem. 44(1): 5-11 (1978).

COUN India

ABST Radiochem. sepns. of carrier-free ^{210}Bi [14331-79-4] and UX_1 (^{234}Th) [15065-10-8] activities from ^{210}Pb and U, resp., were carried out using a silica gel column. ^{210}Pb was adsorbed in the column as molybdate and ^{210}Bi passed unadsorbed. Lead activity was next removed with 25 mL of 0.1M HNO_3. In the case of sepn. of UX_1, the colored carbonate complex of U was removed from the silica surface by washing with satd. sodium carbonate soln., keeping UX_1 retained, and finally UX_1 was washed out with 25 mL of conc. HNO_3. Studies of the β-decay of ^{210}Bi and the γ-spectrum anal. of UX_1 has shown that the sepd. products in both cases are of high radiochem. purity. The processes in each case took <1 h and the yield was satisfactory.

KEY ion exchange, trace metals, adsorbent, uranium, elution

61 AUTH Bilal,B.A.; Braetter,P.; Muehlig,B.; Roesick,U.; Zimen,K.E.

(CONT.)
DATE 1971
TITL Activation-analytical determination of uranium traces in marine systems with separation of neptunium-239 by countercurrent ion migration.
CITA Radiochim. Acta 16(3-4): 191-192 (1971). (German).
COUN W Germany
ABST The U in sea water was detd. by thermal neutron irradn. (5.1×10^{11} n/cm^2 sec) followed by γ-spectrometry with a Ge(Li) detector and a multichannel analyzer. The sample was then sepd. into an anion, a cation, and a Np fraction by countercurrent ion migration. The Np oxalate complex is readily sepd. from other cations, and can be detd. quant. by γ-spectrometry. By this method, U was detectable in sea water in amts. of <0.05 ppb.
KEY uranium, seawater, analysis, concentration, extraction

62 AUTH Binney,S.E.
DATE 1976
TITL Extraction of uranium from seawater, phase I.
CITA Project Report, Nov. 11, 1976, Dept. of Nuclear Engineering, O.S.U.: (1976).
COUN USA
ABST Tasks for this project included developing an analytical method for measuring uranium at very low concentrations, evaluating resins and adsorbents for their ability to selectively remove uranium from sea water, and evaluating processes for eluting the uranium from promising resins or adsorbents. The delayed fission neutron (DFN) counting method was the best analytical method of four tested, the other three being gamma ray spectrometry, x-ray spectrometry, and x-ray fluorescence. A thorough explanation of DFN's equipment, calibration and performance is given. Resins and adsorbents tested include chitosan, crushed crabshell, Duolite ES-I3I, blotter grade and laft grade cellulose, activated charcoal, polyacrylamide, silica gel and peat moss. Additional data are being collected on silica and peat moss, which had the highest loading capacities. Solutions of sodium carbonate, ammonium carbonate and ammonium hydroxide were the best eluting agents, as all were successful, but ammonium hydroxide may be the most promising as it is easily recoverable.
KEY uranium, seawater, analysis, adsorbent, capacity, elution, concentration, economics, extraction

63 AUTH Binney,S.E.
DATE 1977
TITL Extraction of uranium from seawater, phase I.
CITA Project Report, July 22, 1977, Dept. of Nuclear Engineering, O.S.U.: (1977).
COUN USA
ABST Present refinements and possible future improvements of

(CONT.)

the delayed fission neutron (DFN) technique for measuring uranium content in seawater are discussed. Titanium hydroxide and silica gel were found to be the best agents for adsorbing the uranium from the seawater. Ti(OH)$_4$ had a higher loading capacity, but the silica gel was far more consistent. Acetic acid was found to be about ten times better than ammonium hydroxide as an elution solution for silica gel. A cost comparison between the Ti(OH)$_4$ adsorption and that of silica gel showed that costs were approximately the same in either case. Future plans include further analysis of silica gel as an adsorber, and testing of a more crystalline silica gel based on ionic radius information.

KEY analysis, adsorbent, elution, economics, titanium, uranium, seawater, concentration, extraction, capacity

64 AUTH Binney,S.E.
DATE 1978
TITL Extraction of uranium from seawater, phase I.
CITA Progress Report, July 7, 1978, Dept. of Nuclear Engineering, O.S.U.: (1978).
COUN USA
ABST In continuing the work described in two previous reports, the adsorption qualities of silica gel were further examined. The silica gel adsorbed 21.5 μg/g in two days under the conditions of a low specific gravity sodium silicate solution (sp. gr. = 1.15), a three-day synerisis period and being freeze-dried as opposed to oven-dried. The previously reported high had been 5 μ g/g in 15 days. Also, experiments were done with topo-adsorbent silica gel with a pore size of 12Å, to see if the larger pore size would increase the gel's loading capacity. No improvement was indicated, however. Present sensitivity of the delayed fission neutron (DFN) uranium counting system at 1 MW is 2000 counts per μg natural uranium. With a background of 32 counts, this represents a minimum level detection of 8.5 ppb. A study of potential sources of error showed no major problems. Future plans include the optimization of silica gel and the search for other resins and adsorbents, the construction of a new reactor made for long-term exposure of adsorbent to seawater, and a comparison of the He neutron detector with the BF$_3$ neutron detector. Also, the DFN technique is being tested for measurement of U-235, U-238, and Th-232.
KEY uranium, seawater, concentration, extraction, capacity, adsorbent, analysis, economics

65 AUTH Black,W.A.P.; Mitchell,R.L.
DATE 1951
TITL Trace elements in the common brown algae and in sea water.

(CONT.)
CITA Journal of Marine Biological Association of the United Kingdom 30: 575-584 (1951).
COUN UK
ABST Sea water probably contains all the chemical elements, although a number of them have not yet been detected. Considerable information is available on the occurrence of various elements in marine plants and animals, but it is far from complete for any one biological group. Except for recent work by Spooner (1949), on the absorption of radioactive strontium and yttrium by marine algae, no detailed study of the trace elements in the brown algae, nor any attempt to correlate the trace elements in sea water with those in algae, appears to have been carried out. The following is a brief resume of the work that has been done in this field.
KEY multi-purpose process, seawater, marine organisms, adsorbent

66 AUTH Blake,C.A.; Coleman,C.F.; Brown,K.B.; Hill,D.G.; Lowrie,R.S.; Schmitt,J.M.
DATE 1956
TITL Studies in the carbonate-uranium system.
CITA J. Am. Chem. Soc. 78: 5978-5983 (1956).
COUN USA
ABST Portions of the phase diagram for the four component system UO_3-Na_2O-CH_2-H_2O have been investigated at 26°. Solubilities have been determined for UO_2CO_3 in sodium carbonate solutions and for $Na_4UO_2(CO_3)_3$ in sodium carbonate and other salt solutions as a function of the concentration of co-solute. A solubility of 320 g. U/l. was obtained at molar ratio CO_2:Na:U close to 2:2:1 and pH close to 7. From solubilities and spectrophotometric measurements, evidence has been obtained for the existence of $UO_2(CO_3)_2^{-2}$ and $UO_2(CO_3)_3^{-4}$, with an estimate of the stability of the latter, and also for an additional complex ion having the molar ratio CO_2:U = 0.5.
KEY uranium, concentration, salinity, analysis, chemistry

67 AUTH Blanchard,R.L.
DATE 1965
TITL U-234/U-238 ratios in coastal marine waters and calcium carbonates.
CITA J. Geophys. Res. 70: 4055-4061 (1965).
COUN USA
ABST Water and live molluscan shell samples were collected simultaneoously at seven locations on the seacoast of the United States. Samples of silt, water, and shells from an estuary were also included in the study. The water samples were analyzed for U-238, U-234, calcium, and salinity; the shell samples were analyzed for U-238, U-234, calcium and crystal structure. All water

(CONT.)
samples, regardless of salinity or total uranium content, were found to have uranium activity ratios, Au-234/Au-238, within the experimental uncertainty of the 1.15 value accepted for an oceanic environment. The results indicate that the normally higher uranium activity ratio of rivers does not increase the ratio of coastal waters above the 1.15 oceanic value. The activity ratios of all except two shell samples analyzed were similar to those of the surrounding seawater and to the oceanic 1.15 value. The application of the results of the study to the determination of geologic age via uranium-uranium daughter equilibrium is discussed.
KEY seawater, uranium, salinity, marine organisms, estuary, analysis, concentration, geology, nearshore, river

68 AUTH Blesing,N.V.
DATE 1971
TITL Ion exchange applications in desalination and hydrometallurgy.
CITA AMDEL (Aust. Miner. Develop. Lab) Bull. (12): 23-44 (1971).
COUN Australia
ABST Recently developed ion-exchange processes and techniques which are economically attractive for desalination and hydrometallurgy are discussed. The Desal, Sul-bi-Sul, and Sirotherm processes utilize low-cost chems. or low-grade heat to regenerate the adsorbing resin in the desalination of brackish waters. An increase in resin utilization, chem. efficiency, and product recovery results from using moving- or fixed-bed columns with countercurrent operation enabling higher salinity waters, up to 3000 ppm total dissolved solids, to be treated economically. Ion exchange as pretreatment to other desalination processes assists in scale prevention and heat recovery in distn. plants. Moving-bed techniques applied both to packed- and fluid-bed systems operate effectively for the recovery of U, Cu, and Zn from leach liquors and slurries. Low-grade liquors in high suspended solids can be treated for metal recovery without the high capital investment required for fixed-bed operation. Effluents can be treated for the purposes of recovering metal ions, controlling pollution, or enabling water to be reused.
KEY ion exchange, existing system, salinity, trace metals, uranium, water

69 AUTH Bonatti,E.; Fisher,D.E.; Joensuu,O.; Rydell,H.S.
DATE 1971
TITL Postdepositional mobility of some transition elements, phosphorus, uranium and thorium in deep sea sediments.
CITA Geochim. Cosmochim. Acta 35: 189-201 (1971).
COUN USA

(CONT.)

ABST Deep sea hemipelagic sediments from the east Pacific show an oxidized upper zone of variable thickness and a reduced zone below. The geochemistry of a core from this region was studied in detail. The Eh of the upper zone is close to +100 mV, while in the lower zone it reaches about -400 mV. Reducing conditions in the lower section of the core are related to the oxidation of organic matter in the sediment, as indicated by the gradual decrease with depth of the concentration of nitrogen in the upper part of the core. Various elements, such as Mn, Ni, Co, P and La, are enriched in the upper oxidized zone, while Cr, V, U and S are enriched in the lower reduced zone. Postdepositional mobility of the elements in question, mainly by diffusion in the interstitial solutions, can explain their distribution in the core. Redox reactions can account directly for the mobilization of Mn, Ni, Co, Cr, V and U, indirectly for that of P and La. Fe and Cu do not migrate significantly, since they are immobilized as sulfides in the reduced zone. Th appears not to be affected by diagenetical mobility.

KEY sediments,uranium,vanadium,chemistry, organics, interstial water, trace metals

70 AUTH Bonsack,J.P.

DATE 1973

TITL Ion-exchange and surface properties of titania gels from titanium(IV) sulfate solutions.

CITA J. Colloid Interface Sci. 44(3): 430-442 (1973).

COUN USA

ABST Titania gels were prepd. by hydrolysis of Ti(IV) sulfate solns. with NaOH. The granular, air-dried gels had BET type I N adsorption isotherms and cation-exchange capacities $\leq$3-6 mequiv/g TiO_2. Surface and ion-exchange properties were dependent on the final hydrolysis pH between 3 and 12. The max. effective surface area (420 m^2/g), pore vol. (0.19 ml/g), and pore radius, and the min. adsorbed Na^+ or SO_4^{2-} were obsd. for titania gels prepd. near pH 6, the isoelec. point for titania. Gels prepd. at pH $\leq$4 or $\geq$10 had pore entries too small to admit N and effective surface areas were <2 m^2/g. Ion-exchange desorption of Na^+ from the pores of a low surface area gel prepd. at pH 10 allowed entry of N into the fine pore structure and increased the effective surface area from <2 to 178 m^2/g. The Na^+/H^+ exchange rate (H^+ desorption-Na^+ adsorption) in concd. solns. was controlled by the rate of diffusion of Na^+ and H^+ within the gel granule, and apparent diffusion coeffs.~ 1.4×10^{-8}-5.3×10^{-8} cm^2/sec were measured. Gels prepd. at pH 6 had lower ion-exchange capacities, but faster Na^+/H^+ exchange rates than gels prepd. at pH 10.

KEY ion exchange, titanium, adsorbent, capacity, chemistry

(CONT.)

71 AUTH Borole,D.V.; Krishnaswami,S.; Somayajulu,B.L.K.
DATE 1977
TITL Investigations on dissolved uranium, silicon and on particulate trace elements in estuaries.
CITA Estuarine Coastal Mar. Sci. 5(6): 743-754 (1977).
COUN India
AREA Narbada, Tapti, Godavari
ABST The concns. of dissolved U and SiO_2 and the chem. compn. of suspended phases in the Narbada, Tapti, and Godavari estuaries, measured as a function of chlorosity, indicate the U behaves conservatively in all 3 estuaries whereas SiO_2 shows conservative behaviour in the Narbada and Tapti estuaries and nonconservative in the Godavari estuary. The variation of chem. compn. of particles with chlorosity does not show any systematic trend; the obsd. scatter is attributed to variations in mineralogy and size distribution of these particles. In these estuaries the degree of desorption of elements from particles is much less than those reported for European estuaries.
KEY uranium, trace metals, estuary, concentration

72 AUTH Bowen,H.J.M.
DATE 1970
TITL Absorption by polyurethane foams; new method of separation.
CITA J. Chem. Soc. A (7): 1082-1085 (1970).
COUN UK
ABST Flexible polyurethane foams can be used as selective absorbents for a no. of substances from dil. aq. solns. Most of the substances absorbed are those which can be extd. from aq. solns. by use of Et_2O, e.g., iodine, benzene, chloroform, and phenol from water, Hg(II) and Au(III) from 0.2M HCl; iron(III), antimony(V), Th(III), Mo(VI), and RH(III) from 6M HCl; and U(VI) from satd. aluminum nitrate soln. The capacities of different foams for absorption vary, but are of the order of 0.5-1.5 mole kg^{-1} foam. Desorption can usually be achieved without difficulty. The sepns. require simple app. and are rapid and specific. The process was absorption rather than adsorption as detd. by measuring the surface areas of the foams used. Chem. formulae of some of the absorbed species were investigated by chem. and radiochem. techniques.
KEY extraction, water, trace metals, uranium, capacity, adsorbent, elution

73 AUTH Bowen,H.J.M.
DATE 1970
TITL Use of polyurethane foam in extraction of substances from fluid media.
CITA Ger. Offen, 2,004,314 (Cl. B 01d), Brit. Appl. 30 Jan

(CONT.)
1969-29 Jul 1969: 20p (1970).
COUN UK
ABST Polarizable mols. or anions are extd. from a medium, which may be an aq. soln. or a gas, by absorption in a porous polyurethane foam. Nonmetallic compds. are extd. from neutral solns., while metallic compds., depending on their nature, may be extd. from acid, neutral, or alk. solns. The foam may also contain chelate-forming additives. Addns. of dimethylglyoxime, 4-methyl-2-thiouracil, phenylthiourea, sulfadiazine, or sulfathiazole aid in the extn. of Hg and Ag from aq. solns. Aromatic hydrocarbons, halogenated compds., etc. are removed from air or other gases by passage through an absorption vessel packed with pieces of polyurethane foam. Examples given describe the extn. of I, Br, Hg, Fe, Au, Sb, Rh, Th, U, Mo, HCl, metal dithizonates, benzene, chloroform, phenol, styrene, and trichlorethylene from solns. The extn. is aided by sequential compression and expansion of the foam to promote better contact with the medium. Desorption from the foam is accomplished by washing, solvent extn., steaming, heating, etc.
KEY extraction, water, adsorbent, uranium, trace metals, elution

74 AUTH Bowie,S.H.U.; Hayashi,S.; Nininger,R.; Pantanetti,I.F.; Svenke,E.
DATE 1976
TITL Special sessions on breeding. I. Panel on uranium availability.
CITA Nuclear Energy Maturity. Oxford: (1976).
COUN UK
ABST The main conclusions of the panel were the following: (1) Although there are immense quantities of uranium in the earth's crust (approx. 2 x 10^9 T) and in seawater (approx. 4 x 10^9 T), this does not have any influence on the present problems of nuclear strategy. (2) The real question is whether the extremely large quantities of natural uranium required by the end of the century and later can be discovered and extracted at the adequate time, rate, and competitiveness. (3) The general feeling is that there are, at less than $30/lb (1973 price) 2 MT reasonably assured, and 8 MT hypothetical, still to be found, for deposits corresponding to a price of more than $30/lb. Because of the lower grade, there are severe environmental problems to be expected which will limit the extraction. Extraction of uranium from seawater is by far still too academic and potentially too expensive to be taken into account in the present strategy studies. (4) The current rate of discovery is about 30 to 40,000 T/annum. Great confidence in the future of nuclear energy will be required to attract the

(CONT.)
necessary investment to reach rates of 200,000 T/annum or more by the end of the century.
KEY uranium, seawater, environmental impact, economics, extraction

75 AUTH Burnham,J.B.
DATE 1974
TITL Assessment of uranium and thorium resources in the United States and the effect of policy alternatives.
CITA Battelle-Pacific Northwest Laboratories. Prepared for National Science Foundation. (December) PB-238 658: (1974).
COUN USA
ABST Presently, uranium extraction cannot be operated economically. Little research is being done at this time, and most firms that had been conducting studies have placed them on inactive status. For any of the processes, the pumping costs alone are many times the price now being obtained for uranium. Studies of tidal power have indicated a very high initial capital investment, which places some question as to the feasibility of this concept. With present technology and current economics, seawater uranium can only be viewed as a potential future source. Economic studies show that 4.8 million cubic feet of water must be moved to produce 1 lb of uranium at 100% efficiency, and for 1 year's producton, estimated pumping costs alone would be $33/lb of uranium produced. A survey is given of the six basic extraction methods studied so far: adsorption, absorption, ion exchange, solvent extraction, coprecipitation, and complexing.
KEY uranium, extraction, economics, capacity, concentration, current, elution, ion exchange, plant design, plant productivity, pumped system, seawater, tidal system, tide, titanium

76 AUTH Burnside,S.S.; Wenrich-Verbeek,K.J.
DATE 1976
TITL Chemical analysis and statistical data for water samples collected in Colorado, New Mexico, and Arizona as part of a study of surface-water and stream-sediment sampling techniques used in uranium exploration.
CITA Report USGS-OFR-76-851: 314p (1976).
COUN USA
AREA Colorado, New Mexico, Arizona
ABST Anal. data for surface-water samples taken from 16 sampling sites are presented. A statistical treatment of the data showing histograms and frequency distributions, is also included. Samples were collected in the spring and summer of 1975 as part of a water and stream-sediment study to establish methods of sampling for U and other elements in surface waters. Stream

(CONT.)
sediments have been collected along with water samples at each site, and a similar statistical study of the corresponding data for sediment samples is in progress.
KEY analysis, water, sediments, uranium, trace metals

77 AUTH Cagle,G.W.
DATE 1977
TITL Oak Ridge analytical program.
CITA Report CONF-770314-7: 24p (1977).
COUN USA
ABST The anal. procedures were selected for use based on the elements to be detd. and the relative accuracy. U is detd. by fluorescence spectroscopy, mass spectrometry, and neutron activation. The As and Se, frequently assocd. with U, are detd. by flameless at. absorption spectroscopy. Water samples are anlayzed by emission spectroscopy. In addn., elec. cond. and SO_4^{2-} concns. are detd. in water samples. The sample flow, data flow, and quality control are also briefly discussed.
KEY uranium, analysis, trace metals, water

78 AUTH Caletka,R.; Konecny,C.
DATE 1971
TITL Silica gel as a support for inorganic ion exchangers for separation of cesium-137 from acid solutions.
CITA Ustav. Jad. Vysk., Česk. Akad. Ved Report UJV-2643-Ch: 31p (1971).
COUN Czech
ABST A novel method of prepn. and characteristics of inorg. ion exchangers based on ammonium molybdophosphate and insoluble hexacyanoferrates supported in silica jel, and their application to recovery of Cs from nitric acid solns. are described.
KEY ion exchange, adsorbent, extraction, trace metals

79 AUTH Caletka,R.; Konecny,C.
DATE 1972
TITL Adsorption properties of ammonium molybdophosphate supported in pores of silica gel.
CITA Radiochem. Radioanal. Lett. 12(6): 325-329 (1972).
COUN Czech
ABST The prepn. of an ammonium molybdophosphate ion exchanger is described and its suitability for Cs recovery from acid soln. was tested. The decontamination factor was 10^3, i.e., of the same order of magnitude as for Zn hexacyanoferrate(II). In contrast to the hexacyanoferrate(II) exchange materials, ammonium molybdophosphate is gradually dissolved and can be eluted from the column bed with the exception of a thin layer at the top of the column.
KEY adsorbent, ion exchange, trace metals, elution

(CONT.)

80 AUTH Caletka,R.; Konecny,C.
DATE 1972
TITL Adsorption properties of phosphoantimonic acid supported on silica gel.
CITA Radiochem. Radioanal. Lett. 9(4): 285-293 (1972).
COUN Czech
ABST At 22° in aq. 1-10M HNO_3, the order of increasing cation retention on phosphoantimonic(V) acid ion exchanger supported on silica gel was $Sr \approx Na < K < Rb < Eu < Cs$, for ion exchangers with P_2O_5/Sb_2O_5 mole ratios $\alpha \approx 0.5$ and 1.0, resp., and which were prepd. by mixing $SbCl_3$ with aq. 85% H_3PO_4 and then oxidizing the Sb(III) to Sb(V) by addn. of concd. HNO_3. The order was $Li < K \approx Eu < Rb \leq Cs < Sr < Na$ for an ion exchanger with $\alpha \approx 0.2$ that was prepd. by reaction of Sb_2O_5 and 7M H_3PO_4 at room temp. For a given ion exchanger and cation, the cation retention decreased with increasing HNO_3 concn. Adsorbed Na and K were eluted from the ion exchangers with M NH_4NO_3 or M HNO_3 + M NH_4NO_3. At 22°, the soly. of the ion exchangers in 1 or 10M HNO_3 increased with increasing α; for a given α, the soly. was greater in 1 than in 10M HNO_3.
KEY adsorbent, ion exchange, trace metals, temperature, concentration

81 AUTH Caletka,R.; Konecny,C.
DATE 1976
TITL Adsorption properties of titanium (IV) hexacyanoferrate (II).
CITA J. Radioanal. Chem. 30(1): 119-129 (1976).
COUN Czech
ABST The possible use of Ti(IV) hexacyanoferrate(II) as a cation exchanger increased the interest in the prepn. of materials with favorable ion exchange capacities and mech. strength to be used in the columns. A method of prepn. was developed, which is based on treatment of spherical particles of Ti hydroxide gel with acidic solns. of K hexacyanoferrate(II). Materials of variable compn. were obtained. The max. value for the retention capacity for Cs was 2.6 mequiv Cs per gram of ion exchanger.
KEY adsorbent, titanium, ion exchange, capacity

82 AUTH Caletka,R.; Tympl,M.
DATE 1976
TITL Uptake of inorganic acids on hydrogels of tetravalent hydroxides and its application for the preparation of some inorganic sorbents.
CITA J. Radioanal. Chem. 30(1): 155-172 (1976).
COUN Czech
ABST A study was made of inorg. acid uptake on hydrogels of Ti, Zr, and Sn hydroxides prepd. by the sol-gel method

(CONT.)
in the form of regular spherical particles. The aim of the work was the detn. of the basic conditions for the prepn. of inorg. ion exchangers by conversion of the hydroxide gel. The exchange of hydroxide groups of the gel phase for the resp. anions plays the decisive role in the uptake on Zr hydroxide. With similar Ti and Sn compds., the main process affecting the uptake is the formation of adsorption compds. and the free diffusion of the electrolyte into the gel phase. Uses of the sol-gel method for the prepn. of inorg. sorbents are discussed.
KEY ion exchange, titanium, adsorbent

83 AUTH Caletka,R.; Zaitseva,T.D.
DATE 1970
TITL Separation of zirconium and hafnium by adsorption on silica gel from hydrochloric acid solutions.
CITA Zh. Anal. Khim. 25(1): 82-86 (1970). (Russian).
COUN USSR
ABST Micro and macro amts. of Zr and Hf are sepd. from each other and from other elements by adsorption on silica gel from HCl solns. under static conditions. The most suitable sorbents for complete sepn. are the coarsely porous silica gels. Large amts. of Zr can be best sepd. from large amts. of Hf in 11M HCl. For the sepn. of Zr mixts. from large amts. of Hf, 7M HCl is recommended. Sepn. is more complete, when mixed aq.-org. solns. are used, this enhances the purification of Zr and Hf from other elements as well, such as alkali metals, alk. earths, Al, Fe(III), Th, and U(VI).
KEY extraction, adsorbent, trace metals

84 AUTH Carrasco,J.; Gonzales,F.; Munuera,G.
DATE 1971
TITL Developement of the surface of a titanium dioxide gel.
CITA An. Quim. 67(6): 561-576 (1971). (Spanish).
COUN Spain
ABST TiO_2 pigments have mostly V-shaped micropores not very deep, and some pores in the form of a bottle neck which can be detected through hysteresis phenomena appearing in the isotherms at the highest partial pressures of adsorbed N. The surface evolution of a TiO_2 gel has been studied as a function of its sintering temp. by using a micro-BET set-up at 78°K and 2 TiO_2 samples, viz. anatase and rutile, both prepd. by hydrolysis of $Ti_2(SO_4)_3$ and ignition of the ppt. at 700°C and a 2nd portion at 800°C. Before measuring N adsorption isotherms, the samples were degassed in vacuum for 3 hr, either at 18 or 250°C. In the rutile sample, vacuum treatment at 250°C drives off some of the molecularly adsorbed H_2O, leaving ~50-65%; heating to 350°C leaves 25-33%. H_2O is only loosely bound to anatase, and

(CONT.)
heating to 250°C in vacuo leaves a pratically anhyd. surface. For calcgn. the Kelvin pore distribution, it could be assumed that all pores were <50 Å in size. In anatase and in rutile samples, degassing at 250°C led to a higher adsorption capacity than degassing at 18°C in relation to the presence of H_2O mols. on the oxide surface. Degassing rutile at 350°C did not produce a further increase of the adsorption capacity for N. The anal. of N adsorption isotherms at 78°K suggests that seed anatase particles formed through sintering at 700°C fuse together at higher temps. into larger rutile nuclei whereby the surface is decresed in area without changes taking place in the distribution of the pore sizes of the sample. Pores smaller than 15 Å could be detected in the rutile sample.
KEY titanium, temperature, adsorbent

85 AUTH Carter,L.J.
DATE 1974
TITL Floating nuclear plants: power from the assembly line.
CITA Science 183(4129): 1063-1065 (1974).
COUN USA
AREA Florida
ABST The possibilities for the production of floating nuclear power plants by standardized assembly line methods are discussed. Some of the questions concerning public policy toward such a program are examined.
KEY regulations, existing system

86 AUTH Cattalini,L.; Croatto,U.; Degetto,S.; Marangoni,G.
DATE 1974
TITL On the separation of uranium from very dilute aqueous solutions.
CITA Atti. Accad. Peloritana Pericolanti, Cl. Sci. Fis., Mat. Nat. 54: 217-219 (1974). (Italian).
COUN Italy
ABST Recovery of uranium by ion exchange from dil. solns. and sea water is reviewed. 1 Ref.
KEY uranium, ion exchange, seawater, extraction, water

87 AUTH Caude,M.; Rosset,R.
DATE 1977
TITL Comparison of new high capacity ion exchange silicas of the spherosil type and normal microparticulate ion exchangers of the polystryrene divinylbenzene type in high performance liquid chromatography.
CITA J. of Chromatogr. Sci. 15: 405-412 (1977).
COUN France
ABST Synthesis methods, properties, and applications of new microparticulate ion-exchange stationary phase silicas are discussed. Strong and weak cation and anion silicas were prepd. These stationary phases were stable at pH

(CONT.)
2-9, were rigid, and had high exchange capacities (~2.2 mequiv/g). The new ion-exchange silicas were compared to classical resin-based ion-exchange stationary phases; illustrative sepns. of alkenoic and alkenedioic acids, pyridinecarboxylic acids, methylpyridines, B vitamins, and chloroacetic acids showed ion-exchange chromatog. sepns. could be accomplished with greater speed at higher pressures with higher resoln. by using the new ion-exchange silicas.
KEY capacity, ion exchange, chemistry

88 AUTH Charikova,V.M.; Smirnov,E.M.; Zudov,V.G.
DATE 1976
TITL Purification of neutral waste waters from production of titanium dioxide using ion exchange.
CITA Novoe v Tekhnol. Polucheniya Dvuokisi Titana.: 213-216 (1976). (Russian).
COUN USSR
ABST Title only translated.
KEY water, titanium, ion exchange

89 AUTH Chen-Ping,C.; Lien-Sen,L.
DATE 1974
TITL A study of the theory of stepwise equilibrium of inorganic ion exchange in seawater.
CITA Sci. Sin. 17(4): 17p (1974).
COUN China
ABST This article deals with the three achievements acquired in the study of the theory of stepwise equilibrium of inorganic ion exchange in seawater, viz.: (1) It suggests that the theory of stepwise equilibrium of inorganic ion exchange in seawater is also applicable to ordinary aqueous solution system and introduces the average ion exchange number $\bar{n}$, which can be measured experimentally. Three ways are suggested for calculating the formation constants of ion exchange products, by means of general mathematical treatments, using the basic formula of $\bar{n}$. (2) A quantitative discussion of the relationship between the theory of stepwise equilibrium of ion exchange and the theory of adsorption is given. Experimental data obtained by using uranium-hydrous titanium oxide system etc. well confirm this relationship. (3) The theory of stepwise equilibrium of inorganic ion exchange has been used to explain the most important experimental fact in the exchange of inorganic ion - the relationship between ion exchange ratio and pH. Two ways have been suggested for calculating K, the equilibrium constant of ion exchange equilibrium. Experimental data of several separate systems have been utilized in making calculations, with the result that theory and practice comparatively agree.
KEY ion exchange, seawater, chemistry, water

(CONT.)

90 AUTH Cheng,C.H.; Lu,T.H.; Su,C.S.
DATE 1972
TITL Uranium determinations in river water and underground water by fission track counting.
CITA Ho Tzu K'o Hsueh 9(3-4): 22-28 (1972).
COUN Taiwan
AREA Taiwan Rivers
ABST The concn. of U in rivers, wells, and hotsprings was detd. by counting neutron-induced fission tracks with visual and automatic spark counting methods. The concns. in Taiwan are in the range of 0.13-2.69 μg/l.
KEY river, concentration, uranium, analysis, interstitial water

91 AUTH Cheng,C.S.; Huang,T.C.
DATE 1975
TITL Extracting uranium from sea water.
CITA K'o Hsueh Shin Yen (7): 251-253 (1975). (Chinese).
COUN China
ABST Three methods are suggested for further research in extracting uranium from seawater: precipitation adsorption, ion exchange resin, and bubble separation. Titanium hydroxide is suggested as an adsorbent in precipitation adsorption. The ion exchange resin involves a chelate reaction in which there is an exchange of the uranyl ion with the resin. Acid phosphate ester is suggested as an active agent to produce bubbles for bubble separation. Research on how marine organisms, such as a kind of brown seaweed, concentrate uranium from seawater could be a promising approach. Future developments may also include constructing tidal basins with adsorption beds to extract uranium from seawater.
KEY uranium, seawater, ion exchange, titanium, adsorbent, marine organisms, extraction, tidal system

92 AUTH Chernyaev,I.I.; Golovnya,V.A.; Ellert,G.V.
DATE 1961
TITL Preparation of compounds of the type $M_3^+[(UO_2)_2(OH)(CO_3)_3(H_2O)_5]^{3-}$.
CITA Russ. J. Inorg. Chem. 6(2): 196-200.
COUN USSR
ABST Potentiometric titration of ammonium uranyl tricarbonate solution with hydrochloric acid and uranyl nitrate solution has proved the formation of compounds with $U:CO_3$ ratios of 1:2.5, 1:2.0, 1:1.5, and 1:1.0. Triammonium tetraoxohydroxotricarbonato-penta-aquodiuranate, $(NH_4)_3[(UO_2)_2(OH)(CO_3)_3(H_2O)_3]$, and the compounds $Ba_3[(UO_2)_2(OH)(CO_3)_3(H_2O)_5]_2.4H_2O$, $Ag_3[(UO_2)_2(OH)(CO_3)_3(H_2O)_5]$, and $Tl_3[(UO_2)_2(OH)(CO_3)_3(H_2O)_5]$ have been prepared for the first time. The compositions of these compounds have been established, and some of their properties

(CONT.)
studied.
KEY chemistry, uranium

93 AUTH Chernyaev,I.I.; Golovnya,V.A.; Ellert,G.V.
DATE 1961
TITL Synthesis of complex monocarbonates of the type $M^{I}[(UO_2)(OH)(CO_3)(H_2O)_3]$.
CITA Russ. J. Inorg. Chem. 6(2): 191-196 (1961).
COUN USSR
ABST A method has been developed for the separation in the solid state of compounds belonging to the second type of complex in the genetic series of uranyl carbonates. The ammonium, thallium, silver and barium dioxohydroxocarbanato triaquouranates: $NH_4[(UO_2)(OH)(CO_3)(H_2O)_3]$, $Tl[(UO_2)(OH)(CO_3)(H_2O)_3]_2$, $Ag[(UO_2)(OH)(CO_3)(H_2O)_3]$, $Ba[(UO_2)(OH)(CO_3)(H_2O)_3]_2$, have been prepared for the first time and characterized. It has been shown that in aqueous solution, ammonium uranyl tricarbonate, $(NH_4)_4[UO_2(CO_3)_3]$, is more stable towards hydrolysis than $K_4[UO_2(CO_3)_3]$ or $Na_4[UO_2(CO_3)_3]$.
KEY chemistry, uranium

94 AUTH Clark,A.T.Jr.
DATE 1962
TITL Performance of a 10-inch centrifugal contactor.
CITA USAEC Accession No. 15667, Rept. No. DP-752: 14p (1962).
COUN USA
ABST A centrifugal contactor, 10 in. in diam., which uses air pressure on an aq. weir to control the position of dispersions settling in a centrifugal field, was developed. The unit will process natural or enriched U solns. by solvent extn., with excellent mass transfer efficiency at total flows of at least 40 gal./min.
KEY extraction, uranium

95 AUTH Clark,J.; Brownell,W.
DATE 1973
TITL Electric power plants in the coastal zone: environmental issues.
CITA American Littoral Society Special Publication (7): 112p (1973).
COUN USA
ABST Environmental disturbances caused by open-cycle cooling systems of steam electric plants that draw massive quantities of water from public water bodies to cool steam condensers were studied. Topics covered include: estuarine ecology, power plant design, vulnerability of estuarine biota, impacts internal to the plant, impacts external to the plant, federal regulations, and solutions. It was concluded that thermal pollution is not the leading adverse environmental effect from power plants, but the invisible death of masses of small

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aquatic life that are drawn into the plants with the huge volumes of cooling water withdrawn from public waters. Solutions advanced for this problem are: to locate power plants along the open coast where there is deep water nearby for strategic placement of intake and outlet structures and to reduce the volume of cooling water by requiring plants to use closed-cycle systems which recirculate cooling waters.
KEY existing system, environmental impact, water, estuary, marine organisms, regulations, plant design

96 AUTH Clemens,D.H.; Hamann,H.C.
DATE 1974
TITL Strongly basic anion-exchange resin.
CITA Ger. Offen. 2,303,178 (Cl. C 08f), US Appl. 267,336, 29 Jun 1972: 25p (1974).
COUN W Germany
ABST The title resins are prepd. by halomethylation of styrene deriv.-polyol methacrylate polymers, followed by reaction with tertiary amines. Thus, stirring styrene 664, trimethylolpropane trimethacrylate 12.2, Bz_2O_2 6.8, poly(acrylic acid) 2, gelatin 0.9, and H_2O 1018 parts 3 hr at pH 10-10.5 and 80-2° and short heating at 95° gives 98.2:1.8 styrene-trimethylolpropane trimethacrylate polymer (I) [31630-65-6]. $AlCl_3$ -catalyzed chloromethylation of I in $ClCH_2OMe$-$ClCH_2CH_2Cl$ at 35-40° followed by reaction with trimethylamine [75-50-3] for 1-1.5 hr at 5° and 3 hr at 30-5° gives a product, d. $\sim$0.609, solids content 44.8%, ion exchange capacity 50.2 g U_3O_8/l. resin.
KEY ion exchange, temperature, capacity, uranium

97 AUTH Clewett,G.H.
DATE 1957
TITL Progress report on special projects for the month of January 1948.
CITA Contract W-7405-eng-26: 15p (1957).
COUN USA
ABST Uranium recovery from oil shale is discussed as to preparation and testing of shale, leaching experiments on raw and ignited ore at 80°C, leaching experiments at room temperature, specificity of $Al(NO_3)_3$ leaches and the washing necessary to recover $Al(NO_3)_3$ for recycle, chlorination prior to leaching, use of roasting agents prior to leaching and adsorptive properties of oil shales. Analytical development is reported on colorimetric determination of U shale and determination of U in sea water.
KEY uranium, seawater, analysis, extraction, temperature

98 AUTH Copeland,B.J.
DATE 1973

(CONT.)

TITL Policy for location of power plants in coastal areas.

CITA Report of the Governors' Conference on Marine Resources, Coastal Plains Center for Marine Development Services, Charleston, S.C., Dec. 17-18: 43-52 (1973).

COUN USA

ABST A panel presentation was made on the topic of siting and licensing power plants. All speakers felt that nuclear power was needed to meet the country's expanding energy requirements. Coastal areas were discussed because of the many environmental and transportation problems of inland nuclear plants. The panel made several recommendations.

KEY environmental impact, offshore, estuary, plant design, marine organisms, regulations

99 AUTH Cox,G.B.; Loscombe,C.R.; Slucutt,M.J.; Sugden,K.; Upfield,J.A.

DATE 1976

TITL The preparation, properties and some applications of bonded ion-exchange packings based on microparticulate silica gel for high-performance liquid chromatography.

CITA J. Chomatogr. 117(2): 269-278 (1976).

COUN UK

ABST The prepn. of high-efficiency ion-exchange column packings based on silica gel of 5-µm particle size was investigated. Strong cation, strong anion, and weak cation exchangers having efficiencies of up to 38,000 plates/m were synthesized. The prepn. of these materials, the effects of the variation of operating parameters on the sepn. of nucleosides by using the strong cation exchanger, and the use of the ion-exchange materials in a no. of chromatog. applications are described.

KEY ion exchange, adsorbent

100 AUTH Crouthamel,C.E.; Johnson,C.E.

DATE 1952

TITL Spectrophotometric determination of uranium by the thiocyanate method in acetone medium.

CITA Anal. Chem. 24: 1780-1783 (1952).

COUN USA

ABST The use of an acetone-water soln. for the spectrophotometric detn. of U by the thiocyanate method greatly decreases anionic interference, increases sensitivity and color stability, and makes color development independent of pH in the acid region. Analyses are now possible without sepn., of U from sulfate, citrate, phosphate, fluorsilicate, fluoride, Cu, Zn, Fe, Sn, Hg, Ni, or Mn.

KEY analysis, uranium, chemistry, trace metals

101 AUTH Cruickshank,M.J.

(CONT.)
DATE 1974
TITL Mineral resources potential of continental margins.
CITA Geol. Cont. Margins: 965-1000 (1974).
COUN USA
ABST A review with 106 refs. is presented. All classes of minerals including elements in sea water are discussed; fluid hydrocarbons are excluded.
KEY seawater, trace metals

102 AUTH Dadone,A.; Baffi,F.; Frache,R.
DATE 1975
TITL Organic acid solutions in the chromatography of inorganics ions. IV. Cation-exchange of Mn(II), Cd(II), Co(II), Ni(II), Cu(II), Al(III), and Fe(III) in tartrate media.
CITA Univ. of Genoa, Separation of U(VI) and Th(IV): 593-595 (1975).
COUN Italy
ABST Macroporous arsonic acid resins with different pore sizes and surface areas were prepared and the properties compared. One of the resins was used for concentration of trace metal ions from dimineralized water, tap-water, and seawater. The effect of pH and complexing agents on the recovery of metal ions was studied. A method for separation of uranium(VI) and thorium(IV) from each other and from other metal ions was developed.
KEY ion exchange, trace metals, concentration, seawater, chemistry, uranium

103 AUTH Dai,M.H.; Wu,S.C.
DATE 1975
TITL Adsorption of uranium from dilute aqueous solution on inorganic adsorbents.
CITA Sep. Sci. 10(5): 633-638 (1975).
COUN Taiwan
ABST The adsorption of uranium from a dilute aqueous solution by a large number of inorganic adsorbents has been investigated. A mixture of aluminum hydroxide, ferric hydroxide, and activated carbon in the weight ratio 1:3:4 has shown a high adsorbability for uranium. The separation of uranium from a dilute aqueous solution by this mixed adsorbent under various temperatures and pH values has been studied. The adsorbability was found to exhibit a maximum at pH 4.0 to 5.5 and to decrease with increasing temperature. A number of eluting solutions for the desorption of uranium from the mixed adsorbent were also tested. 1 N $(NH_4)_2CO_3$ was found to be the most suitable eluting solution (93% recovery of uranium).
KEY uranium, adsorbent, extraction, water, temperature, chemistry, elution, capacity

(CONT.)

104 AUTH Dashtoyan,S.A.
DATE 1974
TITL Extraction of microquantities of cations on continuous-operation apparatus using ion exchangers.
CITA Prom. Arm. (1): 68-69 (1974). (Russian).
COUN USSR
ABST Equations are derived for detg. the cation regeneration conditions, the cation exchanger-soln. equil. conditions, and the no. of stages of the ion exchange columns. Application of the equations for extg. microquantities of Na^+ from the silica gel pulp by using KU-2 ion exchanger is illustrated, and scheme of the unit is presented.
KEY extraction, trace metals, ion exchange

105 AUTH Dassler,B.; Diekers,G.; Eisenschmidt,W.; Herzog,G.
DATE 1976
TITL Fine-pored silica gel with high coarse grain content.
CITA Ger. (East) 118,595 (Cl. C01B33/16), Appl. 185,828, 05 May 1975: 6p (1976).
COUN E Germany
ABST Alkali silicate solns. are treated with an ion exchanger to give an unstable silica sol. which is then adjusted to a d. of 1.05-1.07 g/cm^3 and pH 2.1-4.5. It is then heated to 30-80° at 10-20°/s and is finally gelled in a known manner. Thus, a Na water glass soln. was treated with Wofatit KPS ion exchanger resin and the product adjusted to d. 1.058 g/cm^3 and pH 3.6. It was then heated to 46-50° and finally gelled.
KEY ion exchange, chemistry, temperature

106 AUTH Davidson,R.S.; Slater,R.M.
DATE 1976
TITL Study of some electron transfer reactions of titanium dioxide.
CITA J. Chem. Soc., Faraday Trans. 1 72(10): 2416-2424 (1976).
COUN UK
ABST Pigmentary samples of TiO_2 react with electron acceptors such as quinones, tetracyanoethylene, and 7,7,8,8-tetracyanoquinodimethane to give paramagnetic species, some of which were identified as the radical anion of the acceptor by ESR and visible absorption spectra. Electron transfer to bipyridinium salts also occurs, with the formation of radical cations. Anthracene and perylene react with activated samples of TiO_2 to give paramagnetic species which are probably the hydrocarbon radical cations. The reactions were discussed in terms of factors which affect electron donation from the oxide, ease of redn. of acceptors and oxidn. of donors, and the adsorption of org. compds. on the surface of the oxide.

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KEY titanium, analysis

107 AUTH Davies,R.V.; Kennedy,J.; McIlroy,R.W.; Spence,R.; Hill,K.M.
DATE 1964
TITL Extraction of uranium from sea water.
CITA Nature 203: 1110-1115 (1964).
COUN UK
AREA Menai Straits, Portland Harbour
ABST A summary of the program to separate uranium from sea water by continuous counter-current extraction is presented.
KEY extraction, uranium, seawater, plant design, concentration, chemical species

108 AUTH Davies,R.V.; Kennedy,J.; Peckett,J.W.A.; Robinson,B.K.; Streeton,R.J.W.
DATE 1965
TITL Extraction of uranium from sea water. Part II. Extraction by organic and inorganic absorbers.
CITA Atomic Energy Research Establishment Report AERE-R-5024: (1965).
COUN UK
ABST The organic absorbers that have the highest loading values in seawater are copolymers of formaldehyde and resorcinol arsonic acid (H_2RA_p) with loadings of 1000 to 1100 µg U/g. With inorganic absorbers optimum loadings were attained by certain compounds of lead, basic zinc carbonate (BZC), and hydrated titanium oxide (HTO), which absorbed 200 to 900, 540, and 280 µg U, respectively, per g lead, zinc, and titanium in absorber. The solubility of HTO in seawater is <0.1 µg Ti/ml and is not sufficiently high to render uneconomic its use as an absorber of uranium from seawater. The resorcinol arsonic acid resins (H_2RA_p) lose approximately 2.3% of their initial arsenic per week in contact with seawater while the losses due to solubility of lead absorbers and BZC in the same medium are not less than 0.5 µg lead or zinc per ml. These losses are considered too high for the economic use of H_2RA_p resins, lead compounds, and BZC as absorbers of uranium from seawater. Uranium(VI) and resorcinol arsonic acid monomer (H_2RA_m) form the 1:1 complex UO_2RA_m, and an analogous complex (UO_2RA_p) is formed between uranium(VI) and the functional group RA_p of the resin H_2RA_p. Carbonate and bicarbonate ions are liberated into soluton during the absorption of uranium(VI) from solutions of sodium uranyl tricarbonate $Na_4UO_2(CO_3)_3$, by BZC and HTO.
KEY seawater, titanium, adsorbent, extraction, economics, capacity, uranium

(CONT.)

109 AUTH Davydov,Y.P.

DATE 1972

TITL Sorption of hydrolyzed forms of plutonium(IV) by silica gel.

CITA Radiokhimiya 14(2): 210-215 (1972). (Russian).

COUN USSR

ABST The sorption of Pu(IV) by SiO_2 gel in 0.5M HNO_3, pH = 2.5, at 20° was studied. Equil. was attained after 10 hr of shaking. Solns. of Pu(IV) were prepd. by the method described previously [Davydov; Torgov, 1972]. On log-log coordinates, the coeff. of distribution (K_d) increased linearly with $[H^+]$. The slope of the line was 0.7. Pu(IV) adsorbed from solns. of different pH was desorbed from SiO_2 gel with 0.2M HNO_3. The ratio $Pu^{4+}/Pu(OH)_n^{4-n}$ in the soln. decreased as the pH of the initial soln. increased above 1, i.e. the hydrolyzed form of Pu(IV), $Pu(OH)_n^{4-n}$, was adsorbed by SiO_2 gel at pH >1. Sorption of the hydrolyzed form was independent of the concn. of 0.1-3.0M NaOH.

KEY adsorbent, chemistry, temperature

110 AUTH Degens,E.T.; Khoo,F.; Michaelis,W.

DATE 1977

TITL Uranium anomaly in Black Sea sediments.

CITA Nature 269: 566-569 (1977).

COUN W Germany

AREA Black Sea

ABST The upper 90 cm of Black Sea basin sediment with an aereal extension of 2.96×10^5 km^2 has an U_3O_8 content of 6.7×10^6 tonnes. Plankton is the prime agent for uranium fixation. Reducing conditions at depth permit uranium to accumulate over the past 5,000 yr. Energetically self-sufficient burning of the top 1-m strata will lead to U_3O_8 concentrations in the order of 100 g per tonne ash.

KEY uranium, sediments, marine organisms, chemistry, concentration, organics, seawater, analysis, geology

111 AUTH Deleon,A.; Lazarevic,M.

DATE 1971

TITL Possibilities for recovery of uranium as a by-product in the production of phosphate fertilizers and tripolyphosphate.

CITA The Recovery of Uranium, Proceedings of a Symposium on the Recovery of Uranium from its Ores and other Sources, IAEA, Sao Paulo, 17-21 August 1970: 351-361 (1971).

COUN Yugoslavia

ABST During the last several years considerable quantities of phosphate fertilizers have been produced in Yugoslavia. In this report results of the distribution of uranium in the various stages of the wet phosphoric acid production

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process as well as in its products are described. Commercially available solvents have been used as uranium extractants. Two precipitation techniques have been tested for recovering uranium as a by-product in the production of tripolyphosphate.
KEY uranium, multi-purpose process, extraction, ion exchange, concentration, analysis

112 AUTH Delimarskii,Yu.K.; Chernov,R.V.; Kovzun,I.G.; Noga,P.V.
DATE 1974
TITL Commercial titanium dioxide.
CITA Otkrytiya, Izobret., Prom. Obraztsy, Tovarnye Znaki 51(46): 150 (1974).
COUN USSR
ABST The TiO_2 is obtained by decompn. of ferruginous Ti raw material with H_2SO_4 or its salts with subsequent leaching of the reaction mixt. with aq. inorg. acid. For simplifying the process the reaction mixt. is heated from 200° to 650-800° at 50-1000°/hr, and leached at 80-100° with a 10-30% inorg. acid with subsequent washing of the product with dil. soln. of this acid.
KEY titanium, adsorbent, temperature

113 AUTH Dement'ev,V.S.
DATE 1967
TITL Absorption of uranium (VI) from natural waters and carbonate-containing solutions by cationites.
CITA Radiokhimiya 9(2): 156-161 (1967). (Russian).
COUN USSR
ABST A study was made of the absorption of uranium from natural waters and carbonate-containing solutions by cationites in relation to the pH, carbonate-concentration, ionic strength of the solutions, and m/v. It was shown that the absorbtion of uranium from waters and solutions on a cationite in which the uranium is definitely in an anionic form, may reach a substantial value.
KEY adsorbent, uranium, water, chemistry, concentration, analysis, ion exchange, chemical species

114 AUTH Diaz,E.N.; Suarez,L.A.I.; Hermana,T.E.
DATE 1977
TITL Electrolysis of brine with a mercury electrode.
CITA Span. 452,238 (Cl. C25B), Appl. 08 Oct. 1976: 13p (1977).
COUN Spain
ABST Brine is electrolyzed using a Hg cathode sepd. from the anode by a cation exchanging membrane having a pore diam. preventing the passage of Hg. The pore diam. of the membrane is $\leq 0.15\,\Delta P$ (mm), where ΔP is the pressure difference between the Hg and the catholyte in N/cm^2. The method has the quality advantages of Hg cells, but

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avoids their risk of contamination. The membrane prevents short circuits between the electrodes, but permits a short distance between them, and it prevents particles from falling on the cathodic Hg film in horizontal cells. Thus, an electrolytic cell with vertical cathode, comprising a Nafion membrane having a surface area of 2.3 cm^2 ($r = 0.8$ cm), using a cathodic pressure of 10 kg/cm^2 Hg anodic pressure of 1 atm, a brine concn. of 250 g/L, an anode of RuO/Ti with an active surface of 0.45 cm^2, and an electrolyte temp. of 55°, produced Cl with an anodic c.d. of 20, 80, 160, 400, 600, and 1000 mA/cm^2 at a cell voltage of 2.73, 3.11, 3.25, 3.62, 3.90, and 4.5 V, resp.
KEY extraction, temperature

115 AUTH Dimov,N.
DATE 1966
TITL Ion exchange on a silica gel surface.
CITA God. Nauchnoizsled. Inst. Neftoprerab. Neftokhim. 5: 167-170 (1966). (Bulgarian).
COUN Bulgaria
ABST The mechanism of silica gel sorption was studied on samples with a surface of 430-120 m^2/g. A moisture content of 2.6% corresponds to 7 μmoles OH/m^2. The replacement of H^+ by Cu^{2+} depends on pH. Only 60% of the OH-groups can react with the metal ions. The ir spectra of silica gel in the H^+ and Cu^{2+} state show differences at 3300-500 cm^{-1}. A well expressed peak at 3400 cm^{-1} appears for the Cu^{2+} state. The ion-exchange capacity is 1.8 meq/g. It does not depend on the concn. of the metal ion in the range 0.1-1.0M at 20-50° but changes considerably with pH. The H^+ ions in the silica gel can be replaced by the $[Cu(NH_3)_4]^{2+}$ ions. The ir spectrum of silica gel in the $[Cu(NH_3)_4]^{2+}$ state has the same absorption max. for NH_3 as $[Cu(NH_3)_4]SO_4$. The amt. of NH_3 in the dried sample was detd. by heating at 450°. Cu^{2+} is absorbed as $[Cu(NH_3)_4]^{2+}$. During heating, the ion irreversibly converts to the metallic state. The kinetic curves of the sorption of metal ions were recorded under dynamic conditions. The mechanism of the sorption is ion exchange.
KEY ion exchange, capacity, adsorbent, chemistry, concentration, trace metals

116 AUTH Doi,K.; Aoyama,Y.
DATE 1973
TITL Uranium content in natural water.
CITA Kozan Chishitsu (5): 35-45 (1973). (Japanese).
COUN Japan
AREA Japan, British Columbia (Canada), Australia
ABST This report summarizes reconnaissance studies of the geochemical prospecting of U by natural water in the

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areas of Japan and overseas countries. The Power Reactor and Nuclear Fuel Development Corporation of Japan has been doing this prospecting since 1958. Each U content of water taken from eight geological terrains, hot springs, mineral springs, and rivers of the main island of Japan, central part of British Columbia, Canada and four geological terrains of Australia has been determined. The U contents of 14,764 water samples taken from main island of Japan are ranged from 0.00 to 68.5 part per billion (ppb) uranium, 68 water samples from British Columbia are ranged from 0.01 to 24.0 ppb and 246 water samples from Australia are ranged from 0.00 to 95.0 ppb. The content of U in natural water is so variable depending on chemical and physical factors of water that many determinations of the uranium content are necessary to set up the correct background and to evaluate the terrain.

KEY uranium, water, river, concentration

117 AUTH Dolezal,J.; Stejskal,J.; Tympl,M.; Kourim,V.

DATE 1974

TITL Improved inorganic ion exchangers. II. Ammonium molybdophosphate-silica gel system.

CITA J. Radioanal. Chem. 21(2): 381-387 (1974).

COUN Czech

ABST The sol-gel method for prepn. of inorg. ion exchangers with a silica gel matrix was demonstrated with the NH_4 molybdophosphate-silica gel (AMP-SG) system. A Na silicate soln. contg. AMP and components to cause gelling to silica gel after increase of the temp. of the soln. was poured into hot stirred silicone oil. The soln. forms droplets, which are filtered off after gelling, washed, and dried. Beads contg. 65 wt. % of AMP per gm of dry material were prepd. and tested in ion-exchange columns for Cs removal from HNO_3. Cs may be desorbed with NH_4Cl or NH_4NO_3 solns. The ion-exchanger is suitable for long-time reversible column operation, having not only good chem. thermal and radiation stabilities, but also good mech. and hydrodynamic properties and resistance to abrasion.

KEY ion exchange, temperature, elution, adsorbent

118 AUTH Dolmatov,Yu.D.; Antonova,N.Ya.; Arbuzina,R.F.; Ryl'nikova,G.Yu.; Kovaleva,N.V.

DATE 1977

TITL Structure and particle size of hydrated titanium dioxide.

CITA Russ. J. Appl. Chem. 50(11): 2328-2330 (1977).

COUN USSR

ABST Methods of controlled synthesis of hydrated titanium dioxide by hydrolytic precipitation from solutions are indicated. The products of the homologous series $(TiO_2)_a$

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.HOH [or $TiO_x(OH)_{4-2x}$] may differ in composition, structure, and particle size in accordance with the synthesis conditions.
KEY titanium, analysis, temperature, concentration

119 AUTH Donaldson,J.D.; Fuller,M.J.
DATE 1970
TITL Ion exchange properites of tin(IV) materials. III. Anion exchange and further cation exchange studies on hydrous tin(IV) oxide.
CITA J. Inorg. Nucl. Chem. 32: 1703-1710 (1970).
COUN UK
ABST The sorption of alkali and alkaline earth cations on hydrous tin(IV) oxide has been investigated, in particular on the exchanger in the NH_4^+ form, and some chromatographic separations among these ions are described. The use of the exchanger in the H^+ form to remove UO_2(II) and transition metal ion contamination from solutions containing large amounts of the above ions has also been investigated. Some anion-exchange properties of this material are reported, and the marked selectivity series established predicts the possibility of facile separations of certain anionic species on columns of hydrous SnO_2.
KEY ion exchange, uranium, trace metals, adsorbent

120 AUTH Doshi,G.R.
DATE 1967
TITL Alkaline earth phosphate as carrier for the determination of trace elements in seawater.
CITA Indian J. Chem. 5: 580-581 (1967).
COUN India
ABST A method is described for the determination of cobalt, zinc and uranium in seawater involving their coprecipitation with alkaline earth phosphate. The individual separation of the elements is achieved by the use of both cation (Dowex-50) and anion (Dowex-1) exchangers. Cobalt and zinc fractions are subjected to a thermal neutron flux in the swimming pool reactor, 'Apsara' and quantitatively determined by gamma spectroscopy. Uranium is determined by fluorimetry.
KEY uranium, seawater, ion exchange, trace metals, extraction, analysis, concentration, chemistry

121 AUTH Doshi,G.R.; Krishnamoorthy,T.M.; Sastry,V.N.; Sarma,T.P.
DATE 1973
TITL Sorption behavior of trace nuclides in sea water on manganese dioxide.
CITA Indian J. Chem. 11(2): 158-161 (1973).
COUN India
ABST Adsorption behavior of 14 radionuclides, viz. Ce, Zr, Ru, Cs, Sr, Hf, Ag, Se, Zn, Co, As, Sb, Sn, and U, from

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sea water is studied on MnO_2 pptd. in situ. Quant. capture is found for Ce, Ru, Zr, Hf, Co, and Zn. Comparisons are made with the sorption capacity of $Fe(OH)_3$ for the same nuclides. The application of the in situ pptn. in the field of activation anal. and monitoring of radioisotopes released from nuclear installations is discussed.

KEY uranium, seawater, capacity, adsorbent, trace metals, analysis, extraction

122 AUTH Dushina,A.P.; Aleskovskii,V.B.; Alekseeva,I.P.

DATE 1972

TITL Correlation of the sorption of metal ions by silica gel with the solubility of the resulting sorption compounds. VI. Interaction of silica gel with copper(II) ions.

CITA Zh. Prikl. Khim. (Leningrad) 45(1): 33-37 (1972). (Russian).

COUN USSR

ABST Silica gel sorbs Cu(II) ions from an ammonia soln. KSK-2.0 and KSM-4.5, as well as A_1-A_6 silica gels were tested in dynamic and static conditions. Sorption takes place in 2 stages: ion-exchange and mol. adsorption. In the 1st stage, the const. regulating the process is the sorption product, defined as the product of the activity of Cu(II) and that of the sum of surface polysilicic acids and the dissolved polysilicic acids. In the mol. adsorption stage, it is the soly. product of the corresponding Cu(II) silicate. In the dynamic tests, a 0.024M soln. of $[Cu(NH_3)_4]^{2+}$ in 0.35N ammonia soln. was passed through a small 5 mm internal diam. column 100 mm high contg. 220 mg of KSM-4.5 silica gel at 0.2 ml/min. Total surface active silicic acid content was 0.49 mmole. Copper was practically completely adsorbed from the 1st portions of soln. Later it continued to be slowly adsorbed. In the 1st (ion exchange) stage the sorption product was almost const. and equal to (1.3-2.3) x 10^{-19}. During the mol. adsorption stage, the soly. product of Cu silicate was (1.3-7.8) x 10^{-18}. During static tests 4 x 10^{-2} to 8 x 10^{-2} mmole/ml of solid silicic acid were used, corresponding to 1 to 2 g of KSK-2.0 silica gel. This was contacted with 25 ml of a 0.1M soln. of $[Cu(NH_3)_4]^{2+}$. Contact time was 5 days in one case, 3 years in another. In the 1st case the Cu silicate soly. product was (0.81-0.90) x 10^{-18} and in the 2nd, (0.12-0.15) x 10^{-18} .

KEY ion exchange, trace metals, adsorbent

123 AUTH Ebregt,J.

DATE 1971

TITL Preparing concentrated colloidal silicon dioxide solutions.

(CONT.)

CITA Neth. Appl. 70 09,423 (Cl. C 01b), Appl. 26 Jun 1970: 7p (1971).

COUN The Netherlands

ABST Colloidal SiO_2 soln. of varying SiO_2 content and uniform particle size is prepd. by continuously mixing, in a 3 l. reactor, at 85°, an aq. alkali metal silicate soln. and aq. SiO_2 soln. The resulting mixt. is fed continuously through a 100 cm high, 6.2 cm diam. ion exchange column contg. 2 l. of IMAC C16P cation exchanger in the H^+-form. The resulting SiO_2 soln. is mixed with fresh alkali metal silicate soln. and the cycle is repeated until the effluent discharged reaches the required SiO_2 content and pH 6-10. The alkali metal silicate dosage, 4.42 g/min, and the flow of mixt. through the ion exchange column, 640 g/min, are both maintained at a constant rate until the resulting soln. reaches $\sim$4 wt. %. The rate is then adjusted so that the value of the expression aV/G_o is 0.3-1.0, where a is the SiO_2 content expressed as wt. % of the Na silicate soln., V is the rate in g/min at which the Na silicate soln. is introduced, and G_o is the wt. in g of H_2O in the system.

KEY temperature, ion exchange, chemistry

124 AUTH Edgington,D.N.; Gordon,S.A.; Thommes,M.M.; Almodovar,L.R.

DATE 1970

TITL The concentration of radium, thorium, and uranium by tropical marine algae.

CITA Limnol. Oceanogr. 15: 945-955 (1970).

COUN USA

AREA Puerto Rico

ABST Twenty species of marine algae were collected between 1961 and 1968 from coastal waters of Puerto Rico and analyzed chemically for total organic material, protein nitrogen, and calcium, and radiochemically for the naturally occurring alpha particle emitters ^{226}Ra, ^{232}Th, and ^{238}U. Study of these data suggests that the concentration of radium, thorium, and uranium by tropical marine algae is controlled by two mechanisms: 1) ion-exchange or coprecipitation of the ion with the calcium carbonate matrix, and 2) complex formation with either the protein nitrogen or some other component of the organic fraction. Radium (and possibly thorium) apparently is concentrated by both mechanisms, the dominant one depending on the phylum. For the Rhodophyta and the highly calcified Chlorophyta it is the former and for the Phaeophyta the latter. Uranium is concentrated by the first mechanism.

KEY marine organisms, organics, water, concentration, environmental impact, extraction, ion exchange, uranium, trace metals, analysis

(CONT.)

125 AUTH El-Garhy,M.; Palma,T.; Lorca,E.
DATE 1973
TITL Adsorption characteristics of tin-113 and indium-113m on silica gel, alumina, and Dowex 1 from hydrochloric acid medium.
CITA J. Inorg. Nucl. Chem. 35(5): 1703-1705 (1973).
COUN Chile
ABST Curves of distribution coeff. K_d and sepn. factor vs. HCl concn. are given for the title substrates. The most suitable working region for sepn. of In from Sn is shown on each set of curves. This region occurs at $\leq$1.5M, $\leq$3.0M, and 5 x 10^{-5}-4M HCl concn. for silica gel, alumina, and Dowex 1, resp.
KEY adsorbent, ion exchange

126 AUTH El-Ramly,N.A.; Congdon,C.F.
DATE 1975
TITL Desalting plants inventory report no. 5.
CITA U.S. Dept. of the Interior - Office of Water Research and Technology: (1975).
ABST This is a list of desalting plants throughout the world. The list includes the respective capacities of the plants in millions of gallons per day.
KEY existing system

127 AUTH Erdelyi,M.; Czegledi,B.; Vigvari,M.
DATE 1974
TITL Elution of uranium from an anion-exchange resin by extraction with an organic extractant in the presence of an aqueous phase.
CITA J. Chromatogr. 102: 429-431 (1974).
COUN Hungary
ABST The elution of uranium from anion-exchange resins by dilute sulfuric acid has many advantages, but as a consequence of unfavorable distribution values it has limited value. However, if the sulfuric acid phase serves only as a medium phase, and elution is carried out by organic extraction, the advantages of both elution and extraction are combined, while the undesirable factors can be eliminated.
KEY ion exchange, extraction, elution, uranium

128 AUTH Eristavi,D.I.; Eristavi,V.D.; Kutsiava,N.A.
DATE 1972
TITL Sorption of uranium on carbonate forms of anion-exchangers, AV-17, AV-16, EDE-10, and AN-2F.
CITA Soobshch. Akad. Nauk Gruz. SSR 65(1): 57-60 (1972). (Georgian).
COUN USSR
ABST Optimal dynamic conditions were established for U sorption on the CO_3^{2-} forms of AV-17, AV-16, EDE-10, and AN-2F anion exchangers, which were suitable for anal. U

(CONT.)

extns. Infrared studies showed the sorption mechanism to be $UO_2^{2+} + CO_3^{2-} \rightleftarrows [UO_2CO_3]$; $UO_2CO_3 + CO_3^{2-} \rightleftarrows [UO_2(CO_3)_2]^{2-}$; $2R^+ + [UO_2(CO_3)_2]^{2-} \rightleftarrows R_2[UO_2(CO_3)_2]$.

KEY adsorbent, ion exchange, uranium, extraction, analysis

129 AUTH Ermatov,S.E.; Bakhabov,M.V.; Suprunenko,K.A.; Shvets,D.I.; Strelko,V.V.

DATE 1971

TITL Sorption of hydrogen by ion-exchange forms of silica gel during gamma-irradiation.

CITA Izv. Akad. Nauk. Kaz. SSR, Ser. Fiz.-Mat. 9(6): 88 (1971). (Russian).

COUN USSR

ABST The radiation chemisorption of H on ordinary and specially synthesized silica gels and the effect of the structure of radiation defects on the nature of H sorption by adsorbents in the field of γ-emission were studied. The temp. of evacuation of the samples essentially affects the γ-absorption capacity only in impurity-free silica gels. Such silica gels evacuated at 200 and 350° do not sorb H during irradiation but only after preliminary thermal conditioning at 500°. The nature of the sorption of H on Al^{3+} and Fe^{3+} ion-exchange forms of silica depends on preliminary thermal treatment of a considerably lesser degree. It sorbs H well after evacuation at 200-500°. The EPR spectra of impurity-free silica gels evacuated at various temps. and γ-irradiated at -196° were studied.

KEY adsorbent, ion exchange, temperature, trace metals

130 AUTH Ermolenko,N.F.; Yatsevskaya,M.I.; Nguyen,T.N.

DATE 1973

TITL Sorption of uranium from aqueous solutions by mineral sorbents and carbon modified by titanium dioxide.

CITA Vestsi Akad. Navuk Belarus. SSR, Ser. Khim. Navuk (3): 65-68 (1973). (Russian).

COUN USSR

ABST Active C SKT, silica gel KSK, and Al_2O_3 were modified by TiO_2. The adsorption capacity of the modified adsorbents for uranyl nitrate increased in the order: C < SiO_2 < Al_2O_3. An addnl. increase of adsorption capacity was obsd. after addn. of carboxylic acids (phthalic, benzoic) forming complexes with U^{6+}. Thermal treatment of the modified adsorbents at 400 and 600° decreased their adsorption capacity.

KEY uranium, titanium, capacity, adsorbent, water, temperature

131 AUTH Fetscher,C.A.

DATE 1963

TITL Metal extraction.

CITA U.S. 3,088,799 (Cl. 23-14.5), Appl. 25 May 1959: 13p

(CONT.)
(1963).
COUN USA
ABST The polyamidoxime fabrics form stable complexes with Pu, Au, Pt, Pd, Rh, Fe, Tl, V, U, Ru, Cu, Ni, Co, and Cr. By controlling the pH, it is possible to selectively complex one or more of these ions in the presence of others of the group, or to selectively elute one or more from the loaded fabric.
KEY trace metals, extraction, chemistry, elution, uranium

132 AUTH Foley,L.M.; Harris,J.L.; Pittman,D.C.
DATE 1974
TITL Assessment of uranium and thorium resources in the United States and the effect of policy alternatives.
CITA NTIS, PB-238 658: 223p (1974).
COUN USA
AREA United States
ABST Objectives of this study were to analyze the known United States uranium/thorium resources and to determine the effect of various policy options on the availability of these resources. It was concluded from this study that, in general, uranium and thorium resources in the U.S. are extensive, but new or improved technology and higher prices are required before they will become economically viable. Five specific conclusions reached during this study were: (1) Reasonably assured uranium reserves recoverable at a 1974 forward cost of $15/lb U_3O_8 should be adequate at least through 1985. (2) Uranium resources from conventional sandstone deposits recoverable at a 1974 forward cost of $30/lb U_3O_8 should be adequate to the year 2000. (3) Thorium resources should be adequate to supply all conceivable needs through the year 2000. (4) Capital and manpower resources may be inadequate in the near furture. (5) Production capacity may be inadequate in the short term.
KEY uranium, economics, extraction, seawater, titanium, tidal system, ion exchange, existing system

133 AUTH Foyn,E.; Karlik,B.; Petterson,H.; Rona,E.
DATE 1939
TITL Radioactivity in seawater.
CITA Nature 143(3616): 275-276 (1939).
ABST An attempt was made to accurately measure the content of uranium, radium, and thorium in seawater. According to the results, uranium concentration was $2x10^{-6}$g/l, radium concentration was 0.03 to $0.2x10^{-12}$g/l (mean = $0.07x10^{-12}$ g/l), and the thorium concentration, very difficult to measure was certainly less than 10^{-6}g/l and probably less than half that amount.
KEY uranium, seawater, concentration, analysis, trace metals

134 AUTH Franchini,C.

(CONT.)
DATE 1973
TITL Fluorimetric uranium determination in some Italian seas.
CITA Arch. Oceanogr. Limnol. 18(1): 39-45 (1973).
COUN Italy
AREA Italian Sea
ABST UO_2^{2+}-8-hydroxyquinoline complex is formed and extd. with $CHCl_3$. The procedure has the advantage of analyzing the yield of the primary extn., self-calibration, and the use of dild. sea water as a blank. The av. U concn. was 3.3 μg/l.
KEY seawater, analysis, extraction, concentration

135 AUTH Fujii,A.; Miyai,Y.; Takagi,N.; Sugasaka,K.; Miyazaki,H.
DATE 1974
TITL Extraction of uranium from sea water using composite adsorbents. I. X-ray fluorometric determination of uranium in composite adsorbent.
CITA Nippon Kaisui Gakkai-Shi 27(150): 309-314 (1974). (Japanese).
COUN Japan
ABST The content of U [7440-61-1] in composite adsorbents from seawater was detd. by x-ray fluorescence spectrometry without using internal std. The x-ray intensity of $UL_{\alpha 1}$ (26.14°) was measured by fixed time method, without prepg. a briquet. At concn. of U 0.1-4 mg/g, the x-ray intensity of $UL_{\alpha 1}$ and the content of U correlated well. The variation coeffs. were 2.2 and 2.4% for the std. samples contg. 0.5 and 1 mg of U in 1 g of the adsorbent, resp. Ti or Zn of the composite adsorbent showed absorption effect on UL line. The x-ray intensity was corrected for the absorption effect by the concn. of the element detd. by x-ray fluorescence spectrometry. The diverse elements in sea water had no effect on the detn. The anal. time was <15 min and the error was within 10%.
KEY uranium, adsorbent, seawater, analysis, titanium, extraction, concentration

136 AUTH Gautier,R.
DATE 1971
TITL Method of extracting uranium from its ores.
CITA French Patent 2,063,581. Filed Oct 1969: (1971). (French).
COUN France
ABST In this process for extracting U from its ores, the ore is reacted with ammonium bisulfate. An aqueous sludge is formed from which the dissolved U compounds are extracted in liquid form. The ammonium bisulfate contained in the ammonium sulfate formed during the reaction, or formed by the action of ammonia gas with the other products produced during the reaction and the dissolution in the aqueous medium, is reused.

(CONT.)
KEY uranium, extraction, water

137 AUTH Geishin,P.A.; Demidova,N.A.; Solomko,K.A.
DATE 1974
TITL Sodium ion adsorption on alumina-silica gel.
CITA Kolloidn. Zh. 36(4): 760-762 (1974). (Russian).
COUN USSR
ABST The equil. adsorption curve of Na^+ from solns. contg. NH_4NO_3 on 1:2 $Al_2O_3:SiO_2$ gel exhibits 2 segments with the inflection point at ~3 x 10^{-4}g Na/g gel. In the Na^+-NH_4^+ exchange, the min. concn. of Na^+ retained by the exchanger was ~3 x 10^{-4}g Na/g gel and a complete exchange of the Na^+ ions for NH_4^+ was not achieved.
KEY adsorbent, ion exchange

138 AUTH Gentile,J.H.; Cardin,J.; Johnson,M.; Sosnowski,S.
DATE 1976
TITL Power plants, chlorine, and estuaries.
CITA U.S. Environ. Prot. Agency. Off. Res. Dev. Report EPA-600/3-76-055: 28p (1976).
COUN USA
ABST Results of field investigations at a power plant indicated that total residual Cl at >1.0 ppm caused mortality of all pumped phytoplankton and up to 75% of the zooplankton. In lab. studies, concns. of Cl which decreased growth of marine phytoplankton by 50% during a 24-hr exposure were 75-330 μg/l. At 0.15 ppm, Cl decreased phytoplankton photosynthesis by 52%.
KEY existing system, estuary, marine organisms, environmental impact

139 AUTH George,D.R.; Rosenbaum,J.B.
DATE 1970
TITL New developments and applications of ion-exchange techniques for the mineral industry.
CITA Soc. Chem. Ind. (London), Monogr. 7: 155-161 (1970).
COUN UK
ABST Essential features of various applications of ion-exchange processes in the mineral industry are reviewed. Included in this work has been the development of improved ion-exchange contactors and operating techniques; the use of ion exchangers, both solid and liquid, for removing sulphate and recovering sulphur and carbonate from brines and sea water; production of sulphur and sodium carbonate from gypsum; production of barium chloride from barite; recovery of potassium from brines; and the application of liquid ion-exchange techniques for the recovery of zinc, copper, and aluminium.
KEY ion exchange, seawater, trace metals

140 AUTH Gloyna,E.F.; Ewing,B.B.

(CONT.)
DATE 1957
TITL Uranium recovery from saline solutions by biological slimes.
CITA Nucleonics 15(1): 78-81 (1957).
COUN USA
ABST The factors affecting the biological concentration of U by bacterial suspensions include: pH, length of aeration period, contact time, methods of mixing, stage of organism growth, condition of sludges, and optimum U dosage for maximum uptake.
KEY extraction, uranium, water, chemistry, marine organisms, capacity

141 AUTH Gohda,S.
DATE 1975
TITL Improvement of the fluorimetric determination of uranium.
CITA Nippon Kaisui Gakkai-Shi 28(155): 334-341 (1975).
COUN Japan
ABST Samples contg. μg quantities of U were fused with fluxes of various compns. under different conditions of temp. and time. After fusing, the resultant bead was powd. finely, fixed in a dish with a quartz plate to give a flat surface, and subjected to fluorimetry, where the sample was excited with Hg-line of 365 nm, and fluorescence of 558 nm was measured. Fusion with $NaF-Na_2CO_3-K_2CO_3$(1:4.5:4.5) or with $NaF-Na_2CO_3-LiF$ (3:3.5:3.5:0.2) at 630° for 20 min enabled the detn. of U as small as 0.2 μg within the error of ±1%. The procedures were applied to the detn. of U in sea water.
KEY uranium, analysis, temperature, seawater

142 AUTH Grabovnikov,V.A.; Samsonova,L.M.
DATE 1968
TITL Effect of the form of uranium occurrence in solutions on its sorption by natural mineral formations.
CITA Geokhimiya (10): 1250-1259 (1968). (Russian).
COUN USSR
ABST Natural mineral formations, as a rule, have neg. charged sorbing surface. These formations can ext. from soln. contg. U only that part which is in cation form (UO_2OH^+). This was proven exptl. by passing solns. contg. U^{6+} 0.27-6 ppm through a column, filled with soil. Adsorption of U in the cation form by loam soil followed the Freundlich equation under static and dynamic conditions. The expts. substantiated literature data on high migration capacity of U in supergene zone where it migrated in the form of uranyl carbonate complexes. These complexes are stable in solns. and do not enter in exchange-sorption reactions with natural mineral formations.
KEY uranium, adsorbent, capacity, chemical species

(CONT.)

143 AUTH Groth,W.; Hussmann,P.
DATE 1977
TITL Method and apparatus for manufacturing silica gel.
CITA Swiss 592,024 (Cl. C01B33/16), Appl. 75/7,224, 04 Jun 1975: 5p (1977).
COUN Switzerland
ABST Silica gel was manufd. by adding a water glass soln. to acid with formation of an unstable silica gel which was then gelified, washed to remove salts, and dried. In the 1st stage, a water glass soln. contg. 20-32% SiO_2 was used and added to an acid of pH 1.5-1.8 and at such a rate that immediate reaction occurred without pptn. of SiO_2. In a 2nd stage, a water glass soln. contg. 8-14% by wt. SiO_2 was added to a soln. of pH 2.6-3.5. The silica sol obtained contg. 15-18% by wt. SiO_2 was then put into a gelification container which was also a washing and drying container wherein salt was washed from the gel with a washing liq. with pH 1.8-11.
KEY adsorbent, chemistry

144 AUTH Haigh,C.P.
DATE 1974
TITL The extraction of uranium from seawater.
CITA Central Electricity Generating Board, Long Term Study Symp., CERL 1974.
COUN UK
ABST Since the known world reserves of uranium will be gone by the turn of the century, there is some incentive to re-examine the possibility of obtaining the required uranium from the sea. The concentration of U in seawater is 3 ppb, and this low concentration, and therefore the enormous volumes of water necessary, precludes the extraction methods of chemical pretreatment or control or colloid flotation. Only filtration and possibly temperature increase by low grade heat are possibilities. Estimates of various seawater handling schemes and their projected annual uranium output include using desalinization plants (1 tonne U) all CEGB fossil stations (50 tonnes), all Magnox stations (23 tonnes), the Menai Straits ($1x10^3$ tonnes), the Severn Barrage ($1.6x10^3$ tonnes), world tidal power locations ($2.5x10^4$ tonnes) and a pumped system (possibly unlimited). The "break-even point" for the pump system (no net energy gain) was calculated to be a head loss of 80 meters of water, but experimentally shown to be only 25 meters. Requirements for sites include constant current, high temperature and low solid content. Many sites were considered, the potentially best being the West Indies and Japan. Cost of uranium produced was at least $70 per lb. and possibly much greater. The possible future development of absorbent beds, absorbents and eluents was discussed.

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KEY uranium, concentration, tidal system, pumped system, adsorbent, elution, filtration, seawater, extraction, temperature, current, economics, multi-purpose process, capacity, chemistry, plant productivity, existing system

145 AUTH Haigh,C.P.

DATE 1976

TITL Extraction of uranium from seawater.

CITA CEGB Document R/M/N787: (1976).

COUN UK

AREA UK Coastline, The Bahamas, Japan

ABST Recent predictions of the world demand for uranium fuel for thermal reactors show that known deposits are not sufficient to support demand past the end of the century. For some time consideration has been given to the recovery of uranium from seawater. The volume of seawater required daily to produce sufficient uranium to support even a moderately sized thermal reactor programme is shown to be outside the potential of the UK. Considered on a world wide scale the number of potential tidal power sites which could be adapted for use for uranium recovery is inadequate to support anticipated world demand. The possibility of employing a pumped scheme is discussed in terms of the siting of such a plant and energy balance considerations. An indication is given of areas where the technology of uranium extraction from seawater is considered to require further development.

KEY uranium, seawater, extraction, tidal system, pumped system, existing system, capacity, temperature, current, economics, adsorbent, elution

146 AUTH Hamilton,E.I.

DATE 1975

TITL The abundance and distribution of uranium in some oceanic, continental ultramafic inclusions and host basalts.

CITA Chem. Geol. 16: 221-231 (1975).

COUN UK

ABST The abundance and distribution of uranium in various continental and oceanic ultramafic inclusions and host basalts are reported. Uranium was determined by neutron activation (fission products, fission tracks and delayed-neutron methods) and alpha-particle autoradiography; data is also reported for the uranium content of various USGS standard rock powders. The concentration of uranium in both oceanic and continental samples is similar, levels are controlled by mineral compositions, and their relative abundance in different rock types. Highest levels are found in feldspathic and lowest in olivine rich inclusions. Uranium is enriched in mylonitised samples and along some inter-crystal

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boundaries. With the exception of some apatites, highest levels of uranium are in clinopyroxenes (chrome) and lowest in olivines; no enrichment of uranium in orthopyroxenes was observed. Attention is drawn to the problem of obtaining representative samples from the sea floor which have not been altered by saline solutions and the identification of uranium and daughter products present along inter-crystal boundaries. Differences in observed heat flow between continental and oceanic areas may reflect inadequate sampling of representative rock types present below the sea floor and lack of information for the true abundance and distribution of uranium in such rocks.

KEY uranium, concentration, analysis, salinity, sediments, geography

147 AUTH Hanai,T.; Fujimura,K.

DATE 1976

TITL Non-aqueous solvent chromatography. V. The comparison of organic and inorganic adsorbents.

CITA J. Chromatogr. Sci. 14(3): 140-143 (1976).

COUN Japan

ABST Comparison of org. and inorg. adsorbents by soly. factors in nonaq. solvent chromatog. suggests adsorption mechanisms and relations as a basis for classifying chromatog. systems and adsorbents. The adsorbents were SiO_2, Al_2O_3, anion exchanger coating, anion exchanger chem. bonded, cation exchanger chem. bonded, polystyrene gel, and reversed phase chem. bonded. Classifications of nonaq. solvent chromatog. are given in relation to types of interaction with the adsorbent, types of support, and mechanisms of adsorption.

KEY adsorbent, ion exchange

148 AUTH Harrington,F.E.; Salmon,R.; Unger,W.E.; Brown,K.B.; Coleman,C.F.; Crouse,D.J.

DATE 1974

TITL Cost commentary on a proposed method for recovery of uranium from sea water.

CITA USAEC Report ORNL-TM-4757: 85p (1974).

COUN USA

AREA Menai Straits

ABST A cost commentary review is presented on a method proposed by U.K. investigators for recovery of uranium from sea water by sorption on hydrous titania. The review follows the original proposal in considering primarily water-sorber contact achieved by tidal flow, in a hypothetical plant at Menai Straits, Wales. Cost analyses of civil works, chemical plant, sorber inventory and makeup, chemical consumption, and other charges were based on available information supplemented with estimates, analogies, and some guesses. (In all

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uncertainties, the more optimistic value was selected.) Together with computer analysis of tides and flow resistances for the hypothetical site, these led to a minimum cost of about \$300/lb U at a production rate of about 500 tons U/yr. In general, the results indicate that the cost of uranium from sea water is not likely to be at a lower level than hundreds of dollars per pound, and might be at a much higher level.
KEY economics, uranium, seawater, titanium, tidal system, tide, plant productivity, adsorbent

149 AUTH Harris,W.E.; Kolthoff,I.M.
DATE 1947
TITL The polarography of uranium. III. Polarography in very weakly acid, neutral or basic solution.
CITA J. Am. Chem. Soc. 69: 446-451 (1947).
ABST From polarograms obtained in solutions of uranyl chloride containing 0.1 M potassium chloride, either with or without small amounts of acid or alkali it is concluded that the first wave corresponds to the reduction of UO_2^{2+}. The hydrolysis product UO_2OH^+ from UO_2^{2+} is not reduced at the first wave, but is reduced at the second wave together with U(V). At the proper concentration of ammonium carbonate (0.1 M in this experiment) two well-defined waves of U(VI) are found. Contrary to statements in the literature each reduction wave corresponds to an electron transfer of one.
KEY analysis, concentration, uranium, chemistry

150 AUTH Hashimoto,T.
DATE 1971
TITL Determination of the uranium content in seawater by a fission track method with condensed aqueous solution.
CITA Anal. Chim. Acta 56: 347-354 (1971).
COUN Japan
ABST The uranium-detection methods of isotopic dilution, fluorimetry and pulse polarography have all found average uranium values of 3.33 μg per liter in all seawater samples, but they all are complicated because they require a careful purification of many other elements. For the fission track method, the uranium content in seawater is determined by counting the fission tracks on muscovite immersed in a condensed aqueous solution during the neutron irradiation. The uranium content in seawater could be determined easily as 3.40±0.12 μg per liter, which is in good agreement with the value of 3.33 ± 0.08 μg per liter by other methods. No further chemical purification was necessary and only 50 ml. portions of seawater were used.
KEY uranium, seawater, analysis, concentration, extraction, chemistry

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151 AUTH Hathaway,L.R.; James,G.W.
DATE 1975
TITL Use of chelating ion-exchange resin in the determination of uranium in ground water by x-ray fluorescence.
CITA Anal. Chem. 47(12): 2035-2037 (1975).
COUN USA
AREA Western Kansas
ABST A method developed to survey uranium concentrations in alkaline earth-bicarbonate type ground waters of western Kansas is described.
KEY ion exchange, uranium, water, chemistry, analysis

152 AUTH Hayashi,T.; Uematsu,Y.; Taguchi,A.
DATE 1976
TITL Collection of uranium from seawater.
CITA Japan. Kokai 76,151,614 (Cl. C22B60/02), Appl. 75/78,266, 23 Jun 1975: 5p (1976).
COUN Japan
ABST U adsorber units are hung in seawater with ropes or chains from a raft to adsorb U from the seawater current and eluted. No practical data are given.
KEY extraction, uranium, seawater, adsorbent, current, elution, platform systems

153 AUTH Hazan,I.; Korkisch,J.; Arrhenius,G.
DATE 1965
TITL Universal method for the anion exchange separation of uranium and its application to the determination of uranium in sea water, marine sediments and other geological samples.
CITA Z. Anal. Chem. 213: 182-186 (1965).
COUN Austria
ABST Before the fluorimetric determination of uranium in sea water, marine sediments and other geological samples, an ion exchange procedure is used to separate uranium from interfering elements. This separation is best performed on Dowex 1 in a medium consisting of 90% methyl glycol and 10% 6N hydrochloric acid. By means of this method easily reproducible and accurate results of determinations of uranium in as little as 250 ml of sea water or in about 0.1 g amounts of solid samples can be obtained. Because of its universal applicability this technique is to be recommended whenever μg but also mg quantities of uranium have to be determined.
KEY uranium, seawater, ion exchange, sediments, geology, analysis, extraction, trace metals

154 AUTH Hecht,F.; Korkisch,J.; Patzak,R.; Thiard,A.
DATE 1956
TITL Zur Bestimmung Kleinster Uranmengen in Gesteinen und naturlichen Wassern.
CITA Mikrochim. Acta 7-8: 1283-1300 (1956). (German).

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COUN W Germany

ABST A method is given for the simple, rapid and quantitative separation of microgram quantities of uranium from those elements which, following a single ether extraction from nitric acid solution, may enter the extract along with the uranium. The uranyl ion forms a negatively charged acetate complex, which is retained on the basic anion exchanger Amberlite I.R.A.-400 ($Ac^{\underline{n}}$). Polarographic determination used after this method was more accurate and less time-consuming than the sodium fluoride bead method.

KEY uranium, trace metals, concentration, extraction, analysis, ion exchange

155 AUTH Heide,E.A.; Paschke,M.; Wagener,K.; Wald,M.

DATE 1975

TITL Matrix consisting of cultivable mutants of unicellular green algae and method of uranium production using this matrix.

CITA Ger. Offen. 2,345,430 (Cl C12K), Appl. P 23 45 430.0-41, 08 Sep 1973: 5p (1975). (German).

COUN W Germany

ABST For uranium production from seawater, a matrix consisting of a cultivable mutant of unicellular green algae is described. The algae are uranium-resistant and are able to take up uranium dissolved in seawater. Unicellular green algae are irradiated with X-rays, then put on culture media with high uranium contents and left there until they form a colony. The matrix is then put into a filter cage whose sieve walls are permeable to seawater but not to the mutants. The filter cage is placed in the sea in such a way that the tidal flows pass through it.

KEY extraction, marine organisms, tidal system, uranium, seawater

156 AUTH Heide,E.A.; Paschke,M.; Wagener,K.; Wald,N.

DATE 1975

TITL Matrix of algae, method of fabrication of the matrix, and method of uranium extraction from seawater by means of this matrix.

CITA German(FRG) Patent 2,441,479/B/: (1975). (German).

COUN W Germany

ABST For uranium extraction from seawater, it is suggested to cultivate uranium-resistant algae - especially green algae - and to make seawater flow through a filter cage containing the algae which is permeable to seawater, but not to the algae (cell dimensions between 50 and 100 m m), preferably in counter-flow. This method requires neither large chemicals nor energy expense. Uranium-resistant algae are produced by adding green algae to a seawater solution of high uranium

(CONT.)		
		concentration (about 25 mg/L.). The following process step is an x-ray irradiation. The remaining algae are sown on uranium-containing culture medium, then further cultivated in a culture solution up to mass culture. The later separation of uranium from the matrix is done by known methods.
	KEY	uranium, extraction, seawater, marine organisms, concentration
157	AUTH	Heide,E.A.; Wagener,K.; Paschke,M.; Wald,M.
	DATE	1973
	TITL	Extraction of uranium from sea water by cultured algae.
	CITA	Naturwissenschaften 60(9): 431 (1973).
	COUN	W Germany
	ABST	The uranium uptake from sea water by some mutants of unicellular green algae was tested. Uranium stored under natural conditions by certain marine species should be found concd. in later stages of the food chain. Uranium contents of 34-43 ppm, equiv. to accumulation factors (against sea water) of 1.1-1.4 x 10^4 , were found in guano from sea birds, the final members of the marine food chain.
	KEY	uranium, extraction, seawater, marine organisms, concentration
158	AUTH	Heide,E.A.; Wald,M.; Paschke,M.; Wagener,K.
	DATE	1977
	TITL	Matrix of algae and method of making same and method of obtaining uranium from seawater by said matrix.
	CITA	U.S. Patent 4,039,445, 08 Sep 1973: (1977).
	COUN	W Germany
	ABST	A method is proposed for obtaining uranium from seawater by using a matrix of uranium compatible algae mutants to pick up uranium dissolved in the seawater. The matrix is placed in an area of the sea in which low and high tides pass streams of seawater through the matrix.
	KEY	uranium, seawater, extraction, marine organisms, tidal system
159	AUTH	Heitner-Wirguin,C.; Albu-Yaron,A.
	DATE	1965
	TITL	Hydrous oxides and their cation-exchange properties.
	CITA	J. Appl. Chem. 15: 445-448 (1965).
	COUN	Israel
	ABST	The hydrous oxides of thorium and titanium were prepared and their cation-exchange properties studied. The hydrous oxide of titanium has good physical and chemical stability and shows good exchange capacities within wide ranges of pH and temperature. The kinetics of the cation-exchange reaction were studied and the diffusion coefficients and energy of activation calculated.
	KEY	ion exchange, titanium, chemistry, temperature,

(CONT.)
adsorbent

160 AUTH Heitner-Wirguin,C.; Albu-Yaron,A.
DATE 1966
TITL Hydrous oxides and their cation exchange properties. II. Structure and equilibrium experiments.
CITA J. Inorg. Chem. 28: 2379-2382 (1966).
COUN Israel
ABST The structure of two cation exchangers, hydrous thorium oxide (THO) and hydrous titanium oxide (TiHO), were studied by thermogravimetric measurements, i.r. spectra and X-Ray diffraction. The data suggest that the exchangers have the general formula $MeO(OH)_2nH_2O$, are amorphous at room temperature and lose weight on heating due to loss of interstitial and chemically-bound water. The steep decrease in capacity of THO samples at high temperature is due to the beginning of crystallization. Distribution coefficients have been evaluated for a series of cations with both exchangers.
KEY ion exchange, titanium, temperature, capacity, adsorbent, analysis

161 AUTH Herald,W.R.; Koenst,J.W.; Luthy,D.F.
DATE 1977
TITL Evaluation of organic and inorganic adsorbents for the removal of uranium and plutonium from process streams.
CITA Mound Lab., Miamisburg Report MLM-2424 (OP): 17p (1977).
COUN USA
ABST Mound Laboratory is evaluating macroporous, ion exchange resins for the removal of plutonium, uranium, and various colloids from process waste treatment effluents. A number of organic ion exchange resins were evaluated for removal of ^{238}Pu(IV), ^{238}Pu(VI), and ^{233}U(VI) from water using batch isotherm tests. The capacity and equilibrium distribution coefficients were compared with each other and with bone char, an inorganic adsorbent consisting of hydroxyapatite (HAP). The various types of adsorbents showed that the extent of removal and the equilibrium coefficients (Kd) were functions of pH. For removal of polymeric plutonium, ^{238}Pu(IV), the best results were achieved using the inorganic adsorbent, bone char (hydroxyapatite), at pH 7. However, macroporous, weak base, anion exchange resins also showed reasonable Kd values at pH 7. Therefore, the best removal of polymeric plutonium can be achieved using chemisorption or weak base anionic exchange, indicating strongly ionized anions. Excellent results for removal of ^{238}Pu(VI) were achieved using macroporous, strong base, anion exchange resins and macroporous, strong acid, cation exchange resins. For removal of ionic ^{233}U(VI), the strongly acidic cation exchangers gave the better results; the Kd values were

(CONT.)

on the order of 10^2 better than bone char. Again, performance was strongly dependent upon pH. Adsorbent resins which remove constituents by physical adsorption did not perform well for uranium removal.

KEY chemistry, ion exchange, uranium, water, capacity, adsorbent

162 AUTH Heye,D.
DATE 1969
TITL Uranium, thorium, and radium, in ocean water and deep-sea sediments.
CITA Earth and Planet. Sci. Lett. 6: 112-116 (1969).
COUN W Germany
ABST From the data of 25 deep-sea cores it is possible to show that the U/Th ratio of sediments is nearly constant at a low $CaCO_3$-content. This result and reflections about some other points have led to the assumptionthat U and Th are being transported into the sediment through the intermediary of minerals. During the transport U (preferably U-234), Ra, and some Th are leached by ocean water. This model provides for a possibility to interpret the activity ratio U-234/U-238 < 1 in deep-sea sediments with low carbonate content as well as the activity ratio Th-228/Th-232 approx. 15 in ocean water. Likewise a part of the Ra-226 excess (compared with the Io in solution) may be caused by that leaching.
KEY uranium, sediments, trace metals, seawater, concentration

163 AUTH Hill,K.M.
DATE 1977
TITL Technology assessment and seawater resource engineering.
CITA International Conference on Technology Assessment, Monaco: (1975).
COUN UK
ABST The various proposals for exploiting the resources of sea water, e.g. uranium from sea water, desalination, plankton harvesting, all propose the diversion and handling of vast volumes of sea water. They have other features in common - they are on a large physical scale; they are concerned with world resource problems; they have long gestation periods and push engineering science to its limits; they raise international legal problems; they have potentially large environmental impacts. Many of these proposals depend for their practicability on a much deeper knowledge of physical oceanography and the marine environment than we currently possess. The problems of technology assessment of such projects will be illustrated by reference to the design of plants for the extraction of uranium from sea water.
KEY seawater, uranium, existing system, plant design, marine organisms, environmental impact, economics, extraction

(CONT.)

164 AUTH Hirono,S.
DATE 1973
TITL Agent for recovery of uranium.
CITA Japan. Kokai 73 97,785 (Cl. 13(9)F2), Appl. 72 30,022, 25 Mar 1972: 3p (1973).
COUN Japan
ABST Sawdust or wood waste is treated with alc., with a 10-fold amt. of 0.1N NaOH at 80° for 3-4 hr, washed with H_2O, then with a 10-fold amt. of N HCl at 80° for several hr and washed with H_2O. The product adsorbed U at pH 3.5-8.5 with a distribution coeff. $>6 \times 10^4$.
KEY adsorbent, chemistry, uranium

165 AUTH Hirono,S.
DATE 1973
TITL Carbonaceous material for recovery of uranium.
CITA Japan. Kokai 73 97,786 (Cl. 13(9)F2), Appl. 72 30,023, 25 Mar 1972: 4p (1973).
COUN Japan
ABST Carbonaceous matter is treated with alkali to remove humic acid and then neutralized with dil. HCl. Thus, peat was treated with 0.1N NaOH at 80° several times, washed with H_2O, treated with N HCl for several hr, washed with H_2O, and dried at 80°. U was adsorbed at pH 3-9 with a distribution coeff. of 1.5×10^4 in sea water.
KEY uranium, seawater, adsorbent, chemistry, temperature

166 AUTH Hodge,V.F.; Gurney,M.E.
DATE 1975
TITL Semi-quantitative determination of uranium, plutonium and americium in sea water.
CITA Anal. Chem. 47(11): 1866-1868 (1975).
COUN USA
ABST A method was developed for surveying liter-sized volumes of seawater semiquantitatively for U, Pu, and Am. These elements are precipitated with small amounts of NaOH, electroplated directly from the dissolved precipitate onto counting discs, followed by high-resolution alpha counting.
KEY uranium, seawater, analysis, trace metals, extraction

167 AUTH Hodge,V.F.; Hoffman,F.L.; Foreman,R.L.; Folsom,T.R.
DATE 1974
TITL Simple recovery of plutonium, americium, uranium, and polonium from large volumes of ocean water.
CITA Anal. Chem. 46(9): 1334-1336 (1974).
COUN USA
ABST Studies indicate that Pu, Am, U, and Po can be consistently recovered from large volumes of seawater for an α-spectrometric determination by partial precipitation of magnesium hydroxide and calcium

(CONT.)
carbonate by the addition of small amounts of sodium hydroxide. When average working recoveries are corrected for expected losses, the partial precipitation appears to carry the four elements with an efficiency of about 90%.
KEY uranium, seawater, analysis, extraction, trace metals

168 AUTH Holm,E.; Fukai,R.
DATE 1977
TITL Method for multi-element alpha-spectrometry of actinides and its application to environmental radioactivity studies.
CITA Talanta 24(11): 659-664 (1977).
COUN Monaco
ABST A method is proposed for measuring simultaneously several actinide elements by alpha-spectrometry. The actinides in sample solutions are sorbed together on an anion-exchange column from a nitric acid-methanol mixture. After simultaneous elution and electroplating on a disc, the actinides are determined by alpha-spectrometry. Radiochemical yields of the procedure for Th, U, Np, Pu, Am, and Cm are better than 50 percent, all falling within a range of ±5 percent. Examples of the application of this method to various marine environmental samples such as sea water, seaweed and marine sediment are presented.
KEY analysis, adsorbent, ion exchange, elution, uranium, seawater, sediments, marine organisms, trace metals

169 AUTH Holynska,B.
DATE 1974
TITL The use of chelating ion exchanger in conjunction with radioisotope x-ray spectrometry for determination of trace amounts of metals in water.
CITA Rap., Inst. Fiz. Tech. Jad. AGH, INT 49-I: 18p (1974).
COUN Poland
ABST The chelating ion exchange resin Chelex 100 (Dowex A-1), was used for collection of trace amts. of several metal ions from water solns. The effects of pH, Na, and Ca on the exchange reaction were detd. The radioisotope x-ray fluorescence method was used to det. the concn. of element sorbed on the resin. The estd. limit of detn. was 0.01 ppm for Fe^{3+}, Zn^{2+}, Cu^{2+}, Hg^{2+}, Pb^{2+}, and Cd^{2+}. Total error of the method was 3-15%, depending on concn.
KEY ion exchange, water, trace metals, chemistry, analysis, concentration

170 AUTH Horvath,E.
DATE 1960
TITL Uranium adsorption on peat in natural waters containing uranium traces.
CITA At. Kozlemenyek 2(2): 177-183 (1960).

(CONT.)

ABST The adsorption of U from natural waters (pH = 6.5 to 8.2) on peat was investigated. The peat was prepd. by washing with water followed by extn. with EtOH and C_6H_6 to remove inorg. impurities, bitumen, and resin content. Its humic-acid content was 21%, its max. adsorption capacity 1.0 meq. U/g. The prepd. peat, packed in a nylon-cloth bag, was placed in 5 to 6 m. deep open wells. Adsorption equil. was reached in 7 to 8 days. The U content of the peat samples was detd. by a fluorimetric method. At equil. the U concn. in the peat was (2-4) x 10^3 times greater than in the water. The equil. U content of the peat was about the same as that found in many coal samples (60 to 200 g./ton). These results suggest that the U content of coals might have originated from natural waters of very low U content, which had not been in contact with primary U ore deposits.

KEY uranium, capacity, adsorbent, water, chemistry, analysis, extraction

171 AUTH Hubicki,Z.; Hubicka,H.; Jusiak,S.

DATE 1977

TITL Selective separation of uranyl(II), thorium(IV), copper(II), nickel(II), and iron(III) from rare-earth elements on chelate ion exchangers.

CITA Mater. Sci. 3(1-2): 53-56 (1977).

COUN Poland

ABST The sepn. of UO_2^{2+}, Ni(II), Cu(II), Th(IV), and Fe(III) from rare earth metals by liq. chromatog. on chelating ion exchangers of the carboxylate, amino acid, phosphate, polyphenol, and mercaptide type was studied. Best selective sepns. of U, Cu, Ni, and Fe from rare earths was obtained with amino acid type exchangers, whereas for sepn. of U and Th the phosphate type ion exchanger is best. Thus, Cu, Ni, Fe, and U were sepd. from the rare earths on Wofatite MC-50 at pH ~2 or 0.1M mineral acid; only the rare earths are eluted. U can be sepd. selectively from rare earths, Fe, Cu, Ni, and Th on Duolite S-30 (polyphenol type) and on Arivan and Diaion CR-40 (mercaptide), which have a high capacity for U. On phosphate ion exchangers, e.g. Duolite ES-63, rare earths are eluted with 1M mineral acid or complexons; U and Th are not eluted with mineral acid even at concns. up to 8M, but they are eluted with $(NH_4)_2CO_3$ soln.

KEY extraction, uranium, trace metals, ion exchange, chemistry, elution, concentration, capacity

172 AUTH Hurst,F.J.

DATE 1977

TITL Recovery of uranium from wet-process phosphoric acid by solvent extraction.

(CONT.)
CITA Trans. Soc. Min. Eng. AIME 262(3): 240-248 (1977).
COUN USA
ABST The rapid expansion of the phosphate fertilizer industry in conjunction with the projected shortage and spiraling price increase of uranium has greatly renewed interest in wet-process phosphoric acid as a significant source of uranium. Two attractive solvent extraction processes for recovering uranium from the acid have recently been developed and tested through bench-scale at Oak Ridge National Laboratory. One of the processes has been successfully tested on a pilot-plant scale at phosphate plants; the second process, which offers several potential advantages, still needs additional testing. The merits of each process are discussed.
KEY uranium, extraction

173 AUTH Husain,S.W.; Eivazi,F.
DATE 1975
TITL Thin layer chromatography of 57 metal ions on an inorganic ion-exchanger in mixed solvent systems.
CITA Chromatographia 8(6): 277-282 (1975).
COUN Iran
ABST The greatest no. of significant sepns. of metals by thin-layer chromatog. on silica gel GF$_{254}$ contg. stannic arsenate ion exchanger were achieved when developing the plates with 2:4:1 Bu_3PO_4-Me_2CO-50% HNO_3; the mixts. resolved were: W(VI)-Rh(III)-Mo(VI); Ti(IV)-V(V)-UO_2^{2+}; W(VI)-Cr(III)-Mo(VI); Pt(IV)-Ni(II)-Pd(II); Ag-Cu(II)-Au(III); Se-Y-La; Be-Mg; Zr(IV)-Y; Cd-Zn; Ce(IV)-Pr; Sm-Nd; Sm-Gd; Tb-Gd; Dy-Ho; Er-Tm; Ga-Al-Zn; and Se-Mo(VI). The developing time was 60 min. Other developing solvents giving sepns. were 3:1:2:1 BuOAc-HOAc-Me_2Co-HCl, 1:2:1:0.5 Et malonate-iso-BuCOMe-Me_2CO-50% HNO_3, and 1:2:2 2% diacetyl monooxime (in EtOH)-dioxane-10% HNO_3. The effects of pH length of heating of plates during prepn., and layer thickness on R_f values are discussed. The chromatog. data for Na obeyed Lederer's equation if Na activities rather than Na concns. were used.
KEY ion exchange, trace metals, chemistry

174 AUTH Husain,S.W.; Kazmi,S.K.
DATE 1972
TITL Thin layer chromatography of metal ions on a new synthetic inorganic ion-exchanger.
CITA Experientia 28(8): 988-999 (1972).
COUN Iran
ABST The thin-layer chromatog. behavior of metal ions was studied on an ion exchanger prepd. by mixing Na arsenate gel with silica gel GF. V(V), Ge, Ba, and W(VI) were sepd. from 28, 30, 33, and 33 metal ions, resp., by developing with 1:1 M NH_4NO_3-0.5M HNO_3, 1:1 0.25M $(NH_4)_2$

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C_2O_4-0.1M $H_2C_2O_4$, 1:1 2M HBr-2M NH_4Br, and 1:1 2M HBr-2M NH_4Br, resp. Pb(II)-Cd, Cr(III)-Mn(II), Ag-Ce(III)-Hg, Se-Hg, Pb-Hg, Ag-Bi, As(III)-Mo(VI), Sb(III)-As(III)-Cd, Ag-Pb(II)-Hg, Pb(II)-Mn(II), Ag-Se-Pd(II), Pb(II)-Pd(II), Ag-Pb(II)-Cu(II), Se-Mo(VI)-Au, Cd-Zn, Pb(II)-Zn, and Pb(II)-As(III)-Ag mixts. were also resolved on the ion-exchange plates.
KEY ion exchange, trace metals, adsorbent

175 AUTH Hydes,D.J.; Liss,P.S.
DATE 1977
TITL The behavior of dissolved aluminum in estuarine and coastal waters.
CITA Estuarine Coastal Mar. Sci. 5(6): 755-769 (1977).
COUN UK
AREA River Conway (North Wales), North Sea
ABST The av. concn. of dissolved Al in surface waters of the North Sea with salinities >34‰ was 1.5 μg/L. The distribution was apparently a function of the Al amts. and distribution in the freshwater inputs. Values decreased away from coastal regions and suggest an oceanic value for dissolved Al of 1.0 μg/L. Freshwaters from the Rivers Great Ouse and Yare in East Anglia are basic (pH ~8.0) and contain 2-5 μg Al/L. Samples of freshwater (pH 6.5-7.9) collected from the drainage basin of the River Conway (North Wales) contain 4-98 μg Al/L. Approx. 30% of the dissolved Al entering the Conway Estuary in fresh water is removed during mixing with seawater in the estuary. Removal occurs during the early stages of mixing, being essentially complete by the time the water has reached a salinity of 8‰. The most probable explanation for the effect is one involving trapping of Al adsorbed on the surface of very fine clay particles entering with the fresh water as the particles are irreversibly coagulated on mixing with saline water in the estuary.
KEY water, concentration, seawater, salinity, estuary, chemistry

176 AUTH Ikeda,H.; Sekine,K.; Komatsu,K.
DATE 1974
TITL Adsorbent for metallic ions.
CITA Japan. Kokai 74,115,988 (Cl. 13(9)F2), Appl. 73 27,618, 10 Mar 1973: 2p (1974).
COUN Japan
ABST Cryst. polyethylenimine or partially hydrolyzed compds. of poly-N-acyl substituted ethylenimine or its hydrated compd. is used to make a metallic ion adsorbent. E.g., a mixt. of cryst. polyethylenimine 1 g with glass beads was packed in a glass tube (8 mm diam.). In this was poured 10 ml. of H_2O contg. $NiCl_2$ 10 ppm. The adsorption was 50%.

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KEY adsorbent, trace metals

177 AUTH Inoue,Y.; Tsuji,M.
DATE 1976
TITL Hydrous titanium oxide ion exchanger. I. Method of synthesis and some properties.
CITA J. Nucl. Sci. Technol. 13(2): 85-91 (1976).
COUN Japan
ABST Synthesis of hydrous titanium oxide ion exchanger was tried from three systems: (a) $TiCl_4$-$NaOH$-H_2O, (b) ATS (ammonium titanyl sulphate monohydrate)-$NaOH$-H_2O and (c) $TiCl_4$-NH_4OH-H_2O. The first method gave the best results under the conditions covered in the present work. It was found that repeated washing and aging of the hydrous titanium oxide precipitate were indispensable in order to obtain reproducible results, and that this operation further obviated the need of precisely adjusting the conditions for mixing the reagents. Both the yield of exchanger and the ion exchange capacity of the resulting product increase with concentration of the reagents. A cation exchange capacity of about 3 meq. Na^+/g could be obtained, which is considerably higher than any corresponding value reported in literature. The value decreased with increasing drying temperature. Irrespectively of the conditions of synthesis, the chemical composition was TiO_2. (2.0-2.2) H_2O, and the impurities contained in the product were found to be less than 0.1 w%. The exchanger produced is in granular form suitable for use in column operation. It is fairly stable in alkaline solution, and also in mineral acid solutions of <0.1N concentration.
KEY titanium, ion exchange, capacity, temperature

178 AUTH Inoue,Y.; Tsuji,M.
DATE 1976
TITL Studies of the hydrous titanium oxide ion exchanger. II. The equivalence of the exchange adsorption of cations and the dissociation constant.
CITA Bull. Chem. Soc. Jpn. 49(1): 111-116 (1976).
COUN Japan
ABST In order to elucidate the fundamental properties of hydrous Ti oxide as a cation exchanger, a study was made of the stoichiometry of cation exchange and the acid-base property of the exchanger by titrn. curves. The equivalent exchange between H^+ and Na^+ or Sr^{2+} holds over a wide range of conditions, such as pH, ionic strength, and particle size of the exchanger. The method of conditioning for obtaining the exchanger in the pure H form was established. The water content in the exchanger depends on the ionic compn. Hydrous Ti oxide is a 4-functional, weakly acidic cation exchanger with pK_1 6.7 ± 0.1, pK_2 10.3 ± 0.2, pK_3 12.3 ± 0.2, and

(CONT.)

pK_4 13.2 ± 0.2. The corresponding ion exchange capacities are 2.2 ± 0.1, 1.2 ± 0.2, 0.7 ± 0.3, and 0.2 ± 0.3 mequiv Na^+/g resp.

KEY titanium, adsorbent, chemistry, capacity

179 AUTH Inoue,Y.; Tsuji,M.
DATE 1978
TITL Studies of the hydrous titanium oxide ion exchanger. III. Distribution coefficients and some applications.
CITA Bull. Chem. Soc. Jpn. 51(2): 479-482 (1978).
COUN Japan
ABST The cation-exchange distribution coeffs. of various cations on hydrous TiO_2 were measured as a function of pH and the ionic strength. The order of selectivity for alkali metals was $Cs^+ > Rb^+ > K^+ > Na^+$; for alk. earth metals, $Ba^{2+} > Sr^{2+} > Ca^{2+}$; and for bivalent transition metals it was $Zn^{2+} > Cu^{2+} > Co^{2+}$. The apparent dissocn. consts. of the exchanger were not const., but gradually decreased with the pH of the medium. By using NH_4NO_3 solns. as eluents, nearly quant. sepns. of ^{137}Cs from ^{133}Ba and ^{89}Sr were achieved with a relatively small column of the exchanger in the NH_4^+ form.
KEY titanium, ion exchange, chemistry, trace metals, elution

180 AUTH Inoue,Y.; Tsuji,M.
DATE 1978
TITL Studies of the hydrous titanium oxide ion exchanger. IV. The effect of radiation and heat treatment.
CITA Bull. Chem. Soc. Jpn. 51(3): 794-799 (1978).
COUN Japan
ABST The effects of ^{60}Co gamma-irradn. and of heat treatment in air were studied on the properties of the hydrous Ti oxide ion exchanger. The ion-exchange capacity of the Na form did not change at all, while that of the H form decreased a little, by the exposure of 5.2×10^8 R. The color of the exchanger, initially white, turned yellow upon irradn. This exchanger was stable against heat treatment up to ∿80° ; thereafter the exchange capacity gradually decreased with the temp. until 324°, where it was abruptly reduced to ∿1/4 of the initial value. The titrn. curves showed that the most acidic exchange site was weaker than less acidic sites against heat treatment. The structural formula of this hydrous Ti oxide ion exchanger is suggested on the basis of the ion-exchange capacity, thermal decompn. curves, x-ray diffraction, and IR spectra.
KEY titanium, ion exchange, capacity, temperature

181 AUTH Isaeva,A.A.; Golovanov,V.I.; Presnyakova,O.E.
DATE 1977
TITL Spectrophotometric determination of uranium in sea water and various types of synthetic sorbents.

(CONT.)
CITA J. Sov. Radiochem. 19(1): 76-78 (1977).
COUN USSR
ABST To det. μg amts. of U, the samples of sea water (5 L) or sorbent (0.5-1.0g) were pretreated with HCl. U was then extd. with a $CHCl_3$ oxychinoline soln., reextd. with HCl and detd. in the water phase as an arsenazo III complex. Interfering elements were either filtered off prior to extn. (Ti, Zr, Hf, Nb) or masked with EDTA and CH_3COONH_4. The relative error was 10.6% for samples contg. $\sim$3 μg U/L.
KEY uranium, seawater, extraction, analysis, adsorbent, trace metals, concentration

182 AUTH Ito,H.; Kantake,Y.; Sasaki,I.
DATE 1977
TITL Uranium adsorbents.
CITA Japan. Kokai 77,114,586 (Cl. B01D15/00), Appl. 76/31,398, 24 Mar 1976: 3p (1977).
COUN Japan
ABST A mixt. of polymer-U adsorbent-solvent and a coagulating soln. (insol. to the polymer soln.) are contacted at a high shear to obtain a U-adsorbing media. Thus, a mixt. of 200 mesh metatitanic acid [12026-28-7] 14, DMF [68-12-2] 100, and an acrylonitrile-vinyl acetate copolymer [24980-62-9] 5 parts and water were contacted at a high shear to obtain a fibrous product, then the product was chopped and screened to recover a >48 mesh product having a sp. surface of 66 m^2/g. The medium was used for U extn. from seawater or other solns.
KEY uranium, adsorbent, seawater, extraction, titanium, water

183 AUTH Ito,H.; Yamazaki,Y.; Kantake,Y.
DATE 1977
TITL Uranium adsorbents.
CITA Japan. Kokai 77,114,587 (Cl. B01D15/00), Appl. 76/31,399, 24 Mar 1976: 4p (1977).
COUN Japan
ABST A Ti compd. forming titanic acid by hydrolysis is bonded on an inorg. porous material having hydroxide groups on its surface to obtain a U-adsorbing medium. The medium is used to ext. U from seawater or low-grade U leaching soln. Thus, dried 20-48 mesh silica gel was immersed 10 min in $TiCl_4$, centrifuged to remove $TiCl_4$, then immersed 0.5 h in boiling water. A pH 8 uranyl tricarbonate soln. was contacted and 21.2 mg U/g adsorbent was desorbed with $(NH_4)_2CO_3$.
KEY uranium, adsorbent, titanium, extraction, seawater, chemistry, capacity, elution

184 AUTH Iwakura,H.; Uchiyama,T.
DATE 1977

	(CONT.)	
	TITL	Separation of uranium.
	CITA	Japan. Kokai 77,104,408 (Cl. C22B60/02), Appl. 76/21,071, 01 Mar 1976: 3p (1977).
	COUN	Japan
	ABST	U is absorbed on hydrated hydraulic cement, e.g. portland, Al_2O_3, CaO-mixed, mixed portland, and high-sulfate slag cements. Thus, portland cement was suspended in a 2.5-fold amt. of H_2O for 1 day, dried at 50°, powd. to <149 μ, 0.1 g was stirred in 200 mL seawater mixed with 100 μg U [a 1:1 mixt. of aq. $UO_2(OAc)_2$ (1 mg/mL) and Na_2CO_3 (1.336 mg/mL) dild. to 100 ppm U] for 1 h, and filtered to absorb 63 μg U.
	KEY	uranium, seawater, adsorbent, extraction, capacity
185	AUTH	Iyengar,M.A.R.; Markose,P.M.
	DATE	1971
	TITL	Distribution of uranium and daughters in the environment of a uranium ore processing facility.
	CITA	Radiat. Radioisotop. Soil Stud. Plant Nutr., Proc. Symp. 1970: 143-153 (1971).
	COUN	India
	AREA	India
	ABST	The distribution of U and its decay products adjacent to the Jaduguda U processing plant was detd. Quant. data are given for soils, waters, vegetation, and plant and animal foods. Atm. concns. of Rn were higher than at the U processing plants at Trombay and Alwaye. The water concn. of Ra, ^{236}Th, and ^{210}Po varied widely. A high activity of ^{226}Ra occasionally escaped into the environment. Fish from adjacent waters were particularly high in natural U. The high radioactivity of surface waters indicated that farming adjacent to the Jaduguda plant was undesirable. Confirming previous reports, aquatic algae concd. high levels of radioactivity. Milk is not a significant factor for human intake of radioactive materials since milk consumption is low in the Jaduguda vicinity.
	KEY	uranium, water, environmental impact, marine organisms, concentration
186	AUTH	Iyer,S.G.; Venkateswarlu,C.
	DATE	1974
	TITL	Exchange of metal ions on a chelating exchanger, Dowex-A1.
	CITA	Bhabha Atomic Research Centre Report BARC-763: 7p (1974).
	COUN	India
	ABST	Exchange of some metal ions was studied employing Dowex-A1 in H^+ form as a function of the initial pH of the aqueous phase. Kd values of ZrO^{2+} at pH 2.0 and Th^{4+} at pHs 2-4 are lower than those on a carboxylic cation exchanger, while those of Ag^+, Ca^{2+}, Be^{2+} and UO_2^{2+} are

(CONT.)
higher. Metal ions which form stronger complexes with the chelating group viz. Ni^{2+}, Co^{2+}, Cu^{2+}, Al^{3+} and Th^{4+} (at pH 1.0 for this element) show much higher Kd values. Bi^{3+} is sorbed almost quantitatively on this exchanger also.
KEY ion exchange, chemistry, trace metals, water, adsorbent

187 AUTH Kageyama,E.; Kusama,Y.; Udagawa,A; Fukano,K.
DATE 1975
TITL Cation exchangers having high exchange rate.
CITA Japan. Kokai 75 89,284 (Cl. B01J, C08F), Appl. 73 137,303, 11 Dec 1973: 6p (1975).
COUN Japan
ABST Vinyl monomers with or without small amts. of divinylbenzene are radiochem. polymd. on silica gel or alumina [1344-28-1] carriers having sp. surface area >100 m^2/g and the polymers are treated to acquire ion exchange groups to give ion exchangers having sp. surface area >50 m^2/g and high ion-exchange rates. Thus, 30-70 mesh silica gel having sp. surface area 480 m^2/g was heated in vacuo at 450°, treated with air satd. with styrene vapor at room temp., γ-irradiated at 10^6 R/hr for 20 hr, extd. with boiling C_6H_6 to give silica gel contg. 21 wt.% grafted polymer and having sp. surface area 280 m^2/g which was treated with oleum (10% SO_3) at 40° for 60 min. The resin [9003-53-6] had exchange capacity 1.9 mequivs./g and exchange rate (0.1 N NaCl to 90%) <30 sec, compared with 180-90 sec for com. cation exchangers.
KEY ion exchange, temperature, capacity, adsorbent

188 AUTH Kamat,K.D.
DATE 1974
TITL Application of the weak base anion exchange resin, Amberlite XE-270, for recovery of uranium from sulphate leach solutions: a preliminary study.
CITA Bhabha Atomic Research Centre Report BARC-731: 19p (1974).
COUN India
ABST Amberlite XE-270, a weakly basic anion exchange resin was tested in the laboratory on a pilot-scale for the recovery of uranium from sulfate acid leach liquors. Data regarding adsorption elution and precipitation are presented and then compared with the performance of strongly basic anion exchange resin, Deacidite FF (530) currently in use at Jaduguda Uranium Mill.
KEY ion exchange, extraction, uranium, elution, adsorbent

189 AUTH Kanno,M.
DATE 1977
TITL Extraction of uranium from sea-water.
CITA The nuclear fuel cycle, part 1. Vol. 2. Proceedings of

(CONT.)
an international conference held by the IAEA in Salzburg, 2-13 May 1977. ISBN-92-0-050177-X. IAEA, Vienna: 431-441 (1977).
COUN Japan
ABST Nuclear power generation is considered to be very important in Japan, but known domestic uranium resources are very rare; therefore, extraction of uranium from sea-water has become of interest. Some experimental work on extraction of uranium from sea-water has been carried out since 1962 at the Japan Tobacco and Salt Public Corporation. Some results have also been obtained by Kyoto University, the Shikoku Government Industrial Research Institute, Tokyo University and others. To investigate the technical and economical feasibility of extracting uranium and other resources from sea-water, a research programme was started in 1975, sponsored by the Ministry of International Trade and Industry with a budget of about $440000. In this programme, the conceptional designs of two types of model plants, the "column type" and the "tidal type" were drawn up. Several problems await solution, but these do not appear technically impossible to solve. Adsorption tests were carried out with more than eleven types of adsorbents, including titanium hydroxide which, it was found, when prepared from titanyl sulphate and urea, had the largest adsorption capacity for uranium. Elution experiments were performed with ammonium carbonate and the efficiency at 60°C was three times higher than at 20°C. A few long-term column operations were conducted mainly with the adsorbent, granulated titanium hydroxide, for 15-60 days. The maximum yield of uranium throughout these operations was over 20%, its maximum concentration in the eluate was 7 ppm.
KEY extraction, uranium, seawater, economics, tidal system, pumped system, adsorbent, titanium, capacity, elution, temperature

190 AUTH Kanno,M.
DATE 1977
TITL Extraction of uranium from seawater.
CITA Nippon Genshiryoku Gakkaishi 19(9): 586-591 (1977). (Japanese).
COUN Japan
ABST A review with 26 refs.
KEY extraction, uranium, seawater

191 AUTH Kanno,M.
DATE 1977
TITL Technical problems in uranium recovery from seawater.
CITA Bulletin of the Society of Sea Water Science, Japan (Translation) 31(4): 172 (1977). (Japanese).
COUN Japan

(CONT.)
ABST It has been confirmed through small size experiments that uranium can be effectively recovered from seawater using titanium hydroxide adsorbent. More studies are necessary to determine the optimum conditions and durability for this reagent. A pumped column system has proven to be the best system for adsorbing uranium from seawater and can be expected to obtain a certain degree of energy gain. There are not enough locations, however, where plants could be constructed to meet the world uranium demand. Japan could utilize "Kuroshio" which flows in the north Pacific. "Kuroshio's" temperature, width, and flow velocity are well suited for uranium adsorption.
KEY uranium, extraction, seawater, titanium, adsorbent, pumped system, tide, current, temperature, capacity

192 AUTH Kanno,M.
DATE 1978
TITL Problems to be solved for uranium recovery from sea water.
CITA Newer Metal Industry (Translation) 270: (1978). (Japanese).
COUN Japan
ABST It has been confirmed through small size experiments that uranium can be effectively recovered from seawater, if all conditions are favorable, using titanium hydroxide as the adsorption reagent. More studies are necessary to determine the optimum conditions and durability of titanium hydroxide adsorbent. A pumped column system has proven to be the best system for adsorbing uranium from seawater and can be expected to obtain a certain degree of energy gain. There are not enough locations, however, where plants could be constructed to meet the world uranium demand. Japan could utilize "Kuroshio" which flows in the north Pacific. "Kuroshio's" temperature, width, and flow velocity are well suited for uranium adsorption.
KEY uranium, extraction, seawater, titanium, adsorbent, pumped system, tide, current, temperature, capacity

193 AUTH Kanno,M.; Ozawa.Y.; Mukaibo,T.
DATE 1970
TITL Extraction of uranium from sea water by titanium hydroxide.
CITA Nippon Genshiryoku Gakkaishi 12(12): 708-714 (1970). (Japanese).
COUN Japan
ABST Sorption of U by Ti hydroxide in simulated sea water decreased sharply with increasing concn. of HCO_3^- $>5 \times 10^{-3}$M. On a log-log plot, the equilibrated U sorption was linearly related to U concn. at <100 μg/l. U sorption was proportional to the reciprocal of Ti

(CONT.)
hydroxide granule radius (0.27-0.04 mm). $(NH_4)_2-CO_3$ was a more effective eluting agent than Na_2CO_3 and $NaHCO_3$. The eluting efficiency increased with increasing temp.
KEY extraction, uranium, titanium, seawater, adsorbent, elution, temperature

194 AUTH Karel,S.; Stamberg,J.; Katzer,J.; Prochazka,H.; Nemec,P.; Hulak,P.; Jilek,R.
DATE 1975
TITL The production of sorbents from mycelia of fungi.
CITA Brit. 1,417,901 (Cl. C12K), Appl. 7163/73, 14 Feb 1973: 4p (1975).
COUN Czech
ABST Reinforced fungal mycelia for use as sorbents to sep. metal ions, esp. U [7440-61-1] from soln., were prepd. by crosslinking mycelium biomass with a formaldehyde or high-mol-wt. material. E.g., mycelium of Penicillium chrysogenum was crosslinked with HCHO [50-00-0], heat cured, and crushed to a grain size of 0.3-0.75 mm; the capacity of the sorbent for U was 95.7 mg/g.
KEY adsorbent, uranium, extraction, capacity, trace metals, marine organisms

195 AUTH Kas'yanov,A.V.; Bezborodov,A.A.; Zhorov,V.A.; Kobylyanskaya,A.G.
DATE 1975
TITL Coprecipitation of uranium with titanium hydroxide from seawater.
CITA Sov. Radiochem. 17(4): 463-467 (1975).
COUN USSR
ABST The process of coprecipitation of uranium with titanium hydroxide from seawater was investigated as a function of certain variable factors. It was shown that coprecipitation is of an adsorption nature, and its mechanism is determined by the concentrations of H^+ and CO_3^- ions in the seawater. It is suggested that when hydroxide is introduced into seawater, the equilibrium between the carbonate and hydrolyzed forms of uranium is disturbed. The extraction of uranium at pH = 8 reaches 70%. At pH = 5 a state of saturation is not reached even at a uranium content in the sorbent four times as great as the mass of the sorbent itself. The maximum capacity of the sorbent at pH = 8 is 0.073 mg U/mg Ti.
KEY uranium, titanium, seawater, extraction, adsorbent, chemistry, capacity, concentration

196 AUTH Kato,S.; Sugasaka,K.; Fujii,A.
DATE 1977
TITL Uranium compound adsorbent.
CITA Japan. Kokai 77,114,486 (Cl. B01D15/00), Appl. 76/31,533, 22 Mar 1976: 5p (1977).
COUN Japan

(CONT.)
ABST A high mol. wt. compd. contg. OH groups is dissolved in H_3PO_4, then $TiCl_4$ is added, to obtain a U compd. adsorbent. Thus, cotton was dissolved in concd. H_3PO_4, and a $TiCl_4$ soln. was added to obtain a ppt. which was dried to obtain an adsorbent consisting of water 15-20, org. compds. 2-25, Ti 17-20, and phosphate 35-50%. The U compd. adsorption was >10 mg/g-adsorbent vs. <10 mg/g for a urea-titanate adsorbent. The adsorbent was used to remove U from seawater or a soln.
KEY uranium, adsorbent, seawater, titanium, capacity, extraction

197 AUTH Katoh,S.; Sugasaka,K.; Fujii,A.; Takagi,N.
DATE 1977
TITL Extraction of uranium from sea water by the composite adsorbent. VI. Change of uranium adsorptivity of the aluminum hydroxide and of the composite adsorbent by heating.
CITA Nippon Kaisui Gakkai-Shi 31(3): 128-130 (1977). (Japanese).
COUN Japan
ABST Alkali consumption and U adsorptivity of $Al(OH)_3$ -activated C composite adsorbents was decreased by heating to >250° but increased for an $Al(OH)_3$ adsorbent and reached a max. by heating to 250°, wherein the x-ray diffraction pattern of bayerite disappeared.
KEY extraction, uranium, adsorbent, seawater, temperature

198 AUTH Katoh,S.; Sugasaka,K.; Fujii,A.; Takagi,N.; Miyai,Y.
DATE 1976
TITL Studies on the extraction of uranium from sea water using composite adsorbent. IV. Adsorptivity of uranium by aluminum-activated carbon composite adsorbent.
CITA Nippon Kaisui Gakkai-Shi 30(3): 118-123 (1976). (Japanese).
COUN Japan
ABST An Al-activated C composite absorbent was contacted with sea water contg. uranyl carbonate complex. Adsorption attained equil. within 2-4 h, during which it proceeded according to Freundlich's isothermal adsorption formula. The velocity of absorption was accelerated by temp. Adsorption increased with pH, and reached nearly 100% between pH 8 and 10. Consideration of the chem. form of U in sea water suggested the absorption by cation-exchange or hydrolysis on the surface of the composite adsorbent.
KEY extraction, uranium, seawater, adsorbent, temperature, chemistry, ion exchange, chemical species

199 AUTH Katoh,S.; Sugasaka,K.; Fujii,A.; Takagi,N.; Miyai,Y.
DATE 1977
TITL Extraction of uranium from sea water by the composite

(CONT.)
adsorbent. V. Properties and uranium adsorptivity of the aluminum-activated carbon composite adsorbent and aluminum hydroxide.
CITA Nippon Kaisui Gakai-Shi 31(1): 7-11 (1977). (Japanese).
COUN Japan
ABST $AlCl_3$ was hydrolyzed at pH 6 and 7 at various temps. from 20 to 80° to prep. $Al(OH)_3$ and its adsorptivity for U was compared with that of an $Al(OH)_3$-active C composite adsorbent. The $Al(OH)_3$ prepd. at low temps. showed an x-ray diffraction pattern of bayerite, but it was weakened and replaced with a pattern of pseudoboehmite with increasing temp. of prepn. The $Al(OH)_3$ prepd. at 40 to 60° showed the largest sp. surface area, alkali consumption, and adsorption capacity for U.
KEY extraction, uranium, seawater, temperature, chemistry, capacity, adsorbent

200 AUTH Keen,N.J.
DATE 1968
TITL Studies on the extraction of uranium from sea water.
CITA J. Brit. Nucl. Energy Soc. 7(2): 178-183 (1968).
COUN UK
ABST The oceans can be regarded as a vast reserve of a liquid low grade ore of well defined composition containing uranium at 3.34 μg/l. Studies were made on extracting U from sea water by absorption on hydrous TiO_2. The absorber has been developed to a point where, although deficient in some respects, it shows a high capacity for absorbing U. Uranium can be eluted from the absorber by $(NH_4)_2CO_3$ solution, but a small proportion appears to be held firmly. For a large scale extraction plant, a system of two tidal lagoons, similar to that employed for tidal power schemes, was considered for providing the head of water necessary to pass sea water through the absorber.
KEY uranium, seawater, capacity, extraction, adsorbent, concentration, elution, tidal system, titanium

201 AUTH Keen,N.J.
DATE 1970
TITL Extracting uranium from sea water.
CITA Indian East. Eng. 112: 337-339 (1970).
COUN UK
AREA Portland Harbor
ABST Methods for the extraction of uranium from sea water have been examined. Trials have been carried out at Portland harbor with seawater flowing through packed beds of granules of hydrous titanium oxide, which absorb uranium from seawater by ion exchange. The uranium can be leached from the absorber bed by treatment with ammonium carbonate solution and isolated. Several

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arrangements for presenting the absorber to the sea have received attention. Use of tidal energy to provide a larger head of water is contemplated. Capital costs, engineering difficulties and proper site selection are still some of the unsolved problems. It is hoped that these problems will be overcome and by the turn of the century the extraction of uranium from seawater will prove to be an economic and feasible project.
KEY extraction, uranium, seawater, titanium, ion exchange, elution, adsorbent, tidal system, economics, trace metals, concentration, capacity, particulate

202 AUTH Keen,N.J.
DATE 1977
TITL Recovery of uranium from sea water.
CITA Chem. Ind. (London) (14): 579-582 (1977).
COUN UK
ABST Recent estimates indicate that there will be a very large shortfall in known uranium reserves by the end of the century compared with world demand. It has been shown that the concentration of uranium in the ocean is reasonably constant at about three ppb representing a total uranium content of about 4×10^9 t. As such it offers a virtually limitless source of supply and it could be argued that as the grades of ore being exploited on land decrease, the prospects for sea water uranium become enhanced. These paper attempts to place these prospects in perspective. Some of the findings are of general applicability to the winning of other trace elements from the sea.
KEY extraction, uranium, seawater, concentration, titanium, tidal system, economics, multi-purpose process, capacity, trace metals

203 AUTH Keen,N.J.; Miles,J.H.; Spence,R.
DATE 1967
TITL Extraction of uranium and other inorganic materials from sea water.
CITA Atomic Energy Research Establishment Report AERE-R-5500 (Vol.2): 387-398 (1967).
COUN UK
ABST The commercial success of plants for the extraction of magnesium hydroxide and bromine from sea water suggests that others of the more plentiful constituents could be separated if prices were favorable. It seems unlikely however, that this will happen so long as present prices prevail. The same is true of elements present at low concentration although special considerations apply in the case of uranium. Progress has been made towards a process based on absorption on hydrous titanium oxide with the aim of establishing a reserve of medium cost uranium. If a plant using this process became operative

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it might be possible to extract certain other useful trace elements at the same time.
KEY extraction, seawater, uranium, titanium, trace metals

204 AUTH Kennedy,J.
DATE 1965
TITL Extraction of uranium from sea water. Part I. The physical and chemical states of uranium in sea water.
CITA Atomic Energy Research Establishment Report AERE-R-5023: 10p (1965).
COUN UK
ABST Uranium (3.34 μg/l) in natural seawater is in true solution as the anionic uranyl tricarbonate complex $UO_2(CO_3)_3^{4-}$. Less than 0.1% of the uranium present in sea water is adsorbed on particulate matter.
KEY extraction, uranium, seawater, chemical species, concentration, particulate

205 AUTH Kennedy,J.; Davies,R.V.; Robinson,B.K.
DATE 1964
TITL Chemical extraction processes.
CITA Brit. 977,460 (Cl. C 01g, C 22b), Appl. Sept. 4, 1957: 3p (1964).
COUN UK
ABST A process is described for the extn. of γ quantities of U from sea water by using basic Zn carbonate having the empirical formula $ZnCO_3.xZn(OH)_2$. Basic Zn carbonate was pptd. on glass wool by adding Na_2CO_3 to a batch of glass wool which had been soaked in 0.1M $ZnSO_4$ soln. until a pH of 8 was attained. The resultant glass wool contg. basic Zn carbonate was packed into glass columns. Sea water was then passed through the packed columns and U from the influent was adsorbed on the Zn carbonate bed. The adsorbed U was then eluted from the columns with 1.0M Na_2CO_3; 500-600 γ U was extd. per g. Zn.
KEY extraction, uranium, seawater, adsorbent, elution, capacity, chemistry

206 AUTH Kennedy,J.; Davies,R.V.; Robinson,B.K.
DATE 1964
TITL Improvements in or relating to chemical extraction processes.
CITA British Patent 977,460. Filed Sept. 4, 1957: (1964).
COUN UK
ABST A process for the extraction of U from sea water consists of contacting the sea water with basic zinc carbonate supported on an inert carrier and eluting the U from the basic zinc carbonate with an aqueous solution of an alkali carbonate. The basic zinc carbonate has a composition intermediate between that of $ZnCO_3$ and $Zn(OH)_2$ and is precipitated directly onto an inert carrier preferably a fibrous material such as glass

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fiber or asbestos fiber in the form of a mass, net, or sheet. The basic zinc carbonate will extract U to the extent of about 500 µg per gram of zinc.
KEY extraction, uranium, seawater, adsorbent, elution, net systems, capacity

207 AUTH Kermarec,M.; Briend-Faure,M.; Delafosse,D.
DATE 1974
TITL Surface properties of silica-magnesia gels.
CITA J. Chem. Soc., Faraday Trans. 1 70(12): 2180-2188 (1974).
COUN France
ABST The acid-base properties of silica-magnesia gels were examd. by ir spectroscopy of absorbed NH_3, pyridine, and 2,6-dimethylpyridine and by cation exchange expts. NH_4+ did not exchange with the gel, NH_3 being evolved instead, revealing the presence of strong basic centers on the gels. The basic properties were due to hexacoordinated Mg, or to OH located on tetracoordinated Mg or neighboring Si. The acidic centers resulted from structural Lewis sites which were formed during Mg insertion into the network.
KEY ion exchange, adsorbent

208 AUTH Khan,S.
DATE 1972
TITL Extraction of uranium from sea water as a by-product from water desalination plants.
CITA Nucleus (Karachi) 9(1-2): 39-46 (1972).
COUN Pakistan
ABST It may be possible to recover uranium from seawater economically as a by-product from waste saline water of the seawater desalination plants, if the cost of pumping water and cleaning it of organic matter is charged on the desalted product. A desalination plant producing 250 thousand tons of water per day at a brine concentration factor 2:1 would discharge an equal amount of waste saline water containing about 1,500 g of uranium daily. This waste water may be brought into contact with 25 tons of galena (lead sulfide) and the sorbed uranium may be eluted with 10% sodium carbonate solution. After elution, galena grains can be regenerated by washing with dilute hydrochloric acid solution of pH 5.0.
KEY economics, multi-purpose process, marine organisms, adsorbent, elution, uranium, seawater, extraction

209 AUTH Khan,S.; Saleem,M.
DATE 1973
TITL Bibliography on the extraction of uranium from sea water.
CITA At. Energy Minerals Centre Report AEMC/Chem. Engg-126:

(CONT.)
45p (1973).
COUN Pakistan
ABST A bibliography of 56 references is presented on the extraction of uranium from seawater and other natural waters. References on other pertinent research, for example, the extraction of trace elements from seawater and the marine geochemistry of the uranium isotopes, are included. Abstracts for each reference and an author index are provided.
KEY extraction, uranium, seawater, titanium, adsorbent, trace metals, marine organisms, concentration, chemical species, water

210 AUTH Khater,M.M.; Korkisch,J.
DATE 1971
TITL Cation-exchange separation of uranium from other elements in tetrahydrofuran-nitric acid media containing trioctylphosphine oxide.
CITA Talanta 18(10): 1001-1004 (1971).
COUN Austria
ABST The batch distribution coefficients of Cu(II), Zn, Cd, Fe(III), Hg(II), Mg, Co(II), Ni, Pb, Ca, and Bi were determined on the strongly acidic cation exchange resin Dowex 50 x 8 in 0.1 M trioctylphosphine oxide in tetrahydrofuran - 5% 12 M nitric acid. In this mixture all these metal ions, except Bi, have high K_d- values and can be separated quantitatively from uranium which has a distribution coefficient of 0.1. Mixtures of U with Cu, Ni, Co, Cd, or Fe were analyzed to test the applicability of such separations. Different titrimetric and spectrophotometric methods were used to determine the elements subsequent to their separation from uranium on ion exchange columns. The results show that accurate and effective separations can be achieved.
KEY ion exchange, trace metals, extraction, analysis, uranium

211 AUTH Kikuchi,M.; Ga,E.; Funabashi,H.; Yusa,H.
DATE 1978
TITL Adsorption of ions on titanium oxide at temperatures up to 280°C.
CITA Radiochem. Radioanal. Lett. 33(5-6): 331-336 (1978).
COUN Japan
ABST The adsorption of Co^{2+} (e.g. in removal from reactor coolant) on TiO_2 was studied as a function of OH group content and temp. in the range 20-280°. The selectivity expts. showed that transition metal ions are preferably adsorbed at high temps. There are apparently 2 reaction mechanisms: 1st, an ion-exchange reaction at low temps., and 2nd, chem. adsorption with the formation of a coordination compd. on the TiO_2 surface at high temp.
KEY titanium, temperature, ion exchange, adsorbent, trace

(CONT.)
metals

212 AUTH Kim,Y.S.; Zeitlin,H.
DATE 1971
TITL Separation of trace-metal ions from seawater by adsorptive colloid flotation.
CITA J. Chem. Soc. 13(672): (1971).
COUN USA
ABST An adsorptive colloid flotation process based on a collector-surfactant-air system makes possible the rapid separation of various cationic and anionic metallic species from seawater.
KEY adsorbent, seawater, extraction, concentration, trace metals, analysis, capacity, chemistry

213 AUTH Kim,Y.S.; Zeitlin,H.
DATE 1971
TITL Separation of uranium from seawater by adsorbing colloid flotation.
CITA Anal. Chem. 43(11): 1390-1393 (1971).
COUN USA
ABST A procedure is described for the separation from seawater of uranium present as the stable tricarbonatouranyl anion by an adsorbing colloid flotation technique which utilizes a collector-surfactant-air system. At pH 6.7 ± 0.1 the uranium is adsorbed effectively on the positively charged ferric hydroxide collector. On addition of the anionic surfactant, sodium dodecyl sulfate, and the bubbling of air through the seawater, the colloidal particulates of ferric hydroxide enriched with uranium by absorption are floated within 2 to 3 minutes to the surface as a stable froth which is easily removed. Uranium was analyzed spectrophotometrically using Rhodamine B. Average recovery of uranium from seawater by this method is 82%.
KEY extraction, adsorbent, chemistry, analysis, capacity, seawater, uranium

214 AUTH Klygin,A.E.; Smirnova,I.D.
DATE 1959
TITL The dissociation constant of the $UO_2(CO_3)_3^{4-}$ ion.
CITA Russ. J. Inorg. Chem. 4(1): 16-18 (1959).
COUN USSR
ABST The solubility of uranyl hydroxyquinolinate in ammonium carbonate solution has been studied at 25° C and ionic strength $\mu = 1.0$. The composition and dissociation constant of $UO_2(CO_3)_3^{4-}$ have been established; the constant is $1.7 \pm 0.6 \times 10^{-23}$ at 25°. This value differs from the approximate one of 5×10^{-19} reported earlier by about a factor of 3×10^{4}.
KEY chemical species, uranium

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215 AUTH Koczy,F.F.; Tomic,E.; Hecht,F.
DATE 1957
TITL On the geochemistry of uranium in the Baltic Sea region.
CITA Geochim. Cosmochim. Acta 11: 86-102 (1957). (German).
COUN W Germany
ABST In order to study the geochemistry of uranium on typical shelf zones, samples of river water and sea water, as well as samples of sediment from the Baltic Sea region, have been examined. The Baltic Sea region was chosen for the investigation since its hydrography is well known, water transport to and from it can be estimated to a high degree of accuracy, and the region can be well sampled.
KEY chemistry, uranium, river, seawater, concentration, trace metals, salinity, organics, sediments, biological productivity, marine organisms, estuary

216 AUTH Koglin,E.; Schenk,H.J.; Schwochau,K.
DATE 1978
TITL Spectroscopic studies on the binding of uranium by brown coal.
CITA Appl. Spectr. 32(5): 486-488 (1978).
COUN W Germany
ABST Brown coal removes U from sea water where it is present mainly as $[UO_2(CO_3)_3]^{4-}$. The adsorption and binding of U is studied by infrared spectroscopy. The spectra of the coal-uranium adducts still exhibit the asymmetric stretching vibration of the uranyl ion, but no CO_3^{2-} frequencies, suggesting that U is retained as UO_2^{2+}. The coal humic acids are shown to be responsible for the decomposition of the carbonato complex. The subsequent uptake of U is not a pure cation exchange process since the shift of the asymmetric uranyl stretching frequency from 950 cm^{-1} (hydrated UO_2^{2+}) to 890 cm^{-1} points to complexation of UO_2^{2+} by carboxylate groups which act as bidentate ligands.
KEY uranium, seawater, extraction, chemical species, adsorbent, analysis, concentration, chemistry

217 AUTH Kolodny,Y.; Kaplan,I.R.
DATE 1970
TITL Uranium isotopes in sea-floor phosphorites.
CITA Geochim. Cosmochim. Acta 34: 3-24 (1970).
COUN USA
ABST Analyses of uranium concentration and U^{234}/U^{238} activity ratios were performed on 40 samples of marine phosphorites, almost all of them dredged from the present sea floor. In each sample, the concentration and isotopic composition of total uranium and U(VI) were analyzed. Uranium concentrations in the analyzed nodules vary between 6 and 524 ppm, tetravalent uranium constituting 38-84 per cent of the total. Whereas the

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mean activity ratio for total uranium is 0.97, the ratio in the U(IV) uranium is 0.71 and the calculated activity ratio for U(IV) uranium is 1.57. The interpretation of these results has two consequences: (a) All the analyzed nodules are old (probably older than 8 x 10^5 yr), and are at the present being eroded rather than deposited; hence, the deposition of phosphorite in the present day ocean is rather doubtful; (b) The difference in isotopic ratios between the two oxidation states of uranium generally confirms previously proposed mechanisms of uranium isotope fractionation. Differential oxidation of U^{234} is largely responsible for the measured U^{234}/U^{238} disequilibrium ratios. A model for evolution of uranium isotope activity ratios in different oxidation states is presented.

KEY analysis, uranium, concentration, chemical species, sediments

218 AUTH Kolosentsev,S.D.; Belotserkovskii,G.M.; Plachenov,T.G.
DATE 1970
TITL Adsorption properties and porous structure of silica gels obtained by an ion-exchange method.
CITA Ionnyi Obmen Ionity: 112-115 (1970). (Russian).
COUN USSR
ABST Microporous silica gels were obtained from the sols of polysilicic acid prepd. from aq. solns. of Na silicate and cation exchange resin KU-2 in the H-form. The sols were either frozen out at -50° and dried at low temp., or gelled by heating. Adsorption and desorption of benzene and water were measured. Adsorption isotherms for benzene are curves with a steep start and without hysteresis loops. Curves for water vapor have both breaks and loops. The av. pore radius according to the Kelvin equation is 13-15 Å. Microporous structure of all samples prepd. by gelation is characterized with 2 different values of the const. B from the equation for adsorption isotherms, and of the vol. of the adsorption space W_0. This indicates the presence of 2 various shapes of micropores. The sample prepd. by freezing has only one value of W_0 and B, which reaches its lowest value. The polycondensation is probably hindered at low temp. The packing d. of silica gel particles increases with increasing time and temp. of gelation. Sp. surface area by BET method is 705 m^2/g.
KEY ion exchange, adsorbent, temperature, elution

219 AUTH Kolosentsev,S.D.; Belotserkovskii,G.M.; Plachenov,T.G.
DATE 1971
TITL Production of silica gels by an ion-exchange process and study of their properties.
CITA Poluch., Strukt. Svoistva Sorbentov 1: 32-39 (1971). (Russian).

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COUN USSR

ABST Silica gels of different characteristics were prepd. from SiO_2 sols stabilized with Na^+, from sols from which the Na^+ was removed with cation exchange resin in H form, and from sols stabilized with NH_3 at pH 8.9. The sols were changed into gels either by evapn. at 100° or by pH change. Adsorption isotherms for benzene at 20° and N at -193° were detd. The results were used for detg. limiting vol. of sorption space W, sp. surface S, total porosity W/V, pore radii corresponding to a max. on the pore-vol. distribution curve r, av. diam. of globules D, and coordination no. n. In gels obtained from sols stabilized with Na^+ the values of W, V, and S decreased with increasing dispersion change factor, whereas r remained const. Increase in D was accompanied by increase of n. Gels obtained by evapn. of acid sols had higher S and smaller r. Gels obtained from sols stabilized with either NH or higher concns. of NaOH were wide-porous materials with high V, W, and r. Heat treatment for 4 hr at 800° had little effect on benzene sorption and only slightly diminished S.

KEY ion exchange, chemistry, temperature, adsorbent

220 AUTH Kolosentsev,S.D.; Belotserkovskii,G.M.; Plachenov,T.G.

DATE 1975

TITL Regulation of the porous structure of silica gels prepared by ion exchange.

CITA Zh. Prikl. Khim. (Leningrad) 48(4): 940 (1975). (Russian).

COUN USSR

ABST Addnl. data considered in abstracting and indexing are available from a source cited in the original document. The porosity of silica gel, prepd. from silicic acid by ion-exchange method, may be regulated by changing the particle size and concn. of their sols. The ion-exchange method of the sol. prepn. is suitable for a geometric modelling of very fine porous materials which has a globular structure.

KEY ion exchange, concentration

221 AUTH Komarov,A.N.; Zhitkov,A.S.; Dmitriev,L.V.; Leonova,L.L.

DATE 1973

TITL Nature of the distribution of uranium in ultrabasites of Indian Ocean rift zones.

CITA Geokhimiya (2): 304-309 (1973). (Russian).

COUN USSR

AREA Indian Ocean

ABST The distribution character and occurrence forms of U in peridotites from the Indian Ocean bottom (Carlsberg and western Indian rift zones) is detd. by means of fragmental radiography (A.N. Komarov, 1969). The Th/U ratio in the ultrabasites of the Indian Ocean is

(CONT.)
$\sim$0.18-0.52; parts enriched by U are nonuniformly distributed in the rocks. Enriching of the ultrabasites by U was caused by hydrothermal and volcanic action. U sorption into the rocks took place after the ultrabasite formation and began at the rock surface.
KEY uranium, chemical species, seawater, analysis

222 AUTH Konecny,C.; Caletka,R.
DATE 1973
TITL Adsorption properties of insoluble hexacyanoferrates(II) supported on silica gel.
CITA J. Radioanal. Chem. 14(2): 255-266 (1973).
COUN Czech
ABST Inorg. ion exchangers were prepd. from insol. hexacyanoferrates(II) supported on SiO_2 gel. The hexacyanoferrates contained Cu, Cd, Ni, Fe(III), or Zn. They were used to recover Cs.
KEY adsorbent, ion exchange, trace metals

223 AUTH Konovalova,Y.V.; Dushina,A.P.; Aleskovskii,V.B.; Smirnova,M.F.
DATE 1976
TITL Preparation of barium and strontium polysilicates and study of their anion exchange properties.
CITA J. Sov. Chem. 49(8): 1752-1756 (1976).
COUN USSR
ABST Sorption isotherms of Ba^{2+} and Sr^{2+} were detd. on silica gel. The soln. pH decreases from 11 to 9.5 after 30 days contact and some relatively sol. polysilicates are formed in addn. to the insol. salts. The insol. polysilicates were used to sorb $SO_4^{2-}$from solns. and CO_2 from air (forming insol. $BaSO_4$, $BaCO_3$, or $SrCO_3$ on the surface).
KEY ion exchange, chemistry, adsorbent

224 AUTH Korkisch,J.
DATE 1964
TITL Analytical application of the ion exchange of uranium and thorium in mixed aqueous systems. II.
CITA Mikrochim. Ichnoanal. Acta (6): 905-942 (1964). (German).
COUN Austria
ABST The factors influencing the adsorption of UO_2^{++}, Cu^{++}, Ni^{++}, Co^{++}, Pb^{++}, La^{3+}, and Gd^{3+} on Dowex 1 ion exchange resin were studied. The effect on the distribution coeff. was reported of addn. of org. acids (HCO_2H, AcOH, $EtCO_2H$) and org. solvents (MeOH, EtOH, PrOH, iso-PrOH, BuOH, iso-BuOH, Me_2CO, and dioxane) as compared with pure H_2O, and the effect of variation in ion concn. An attempt was made to provide a theoretical explanation for the enhanced absorption of U and Th in mixed solvent soln. as compared with pure H_2O.

(CONT.)
KEY ion exchange, uranium, adsorbent, water, concentration

225 AUTH Korkisch,J.
DATE 1965
TITL Ion exchange separation of uranium and thorium in non-aqueous and mixed media.
CITA (Progress Report on Research Project). At (30-1) - 2623. (April): 35p (1965).
COUN W Germany
ABST A fluorimetric method for determination of U in sea water and other geological samples is described. Ion exchange is used to separate U from interfering elements on Dowex 1 in 90% methyl glycol and 10% 6 N HCl. Determinations of U can be made in 250 ml of seawater or in 0.1 g solid samples. A method of separation of small quantities of U from large excess of Bi is described. In 90% isopropanol - 10% 6 normal HCl, U (IV) is retained on Dowex 50 whereas Bi as an ionic chloride complex passes into the effluent unadsorbed. For the elution of U, 12 N HCl is employed.
KEY uranium, seawater, adsorbent, elution, chemistry, trace metals, analysis, ion exchange, extraction

226 AUTH Korkisch,J.; Goedl,L.
DATE 1974
TITL Determination of uranium in natural waters after anion-exchange separation.
CITA Anal. Chim. Acta 71(1): 113-121 (1974).
COUN Austria
AREA Austria
ABST U is detd. by fluorimetry and spectrophotometry in samples of natural nonsaline waters. After acidification with HCl, the water sample is filtered and, following the addn. of ascorbic acid and K thiocyanate, passed through a column of the strongly basic anion-exchange resin Dowex 1-X8 (thiocyanate form). On this exchanger U is adsorbed as an anionic thiocyanate complex. After removal of Fe and other coadsorbed elements by washing first with a mixt. consisting of 50 vol.% tetrahydrofuran, 40 vol.% methyl glycol and 10 vol.% 6M HCl, and then with pure aq. 6M HCl, the U is eluted with 1M HCl. In the eluate, U is detd. fluorimetrically or by the spectrophotometric arsenazo III method. The procedure was used for the routine detn. of U in water samples collected in Austria.
KEY uranium, water, ion exchange, extraction, adsorbent, analysis, elution

227 AUTH Korkisch,J.; Goedl,L.
DATE 1974
TITL Use of ion exchange methods for the determination of

(CONT.)
trace elements in natural waters. IV. Uranium, cobalt, and cadmium.
CITA Talanta 21(10): 1035-1046 (1974). (German).
COUN Austria
AREA Austria
ABST A method is described for separating and determining, by spectrofluorimetric or spectrophotometric measurement, traces of uranium, cobalt and cadmium at ppM levels in natural waters. The sample is acidified with HCl, filtered, and after addition of ascorbic acid and potassium thiocyanate, passed through a column of Dowex 1-X8 anion-exchange resin in the thiocyanate form. The three ions are concentrated on the resin as thiocyanate complexes, being at the same time separated from most of the other ions present in the sample. Elution with a tetrahydrofuranmethyl-glycol-HClmixture removes other interfering ions, then 6M HCl strips the cobalt, 1M HCl the uranium, and 2M HNO_3 the cadmium. Data are presented for concentrations of uranium (0.01 to 5 ppM) cobalt (0.04 to 1.9 ppM) and cadmium (0.04 to 0.6 ppM) in a large number of water sources in Austria.
KEY ion exchange, uranium, elution, analysis, trace metals, water, concentration, adsorbent, extraction

228 AUTH Korkisch,J.; Koch,W.
DATE 1973
TITL Determination of small amounts of uranium after concentrating by extraction and anion exchange in a solvent system containing tri-n-octylphosphine oxide.
CITA Mikrochim. Acta (1): 157-168 (1973). (German).
COUN Austria
ABST Prior to fluorometric (J. Korkisch and F.Hecht, 1972) or spectrophotometric (K. and K., 1972) detn. of U, U was sepd. and preconcd. by extn. from 1N HCl contg. ascorbic acid into Et_2O and adsorbed from 1:9:10 12N HCl-methyl glycol-0.1N tri-n-octylphosphine oxide (in Et_2O) on a Dowex 1 x 8 anion exchange resin (Cl^- form). U was eluted with 1M HCl for detn. The technique was applied to detn. of U in sea water and monazite. The technique was esp. useful for removing Mo prior to U detns.
KEY uranium, extraction, seawater, analysis, ion exchange, adsorbent, elution

229 AUTH Korkisch,J.; Sorio,A.
DATE 1975
TITL Determination of seven trace elements in natural waters after separation by solvent extraction and anion-exchange chromatography.
CITA Anal. Chim. Acta 79: 207-218 (1975).
COUN Austria
AREA Austria, Adriatic Sea
ABST A method is described for the determination of cadmium,

(CONT.)
cobalt, copper, manganese, lead, uranium, and zinc in samples of natural waters. After acidification with hydrochloric acid, the water sample is filtered and the diethyldithiocarbamates of the trace elements are isolated by extraction with acetone-chloroform (2:5) at pH 5. Following this preconcentration step, the metal ions are adsorbed on a column of the strongly basic anion-exchange resin Dowex 1-X8 (chloride form) using as sorption solution a mixture (5:4:1, v/v) of tetrahydrofuran, methyl glycol and 6 M hydrochloric acid. Successive elution is effected with 6 M hydrochloric acid (Co, Cu, Mn and Pb), 1 M hydrochloric acid (U) and 2 M Nitric acid (Cd and Zn); the metal ions in the eluates are determined by atomic absorption spectrophotometry (except uranium, which is determined fluorimetrically). The procedure was used to determine the trace metals in water and snow samples collected in Austria and to analyze a sample of seawater from the Adriatic Sea.
KEY extraction, uranium, elution, analysis, trace metals, water, adsorbent, ion exchange, seawater, chemistry

230 AUTH Korkisch,J.; Steffan,I.
DATE 1975
TITL Determination of uranium in sea water after anion-exchange separation.
CITA Anal. Chim. Acta 77: 312-314 (1975).
COUN Austria
ABST The fluorimetric and spectrophotometric detn. of U [7440-61-1] in natural waters after preliminary isolation by adsorption of its thiocyanate complex on strongly basic anion-exchange resin Dowex 1 is useful for analysis of waters with high salt content, such as sea water.
KEY analysis, uranium, seawater, ion exchange, adsorbent, water

231 AUTH Korkisch,J.; Steffan,I.
DATE 1976
TITL Separation and concentration of seawater constituents on synthetic ion-exchange resins.
CITA Strategies Mar. Pollut. Monit.: 241-256 (1976).
COUN Austria
ABST In the present paper the use of synthetic ion-exchange resins is reviewed with respect to their applicability for the isolation of dissolved inorganic constituents from seawater. The ion-exchange materials considered include both strongly acidic cation- and strongly basic anion-exchangers as well as chelating resins. The principles on which the separation and concentration techniques are based are presented in tabular form in order to illustrate most clearly the scope of the

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ion-exchange methods. Also treated are multi-step separations in which ion-exchange is combined with other concentration techniques such as coprecipitation or liquid-liquid extraction procedures which are employed to preconcentrate seawater constituents.
KEY ion exchange, seawater, extraction, trace metals

232 AUTH Korpak,W.; Urbanski,T.S.; Deptula,Cz.; Majchrzak,K.; Golinski,M.; Modrzew,J.; Borysowski,J.
DATE 1966
TITL Recovery and purification of uranium and other metals by ion exchange and solvent extraction.
CITA Nukleonika, Suppl. 10: 269-273 (1966). (Polish).
COUN Poland
ABST A survey is given of the development of U recovery, and theoretical and practical works performed in Poland in 1955-62. The solvent extn. methods were also applied to the production of Ce and to some other hydrometallurgical processes of recovery and purification of metals.
KEY uranium, ion exchange, extraction, trace metals

233 AUTH Korshak,V.V.; Zubakova,L.B.; Kachurina,N.V.; Shmakova,N.A.
DATE 1975
TITL Production of mineral-organic sorbents by chemical grafting of 2-methyl-5-vinylpyridine to silica gel.
CITA Deposited Doc., VINITI 2844-2875: 9p (1975). (Russian).
COUN USSR
ABST The optimum prepn. conditions and sorption kinetics of 2-methyl-5-vinylpiperidine (I) [140-76-1]-grafted silica gel are detd. The max. yield of I-grafted silica gel was obtained on polymn. at 85° and monomer and initiator concn. 1.65 and 0.04 mol/L, resp. The static ion exchange capacity of I-grafted silica gel for iodine depended linearly on the amt. of grafted I. The max. ion exchange capacity with the mineral-org. sorbent, contg. 15% I was obtained after 10 h, compared to 50 h for MVP 3 anion exchanger. A 70% desorption of iodine occured after 15 min with I-grafted silica gel, compared to 61% after 6 h with MVP 3.
KEY adsorbent, ion exchange, capacity

234 AUTH Kourim,V.; Stejskal,J.; Santarova,M.
DATE 1976
TITL Improved inorganic ion-exchangers. III. Polyantimonic acid and mixed sulfate-silica gel systems.
CITA J. Radioanal. Chem. 30(1): 147-153 (1976).
COUN Czech
ABST A series of mixed sulfates of Pb and Ca, as well as polyantimonic acid were tested for their ability to isolate Sr from acidic solns. The sol-gel method was

(CONT.)
used for prepns. of particles with a silica gel matrix. Both polyantimonic acid and Pb Ca sulfate were promising ion exchangers. The studies were made in relation to Sr recovery from radioactive wastes.
KEY ion exchange, trace metals

235 AUTH Kovarik,J.F.
DATE 1975
TITL Metal oxide sols.
CITA U.S. 3,864,142 (Cl. 117-100S; B 01j), Appl. 137,670, 26 Apr 1971: 4p (1975).
COUN USA
ABST Sols of Al_2O_3, Cr_2O_3, Fe_2O_3, TiO_2, or Ti_2O_3 and SiO_2 sols coated with 0.1-1.0 monolayer of one of the metallic oxides were made by dissolving the corresponding chloride salt in H_2O or in a SiO_2 sol suspension and exchanging the chloride for bicarbonate with an anion exchange resin. For example, 441 g of a 30 wt.% SiO_2 sol, Nalcoag 1034 A, was added to a soln. of 28 g $Al_2(OH)_5Cl$ in 45 g H_2O. Then 50 g of an anion exchange resin, Nalcite SAR in bicarbonate form, was slurried in the suspension to absorb the chloride ions. The coated sol filtered from the exchange resin had pH 4.95, 1/2 monolayer coating of Al_2O_3, and an Al_2O_3/SiO_2 ratio of 0.045. Elec. cond. of the sols, which are salt free, is given.
KEY ion exchange, titanium

236 AUTH Koyanaka,Y.
DATE 1970
TITL Collection of uranium from sea water by galena.
CITA J. Nucl. Sci. Technol. 7(8): 426-427 (1970).
COUN Japan
ABST Expts. with the extn. of U from artificial and natural sea water indicated that galena could be a suitable absorbent for the large-scale collection of U from natural sea water. Galena (100-200 mesh) (30 g) absorbed 125 μg of U from 49 l. of natural sea water. Elution with 40 ml of Na_2CO_3 removed 120 μg of the absorbed U from the galena which was regenerated for future use with pH 5 HCl.
KEY extraction, uranium, seawater, adsorbent, capacity, elution, chemistry

237 AUTH Kraus,K.A.; Phillips,H.O.; Carlson,T.A.; Johnson,J.S.
DATE 1958
TITL Ion exchange properties of hydrous oxides.
CITA Proc. UN Intern. Conf. Peaceful Uses At. Energy, 2nd (Geneva) 28: 3-16 (1958).
COUN USA
ABST The large class of amorphous insoluble hydrous oxides has interesting ion exchange properties. These

(CONT.)
materials have high capacities and suitable exchange rates and may therefore be used in packed columns in typical chromatographic (ion exchange) manner. Hydrous oxides may exhibit either cation exchange or anion exchange properties, or both. The type of adsorption depends on the element on which the oxide is based, on the acidity of the medium and, to some extent, on the ion adsorbed. Though some of the most acidic oxides are soluble (e.g., P_2O_5) or easily dispersible (e.g., MoO_3, WO_3) their intrinsic cation exchange properties may be utilized by incorporating them in excess into an insoluble matrix, i.e., by preparing certain insoluble acidic salts. Some of the materials with cation exchange properties may be used even with extremely small columns for the separation of the alkali metals from each other or of the alkaline earths. The specificity of these compounds for cesium in acidic solutions permits the almost unique isolation of this element from practically all others. Those oxides with anion exchange properties also have unusual selectivities compared with the organic ion exchangers. Oxides based on Bi(III) have high selectivities for the heavier halides and others, such as the oxides of Zr(IV), Nb(V), and Ta(V) for remarkable selectivities for fluorides.
KEY ion exchange, capacity, adsorbent, chemistry, trace metals

238 AUTH Krauss,R.W.(Ed.)
DATE 1977
TITL The marine plant biomass of the Pacific Northwest coast.
CITA Oregon State University Press, Corvallis, Oregon: (1977).
COUN USA
AREA Pacific Northwest
ABST A compilation of the following articles: (1) Growth of Pacific NW marine algae in semi-closed culture, (2) Growth of Pacific NW marine algae on artificial substrate - potential and practice, (3) The domestication of the giant kelp, Macrocystis, as a marine plant biomass producer, (4) Eucheuma - current marine agronomy, (5) Potential yields from a waste-recycling algal mariculture system, (6) Potential yields of marine algae - with emphasis on European species, (7) Survey of chemical components and energy considerations, (8) Essential considerations for establishing seaweed extraction factories, and (9) Marine plant production and utilization - a systems perspective.
KEY pacific northwest, marine organisms, seawater, nutrients, chemistry, organics

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239 AUTH Krejcik,L.; Marvan,P.; Pribil,S.; Trebichavsky,J.
DATE 1976
TITL Sorbent for the recovery of trace amounts of metals from aqueous solutions and dispersions.
CITA Czech. 162,027 (Cl. C02C5/02), Appl. 69/2,721, 17 Apr 1969: 3p (1976).
COUN Czech
ABST Algae Scenedesmus quadricauda and Stigeoclonium were cultivated in an aq. soln. of nutrient salts with feeding of CO_2 and periodic addn. of batched amts. of $UO_2(NO_3)_2$. Afer a 7-day run, >95% of the added U was retained in the algae without noxious effects of UO_2^{2+} on the prodn. of biomass.
KEY uranium, extraction, marine organisms, nutrients, water

240 AUTH Krylov,O.T.; Novikov,P.D.; Gordievskii,A.V.
DATE 1973
TITL Extraction of uranium from ocean water using anion-exchange resins.
CITA Khim. Morei Okeanov, Mater. Vses. Konf. Khim. Morya, 5th 1971: 101-105 (1973). (Russian).
COUN USSR
AREA Pacific Ocean, Atlantic Ocean
ABST Selective extn. of U from the Pacific and the Atlantic ocean waters was peformed using the AN-2f, EDE-10p, and AN-31 anion exchangers in the Cl^- form in an exptl. on-ship sorption installation working with the output of 200-50 l./hr. After burning of the resin samples, concns. of $U \leq 3 \times 10^{-3}$% (in AN-2f) were found by the use of an extn.-photometric method with arsenazo III and independently by emission spectrographic anal. In addn. to the U, Cr, Fe, Mn, and Al were also concd. The effectiveness of the anion exchangers used decreased in the following order: AN-2f > EDE-10p > AN-31. The concn. of U in the first 2 resins was comparable with its concn. in the U-poor ores ($\geq$0.003%) whose industrial exploitation is economically feasible. The calcd. concn. of U in the Pacific Ocean water (3.5×10^{-6} g/l.) is close to the literature data and shows that the sorption, esp. on AN-2f was quant.
KEY extraction, uranium, shipboard systems, trace metals, economics, adsorbent, ion exchange, analysis, concentration

241 AUTH Ku,T.L.; Knauss,K.G.; Mathieu,G.G.
DATE 1977
TITL Uranium in open ocean: concentration and isotopic composition.
CITA Deep-Sea Res. ISSN 0011-7471. 24(11): 1005-1017 (1977).
COUN USA
AREA Pacific Ocean, Atlantic Ocean, Arctic Ocean, Antarctic Ocean

(CONT.)
ABST Uranium concentrations and $^{234}U/^{238}U$ activity ratios have been determined in 63 seawater samples (nine vertical profiles) from the Atlantic, and Pacific, and Arctic, and the Antarctic oceans, using the alpha-spectrometric method for their determinations. Correlation between uranium and salinity is well manifested by the data from the Arctic and the Antarctic oceans, but such a relation cannot be clearly defined with the ±(1 to 2)% precision of uranium measurements for the Atlantic and Pacific data. At the 95% confidence level: (1) the uranium/salinity ratio is $(9.34 \pm 0.56) \times 10^{-8}$ g/g for the seawater analyzed with salinity ranging from 30.3 to 36.2 per thousand; the uranium concentration of seawater of 35 per thousand salinity is $3.3_5 \pm 0.2$ $\mu g\ l^{-1}$; (2) the $^{234}U/^{238}U$ activity ratio is 1.14 ± 0.03. Uranium isotopes in interstitial waters of the Pacific surface sediments analyzed do not show large concentration differences across the sediment-water interface as suggested by previous measurements. Current estimations of the average world river uranium concentration (0.3 to 0.6 $\mu g\ l^{-1}$) and $^{234}U/^{238}U$ ratio (1.2 to 1.3) and of the diffusional ^{234}U influx from sediments (0.3 dpm $cm^{-2}\ 10^{-3}\ yr^{-1}$) are essentially consistent with a model which depicts a steady state distribution of uranium in the ocean. However, the 0.3 to 0.6 $\mu g\ l^{-1}$value for river uranium may be an upper limit estimate.
KEY uranium, concentration, seawater, salinity, interstitial water, river, analysis, chemical species, sediments

242 AUTH Kul'bich,T.S.; Tarkovskaya,I.A.; Nikashina,V.A.; Senyavin,M.M.
DATE 1974
TITL Calculations for ion exchange on silica gel.
CITA Teor. Prakt. Sorbtsionnykh Protsessov 9: 111-115 (1974). (Russian).
COUN USSR
ABST The kinetics of adsorption of traces of Cs compds. from milk on SiO_2 was studied. Exptl. data agreed with adsorption isotherms derived on the basis of theor. considerations.
KEY ion exchange, adsorbent, trace metals

243 AUTH Kunzendorf,H.; Friedrich,G.H.W.
DATE 1976
TITL Distribution of U and Th in growth zones of manganese nodules.
CITA Geochim. Cosmochim. Acta 40(7): 849-852 (1976).
COUN Denmark
AREA Pacific Islands
ABST Growth zones and individual sublayers from one manganese nodule and three manganese crusts from an area south of

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Hawaii were analyzed for U and Th by the delayed-neutron counting technique. The concentrations of uranium and thorium in the manganese nodule are highest in the outermost zone on top of the nodule, being the surface last exposed to sea water. In this zone U varies from 6.3 to a maximum of 8.3 ppm in different sublayers, decreasing to 5.0 ppm in the inner zones and 3.4 ppm in the outer zone last exposed to the sediment. Ferromanganese material scraped from the zone last exposed to the sediment which has low concentrations of Fe, relative to the zone last exposed to sea water, has also low U contents (2.7 ppm). Th concentrations are higher in the outermost zone on top of the nodule (40 to a max. of 130 ppm) than in the zone last exposed to the sediment (about 20 ppm Th). Manganese crusts contain up to 9 ppm U in the outermost zones last exposed to the sea water. They also have higher concentrations of Th (up to 64 ppm) relative to the inner zones of the crust growing on altered andesitic rock, which contains about 8 ppm U and about 26 ppm Th as an average.
KEY uranium, analysis, seawater, concentration, sediments, trace metals, pacific islands

244 AUTH Kunzendorf,H.; Friedrich,G.H.W.
DATE 1976
TITL Uranium and thorium in deep-sea manganese nodules from the central Pacific.
CITA Inst. Min. Metall. Trans., Sect. B. 85: B284-B288 (1976).
COUN Denmark
AREA Central Pacific
ABST Analytical data on uranium and thorium from 119 nodules are presented. A small number of samples were collected in the vicinity of some seamounts. Correlation figures between uranium, thorium, manganese and iron are included. Uranium enrichment generally occurred in samples with relatively high iron contents. Correlation between iron and thorium was a factor less than that between iron and uranium. It is therefore possible that thorium enrichment follows different and probably more complex paths during precipitation from sea water.
KEY uranium, seawater, analysis

245 AUTH Kurochkina,G.N.; Virskaya,G.M.; Akhmedov,K.S.
DATE 1970
TITL Interaction of polyelectrolytes with synthetic silica, alumina, aluminosilica gels.
CITA Vzaimodeistvie Vodorastvorimykh Polielektrolitov Dispersnymi Sist.: 16-20 (1970). (Russian).
COUN USSR
ABST The sediment vols. of neg.-charged silica gel, alumina gel, or alumina-silica gel are little affected by the

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addns. of water-sol. polyelectrolytes, such as poly(acrylic acid) [9003-01-4], polyacrylamide [9003-05-8], or polyacrylonitrile [25014-41-9], but the sediment vols. of pos.-charged gels are increased by the addns. of these polyelectrolytes, indicating coagulation. The changes of pH and elec. cond. of the pos.-charged gels, obsd. during their treatment with the polyelectolytes, shows that the interaction between them involves adsorption with ion exchange.
KEY ion exchange, adsorbent

246 AUTH Kuroda,Y.
DATE 1972
TITL Purification of waste uranium solution.
CITA Japan. 72 35,199 (Cl. C 01c), Appl. 67 06,319, 02 Feb 1967: 2p (1972).
COUN Japan
ABST Excess alk. earth oxide and (or) hydroxide are added to waste U soln. contg. F and NH_3. Then U is copptd. with F. By distn., NH_3 is recovered.
KEY uranium, extraction

247 AUTH Kuznetsov,V.I.; Akimova,A.A.
DATE 1958
TITL Organic coprecipitants. VIII. Coprecipitation of uranium for its determination in sea water.
CITA Zh. Anal. Khim. 13: 79-82 (1958). (Russian).
COUN USSR
ABST The precipitation and separation of U from sea water are described. Addition of NH_4SCN and methyl violet to acidified sea water causes a precipitate to form which carries down U, even for dilutions of $1:10^{10}$. The deposit is then filtered and calcined, thus obtaining U separated from other seawater salts.
KEY uranium, seawater, extraction

248 AUTH Kuznetsov,Y.V.
DATE 1971
TITL The question of possible variations in the past concentrations of uranium in the ocean.
CITA Radiokhimiya 13(1): 118-125 (1971).
COUN USSR
ABST Inasmuch as the theory and practice of geochronology of ocean formations by dating with ionium and uranium is based on the constancy of uranium concentration with time, experiments were carried out to verify whether ionium found in sediments is the value that would have been deposited assuming that the annual production of ionium from uranium dissolved in the water was constant in the past. An undeniable excess of ionium (average value of A = 2.7) was found. Three possible hypotheses were offered.

(CONT.)
KEY uranium, concentration, sediments, chemistry, seawater

249 AUTH Lal,D.; Arnold,J.R.; Somayajulu,B.L.K.
DATE 1964
TITL Method for the extraction of trace elements from sea water.
CITA Geochim. Cosmoshim. Acta 28(7): 1111-1117 (1964).
COUN India
ABST A simple technique is described that permits an in situ extraction of many elements present in trace quantities in sea water. The basis of the technique is adsorption of the elements on ferric hydroxide. A matrix of finely dispersed ferric hydroxide gel, using fibrous jute or spongin as the framework, is constructed through which water could flow freely; this matrix is towed through sea water permitting an in situ extraction of elements from large quantities of water. Four elements present in concentrations ranging from ca 10^{-4} to 10^{-9} g/l of sea water were extracted from the equivalent of a few hundred tons of coastal waters. In the beryllium and silicon extracts the radioactivities due to cosmic ray produced isotopes ^{7}Be and ^{32}Si were measured. The extraction technique described should prove valuable for studying the distribution and isotopic composition of several trace elements present in sea water as well as in lakes or rivers.
KEY extraction, seawater, trace metals, adsorbent, concentration, river

250 AUTH Lalou,C.; Lambert,G.; Le Roulley,J.C.; Nguyen,H.V.; Sanak,J.
DATE 1970
TITL Use of low level α-spectrometry for the determination of trace elements in natural inorganic substances.
CITA Dosage Elem. Etat Traces Roches Autres Subst. Miner. Natur., Actes Colloq. 1968: 395-409 (1970). (French).
COUN France
AREA Atlantic Ocean, Mediterranean Sea, Antarctica
ABST Low level α-spectrometry was used to study the U balance on the earth. The concns. of ^{238}U and the ^{234}U/^{238}U ratios were detd. in the Atlantic Ocean at depths of 0-4800 m, in the Mediterranean Sea at 22-2400 m, and in several rivers. The method was used to det. the age of a stalagmite (93,000 ± 2000 yr) from the Orgnac Chasm and of marine carbonates by ^{230}Th/^{234}U dating. The method was also used to measure the accumulation rate of snow in Antarctica by studying Pb-^{210}Po ratios. The semiconductor detector used is described.
KEY analysis, trace metals, concentration, river

251 AUTH Lamotte,C.
DATE 1972

(CONT.)
TITL Metal recovery and electrolyte purification by ion-exchange resins.
CITA Trait. Surface 13(113): 7,9 (1972). (French).
COUN France
ABST Various ion-exchange resins were used for removing metal ions from solns. for recovery or for pollution control. Zn was recovered from rayon-plant strong acids by using a cationic resin, which was regenerated with Na_2SO_4 soln. $UO_2(SO_4)_2^{2-}$ was concd. by anionic polystyrene DVB trimethylammonium resin, which was regenerated with NaCl or NH_4NO_3 soln. Similarly, processes are described for recovering various metallic ions in mineral processing, electrolysis baths, and anodization solns.
KEY ion exchange, trace metals, extraction

252 AUTH Lange,G.
DATE 1975
TITL New possibilities for exploration of uranium.
CITA Reaktortagung 7th: 307-310 (1975). (German).
COUN W Germany
ABST A review is given with no refs. on improving the recovery of U from low-grade ores and exploration of new U sources, e.g. seawater and phosphate ores, to meet the expanding demands for U as a nuclear fuel.
KEY uranium, seawater, extraction

253 AUTH Larionov,Eh.G.; Nikolaeva,N.M.; Pirozhkov,A.V.
DATE 1977
TITL Forms of uranium and Fe existence in natural water and leaching solutions.
CITA Geol. Geofiz. (2): 162-165 (1977). (Russian).
COUN USSR
ABST The measurement of pH, Eh and temperature in a number of pumped out and non-acidified wells in deposits and sampling of the solution from these wells for analysis and comparative evaluation of pH and Eh under laboratory conditions have been carried out in order to calculate experimentally the forms of U and Fe presentation in the leaching solution. For the sulphate solution with the minimum oxidizing potential $E_0 = 0.404$, ionic strength 0.05-2.75 and temperature 25°C, the ratio $(UO_2^{2+})/(U^{4-})$ is estimated to be 2.5 x 10^{18} and the ratio $(UO_2SO_4)/(UO_2^{2+})$ approximately 80, and hence in leaching solutions the concentration of U(4) in the form of sulphate complexes is higher than in the form of uranyl ions by 80 times. In the natural water with Eh = 0.247B, pH = 7.58 and E = 404 the ratio $(UO_2^{2+})/(U^{4+}) = 10^{25}$ and hence uranium is in the oxidized condition. When pH of the natural water equals 7 and the concentration of bicarbonate ions approximately 10^{-3} M the constant of the formation of carbonate complexes of uranyl is equal to 10^{22} which is higher than the constant of sulphate complexes by 18

(CONT.)

points, and consequently it is the most probable that U is present in such waters in the form of carbonate complexes. Forms of the Fe present have been calculated in the same way.

KEY uranium, chemistry, temperature, analysis, water, chemical species, trace metals, concentration

254 AUTH Laskorin,B.N.; Metal'nikov,S.S.; Smolina,G.I.

DATE 1977

TITL Extraction of uranium from natural waters.

CITA At. Energ. 43(6): 472-476 (1977). (Russian).

COUN USSR

ABST U was recovered from natural waters by sorption with granular ion-exchange sorbents. Expts. were made with natural water having a salt content 5.8 g/L, U content 60 mg/m^3, and pH 8.4-8.7. The sorption and regeneration cycles took 48 and 6 h, resp. The highest sorption capacity (5.3 mg U/g) was obtained with the highly basic anion exchanger AM-10Khp [65666-37-7]. The U content in the eluate was 600-1600 mg/L. The possibility of sorption of U from sea and ocean waters is outlined.

KEY extraction, uranium, ion exchange, water, adsorbent, salinity, chemistry, capacity, seawater

255 AUTH Laskorin,B.N.; Metalnikov,S.S.; Terentiev,A.S.

DATE 1958

TITL Extraction of uranium from natural water.

CITA Proc. UN Intern. Conf. Peaceful Uses At. Energy, 2nd, Geneva 3: 211-215 (1958).

COUN USSR

ABST Research was conducted to develop industrial methods for the extn. of U from natural waters which contain from 2.0 to 67 mg. U/ cu. m. H_2O from some waters from mines and oil wells that contain 0.2-1.0 g. U/cu. m. In natural H_2O with pH >8.0, the U is usually present in the form of anions in a CO_3^{--} complex. Various natural and synthetic adsorbents and synthetic resins were examd. The quantities required were excessive. Extn. with very dil. solns. of org. compds. in kerosine was tried. The most attractive method examd. was copptn. of U with solns. of various salts, especially $CuSO_4$ and $Al_2(SO_4)_3$. This method was developed into an industrial process and a detailed flow sheet is given. The U-bearing ppt. had the ability to ppt. addnl. U when redispersed in new portions of untreated H_2O. After clarification the ppt. was dissolved in H_2SO_4 and U recovered by solvent extn. The sulfate soln. contg. $Al_2(SO_4)_3$ or other coprecipitant was recycled to treat new H_2O. In 1954-55 >1 ton of U was extd. from natural waters with salt concn. comparable to that of sea water.

KEY extraction, uranium, water, chemistry, chemical species, salinity, seawater

(CONT.)

256 AUTH Lawton,F.L.
DATE 1972
TITL Economics of tidal power.
CITA Tidal Power, by Gray and Gashus, Plenum Press, New York: 105-129 (1972).
COUN Canada
ABST Tidal power plants are characterized by the influence of the tidal cycle dictated by the astronomical forces controlling the tides. The output, entirely predictable many years in advance, follows the lunar cycle and hence gradually moves out of and then back into phase with the solar cycle. The solar cycle shapes the energy requirements of the community.
KEY tidal system, tide

257 AUTH Laxen,P.A.
DATE 1971
TITL The dissolution of UO_2 as an electron transfer reaction.
CITA The Recovery of Uranium, Proceedings of a Symposium on the Recovery of Uranium from its Ores and other Sources, IAEA, Sao Paulo, 17-21 August 1970: 321-330 (1971).
COUN S Africa
ABST In the course of a study of the fundamental aspects of the dissolution of UO_2 in acid solutions containing Fe^{3+} , the strong similarity was observed between factors affecting the dissolution of UO_2 and factors affecting many electron transfer reactions occurring in solution - particularly the Fe^{3+} - Fe^{2+} exchange.
KEY concentration, uranium

258 AUTH Lazar,A.; Nemes,L.; Deica,D.; Peteu,I.; Lupan,S.
DATE 1975
TITL Active silica.
CITA Rom. 58,189 (Cl C01B33/18), Appl. 69,356, 11 Jan 1972: 3p (1975).
COUN Romania
ABST An active silica gel was prepd. by treating a soln. of Na silicate with an ion exchanger. Thus, a soln. of Na silicate (d_4^{20} 1.045, contg. SiO_2 4.28 Na_2O 1.2, and NaCl 0.02%) was passed through a column contg. a H-form cation exchanger, which was regenerated with a 4-5% H_2SO_4 and washed with a decationized H_2O, to give a sol of SiO_2, which was dehydrated for 48 h at 160-300°, to give an active silica gel.
KEY ion exchange, temperature, adsorbent

259 AUTH Lee,C.; Kim,N.B.; Lee,I.C.; Chung,K.S.
DATE 1977
TITL The use of a chelating resin column for preconcentration of trace elements from sea-water in their determination by neutron-activation analysis.
CITA Talanta 24(4): 241-245 (1977).

(CONT.)
COUN Korea
ABST A Chelex-100 resin column has been employed for the preliminary concentration of trace elements in water samples before their determination by neutron-activation analysis. The column filled with a 1:1 mixture of the resin (50 to 100 mesh) and Pyrex glass powder of the same mesh size, is shown to maintain a constant flow rate and give reproducible results. By a combination of preconcentration and neutron-activation analysis it is possible to determine Ba, Ca, Cd, Ce, Co, Cr, Cu, Fe, La, Mg, Mn, Sc, U, V and Zn in sea-water and/or fresh water simultaneously at the parts per milliard level.
KEY ion exchange, analysis, trace metals, extraction, water, seawater, uranium

260 AUTH Lejkin,Y.A.; Ratajchak,V.; Korshak,V.V.
DATE 1977
TITL Investigation of ion exchangers with groups of aminoethylphosphonium acids and their derivatives.
CITA Russ. J. Phys. Chem. 51(6): 856-859 (1977).
COUN USSR
ABST Acid-base equilibrium has been investigated on polymeric chelate compounds with groups of aminoethylphosphonium acids, AEP-3, their monoesters, AEP-2 and diesters, AEP-1. Values of the acid-base equilibrium constants of the chelate compounds have been calculated, and schemes of consecutive protonation of the ion exchangers investigated are suggested. Sorption characteristics for the series of U, Fe, Co, Ca, Th metals have been investigated. Values of the distribution coefficients and capacity from acid-base media of various concentration are given. Assumptions are made, which explain an increase in the selectivity and affinity in the series of the chelate compounds investigated. In the AEP-3 > AEP series-2 > AEP-1 weakening of the affinity to U, Fe, Th is observed.
KEY ion exchange, uranium, trace metals, capacity

261 AUTH Leung,G.; Kim,.Y.S.; Zeitlin,H.
DATE 1972
TITL Improved separation and determination of uranium in sea water.
CITA Anal. Chim. Acta 60(1): 229-232 (1972).
COUN USA
ABST An adsorbing colloid flotation technique (K. and Z. (CA 75:9738c, 112756f)) using colloidal $Th(OH)_4$ and $C_{11}H_{23}CO_2$ Na (I) as surfactant is used for separation of U from sea water. To 500-ml samples of filtered sea water contg. 0-6 μg of U^{6-}, 2 ml 0.1M $Th(NO_3)$ was added and the pH was adjusted to 5.7 ± 0.1 with M HCl. The flow of air in the cell was 10 ± 2 ml/min. Three ml of 0.05% I soln. (in 95% EtOH) was added; after 2-3 min, the

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froth was collected in a small conical flask. The froth was treated as previously described, except that the vol. of $Ca(NO_3)_2$-EDTA salting soln. was 15 ml. The fluorescence intensity of the pink U-rhodamine B complex soln. was measured at the 575 nm max. The calibration curve of fluorescence intensity vs. U^{6+} concn. in spiked samples is linear for 0-8 μg U. The recoveries of 2-6 μg U^{6+}, added to 500-ml samples of sea water originally contg. 3.1 μg U/l., were 89.2- 93.5, av. 90.0%.

KEY extraction, uranium, seawater, analysis, concentration, chemistry, capacity

262 AUTH Lewis,W.B.

DATE 1964

TITL How much of the rocks and the oceans for power? Exploiting the uranium-thorium fission cycle.

CITA Atomic Energy of Canada Ltd. Report AECL-1916: 33p (1964).

COUN Canada

ABST When rich uranium ores become scarce, the price will rise from $13/kg U, but with improved techniques of extraction and the choice of an economical fuel cycle, abundant uranium for many centuries appears to be available in the rocks and the oceans. Even from reactors already developed to the stage of engineering design it is possible to choose a fuel cycle to which uranium at $250/kg U would contribute no more than 2 mill/kwh. Without suggesting when such a high cost might be reached, its implications are examined. The optimum fuel cycle would balance the financing charges on the fuel inventory and the costs of fuel make-up supply and reprocessing. By using uranium and thorium in combination it was calculated that at least 50,000 Mwd can be derived per ton of uranium. At a net conversion efficiency of 30% and an overall rating of 6 thermal kw/kg, the natural uranium inventory would cost at the suggested high price $250/(6 x 0.3) = $139/ekw and for 7000 hr/yr at 7% annual charges would contribute 1.4 mill/ekwh. At 50 Mwd/kg U the make-up supply contributes 250/(50 x 24 x 0.3) = 0.7 mill/ekwh. Probably higher efficiency and possibly higher specific power ratings would be used to lower such costs. The value of uranium is related to its content of the fissile ^{235}U, and even though most power may be derived from thorium, it was concluded that its value will not rise comparably with that of uranium. The total cost of nuclear power also includes contributions from the cost of equipment and plant operation as well as from costs of fabricating and processing materials. Any other technique or fuel cycle is considered unable to supplant the thermal fission reactors merely by showing a lower demand for fissile material, but if plant and operating

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costs are not excessive, may enter the competition or become a valuable supplement. Three such techniques recognized are: fast neutron breeders, neutron production by the excitation of heavy nuclei to high energies, and controlled thermonuclear fusion.
KEY uranium, extraction, economics

263 AUTH Lieberman,M.A.
DATE 1976
TITL United States uranium resources - an analysis of historical data.
CITA Science 192(4238): 431-436 (1976).
COUN USA
AREA USA
ABST Using historical data, a study of U.S. uranium resources was performed with emphasis on discovery and drilling rates for the time interval from 1948 until the present. The ultimate recoverable resource up to a forward cost category of $30 or less per pound is estimated to be 1,134,000 short tons - about one third the estimate offered by ERDA. A serious shortfall in uranium supply is predicted for the late 1980's if nuclear power proceeds as planned; and courses of action are recommended for uranium resource management.
KEY uranium, economics

264 AUTH Lieser,K.H.; Loc,I.; Quandt,S.
DATE 1976
TITL Separation of uranium in columns filled with hydrated titanium dioxide.
CITA Radiochim. Acta 23: 133-136 (1976).
COUN W Germany
ABST Results of experiments are presented in which relatively large volumes of uranyl nitrate and uranyl acetate solutions (both 10^{-3}M, pH 5) are passed through columns filled with hydrated titanium dioxide. Under the conditions of the experiments (pH 5) uranium is retained in amounts of the order of 1 mmol/g TiO_2, to a small extent probably in form of anionic species but mainly in form of neutral compounds. The influence of complexing ligands like acetate ions is discussed.
KEY extraction, uranium, titanium, chemistry, chemical species

265 AUTH Lin,Y.M.
DATE 1973
TITL Determination of uranium content in sea water by a fluorimetric method with dinonyl naphthalene sulfonic acid as a extractant.
CITA Ho Tzu K'o Hsueh 10(3-4): 38-42 (1973). (Chinese).
COUN Taiwan
AREA Taiwan

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ABST The seawater is added to 1% HCl right after sampling to prevent the loss of U [7440-61-1] through ppt. and adsorption on the sample vessel. Seawater 2 ml is mixed with 8 ml conc. $HCLO_4$ and 10 ml of 8×10^{-3} F dinonyl naphthalene sulfonic acid [25322-17-2] in n-hexane was added and the mixt. shaken at 25 ± 1° for several min. After phase sepn., 0.2 ml was placed in a Pt dish and dried under an ir lamp. Then 0.4 g 98% NaF and 2% LiF were placed in the dish and fused at 850-900° for 3 min so that the reagent completely fused in the 1st min and then the temp. was reduced slightly in the next 2 min. The dish was cooled and dried in an amberlite dessicator, and fluorescence detd. in 30 min. The calib. curve of U_3O_8 is linear at $0\text{-}20 \times 10^{-9}$ g. The efficiency of U extraction in $HClO_4$ is in proportion to the concn. of dinonyl naphthalene sulfonic acid. The optimum concn. is 8×10^{-3} F. The extraction yield reached 85% even after a few min of shaking and settling. The U content in sea water around the coast of Taiwan was 9.37-13.3 mg/l.

KEY analysis, extraction, temperature, capacity, concentration, seawater, uranium

266 AUTH Lin,Y.M.; Weng,P.S.; Ma,I.

DATE 1974

TITL Use of dinonylnaphthalenesulfonic acid for the determination of environmental uranium in air, sea, and soil.

CITA Hoken Butsuri 9(3): 157-158 (1974).

COUN Taiwan

ABST The U in soil, seawater, and air (dusty filter paper from a low-vol. air sampler) was detd. The sample was dissolved in 9.4N $HClO_4$. The resulting soln. was dild. to an acidity of <2N and U was extd. with dinonylnaphthalenesulfonic acid in n-hexane. The U in the org. phase was detd. by fluorometry after fusing with NaF and LiF at 850-900° for 2.5 min. The detn. range was 4.43×10^{-14} to 3.37×10^{-4} g U/l. for air samples. The overall extn. of U was ∿80%.

KEY analysis, uranium, concentration, seawater, extraction, temperature, capacity

267 AUTH Liu,C.P.; Liu,L.S.

DATE 1974

TITL Absorption of minor elements on hydrous metal oxides in sea water.

CITA K'o Hsueh T'ung Pao 19(11): 514-520 (1974).

COUN China

ABST A method based on a modified version of the Sips equation is presented to calculate the distribution of the absorption of minor elements on hydrous metal oxides in sea water. The amount of minor elements per unit

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surface area is represented as a function of the concentration of minor elements in sea water. The application of this method to the following 3 actual cases is presented: (1) minor elements such as molybdenum and tungsten on hydrous ferrous oxides, (2) minor elements such as boron and boric acid on hydrous magnesium oxide, and (3) minor elements such as uranium on titanium oxide.

KEY seawater, adsorbent, trace metals, uranium, titanium

268 AUTH Llewelyn,G.I.W.
DATE 1976
TITL Extraction of uranium from seawater.
CITA Atom (London) (238): 214-219 (1976).
COUN UK
AREA Straits of Dover, Irish Sea

ABST This paper is based on the conclusions of a working party set up by the United Kingdom Atomic Energy Authority some years ago to assess the problems involved in the extraction of U from sea water. Headings include the following: the sea as a source of U - an examination of possible schemes; energy balance analysis for extraction of U from sea water; environmental aspects; possible extractive plant sites; and sites of process development. Amongst conclusions reached are (i) there are a number of uncertainties associated with the process and extensive further research would be necessary to appreciably reduce the level of these uncertainties; (ii) the most promising extraction system is that based on pumped sea water flow; (iii) it seems unlikely that there are sites around the UK where U extraction from sea water could appreciably help UK requirements; (iv) a large scale U extraction plant could involve a major biological management effort both within the process and the environment, although the biological problems could probably be overcome; (v) in view of the uncertainties associated with such a project, it is at present unrealistic to attempt to give even approximate cost estimates; (vi) it would be unwise to expect U from sea water to contribute significant amount to world U demands for thermal reactors on an acceptable time scale.

KEY extraction, uranium, seawater, environmental impact, pumped system, marine organisms, economics, adsorbent, current, temperature, particulate, elution, existing system

269 AUTH Llewelyn,G.I.W.
DATE 1976
TITL Recovery of uranium from sea-water.
CITA Uranium ore processing. Proceedings of an advisory group meeting organized by the IAEA and held in

(CONT.)
Washington, D.C., 24-26 November 1975. ISBN 92-0-041176-2. IAEA, Vienna: 205-212 (1976).
COUN UK
ABST The possibility of extraction of uranium from sea-water on a sufficiently large scale to contribute significantly to national UK requirements is placed in perspective. It seems unlikely that there are sites around the UK coast where this could be achieved, and insufficient work has been done to be confident that sites exist anywhere to enable uranium extraction to be carried out on a large scale. Process techniques have been developed on a small scale, but extensive further research work would be necessary to reduce appreciably the present uncertainties. It would be unwise to expect uranium from sea-water to contribute significant amounts to the world's uranium demand for thermal reactors on an acceptable timescale.
KEY extraction, uranium, seawater, economics

270 AUTH Lombaard,R.; Lovell,V.M.; Allison,S.A.
DATE 1971
TITL Adsorption of uranyl species on pyrophyllite, quartz, and acid-treated South African uranium ores. A preliminary investigation.
CITA National Inst. for Metallurgy Report NIM-1205: 21p (1971).
COUN S Africa
ABST The adsorption of ionic species of uranium by pyrophyllite and quartz was investigated. A more detailed study of the adsorption and desorption of uranyl species (from sulfate solution) by ore from the Rossing deposit was also undertaken. Owing to poor reproducibility, the interpretation of the results was difficult. However, it was found that complete desorption of the uranium occur after adsorption from solutions containing 8.5 ppM of uranium. Adsorption of uranyl species by Buffelsfontein ore was also investigated. It was concluded that the amounts of uranium that might be lost due to adsorption in the extraction process were probably very small, amounting to less than 0.6% of the head value of the uranium.
KEY adsorbent, uranium, elution, extraction

271 AUTH Lyle,S.J.
DATE 1973
TITL Solvent extraction in inorganic analytical chemistry.
CITA Selec. Annu. Rev. Anal. Sci. 3: 1-57 (1973).
COUN UK
ABST The subject is reviewed under the following headings: general reviews and monographs; laboratory apparatus and technique; kinetic aspects of extraction; some thermodynamic properties, solubility and salt effects;

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equilibrium and mechanistic aspects of extraction; applications (separation and concentration; determination of the metal in the non-aqueous phase). The elements covered include the following: Be, B, Cd, Cs, Ce, Eu, Hf, In, I, La, Lu, Mo, Nb, Re, Ru, Sc, Sr, Ta, Te, Tm, V, W, Y, Zr, Am, Ac, Cf, Cm, Np, Pa, Po,Pu, Th, and U.
KEY extraction, analysis, trace metals, uranium

272 AUTH Lynch,R.W.; Dosch,R.G.; Kenna,B.T.; Johnstone,J.K.; Nowak,E.J.
DATE 1976
TITL Sandia solidification process: a broad range aqueous waste solidification method.
CITA Report SAND-75-5907: 15p (1976).
COUN USA
ABST Ion-exchange material of the hydrous oxide type were developed for solidifying aq. radioactive wastes. These materials have the general formula: $M[M'_2 O_y H_z]_n$, where M is an exchangeable cation of charge n and M' may be Ti, Nb, Zr, or Ta. Affinities for polyvalent cations were very high and ion-exchange capacities large (e.g. 4.0-4.5 mequiv./g for $NaTi_2O_5H$ [60704-88-3], depending on moisture content). The effectiveness of the exchangers for solidifying high-level waste resulting from reprocessing light-water reactor fuel was demonstrated in small-scale tests. Used in conjunction with anion exchange resin, these materials reduced test soln. radioactivity from $\sim$0.2 Ci/ml to as low as $\sim$2 nCi/ml. The residual radioactivity was almost exclusively due to ^{106}Ru and total α activity was only a few pCi/ml. Alternative methods of consolidating the solidified waste were evaluated with nonradioactive simulants. Best results were obtained by pressure-sintering which yielded essentially fully dense ceramics, e.g. titanate/titania ceramics with bulk d. as <4.7 g/cm^3, waste oxide content as high as 1.2 g/cm^3, and leach resistance comparable to good borosilicate glass. A baseline process for solidifying high-level waste was defined and approx. economic anal. indicated costs were not prohibitive. Also, operating conditions could be modified to alloy recovery of radiocesium (and perhaps other isotopes) during solidification of the remaining constituents of high-level waste. These materials might be used for treating tank-stored neutralized wastes.
KEY ion exchange, titanium, economics, capacity

273 AUTH Mahdavi,A.
DATE 1976
TITL Study on the behaviour of radionuclides in seawater in the Persian Gulf and Caspian Sea area. Part of a

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coordinated programme on marine radioactivity studies.
CITA International Atomic Energy Agency, Vienna (Austria). Final report for the period 1 Nov. 1973 - 31 Oct. 1974. IAEA-R-1405-F: 5p (1976).
COUN Iran
AREA Persian Gulf, Caspian Sea
ABST Results of the analysis of coastal waters from the Persian Gulf and the Caspian Sea are reported. Certain radionuclides, trace elements and salts (U, Ra226, Cu, Mn, Zn, Pb, Fe, Cd, Hg, Na, K, Ca, Cl, So$_4$) were determined in samples from the two different areas. The measured concentrations are given (table) and compared with reported values for open sea water in the areas studied. The results indicate an obvious difference between the two water bodies compared with open sea water.
KEY analysis, uranium, seawater, trace metals, concentration

274 AUTH Makarova,E.D.; Belinskaya,F.A.
DATE 1976
TITL Structural and ion exchange properties of titanium hydroxide. 1. Literature review.
CITA Ionnyi Obmen Ionometriya 1: 3-21 (1976). (Russian).
COUN USSR
ABST A review of Ti hydroxide ion exchangers structure and properties with 49 refs.
KEY ion exchange, titanium, adsorbent

275 AUTH Malik,W.U.; Sharma,T.C.
DATE 1972
TITL Spectrophotometric determination of micro-amounts of uranium(VI) and thorium(IV) with dithizone.
CITA Indian J. Appl. Chem. 35(4): 147-148 (1972).
COUN India
ABST Uranyl complexes and thorium complexes with dithizone were prepared and studied spectrophotometrically with a view to assess suitability of dithizone as a reagent for colorimetric estimation of uranium and thorium. The complexes obey Beer's law. Uranium and thorium in quantities as low as 1 ppm can be determined. The molar composition of the complexes shows that it contains metal and dithizone in the molar ratio 1:2. Interferences by a large number of added foreign ions have been studied and tolerance limit determined.
KEY uranium, analysis, trace metals

276 AUTH Malinowski,M.; Malinowski,S.; Krzyzanowski,S.
DATE 1976
TITL Investigation of surface phenomena on solid catalysts by simultaneous TG and DTA. Part III. Adsorption of water on the surface of ion exchange zeolites, silica and alumina gels treated with sodium hydroxide.

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CITA J. Therm. Anal. 10(1): 65-72 (1976).
COUN Poland
ABST Simultaneous thermogravimetry and DTA were used to study adsorption, desorption, and surface reactions of water vapor on NaX and NaY type and NaX-exchanged zeolites, and treated with NaOH. Water in zeolites is probably bound by O-alkali metal bonds. Information was obtained on surface phenomena and active centers on the catalyst surface.
KEY adsorbent, water, ion exchange, analysis

277 AUTH Marcu,Gh.; Curtui,M.; Haiduc,I.
DATE 1977
TITL Solvent extraction of dioxouranium(VI) with dialkylphosphorodithioic acids. 1. The mechanism of extraction in n-butanol.
CITA J. Inorg. Nucl. Chem. 39(8): 1415-1418 (1977).
COUN Romania
ABST The extraction of dioxouranium(VI) from acidic solutions with O,O-dialkylphosphorodithioic acids, $(RO)_2P(S)SH$ (where R = Et, n-Pr, n-Bu) as chelating agents, in n-butanol as solvent, was investigated and distribution coefficients were measured at various concentrations and pH values of the aqueous phase. The treatment of the extraction shows that the extracted species are 1:2 complexes of the dioxouranium(VI) ion with phosphorodithioato groups of the type $UO_2[S_2P(OR)_2]_2$, probably associated with additional solvent molecules.
KEY extraction, uranium, concentration, chemistry

278 AUTH Marhol,M
DATE 1976
TITL Rare earth separation using selective ion-exchangers containing phosho-groups.
CITA 2nd national conference on analytical chemistry with international participation. Varna, Bulgaria. INIS-mf-3321: 23p (1976).
COUN Czech
ABST The behavior of various cation exchangers containing phosphinic, phosphonic or phosphoric acid groups was investigated for the selective separation of lanthanides either from miscellaneous elements or inside the lanthanide series. The observed affinity of $-PO(CH)_2$ or $-OPO(CH)_2$ exchanging groups in acidic solutions falls from lutetium to lanthanum. Using a chromatographic technique it is possible to separate on such exchangers some mixtures of lanthanides without a complexing elution agents. For such separation procedures, solutions of hydrochloric or nitric acid are useful. The influence of the resin composition, particle size, temperature, flow rate, composition and concentration of eluting solutions on the quality of the separation is

(CONT.)
discussed.
KEY temperature, ion exchange, extraction, trace metals, elution, concentration

279 AUTH Markl,P.; Jettmar,A.A.
DATE 1975
TITL Extraction of metal ions by sulfoxides. III. Solvation of metal species by dicyclohexylsulfoxide and thioxanthene-10-oxide: Comparison of the solvation and extraction properties of sulfoxides of varying structure.
CITA Mikrochim. Acta 2(1): 109-123 (1975). (German).
COUN Austria
ABST A report is given of the possibilities of extractive and extraction-chromatographic separations, that result from the differing solvation of metal species by dicyclohexylsulfoxide and thioxanthene-10-oxide. The R_f -spectra were determined by means of paper chromatography with inverted phases of 50 ions in dicyclohexylsulfoxide-HNO_3 system, of 19 ions in thioxanthene-10-oxide-HNO_3 system, of 31 ions in dicyclohexylsulfoxide-HCl system, as well as of 34 ions in thioxanthenesulfoxide-HCl system. On the basis of the R_f-spectra of selected metals, the solvation properties of dibenzylsulfoxide, diphenylsulfoxide, dicyclohexylsulfoxide, and thioxanthene-10-oxide were compared along with the selectivity of these compounds for certain separations. The relative extraction abilities of these sulfoxides as well as that of di-n-hexylsulfoxide were studied with regard to the extraction of uranyl nitrate, palladium(II)nitrate, and nitric acid.
KEY extraction, trace metals, analysis, uranium

280 AUTH Martinec,M.
DATE 1973
TITL Influence of uranium extraction upon radium-226 content in surface water, reed, and freshwater fish.
CITA Cesk. Hyg. 18(10): 475-478 (1973). (Czech).
COUN Czech
ABST ^{226}Raconcn. in the Horka pond was 3 pCi/l. before mining began and rose to 5-20 pCi/l. during mining. The ^{226}Ra concn. in reeds and fish also increased. ^{226}Ra levels in scales and bones were 334-365 and 286-327 pCi/1000g, resp.; levels in flesh were 0.1-12 pCi/1000g which is within the natural range.
KEY uranium, extraction, water, marine organisms, environmental impact

281 AUTH Maruichi,N.; Kakihana,H.
DATE 1976
TITL Recovery of uranium from seawater.

(CONT.)
CITA Japan. Kokai 76,149,815 (Cl. C22B60/02), Appl. 75/74,654, 18 Jun 1975: 3p (1976).
COUN Japan
ABST One or more assemblies of U adsorber in a band, net, or rope form is/are fixed or moved countercurrently in seawater current, the one at the top is taken out, desorbed, and connected to the other end to recover U in a short period. No practical data are given.
KEY uranium, seawater, current, extraction, adsorbent, net systems, elution

282 AUTH McClaine,L.A.; Bullwinkel,E.P.; Huggins,J.C.
DATE 1956
TITL The carbonate chemistry of uranium: theory and applications.
CITA Proc. UN Intern. Conf. Peaceful Uses At. Energy 8: 26-37 (1956).
COUN USA
ABST In recent years great interest has been shown in the leaching of uranium ores with carbonate solutions. Primarily as a result of this interest, uranium carbonate chemistry has been extensively studied in certain of its theoretical and practical implications. In this paper these implications are reviewed and a consistent picture of this phase of uranium technology is presented with the hope that this review will contribute to a better understanding of the applications of carbonate systems to uranium extractive metallurgy. As will be evident, much further research is required in this field.
KEY chemical species, uranium, chemistry, extraction, ion exchange

283 AUTH McKay,H.A.C.
DATE 1972
TITL By-products of nuclear power.
CITA Chem. Ind. (London) (7): 275-280 (1972).
COUN UK
ABST A review with 25 refs. The by-products of nuclear power (i.e., waste heat, fission products, various radiations, and depleted U) and their possible applications are discussed.
KEY multi-purpose process, uranium, economics, concentration, chemical species, adsorbent, titanium, elution, marine organisms, particulate, tidal system, existing plants

284 AUTH Medvedev,P.I.; Vasilenko,I.P.
DATE 1971
TITL Effect of temperature on the ion-exchange equilibrium in the magnesium-calcium system.
CITA Pochvoved. Agrokhim.: 136-138 (1971). (Russian).

(CONT.)
COUN USSR
ABST $Ti(OH)_4$ ion exchanger (1 g) was satd. with 80 ml of a soln. contg. $CaCl_2$ and $MgCl_2$ and the suspension was kept at 20, 40, and 60°. The total concn. of the soln. was 1.04N but the ratios of the amts. of salts varied. $Ti(OH)_4$ was prepd. from $TiCl_4$ by reaction with NH_4OH. Its capacity was 0.70 mg-equiv./g. After establishing the equil., the soln. compn. was detd. volumetrically. The ion exchanger contg. both cations was treated with 1N KCl and the concn. of the eluted Ca and Mg ions was detd. From these data, the free energy, enthalpy, and entropy changes were evaluated. The thermodynamic equil. const. was 6.70 and 3.32 at 20 and 60°, resp. The selectivity of the exchanger with respect to Ca decreased when the temp. was increased. The Mg ion was hydrated to a higher degree than the Ca ion. The entropy change was neg., which is believed to be a result of the transition of the Mg ions from the ion exchanger, in which the ions have only the 1st hydrate envelope, into the soln., where a 2nd hydrate envelope of considerable size forms.
KEY temperature, ion exchange, titanium, trace metals, capacity, elution

285 AUTH Meiller,F.
DATE 1975
TITL Inorganic oxide-based anion exchanger.
CITA Ger. Offen 2,433,409 (Cl. B 01j), Appl. P 24 33 409.6-41, 11 Jul 1974: 13p (1975).
COUN W Germany
ABST Porous anion exchangers were made by grafting silyl amines or silanes and amines on silica gel or Al_2O_3 [1344-28-1]. Thus, silica gel (particle diam. 100-200μm, surface area 600 m^2/g, pore vol. 0.9 ml/g) was refluxed 8 hr with trichloro(γ-chloropropyl)silane [2550-06-3] in xylene, dried, and treated with dibutylamine [111-92-2] in PhMe at 140° and 5 bar to give an anion exchanger of surface area 400 m^2/g, pore vol. 0.7 ml/g, and exchange capacity 0.51 m equiv./g.
KEY ion exchange, temperature, capacity, adsorbent

286 AUTH Merrill,R.M.; Harrison,P.E.
DATE 1978
TITL Equilibrium studies of an inorganic ion exchange material with liquid nuclear waste simulant using radiotracer techniques.
CITA J. Radioanal. Chem. 43(1): 93-100 (1978).
COUN USA
ABST Ion exchange distribution coeffs. of ^{95}Zr, ^{106}Ru, ^{152}Eu, and ^{85}Sr found in high level nuclear waste, were detd. for Na titanate $Na[Ti_2O_5H]$ [51142-87-1] ion exchanger at ambient temps. and at 85°. The equilibrations were done

(CONT.)
in solns. simulating the compn. of nuclear waste. The progress of each reaction was monitored by adding a radiotracer of the element investigated to the simulated waste soln. Ambient temp. distribution coeffs. ranging from a high of 1.2 . 10^6 for Zr to a low of 58 for Eu were obtained when equal wts. of ion exchange material were used. Significantly higher distribution coeffs. were found at 85° than at ambient temps.
KEY ion exchange, titanium, temperature

287 AUTH Mihalik,B.
DATE 1974
TITL Contribution to the determination of microquantities of uranium in water.
CITA Chem. Listy 68(12): 1278-1281 (1974). (Czech).
COUN Hungary
ABST A procedure is described for the isolation of uranium salts from superficial waters using a sorption on activated charcoal and spectrophotometric determination of uranium with arsenazo III in acid medium (pH = 2). The method permits microdetermination of uranium in various superficial waters.
KEY water, uranium, adsorbent, analysis, chemistry, extraction

288 AUTH Miller,F.
DATE 1974
TITL Carboxylic acids as metal extractants.
CITA Talanta 21(7): 685-703 (1974).
COUN Scotland
ABST One of the problems in the extraction of trace elements is that matrix elements must usually be masked, involvng the addition of large amounts of extra reagent and thus increasing the risk of contamination. If the matrix element is to be removed, an extraction system of high capacity is needed to avoid dilution effects. In this respect, long chain or substituted carboxylic acids show great promise. A literature review on their use as metal extractants is presented. The metals extracted include U, Th, Zr, Nb, rare earth metals, In, Te, V, Cd, Y, Sc, Ce, Sr, Be, Ru, Cs.
KEY extraction, capacity, uranium, trace metals

289 AUTH Milner,G.W.C.; Wilson,J.D.; Barnett,G.A.; Smales,A.A.
DATE 1961
TITL The determination of uranium in sea water by pulse polarography.
CITA J. Electroanal. Chem. 2: 25-38 (1961).
COUN UK
ABST A procedure is described for the determination of uranium content in sea water. Uranium-237 is employed as a radioactive tracer to measure the percentage

(CONT.)
recovery of uranium in the chemical separation processes. The value obtained for English Channel water is 3.37 ± 0.08 μg of uranium per liter.
KEY analysis, uranium, seawater, concentration, extraction, organics

290 AUTH Minart,P.; Pelletier,M.; Mazoyer,B.; Pottier,P.
DATE 1967
TITL Treatment of uranium-containing solutions on a mobile layer of ion exchange resins.
CITA Ind. Chim. Belge 32(1): 526-529 (1967). (French).
COUN Belgium
ABST Trials were run on a pilot installation comprising an extn. and an elution column operating simultaneously. Mine water, 30 m.^{3}/hr., with an av. content of 100 mg. U/l. were treated. The eluate is chlorosulfate at 10 g./l. The resin was moved intermittently from the bottom towards the top of the bed. Full-scale industrial columns have been designed from the data obtained on the two in pilot plant columns. The presence of clay in the water necessitated periodic countercurrent washing of the columns (bottom to top). No problems as to wear of valves by the resin were experienced at flow rates under 70 l./hr.; this flow rate could be increased if countercurrent flow in the valves was avoided.
KEY uranium, ion exchange, extraction, elution, water, concentration, particulate, plant design

291 AUTH Mitchell,W.S.; Aumento,F.
DATE 1974
TITL Geochemical comparison of minerals of oceanic and continental ultramafic origin.
CITA J. Geophys. Res. 79(35): 5529-5532 (1974).
COUN Canada
AREA Mid-Atlantic Ridge
ABST The U concns. within individual mineral phases from oceanic, stable cratonic, and ophiolitic environments are compared to distinguish between ancient oceanic crust (now exposed on the continents) and similar rocks of true continental origin. Orthopyroxenes (opx) in ultramafic rocks of the oceanic crust have lesser concn. of U, as detd. by fission track mapping, than the opx in ultramafic rocks from mid-Atlantic ridges. The U content of primary mineral phases is related to the depth of origin and to the FeO/MgO ratio.
KEY uranium, concentration, m atlantic

292 AUTH Miyake,T.; Takeda,K.; Yonemochi,J.
DATE 1977
TITL Composite-base ion-exchanger.
CITA Japan. Kokai 77 26,386 (Cl. B01J1/04), Appl. 75/102,102,

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25 Aug 1975: 4p (1977).
COUN Japan
ABST An ion exchanger was prepd. by treating 100 g silica gel B with 50 g γ-mercaptopropyltrimethoxysilane [4420-74-0] in 350 g water contg. HCl (pH 4.2) at 84° for 3 h, washing with water at pH 4.2, mixing (30 g) with 500 mL water, 5 g Na lauryl sulfate, 30 g 2-vinylpyridine [100-69-6], 30 g toluene, and 4 g $K_2S_2O_8$, and graft-polymg. at 80° for 3 h.
KEY ion exchange, temperature, chemistry, adsorbent

293 AUTH Miyake,Y.; Sagimura,Y.; Uchida,T.
DATE 1972
TITL A new method of spectrophotometric determination of uranium in sea water and uranium content with $^{234}U/^{238}U$ ratio in the Pacific water.
CITA Rec. Oceanogr. Works Jpn. 11(2): (1972).
COUN Japan
AREA North Pacific (Japan), Japan Sea
ABST A new method of determination of uranium in sea water is deviced. The uranium is adsorbed on a chelating resin (Dowex A-1 or Chelex-100) under the presence of CyDTA at pH 3, and then eluted with 5 M HCl. For the spectrophotometric determination of uranium, Arsenazo-III is used at pH 1. Uranium forms 1:1 complex with Arsenazo-III which has a maximum absorption at 650 mμ. The average recovery of uranium in sea water is 99.7 ± 0.5%. By using the above method and alpha-ray spectrometry, the content of uranium of 3.31×10^{-6} g/l and the activity ratio $^{234}U/^{238}U$ of 1.13 were obtained on the average in sea water in the western North Pacific off Japan and the Japan Sea.
KEY uranium, seawater, analysis, adsorbent, chemistry, elution, concentration

294 AUTH Miyake,Y.; Sugimura,Y.
DATE 1964
TITL Uranium and radium in the western North Pacific waters.
CITA Studies on Oceanography, Prof.K.Hidaka, Sixtieth Birthday Commemorative Volume, Univ. of Tokyo Press, Tokyo. p 274-278. Reprinted in: Geochemical Study of the Ocean and the Atmosphere, Geochemical Laboratory, Meteorological Research Institute, Tokyo, Japan: 293-297 (1964).
COUN Japan
AREA Western North Pacific
ABST The vertical profile of radium and uranium in sea waters, collected along 38°N extending from 143°E to 148° E in the western North Pacific was studied. Radium content in sea water ranged from 0.4 to 0.6×10^{-13} g/l at the surface and from 0.9 to 1.3×10^{-13} g/l at the bottom. The mean value was 7.3×10^{-14} g/l. The analytical result

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of uranium showed that its content in sea water varied considerably on both horizontal and vertical directions ranging from 1.9 to $4.7x10^{-6}$g/l. Average content of uranium was $3.4x10^{-6}$ g/l which is in good agreement with the mean value of $3.3x10^{-6}$ given for the Pacific and the Atlantic by RONA et al. (1956). It is to be noted that the uranium content also increases with the depth.
KEY trace metals, uranium, seawater, analysis, ion exchange, concentration, pacific northwest

295 AUTH Miyake,Y.; Sugimura,Y.; Mayeda,M.
DATE 1970
TITL Uranium content and the activity ratio $^{234}U/^{238}U$ in marine organisms and sea water in the western North Pacific.
CITA Nippon Kaiyo Gakkai-Shi 26(3): 123-129 (1970).
COUN Japan
AREA Pacific Northwest
ABST The U content, activity ratio of $^{234}U/^{238}U$, salinity, and water temp. of sea water samples were studied at various depths. The concn. of U in phytoplankton and zooplankton was obtained. The U content and activity ratio in dried marine algae and environmental sea water was detd. The av. U was $3.34 \pm 0.28 \times 10^{-6}$ g/l. and the av. activity ratio of 1.13 ± 0.04 were found in the open sea. The U content of plankton and algae were 1.7 to 7.8×10^{-7} g/g and 0.4 to 23.5×10^{-7} g/g on dry basis with the resp. concn. factors of 48 to 260 and 10 to 733. The activity ratio in plankton and algae ranged from 1.07 to 1.18. The results showed there was little biol. fractionation of U isotopes by marine biota.
KEY uranium, marine organisms, seawater, pacific northwest, temperature, chemistry, concentration, salinity, analysis

296 AUTH Miyake,Y.; Sugimura,Y.; Uchida,T.
DATE 1966
TITL Ratio U-234/U-238 and the uranium concentration in seawater in the western North Pacific.
CITA J. Geophys. Res. 71(12): 3083-3087. Geochemical Study of the Ocean and the Atmosphere, ed. by Geochemical Laboratory, Meteorological Research Institute, Tokyo, Japan: 288-292 (1966).
COUN Japan
AREA Western North Pacific
ABST The concentration of uranium and the activity ratio of U-234/U-238 in sea water collected in the Kuroshio region and in the area of the mixing of Oyashio and Kuroshio waters in the western North Pacific were determined. Uranium was analyzed by the absorption spectrophotometric method with Arsenazo-III after separating it with a chelating resin. The activity

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ratio was determined by α-particle spectrometry after electroplating concentrated samples on a silver disk. The average content of uranium of $3.31x10^{-6}$ g/l and the average activity ratio A_{U234}/A_{U238} of 1.09 ± 0.05 were obtained.
KEY concentration, uranium, seawater, analysis, current, pacific northwest

297 AUTH Miyoshi,M.; Tajima,Y.
DATE 1977
TITL Uranium adsorbents.
CITA Japan. Kokai 77 28,489 (Cl. B01D15/08), Appl. 75/104,101, 29 Aug 1975: 6p (1977).
COUN Japan
ABST The U adsorbents consist of a hydrolyzate of $TiCl_4$ and a solid support. The support consists of ≥ 1 of oxides, double oxides, sulfides, phosphates, silicates, or double silicates of Mg, Pb, Mn, Zn, Fe, Zr, and Cr. Thus, $MgO.Fe_2O_3$ at ∿145° was immersed in a soln. of $TiCl_4$, and the $TiCl_4$ was hydrolyzed with a NaOH soln., and rinsed and dried to obtain an adsorbent. The adsorbent (1 g) adsorbed 83.4% U from 0.1 L seawater contg. 50 μg U.
KEY uranium, adsorbent, seawater, titanium, temperature, capacity

298 AUTH Miyoshi,M.; Tajima,Y.
DATE 1977
TITL Uranium adsorbents.
CITA Japan. Kokai 77 28,490 (Cl. B01D15/08), Appl. 75/104,102, 29 Aug 1975: 7p (1977).
COUN Japan
ABST The U adsorbents consist of a crushed mixt. of an inorg. support and a Ti compd. or its hydrolyzate. The adsorbent is used to ext. U from a soln. or seawater. Thus, a $Mg(OH)_2$-$Ti(OH)_4$ (1:1) mixt. was ball-milled to obtain the adsorbent, and the adsorbent 0.989 g was added to 0.1 L of seawater contg. 50 μg of U, and then held 1 h at 60° to adsorb 90% of the U.
KEY uranium, adsorbent, titanium, seawater, extraction, capacity, temperature

299 AUTH Mo,T.; O'Brien,B.C.; Suttle,A.D.Jr.
DATE 1971
TITL Uranium: Further investigation of uranium content of Caribbean cores P6304-8 and P6304-9.
CITA Earth Planet. Sci. Lett. 10(2): 175-178 (1971).
COUN USA
AREA Caribbean
ABST U content in P6304-8 and P6304-9 Caribbean cores is detd. by thermal neutron activation followed by (1) delayed neutron counting, and (2) ^{132}Te-fission product

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radiochemistry. The av. value obtained by these two methods is 34% higher than that obtained previously by α-spectrometry.
KEY uranium, analysis, caribbean, concentration

300 AUTH Mo,T.; Suttle,A.D.; Sackett,W.M.
DATE 1973
TITL Uranium concentrations in marine sediments.
CITA Geochim. Cosmochim. Acta 37: 35-51 (1973).
COUN USA
AREA Pettaquamscutt River (Rhode Island), Gulf of Mexico, Pacific
ABST Uranium concentrations in a large number of marine samples of different types with world-wide spatial distribution have been determined using the rapid, precise and nondestructive technique of counting the delayed neutrons emitted during U^{235} fission induced with thermal neutrons. Several interesting relationships were apparent. (1) A direct proportionality was observed between percentage of organic carbon and uranium in sediments deposited in an anoxic environment in the Pettaquamscutt River in Rhode Island with concentrations ranging from 7 per cent organic carbon and 7 ppm uranium to 14 per cent organic carbon and 30 ppm uranium. A similar relationship was found in cores of sediments deposited on the Sigsbee Knolls in the Gulf of Mexico. (2) For manganese nodules a direct relationship can be seen between uranium and calcium concentrations and both decrease with depth of deposition. For nodules from 4500 m in the Pacific, concentrations are 3 ppm uranium and 0.3 per cent calcium compared with 14 ppm uranium and 1.5 per cent calcium at 1000 ppm. (3) Relatively high uranium concentrations were observed in carbonates deposited in the deepest parts of the Gulf of Mexico, with the $>88\mu$ carbonate fraction in Sigsbee Knoll cores having as much as 1.20 ppm. A model to explain the observed variations must include uranium enrichment in near shore environments via an anoxic pathway, followed by redeposition in a deep ocean environment with dilution either by low-uranium-bearing foraminiferal or siliceous oozes or, along the continental margins, dilution with high-uranium-bearing carbonate sands.
KEY uranium, concentration, organics, gulf of mexico, sediments, analysis, river, nearshore

301 AUTH Mochizuki,T.
DATE 1970
TITL Chemical features of the sea water in the Miho Bay and around the Oki Islands, with special reference to its uranium contents.
CITA Chishitsu Chosasho Geppo 21(4): 271-278 (1970).

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(Japanese).
COUN Japan
AREA Miho Bay, Oki Islands
ABST Uranium contents of the sea waters in the Miho Bay and around the Oki Islands, Japan, are shown together with temp. and pH, Ca^{2+}, Mg^{2+}, and Cl^- contents. U/Cl ratios were lower for the samples in the Miho Bay, where mixing of sea water with fresh water occurs, than the ratios for the samples around the Oki Islands, which are about the same as those of std. sea water.
KEY uranium, seawater, temperature, chemistry, trace metals, concentration

302 AUTH Mohanty,S.R.; Reddy,A.S.
DATE 1972
TITL Solvent extraction of uranium from hydrochloric acid solutions by mixtures of di-n-pentyl sulfoxide and tri-n-butyl phosphate.
CITA Proceedings of the Chemistry Symposium. Vol.II. Bombay; Dept. of Atomic Energy. See CONF-721239-P2: 193-198 (1972).
COUN India
ABST The extraction of uranium with DPSO-TBP mixtures was studied to determine whether the mixed species are formed by addition or substitution. The results tend to indicate a substitution mechanism.
KEY extraction, uranium, analysis

303 AUTH Moore,W.S.
DATE 1967
TITL Amazon and Mississippi River concentrations of uranium, thorium and radium isotopes.
CITA Earth and Planetary Science Letters 2: 231-234 (1967).
COUN USA
ABST Concentrations of uranium and thorium series isotopes were measured in two large samples of river water and associated sediment. From these data an oceanic residence time for uranium of 4 m.y. is calculated. The concentration of Th-232 in these rivers is an order of magnitude greater than in surface Atlantic waters. The amounts of Th-230 and Ra-226 being supplied to the ocean directly from rivers are less than 4% of that coming from other sources.
KEY concentration, uranium, trace metals, analysis, river, sediments, chemistry

304 AUTH Morris, A.W.
DATE 1968
TITL The simultaneous determination of vanadium, chromium, manganese, iron, cobalt, nickel, copper and zinc in sea water by x-ray fluorescence spectrometry.
CITA Anal. Chim. Acta 42: 397-406 (1968).

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COUN UK
ABST Continuous solvent extraction is described to separate and concentrate the elements vanadium, chromium, manganese, iron, cobalt, nickel, copper, and zinc in seawater. This is to prevent matrix interferences in the subsequent X-Ray flourescence spectrometric method of analysis. Sensitivity of 0.14 μg or better were obtained with a 600 sec counting period in the X-Ray flourescence.
KEY extraction, concentration, vanadium, trace metals, analysis, chemistry, seawater

305 AUTH Moskvin,L.N.; Krasnoperov,V.M.; Grigor'ev,G.L.; Tsaritsyna,L.G.
DATE 1976
TITL Separation of uranium and fission products by means of liquid extraction membrane.
CITA Sov. Radiochem. 18(6): 722-727 (1976).
COUN USSR
ABST Dependencies were taken for uranium fluxes passing through a liquid extraction membrane for which TBP was used fixed on an inert porous carrier. Coefficients of uranium purification from the fission products for the solutions of the following compositions: 0.5 n HNO_3 and 6 n NH_4NO_3 + 0.1 n HNO_3 - were found. For the former solution these coefficients were considerably higher than for the latter one. Irrespective of the carrier material (a porous polytetrafluoroethylene, hydrofuged Schott's glass filters) the principal characteristics of the dialysis process remain unaltered.
KEY uranium, extraction

306 AUTH Moszkowicz,P.; Kikindai,T.
DATE 1975
TITL Extraction of hexavalent uranium and quadrivalent plutonium by tributylphosphate: interfacial mass transfer.
CITA C.R., Ser. C. 280(6): 321-324 (1975). (French).
COUN France
ABST Interfacial extractions of hexavalent uranium and tetravalent plutonium by tributylphosphate show a first order dependence with neutral species of these metals in nitric acid media and show a second order dependence with the extractory agent. The limiting step is the interfacial complexation by two TBP molecules. Effects of temperature have been studied and apparent activation energies for extractive reactions were measured.
KEY extraction, uranium, temperature, trace metals

307 AUTH Moyers,E.M.
DATE 1976
TITL Synthesis, characterization, and application of

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chelating ion-exchange resins.
CITA Iowa State Univ. (Ames), University Microfilms, 3 341 000: (1976).
COUN USA
ABST Arsonic acid resins are synthesized on XAD-1, -2, and -4. The physical properties are compared as a function of the surface area and pore diameter. The selectivity order of the resin is Th(IV) > U(VI) > Re(III) = Cu(II) = Pb(II) = Al(III), Fe(III) = Zn(II) = Ni(II), Co(II) = Cd(II) = Mn(II) = Mg(II). AA-4 which contains 0.75 mmole arsenic/benzene ring is used to concentrate trace heavy metals. The effects of pH and complexing agents and a comparison of batch and column techniques on recovery are studied. Separations of U(VI) and Th(IV) from other metal ions are developed. XAD-4 was used as a starting material for the synthesis of an N-hexylthioglycolate resin. Batch capacity studies show the resin to form 1:1, 2:1, and 3:1 R:M complexes with Ag(I), Hg(II), and Au(III). Bi(III), Ag(I), Hg(II), and Au(III) can be separated from each other and other metal ions by selectivity complexation from 0.1 M perchloric acid and sequential elution with 0.5, 2.0, and 6.0 M hydrochloric acid and pH 3.0-thiourea. A new spectrophotometric method for gold is reported. A propylenediamine tetraacetic acid resin synthesis is described. Stability constants of the resin are determined for four metal ions and compared to the monomer and EDTA. The resin has a stability order of Zr(IV) > Th(IV) = U(VI) = Bi(III) = V(V) = Fe(III) = Cr(III) = Pb(II) = Cu(II) = Ni(II) = Co(II) = Zn(II) = Cd(II) = Mn(II) = Mg(II) in hydrochloric acid. Uranium(VI), thorium(IV), and zirconium(IV) can be separated from each other and other metal ions by selective complexation from 0.01 M HCl and sequential elution with 0.1 M and 1.0 M HCl and 1.0 M H SO . The determination of uranium in low grade ores and thorium in monazite sand is demonstrated.
KEY ion exchange, uranium, trace metals, capacity, elution, analysis

308 AUTH Moyers,E.M.; Fritz,J.S.
DATE 1977
TITL Preparation and analytical applications of a propylenediaminetetraacetic acid resin.
CITA Anal. Chem. 49(3): 418-423 (1977).
COUN USA
ABST A new chelating resin has been synthesized that contains a propylenediaminetetraacetic acid functional group which is attached to a carboxylic acid divinylbenzene resin via an esterification reaction. The new resin retains polyvalent metal cations at pH 3 or higher. It retains copper(II), uranium(VI), thorium(IV), and

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zirconium(IV) from more acidic solutions. A scheme is given for clean, rapid chromatographic separation of the last three elements from each other. The resin is also able to retain quantitatively a number of trace elements from simulated seawater.
KEY ion exchange, chemistry, trace metals, uranium

309 AUTH Muchova,A.; Jokl,V.
DATE 1971
TITL Thin layer chromatography of inorganic ions. II. Chromatography in silica gel (impregnated with liquid anion exchangers)-aqueous inorganic acid-salt solution systems.
CITA Chem. Zvesti 25(4): 280-291 (1971). (German).
COUN Czech
ABST The chromatog. behavior of Ag, Pb, Cu, Hg, Cd, Zn, Bi, Fe, Co, Ni, Be, Al, Mn, UO_2^{2+}, La, Sb, Sn, and Cr ions was examd. on silica gel impregnated with the liq. anion exchangers tri-n-octylamine and Amberlite LA-1 (N-dodecenyl-trialkylmethylamine with 24-27 C atoms and an av. mol. wt. of 372). Varying concns. of HCl, H_2SO_4, HNO_3, LiCl, NaBr, NaI, KSCN, and KCN were used as eluents. Ion mobilities (R_f values) were plotted vs. eluent concn. for both films. R_f values for tri-n-octylamine generally were lower than for Amberlite LA-1. Potential sepns. are listed in each case.
KEY trace metals, uranium, ion exchange, elution, adsorbent, concentration

310 AUTH Muchova,A.; Jokl,V.
DATE 1974
TITL Ion-exchange and extraction chromatography of metal ions on thin layers.
CITA Acta Fac. Pharm. Univ. Comenianae 26: 9-58 (1974). (German).
COUN Czech
ABST The effect of complexing agents on metal ion sepns. was studied on silica gel layers impregnated with tri-n-octylamine and Amberlite LA-1, by using HCl, H_2SO_4, HNO_3, NaBr, NaI, KSCN, KCN, lactic acid, tartaric acid, citric acid, glycine, iminodiacetic acid, nitrilotriacetic acid, hydroxyethyliminodiacetic acid, and EDTA solns. as mobile phases, and on silica gel layers impregnated with bis(2-ethylhexyl) phosphate and Bu_3PO_4 by using HCl, NHO_3, and KSCN, and by using LiCl, NaBr, and NaI solns., resp., as mobile phases. The R_f and the R_M values of the metal ions were obtained as a function of the pH and the concns. of the mobile phases.
KEY ion exchange, extraction, trace metals, chemistry, adsorbent, concentration

311 AUTH Mukai,S.; Koyanaka,Y.

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DATE 1974
TITL Extracting uranium from sea water and uranium-containing aqueous solutions by galena.
CITA Japan. 74 14,443 (Cl. C 22b. B01d), Appl. 69 95,789, 28 Nov 1969: 2p (1974).
COUN Japan
ABST Galena of grain size 0.2-1.0 mm is used to adsorb U from sea water or aq. solns. contg. 1.0-100 ppm U. The U is adsorbed by the galena grains at the rate of 4-250 mg U/1 g of galena. The recovery is 95% and the adsorbed U may be removed as the nitrate by washing with 0.01 N HNO_3. The galena may be washed with water and reused.
KEY uranium, seawater, water, concentration, extraction, capacity, elution, adsorbent

312 AUTH Murata,T.
DATE 1976
TITL Agent for recovery of uranium.
CITA Japan. Kokai 76 54,818 (Cl. C22B60/02), Appl. 74/114,520, 03 Oct 1974: 4p (1976).
COUN Japan
ABST Aq. Ti compd. and arsenate are mixed in Ti/As 0.1-5 at. ratio and the ppt. treated with inorg. acid. Thus, to Na_3AsO_4 soln. was added $TiCl_4$ in 0.01M HCl, adjusted to pH 2 with aq. NH_3, filtered after 1 day, washed, treated with 1N HNO_3 for 2 hr, filtered, and air-dried. The product was stirred in seawater contg. 140 μg U for 1 day, decanted, filtered, and leached with 2N HCl for 10 min.
KEY titanium, seawater, uranium, extraction, adsorbent, chemistry, elution

313 AUTH Musha,M.; Miyamatsu,N.; Tsusui,Y.
DATE 1977
TITL Uranium adsorbents.
CITA Japan. Kokai 77,114,588 (Cl. B01D15/00), Appl. 76/31,401, 24 Mar 1976: 4p (1977).
COUN Japan
ABST A swelling polymer is immersed in a soln. contg. Ti sulfate or titanyl sulfate and then neutralized to obtain a U-adsorbing medium. Thus, a weakly acidic cation-exchanging fiber (OH-contg. acrylic fiber) was immersed in a soln. contg. titanyl sulfate (as 200 g TiO_2/L), heated 1 h at 120°, and cooled, then rinsed and chopped to obtain the medium. The medium adsorbed 3.11 mg U/g adsorbent in 23 h vs. 0.01 mg U/g weakly acidic cation-exchange resin.
KEY titanium, uranium, adsorbent, ion exchange, temperature, capacity

314 AUTH Muto,T.; Hirono,S.
DATE 1965

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TITL Some aspects of fixation of uranium from natural waters.

CITA Kozan Chishitsu 15: 287-298 (1965). (Japanese).

COUN Japan

ABST Uranium in natural waters can be fixed either by precipitation of uranium minerals or by adsorption on some adsorbents such as clay minerals and carbonaceous materials. The precipitation is controlled by factors contributing to the conditions of a system from which a uranium mineral is precipitated, such as temperature, pressure, pH, Eh, and concentration of the elements constituting it. Each factor was examined thermochemically. Decrease in Eh is most effective for the formation of primary uranium minerals, while pH and concentration of such anions as those of phosphorus, vanadium, and arsenic play the most important role in the precipitation of secondary uranium minerals. Adsorption and desorption experiments of hexavalent uranium on montmorillonite, kaolin, and limonite reveal that they have more or less an order of 10,000 ml/g of enrichment factor (Kd) at about pH 6. The adsorbed uranium was found to alter to a uranium mineral most favorable to the surrounding condition when aged experimentally. It suggests that the adsorbents perform a kind of catalytic action for the formation of uranium minerals from very dilute solution such as surface waters.

KEY uranium, temperature, concentration, water, adsorbent, extraction, chemistry, trace metals, capacity, elution

315 AUTH Muzyka,I.D.; Romanenko,E.D.; Tananaeva,N.N.

DATE 1964

TITL The adsorption of uranium complexes from aqueous solutions.

CITA Sov. Radiochem. 6(6): 619-624 (1964).

COUN USSR

ABST The absorption spectra of aq. solns. of $UO_2[Et_2NCS_2]_2$ which were prepd. by mixing calc. amts. of aq. solns. of $UO_2(NO_3)_2$ and Na diethyldithiocarbamate (I), are shown; absorbance peaks are observed at $\lambda = 533$, 665, and 726 mμ.

The absorbance at 665 mμ, measured at different $UO_2^{2+}.[Et_2NCS_2]^-$ ratios in the soln., had a max. value when the above ratio was 1:2; this max. becomes even sharper when the measurements are carried out in a soln. contg. 34 g. KCl/l. The absorbance of solns. contg. the uranyl complex of I obeys the Beer-Lambert law. Although the exptl. data indicate that $UO_2[Et_2NCS_2]_2$ is the predominant complex formed in aq. solns., the existence of other complexes or double salts is not excluded. Under dynamic conditions, the adsorption of I on activated C increases from 100 to 240 g. I/g. C when the I concn. in the starting aq. soln. is increased from 0.01 to 0.3-0.5M. The adsorption of I on activated C

(CONT.)
inceasess in the presence of KCl in the aq. soln.; the increase is $\sim$16%, and changes in the KCl concn., in the range 34-306 g./l., have no effect on the adsorption of I. The adsorption of U (as $UO_2[Et_2NCS_2]_2$) on activated C increases from 50 to 320 mg./g. when the starting U concn. in the soln. is increased from 71 to 250 g./l.; when measuring the adsorption of U, the UO_2^{2+}:$[Et_2NCS_2]^-$ ratio in the starting soln. was 1:3 instead of 1:2, in order to eliminate the presence of uncomplexed uranyl ions in the soln. The max. adsorption of U is obtained from solns. at pH 5.75-6.00, and the adsorption decreases when the pH is reduced below those values (e.g., froma soln. at pH = 3, the max. adsorption of U is only 12 mg./g.); the $UO_2[Et_2NCS_2]_2$ complex is most stable at pH 5.5-6.5, and is completely dissocd. at pH $\leq$ 1.5. The uranium may be desorbed quant. from the activated C by leaching with a soln. of 10 g. H_2SO_4/l.; the activated C may be reused for the adsorption of more U, but its capacity is reduced to only 70% of the initial value.
KEY adsorbent, uranium, analysis, capacity, water, concentration, chemistry, elution

316 AUTH Muzzarelli,M.G.; Nee Weckx
DATE 1972
TITL Chitin and chitosan as chromatographic supports and adsorbents for collection of metal ions from organic and aqueous solutions and sea water.
CITA U.S. Patent 3,635,818 (U.S. Cl. 210/31C, Int. Cl. B01d 15/08), Appl. 1836/68, Priority date 6 Dec 1968 (Italy): 4p (1972).
COUN Italy
ABST The present invention relates to the use of chitin as a chromatographic chelating support and adsorbent for the collection and for the separation of the metal ions from aqueous and organic solutions and from sea water.
KEY adsorbent, extraction, uranium, trace metals, seawater, water, elution, temperature, chemistry, concentration, analysis

317 AUTH Muzzarelli,R.
DATE 1971
TITL Applications of polymers in marine ecology.
CITA Rev. Intern. Oceanogr. Med. Tome 21: 93-108 (1971).
COUN Italy
ABST Interactions between ions present in sea water have been examined with two natural polymers, chitin and chitosan, by means of radiochemical and roentgenographic techniques. Chitin is very wide-spread in marine organisms, especially in crustaceans; chitosan is the deacetylated chitin. The authors present some data on the mechanism of ion adsorption on these polymers, and

(CONT.)
some values relating to their adsorption ability. It can be noted that these polymers adsorb selectively ions of transition metals, when they do not adsorb alkaline and alkaline-earth ions. These characteristics are used for the decontamination of sea-water and the analytical study of radioactive pollution of the sea.
KEY extraction, uranium, adsorbent, concentration, seawater

318 AUTH Muzzarelli,R.A.A.; Tubertini,O.
DATE 1969
TITL Chitin and chitosan as chromatographic supports and adsorbents for collection of metal ions from organic and aqueous solutions and sea-water.
CITA Talanta 16(12): 1571-1577 (1969).
COUN Italy
AREA Italy
ABST The rates of adsorption of several metal ions on chitin and chitosan in water and sea-water have been measured; chitin and chitosan are proposed as chromatographic chelating supports. These natural polymers are also suitable for recovery of trace metals from sea water.
KEY adsorbent, water, seawater, extraction, trace metals, capacity, analysis, chemistry, temperature, elution

319 AUTH Nadkarni,M.N.; Mayankutty,P.C.; Pillai,N.S.; Shinde,S.S.
DATE 1977
TITL Exchange of Th, U and Pu on macroporous ion exchange resins.
CITA Bhabha Atomic Research Centre Report BARC-899: 10p (1977).
COUN India
ABST Absorption of Th, U and Pu on macroporous ion exchangers. Amberlyst 15 (cationic) and Amberlyst A-26 (anionic) were studied in nitric acid solutions and the results were found comparable with those on their microreticular counter parts, Dowex 50x8 and Dowex IX4. With a view to evaluate the efficiency of Amberlyst A-26 for the final purification of plutonium from the purex process stream, detailed studies conducted to determine the breakthrough capacity of Pu(IV) from 7.2 M nitric acid, elution by 0.5 M nitric acid and the decontamination factors for uranium and zirconium-95. Because of its faster kinetics, Amberlyst A-26 exhibited a much more efficient elution of Pu(IV) by 0.5 M nitric acid than Dowex IX4.
KEY uranium, ion exchange, adsorbent, capacity, elution

320 AUTH Nagata,Y.; Uematsu,Y.; Onada,H.; Ono,S.
DATE 1976
TITL Uranium from seawater.
CITA Japan. Kokai 76 76,114 (Cl. C22B60/02), Appl. 75/1,796, 27 Dec 1974: 5p (1976).

(CONT.)
COUN Japan
ABST Units of U adsorber columns are suspended under a raft with ropes or chains to allow sea water to pass through them due to ocean currents, exchanged with new ones, and U is desorbed. As the unit, thin plates coated with 0.5-3 mm diam. particles or filament adsorbed such as TiO_2, galena, or Zn basic carbonate were arranged at a definite sepn. distance.
KEY adsorbent, uranium, seawater, titanium

321 AUTH Nakayama,H.; Taniguchi,H.; Tani,H.
DATE 1978
TITL Heavy metal adsorbents.
CITA Japan. Kokai 78 23,891 (Cl. B01D15/00), Appl. 76/99,299, 19 Aug 1976: 7p (1978).
COUN Japan
ABST A polyaminostyrene copolymer is diazotized and coupled with a catechol deriv. to prep. a heavy metal adsorbent. The adsorbent is useful for extg. UO_2 from seawater. Thus, amminated styrene-divinylbenzene copolymer was diazotized and coupled with 3-nitrocatechol to prep. a UO_2 adsorbent.
KEY adsorbent, trace metals, uranium, seawater, extraction

322 AUTH Nanba,Y.; Matsuda,M.
DATE 1976
TITL Anion exchange resins.
CITA Japan. Kokai 76 45,197 (Cl. C08F8/30), Appl. 74/119,019, 15 Oct 1974: 5p (1976).
COUN Japan
ABST PVC [9002-86-2] having particle size >0.3 mm, sp. surface area >2 m^2/g, pore size 500-75,000 Å, and pore vol. >0.4 cm^3/g was reacted with amines to prep. anion exchangers. Thus, PVC aggregates 62, ethylenediamine [107-15-3] 120, and water 30 parts were heated at 112-5° for 4 hr to prep. an ion exchanger.
KEY ion exchange, water, temperature

323 AUTH Nastasi,M.J.C.; Lima,F.W.
DATE 1974
TITL Study on the solvent extraction of the lanthanide elements, scandium, uranium, and thorium using tetracycline as the complexing agent.
CITA Instituto de Energia Atomica Report IEA-356: 19p (1974).
COUN Brazil
ABST Acid and extractant concentration dependence for the extraction of the 15 lanthanide elements with benzyl alcohol-tetracycline are reported. The behavior towards solvent extraction of U, Th, and Sc as well as the study of the possibility of using the system tetracycline-benzyl alcohol for the separation of the lanthanide elements and for the separation of U from

(CONT.)
those elememts are presented.
KEY extraction, uranium, concentration, trace metals

324 AUTH Nicholson,R.L.R.(Chairman)
DATE 1976
TITL Report of the working party on extraction of uranium from sea-waters.
CITA UKAEA Report HL76/3346(C9), ISBN 0-70-580337-6: 28p (1976).
COUN UK
AREA UK Coastline, North Atlantic, South Atlantic, Indian Ocean, Pacific Northwest, Pacific Southwest
ABST This report presents the conclusions of the Working Party which was set up to consider the problems inherent in the extraction of uranium from sea-water and identify some of the uncertainties associated with the concept.
KEY extraction, seawater, uranium, adsorbent, titanium, economics, concentration, existing system, capacity, elution, environmental impact, tidal system, pumped system, biological produtivity, marine organisms, particulate, trace metals, plant design, tide, current, temperature, n atlantic, s atlantic, pacific northwest, pacific southwest

325 AUTH Nimiya,A.; Suganami,K.; Fujii,A.
DATE 1969
TITL Extracting and separating uranium from a uranium-bearing solution.
CITA Japan. 74 00,648 (Cl. C 22b, B 01d), Appl. 69 29,153, 15 Apr 1969: 2p (1974).
COUN Japan
ABST U is adsorbed from a soln. by active C treated with metal hydroxides. Thus, a suspension of metal hydroxide, prepd. by hydrolysis of 500 ml 0.1 mole/l. chloride on nitrate of Fe or Al, was mixed with 5 g active C. After agitating for 3 hr and filtering, the active C was rinsed with water. The treated active C was added to a 100 ml sea water contg. 500 μg U and stirred for 12 hr. Then the active C was heated in a Na_2CO_3 soln. and the amt. of U in the soln. was detd. For 5 g active C contg. 2 mg Al, 400 μg U was adsorbed from the sea water.
KEY uranium, seawater, extraction, adsorbent, analysis, temperature, capacity

326 AUTH Nininger,R.D.
DATE 1976
TITL Uranium resources - are they adequate?
CITA Nuc. Technol. 30(3): 224-231 (1976).
COUN USA
ABST Uranium resources continue to be an important concern in assessing energy options and strategies. The question

(CONT.)
of the uranium supply for the development of nuclear power has also become one of the major focal points in the controversy over the breeder reactor program and nuclear fission energy in general. World reserves at a cutoff cost of production up to $15/lb of U_3O_8 are approx. 1.1 million MTU, and the estimate of undiscovered potential resources approx. 1.7 million MT. Exploration throughout the world has not yet identified significant numbers of new types of uranium deposits that might begin to fill the apparent gap between long-term demand and supply; that is, large intermediate-grade deposits containing 100 to 700 ppM uranium. In 1973 the U.S. Atomic Energy Commission initiated an accelerated and expanded resource evaluation program to ascertain the total U.S. uranium resource base, including the potential of areas largely ignored in past exploration. Preliminary investigations to date have indicated additional potential reources in the possible and speculative categories of approx. 850,000 MT at a production cutoff cost of up to $30/lb. It is unlikely however, that the annual production of approx. 100,000 MT projected by the year 2000 could be achieved from the presently estimated resource base of 2.7 million MT - reserves plus potential - 80 percent of which remains to be found. Thus, information to date continues to support the need for the early introduction of the breeder reactor.
KEY uranium, economics

327 AUTH Ninomiya,A.; Sugasaka,K.; Fujii,A.
DATE 1971
TITL Recovery of metal ions by active carbon-metal hydroxide adsorbents.
CITA Kagaku Zasshi 74(7): 1486-1487 (1971). (Japanese).
COUN Japan
ABST In the extn. of U from sea water with C-OH-Cu, C-OH-Al, and C-OH-Ti complex adsorbents, the amts. of U adsorption (μg/g metal) passed through max. values as the metal contents in the adsorbents increased. The recoveries of U by C-OH-Al and C-OH-Fe were higher than those by $Al(OH)_3$ and $Fe(OH)_3$ alone. Active C alone also showed little U adsorption.
KEY adsorbent, extraction, uranium, capacity, seawater

328 AUTH Nissenbaum,A.
DATE 1977
TITL Minor and trace elements in Dead Sea water.
CITA Chemical Geology 19: 99-111 (1977).
COUN Israel
ABST The average concentration of several metals in six water profiles taken from the Dead Sea are: Sr = 308-330 mg/l; Li = 17-21 mg/l; Mn = 3.1-8.0 mg/l; Cu = 300-500 μg/l;

(CONT.)
Zn = 500 µg/l; Fe = 10-15 µg/l; Ni = 20-25 µg/l; Co = 8 µg/l; Cd = 8-10 µg/l; Pb = 120-300 µg/l; I = 80-120 µg/l and U = 1.5-2.5 µg/l. The mechanisms which govern the behavior of metals in the Dead Sea are: (a) incorporation into authigenic carbonates and sulfides in the sediment (Sr, Zn, Cd, Fe); (b) formation of soluble salts or soluble chloridic complexes (Li, Mn, Pb); and (c) removal due to reduction and formation of sparingly soluble compounds (U).
KEY concentration, trace metals, sediments, interstitial water, seawater

329 AUTH Novikov,P.D.; Krylov,O.T.
DATE 1973
TITL Chemical structure of ion exchangers and selective sorption of uranium from sea water. I. Sorption of uranium on nitrogen-containing anion exchangers.
CITA Teor. Prokt. Sorbtsionnykh Protsessov 8: 144-148 (1973). (Russian).
COUN USSR
ABST Isotherms are given for sorption of U from sea water (pH8) on com. anion exchangers contg. N groups (like R^- $-CH_2-{}^+N(CH_2CH_2OH)_3$ $R^--CH_2-{}^+NMe_3$, etc.). The sorption capacity for U from sea water decreased in the exchangers' order AN 2F > EDE 10P > AN31 > ASD 4P > AN 1 > AV 16GS > AV 27x8, for U from aq. Na tricarbonatouranyl solns. in the order AN 31 > AN 2F > EDE 10P > AN 18x6 > AV 17x8. The mechanism of U sorption is discussed by taking into account the participation of the O-contg. groups of the exchangers.
KEY uranium, seawater, capacity, ion exchange, adsorbent

330 AUTH Novikov,P.D.; Krylov,O.T.
DATE 1973
TITL Chemical structure of ion exchangers and selective sorption of uranium from sea water. II. Sorption of uranium on cation exchangers.
CITA Teor. Prakt. Sorbtsionnykh Protsessov 8: 149-153 (1973). (Russian).
COUN USSR
ABST Sorption capacity of the investigated cation exchangers for sorption of U from sea water increased in the exchanger order: sulfo cation exchangers (KU 2x8) < sulfophenolic cation exchangers (KU 1) < carboxylic cation exchangers (KB 2, KB 4Px2) < phosphonic acid cation exchangers (KRF 2P, KF 1x8). The sorption involves the ion exchange reaction $[UO_2(CO_3)_3]^{4-} = UO_2{}^{2+} + 3CO_3{}^{2-}$.
KEY capacity, uranium, seawater, ion exchange, adsorbent

331 AUTH Ogata,N.
DATE 1968

(CONT.)
TITL Extraction of uranium from seawater. I. Coprecipitation of uranium in seawater with metal hydroxides.
CITA Nippon Genshiryoku Gakkaishi 10(12): 672-678 (1968).
COUN Japan
ABST With the view to studying the possibility of separating uranium from seawater by coprecipitation, the carrier properties of ferric, aluminum, and titanium hydroxides were examined, with the following results: (1) The values of pH at which uranium started to coprecipitate with the carriers were 8 to 9 for aluminum and ferric hydroxides, and 4.5 for ferric hydroxide, 5.0 for aluminum hydroxide, and 2.8 for titanium hydroxide. (2) Optimum pH values for decarbonated seawater to obtain maximum recovery of uranium were 4.5 to 9 for titanium hydroxide with natural seawater; the values were appreciably lower for ferric and aluminum hydroxides; but unchanged for titanium hydroxide. (3) In the case of ferric and aluminum hydroxides, the coprecipitation ratios of uranium were much smaller in natural than in decarbonated seawater. With titanium hydroxide, however, uranium coprecipitated with equal ease in natural seawater and decarbonated seawater. (4) Uranium was effectively separated from the carriers by carbonate salt extraction but not by acid extraction.
KEY extraction, uranium, seawater, titanium, chemistry

332 AUTH Ogata,N.
DATE 1970
TITL Recovery of uranium from sea water.
CITA Genshiryoku Kogyo 16(12), 19-22 (1970). (Japanese).
COUN Japan
ABST The status of investigation of uranium recovery from seawater is reviewed. Recent values of uranium content in seawater are from 0.0030 to 0.0035 ppM, and the total amount of uranium in the world's seawater is estimated as 4,500 million tons. English investigators recently obtained 550 µg of uranium per 1g of titanium, using titanic acid adsorbent. Inoue and Kokibama reported 1550 µg of adsorbed uranium per 1g of titanium, using titanic acid by a thermal dissociation process. This method is explained together with the method that uses titanic acid prepared from a neutralization process. Factors that have great effects on the adsorption of uranium in seawater, such as temperatures and amount of contacting seawater, are discussed.
KEY uranium, seawater, temperature, concentration, adsorbent, titanium, capacity, extraction

333 AUTH Ogata,N.
DATE 1971
TITL Collection of uranium in sea-water. VI. Adsorption of uranium in sea-water with titanic acid.

(CONT.)

CITA Nippon Genshiryoku Gakkaishi 13(3): 121-127 (1971). (Japanese).

COUN Japan

ABST The adsorbing capacity for uranium shown by titanic acid prepared in homogeneous and acidic solution was found larger than titanic acid prepared in nonhomogeneous and neutral solution. The uranium adsorbed on titanic acid increased with rising temperature of seawater. The adsorption reached equilibrium within 2 days. The concentration of uranium in the titanic acid was found experimentally to have a maximum value of U/Ti=1,500μg/g.

The concentration of uranium adsorbed on the titanic acid at a given temperature was determined by the amount of seawater and the concentration of uranium in seawater on the same titanic acid. An empirical formula was obtained for this relationship; the adsorption was applied to Freundlich's isotherm, and the distribution coefficients were found nearly constant within the range of seawater volume covered by the present experiment. The adsorption capacity was estimated from the term of multiplication of the distribution coefficient and the concentration of uranium in seawater. The maximum value evaluated was U/Ti=4,200 μg/g, with the titanic acid prepared by hydrolysis. The uranium adsorbed on the titanic acid increased with rising temperature of the seawater, the empirical relationship being $c=k \exp(\alpha t^2)$, (c: concn. of U., t: temp., k and α: const.).

KEY capacity, uranium, concentration, temperature, titanium, chemistry, adsorbent

334 AUTH Ogata,N.

DATE 1971

TITL Collection of uranium in sea-water. VII. Desorption of uranium adsorbed on titanic acid.

CITA Nippon Genshiryoku Gakkaishi 13(5): 253-259 (1971). (Japanese).

COUN Japan

ABST A basic study was carried out on the desorption of uranium adsorbed on titanic acid, using alternatively, a mixed solution of $(NH_4)_2CO_3$ and NH_4OH, a mixed solution of Na_2CO_3 and $NaHCO_3$, dilute H_2SO_4, or dilute HCl. The titanic acid used was prepared by homogeneous precipitation, in which urea was added to $Ti(SO_4)_2$ solution and then the solution was heated to produce titanic acid precipitate. Uranium was adsorbed by dipping the titanic acid in natural seawater. In the case of uranium desorption with carbonate solution, there was little dissolution of the titanic acid and of impurities in the solution after desorption, but the drawback of this agent is its expensiveness and it is further liable to be gradually consumed upon repeated

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use. Desorption with acid, which it was believed to have the disadvantage of dissolving titanic acid in much greater quantity, proved on experiment not to be any worse than with carbonate. The cost of acid, moreover, is lower, and there is little deterioration of the adsorption ability of titanic acid because of the small amount of impurities remaining in it. It was concluded that desorption with acid could be used in practice with good chances of rivaling the carbonate method. For the desorption, it is recommended to heat above 90°C the titanic acid carrying the uranium in HCl (0.5N) or in a mixed solution of $Na_2CO_3/NaHCO_3$ (8/2 to 0/10) containing over 6% CO_3.
KEY uranium, seawater, titanium, adsorbent, elution, temperature, economics

335 AUTH Ogata,N.
DATE 1971
TITL Fundamental study on the recovery of uranium in seawater.
CITA Nippon Kaisui Gakkai-Shi 24(5): 197-212 (1971). (Japanese).
COUN Japan
ABST Through the course of a fundamental study on the collection of uranium in seawater, an extensive improvement was made in the separating and determining methods of uranium. Various studies were made on the collecting methods of uranium in seawater, the adsorption method with titanic acid being the most effective. Chemical species of uranium in seawater were researched by the stability constants of such components as Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, SO_4^{2-}, F^-, PO_3^{3-}, HPO_3^{2-},CO_3^{2-}, OH^-, and UO_2^{2+}. As consequence, most of the dissolved uranium species were found to be $UO_2(CO_3)_3^{4-}$. The adsorption mechanism of uranyl carbonate complex ion on titanic acid was presumed an anion exchange reaction. The adsorption of uranium was governed by the kind of titanic acid, the temperature of seawater, the contacted volume of seawater, and the concentration of uranium in seawater.
KEY uranium, seawater, chemical species, temperature, concentration, extraction, adsorbent, titanium, ion exchange, trace metals

336 AUTH Ogata,N.
DATE 1974
TITL Approach to industrialization on collection of uranium in sea-water.
CITA Genshiryoku Kogyo 20(12): 51-56 (1974). (Japanese).
COUN Japan
ABST Research for collecting uranium in seawater was started in Japan in 1967, but it has been interrupted since

(CONT.)

about 1971 except Shikoku Industrial Laboratory, MITI. Knowledges and experiences obtained so far are introduced, as the research project is going to start again. The methods used for collecting uranium in seawater are briefly reviewed. Methods and apparatuses for adsorption are referred to. The method of flowing seawater through columns charged with particle form adsorbent is suitable for test plants, but cannot be used over 2 cm/sec flow speed. Filter type, fluidized bed type, and cyclone type show good recovery rate, but pumps are required. In pool type, formed adsorbent (particles, films, and nets) is packed in the channels of pools. This method can be used for the dam method utilizing tide. The dam method is estimated at $62 per lb in Japan. Adsorber type idea was contemplated to solve the fault in changing to fresh seawater in tide-utilizing method. Problems in the tide-utilizing dam system may be siting conditions where fresh seawater can be introduced, sufficient tide difference, relatively high temperature, large ground area required, for example 1.57 km^2 of bed area only, the quality and form of adsorbent, unbalance in material account, and the deterioration of adsorbent by repetition of use, the obstruction of adsorption and flow by diatom and green weed, and the effect of the titanic acid because of contaminant adsorption. Desorption step must be studied further.

KEY extraction, uranium, seawater, adsorbent, filtration, pumped system, particulate, net systems, tidal system, tide, temperature, titanium, elution

337 AUTH Ogata,N.
DATE 1974
TITL Production of uranium from sea water.
CITA Genshiryoku Kogyo 20(12): 51-56 (1974). (Japanese).
COUN Japan
ABST A review with 15 refs. is given on the engineering problems assocd. with large-scale extn. of U from sea water by adsorption methods, with emphasis on the method utilizing the natural movement of sea water, such as tides and current.
KEY uranium, seawater, tide, current, extraction, economics, adsorbent, plant design

338 AUTH Ogata,N.
DATE 1976
TITL Uranium from the sea. Present status and future problems of researches.
CITA Nippon Kaisui Gakkai-Shi 30(1): 3-13 (1976). (Japanese).
COUN Japan
AREA Seto Inland Sea
ABST The problems of a future plant having the capacity of

(CONT.)

extracting 1,000 tons of uranium per year from sea in Japan are studied. The investigations into the extraction of uranium from sea water in F.R. Germany, United Kingdom, France, United States of America and other foreign countries are described. The operation of a test plant having the capacity of ten kg uranium per year will be started by a project team in Japan. The team consists of four sub teams to study separately the total system, the absorption and desorption, the enrichment and separation, and the location and environment. About 40,000 tons of sea water per day are required for the test plant at the recovery rate of 27.7% during 300 operation days. The concentration of uranium in sea water of the Seto inland sea is assumed as 3.0 microgram per litre. The adsorption power was compared among titanic acid adsorbent, the composite adsorbent of activated carbon and titanic acid, and galena adsorbent. As a result of testing, the titanic acid indicated the adsorption capacity of 750 U-microgram/g; the composite showed 1,200 U-microgram/g; and the galena gave 550 U-microgram/g. For the desorption process, 1 M carbonate solution or 0.05 N dilute hydrochloric acid solution is used. For the processes of enrichment, separation and purification, the system of ion exchange membrane electrodialysis and flash evaporator may be the most effective. The aim for future is the production cost of uranium of 150 dollars/lb.

KEY capacity, uranium, extraction, seawater, concentration, ion exchange, adsorbent, elution, plant design, economics, environmental impact, geography

339 AUTH Ogata,N.
DATE 1977
TITL Extraction of uranium from seawater (II).
CITA Nippon Kaisui Gakkai-Shi 31(3): 97-109 (1977). (Japanese).
COUN Japan
ABST This is a review of the situation Japan expects to find itself in in reqards to a source of uranium and of steps taken to develop a seawater extraction scheme. The situations in various countries are outlined with brief discussions of specific methods under development around the world. Aspects such as adsorption, desorption, seawater mobilization, plant situation and plant cost are summarized and some effort is made to estimate a few paramaters.
KEY uranium, seawater, extraction, adsorbent, economics, plant design, capacity

340 AUTH Ogata,N.
DATE 1978

(CONT.)
TITL Possibility of an industry for extracting uranium from sea water.
CITA Genshiryoku Kogyo 24(1): 27-31 (1978). (Japanese).
COUN Japan
ABST The process for U extn. from seawater and its industrialization feasibility is discussed.
KEY extraction, uranium, seawater, economics

341 AUTH Ogata,N.; Inoue,N.
DATE 1970
TITL Separation and determination of uranium in sea water.
CITA Nippon Kaisui Gakkaishi 23: 148-153 (1970). (Japanese).
COUN Japan
AREA Odawara Coast
ABST A study was made to improve the separation method and fluorophotometric method for the determination of U in seawater without using the isotope dilution method. Uranium in the sample of seawater was adsorbed into titanic acid and extracted with mixture of sodium carbonate and sodium hydrogen carbonate at 100°C. The extracted solution was passed through in anion exchange resin of carbonate type, and the U adsorbed into the resin was eluted with HCl solution. The recovery of U by this method represented 90%, which was higher than the conventional methods but was still incomplete. Therefore, the condition of adsorption must be kept stable to obtain the recovery with small variation, and the determined value was corrected with the recovery. A given amount of this pretreated solution was pipetted into a Pt dish, dried, and melted at 665°C with carbonate - sodium fluoride flux, and the fluorescence strength of the dish was measured. The error caused by the variation of melting condition could be decreased by using a furnace with a fan and correction by simultaneous operation with the U standard solution. The unevenness of the fluorescence strength in the dish could be decreased by using the temporary standard and rotating the fused dish during the measurement, and the measuring error was below 2%. Uranium content in seawater collected along the coast of Odawara showed 3.34 μg/l by this method.
KEY uranium, seawater, analysis, adsorbent, titanium, elution, temperature, ion exchange, chemistry, concentration

342 AUTH Ogata,N.; Inoue,N.
DATE 1971
TITL Collection of uranium in sea water. VIII. General properties of titanic acid.
CITA Nippon Kaisui Gakkai-Shi 24(130): 149-153 (1971). (Japanese).
COUN Japan

(CONT.)

ABST General properties of titanic acid used as adsorbent of U in sea water were investigated by x-ray diffraction, iv spectroscopy, electron microscopy, thermal anal., electrophoresis, and soly. in mineral acids. Four types of titanic acid were prepd. from $Ti(SO_4)_2$ by the following procedures: neutralization at room temp. or at the b.p., and homogeneous pptn. with NH_4OAc or urea. The products of neutralization procedures and pptn. by using NH_4OAc were bulky, fibrous, and amorphous, contg. a large quantity of adsorbed water. The product of pptn. by using urea was powder-like cubic crystals. Regardless of the types, soly. of titanic acid in HCl and H_2SO_4 depended on the concn. of the acids and temp. Although the product of neutralization at room temp. was sol. in the acids at room temp., the soly. decreased gradually as time proceeds. Surface charge of the titanic acid in sea water was neg. The product of neutralization at room temp. was $TiO_2.3/2H_2O$ and that at the b.p. was $TiO_2.5/3H_2O$; the product of both homogeneous pptn. techniques was $TiO_2.H_2O$.

KEY adsorbent, uranium, seawater, chemistry, temperature, analysis, titanium, concentration

343 AUTH Ogata,N.; Inoue,N.; Kakihana,H.

DATE 1970

TITL Extraction of uranium from seawater. IV. Adsorption of uranium in artificial seawater with titanic acid.

CITA Nippon Kaisui Gakkai-Shi 24(2): 68-72 (1970). (Japanese).

COUN Japan

ABST Effect of the methods of prepn. of titanic acid on the adsorption of U was investigted. Titanic acid was prepd. by quick or slow neutralization with alkali solns., by homogeneous pptn., and by heating hydrolysis. Capacity for the adsorption increased by keeping the soln. of Ti_4^+ acidic and homogeneous in the prepn. step.

KEY uranium, seawater, titanium, adsorbent, chemistry

344 AUTH Ogata,N.; Inoue,N.; Kakihana,H.

DATE 1971

TITL Collection of uranium in sea-water. X. Chemical state of uranium dissolved in sea-water and adsorption mechanism of titanic acid.

CITA Nippon Genshiryoku Gakkaishi 13(10): 560-565 (1971). (Japanese).

COUN Japan

ABST The chemical state of uranium in seawater was sought from stability constants. It was estimated that uranium in seawater existed as U(VI) and that the distribution of the chemical species in standard seawater was: $UO_2(CO_3)_3^{4-}$ 97.9%, $UO_2(OH)_3^-$ 1.73%, and $UO_2(CO_3)_2^{2-}$ 0.4%. The cation-exchange ability of titanic acid was demonstrated

(CONT.)
from the fact that the pH value of NaCl solution shifted toward the acidic side by the adition of titanic acid. But, despite this cation-exchange ability, it is thought that the form in which titanic acid adsorbed uranium is probably $UO_2(CO_3)_3^{4-}$, because it was found to adsorb HCO_3^- in quantities proportional to uranium. From the results of the present and previous studies, it is presumed that uranium is adsorded by the coordinate bond.
KEY uranium, seawater, chemical species, chemistry, adsorbent, titanium

345 AUTH Ogata,N.; Kakibana,H.
DATE 1975
TITL Extracting uranium from diluted uranium solution.
CITA Japan. 75 13,213 (Cl. C22B, B01D), Appl. 70 10,285, 06 Feb 1970: 4p (1975).
COUN Japan
ABST U [7440-61-1] is recovered from a dil. inorg. salt soln. by absorption on alkali metal titanate. The titanate is sepd. from the soln. and treated with a dil. acid or alkali to sep. U from the titanate. Thus, U is extd. at high efficiency with a small amt. of reagent.
KEY extraction, uranium, adsorbent, titanium, elution

346 AUTH Ogata,N.; Kakihana,H.
DATE 1969
TITL Extraction of uranium from seawater. II. Adsorbents for extraction of uranium from seawater.
CITA Nippon Genshiryoku Gakkaishi 11(2): 82-87 (1969). (Japanese).
COUN Japan
ABST About fifty insoluble compounds of titanium, aluminum, magnesium, calcium, silicon, zinc, chromium, lead, and tin were examined in a search for suitable adsorbents of uranium in seawater. The only materials that exhibited an effective uptake were titanium hydroxide, lead sulfide, and chromium hydroxide, the uptake capacities of which were 196, 134, 68 μg/g, respectively. While their uptake capacity was small, manganese dioxide, zinc hydroxide, and lead hydroxide also adsorbed uranium in the pH range of seawater. Ferric hydroxide, ferrous sulfide, ferric phosphate, tin sulfide, titanium hydroxide, and manganese oxide were found to be good adsorbents in acidified seawater, though acidification of seawater would not be practical in industrial scale operations. Tannic acid salts of magnesium, calcium, and titanium adsorbed uranium in seawater, but had the drawback of relatively large solubility.
KEY titanium, adsorbent, uranium, seawater, capacity, chemistry

347 AUTH Ogata,N.; Kakihana,H.

(CONT.)
DATE 1969
TITL Extraction of uranium from seawater. III. Concentration of the uranium in weak uranium solutions by means of surfactants.
CITA Nippon Genshiryoku Gakkaishi 11(8): 469-476 (1969). (Japanese).
COUN Japan
ABST A study was made of foam separation with various kinds of surface active agents and adsorption separation with metallic soaps and laurylamine salts, for the purpose of concentrating trace amounts of U in various kinds of salt solutions and seawater. The optimum conditions were influenced by the chemical components of the solutions. The most effective methods brought to light were as follows: (1) foam separation with laurylamine acetate on neutral solutions of various salts, alkylbenzylammonium chloride on weak alkali solution, and laurylbetain on acidic solution of nitrate and seawater. (2) Adsorption of U contained in seawater by Fe, Ti, and Zn soaps. In acidified seawater, it was adsorbed by Mg, Ti, and Ni soaps. (3) Adsorption of U in chloride, sulfate, and nitrate solutions by Ca soap. U in seawater was adsorbed only when acidified. (4) Adsorption of U in the various salt solutions by laurylamine phosphate.
KEY extraction, uranium, seawater, chemistry, titanium, adsorbent

348 AUTH Oguchi,N.; Harada,H.
DATE 1976
TITL Collection of uranium.
CITA Japan. Kokai 76,151,613 (Cl. C22B60/02), Appl. 75/77,683, 23 Jun 1975: 3p (1976).
COUN Japan
ABST U is adsorbed on a knit cylinder form from aq. soln. Thus, 20 g galena 200-1000μ was carried on 75 denier polypropylene knit of max. 200μ net. Five knit forms were soaked in 0.2% $Na_4UO_2(CO_3)_3$ at pH 7.5 and 30° for 100 h, and eluted with 10% Na_2CO_3. U 50 mg/g galena was adsorbed.
KEY uranium, adsorbent, chemistry, temperature, elution, capacity

349 AUTH Ohnishi,K.; Hori,Y.; Tomari,Y.
DATE 1977
TITL Rapid spectrophotometric determination of trace amounts of uranium in sea water.
CITA Bunseki Kagaku 26(1): 74-77 (1977). (Japanese).
COUN Japan
ABST Published in summary form only.
KEY uranium, seawater, analysis, concentration, chemistry

(CONT.)

350 AUTH Okada,N.; Kakihanna,H.
DATE 1970
TITL Recovery of uranium from inorganic salt solution containing a small amount of uranium.
CITA Japan. 70 39,329 (Cl. C 221b), Appl. 05 Jul 1968: 4p (1970).
COUN Japan
ABST U (0.1 mg/l.) was adsorbed from sea water with Ca stearate (250 mg) at pH 5, and then desorbed with 10% $(NH_4)_2CO_3$ at 60°. The recovery of U was 95%. The Ca stearate could be replaced by Mg soap, other metallic stearates, or tannates. The $(NH_4)_2CO_3$ could be replaced by Na_2CO_3.
KEY uranium, seawater, adsorbent, chemistry, elution, temperature, capacity

351 AUTH Omura,A.
DATE 1977
TITL On the apparent distribution coefficient of uranyl between sea water and skeletal calcium carbonates.
CITA Sci. Rep. Kanazawa Univ. 22(1): 106-116 (1977).
COUN Japan
AREA Malay Peninsula, Ryukyu Islands
ABST Some hermatypic corals, molluscs, and their inhabiting sea water were collected from the tropical (Malay Peninsula) and subtropical (Ryukyu Islands) localities, and the $m_{UO2}{}^{2+}/m_{Ca2}{}^{2+}$ of them were determined in order to evaluate the apparent distribution coefficient of uranyl between biogenic carbonate and seawater, which can be an aid to understand the factors controlling uranium concentration in skeletal calcium carbonates. The result suggests that the compositional factor such as mineral phases and organic matrices and the physiological factor such as chemistry of the body fluid and extrapallial fluid become of major causes to control uranium concentration in skeletal carbonates. Moreover, a little difference in distribution coefficient of uranyl in coralline aragonite between Malay Peninsula and Ryukyu Islands may be attributed to the difference in water temperature. The difference in uranium concentration between two shell layers of an individual specimen of Tridacnid may be interpreted as the result of a subtle control over physiological process during shell formation, rather than compositional and environmental causes.
KEY seawater, uranium, concentration, chemistry, temperature

352 AUTH Onorin,S.A.; Khodyashev,N.B.; Zavezenov,V.K.; Vol'khin,V.V.
DATE 1973
TITL Ion exchange properties of titanium dioxide hydrate ($TiO_2 .xH_2O$), zirconium dioxide ($ZrO_2.xH_2O$), and cation

(CONT.)
exchangers prepared from them.
CITA Khim. Khim, Tekhnol., Obl. Nauchno-Tekh. Konf., [Mater], 4th 2: 115-116 (1973). (Russian).
COUN USSR
ABST The exchange capacity of the H-forms of the cation exchangers prepd. from $TiO_2.xH_2O$ and $ZrO_2.xH_2O$ with respect to Li^+, Na^+, K^+, Rb^+, and Cs^+ was detd. The capactiy diminished in the given sequence. Modified cation exchangers, with better mechanical and chem. stability, were prepd. by annealing TiO_2 and ZrO_2, previously satd. with Li^+ or Na^+. Those contg. Li were selective for Li, whereas those contg. Na were selective for Na.
KEY ion exchange, titanium, capacity

353 AUTH Onorin,S.A.; Vol'khin,V.V.
DATE 1974
TITL Composition for an inorganic ion exchanger.
CITA USSR 451,456 (Cl. B01j), Appl. 1,837,064, 11 Oct 1972: (1974).
COUN USSR
ABST For increasing the chem. stability and the mech. strength of an ion exchanger and for ensuring its selectity for Li ions, LiOH (6.5-6.8 mole %) is added to the inorg. ion exchanger contg. 1.0-1.2 mole % TiO_2, the balance being H_2O.
KEY ion exchange, titanium

354 AUTH Onorin,S.A.; Vol'khin,V.V.
DATE 1976
TITL Preparation and ion-exchange properties of alkali metal titanates.
CITA Russ. J. Appl. Chem. 49(1): 26-29 (1976).
COUN USSR
ABST Alkali metal titanates, $Li_{0.48}TiO_{2.24}$, $Na_{0.40}TiO_{2.20}$, $TiO_{2.17}K_{0.34}$, $Rb_{0.32}TiO_{2.16}$, and $Cs_{0.30}TiO_{2.15}$, prepd. by thermal treatment at 300-500° of hydrated TiO_2, preliminarily satd. with Li^+, Na^+, K^+, Rb^+, and Cs^+, resp., have better ion-exchange properities than the original materials. At the same time stability is gained toward the action of alkali and acid solns.
KEY ion exchange, titanium, temperature, chemistry

355 AUTH Onorin,S.A.; Vol'khin,V.V.; Zil'berman,M.V.; Khodyashev,N.B.
DATE 1978
TITL Synthesis of the cation exchangers ISM-1A and IST-1A with increased exchange capacity.
CITA Izv. Akad. Nauk SSSR, Neorg. Mater. 14(1): 150-153 (1978). (Russian).
COUN USSR
ABST The treatment of hydrated MnO_2 or TiO_2 with aq. solns.

(CONT.)
contg. 75-100 g/L LiOH for 4-6 h at 50-70°, followed by sintering at 450-480° or at 470-510° resp. for 4-6 h gave modified MnO_2 or TiO_2 which at pH 12 had ion exchange capacity 11.5 or 6.0 mg equiv/g resp. The foregoing prepn. conditions were optimum. They were detd. by a statistically-planned exptl. procedure. The cation exchanger based on MnO_2 had hexagonal crystal structure similar to the spinel structure. The TiO_2 -based exchanger contained 2 phases: rutile and Li_2TiO_3 phase. The absorbed Li^+ occupied spaces between O atoms of the cation exchangers which were not accessible to larger atoms. Hence selectivity of these modified MnO_2 and TiO_2 towards Li^+.
KEY ion exchange, capacity, temperature, titanium, chemistry, analysis

356 AUTH Orf,G.M.
DATE 1975
TITL Extraction of metal ions with N, N-distributed amides.
CITA Contract W-7405-eng-82: 55p (1975).
COUN USA
ABST Extraction of Al^{3+}, Ca^{2+}, Cd^{2+}, Cu^{2+}, Co^{2+}, Fe^{3+}, Hg^{2+}, Mg^{2+}, Ni^{2+}, Pb^{2+}, Th^{4+}, UO_2^{2+}, Zn^{2+}, and ZrO^2 from perchlorate solutions by N,N-Dibutylformamide (DBFA), N,N-Diethyldodecanamide (DEDA), and N,N-Dihexylacetamide (DHAA) was studied. Uranium, thorium, zirconium, and mercury were extracted to some extent by all three of the amides, but iron was extracted only by DBFA and BHAA. Lead was extracted only to a small extent by the formamide. The best extractant for the actinides appears to be DHAA, and for the other ions the formamide appears to be the superior extractant.
KEY extraction, uranium, trace metals

357 AUTH Orf,G.M.
DATE 1977
TITL Analytical applications of resins containing amide and polyamine functional groups.
CITA IS-T-783: 125p (1977).
COUN USA
ABST A dibutyl amide resin is used for the separation of uranium(VI), thorium(IV), and zirconium(IV) from each other and several other metal ions. Uranium(VI) and thorium(IV) are determined in the presence of large excesses of foreign metal ions and anions. A practical application of the amide resin is studied by determining uranium in low grade uranium ores. The amide resin is also used for the selective concentration of gold(III) from sea water.
KEY uranium, trace metals, ion exchange

358 AUTH Ouchi,S.; Ogawa,I.; Masuda,S.; Kurabayashi,M.

(CONT.)
DATE 1970
TITL Uranium contamination of the Shinkawa River.
CITA Tokai Jigyosho, Doryoku-do, Kaku-nenryo Kaihatsu Jigyo-dan, Report N831-70-02: 91-98 (1970).
COUN Japan
AREA Shinkawa River
ABST A ten year (1959-69) discharge of low-level liq. wastes, contg. (1-2)x10^{-7} μCi U/cm^3 caused <100 fold increase in the background radioactivity of the Shinkawa River muds; over 90% of all the U activity was adsorbed on <1 mm mud particles. Using fluorometric anals. Carassius auralus (goldfish), cambaroides clarkii (crayfish), and reed in Shinkawa showed U concns. of 2x10^{-7}, (7 and 8)x10^{-2} in the middle and downstream, and (4,5,12)x10^{-2} μg/g wet wt. upstream, in the middle, and downstream, resp.
KEY uranium, environmental impact, analysis, concentration, river

359 AUTH Ovcharenko,F.D.; Tarasevich,Y.I.
DATE 1973
TITL Adsorption on finely divided minerals.
CITA Kolloid. Zh. 35(3): 867-873 (1973). (Russian).
COUN USSR
ABST The role of primary and secondary porosity in the adsorption of polar and nonpolar substances by clay minerals of different cryst. structure was investigated. On the basis of earlier adsorption studies and x-ray structural anal., quant. characteristics of micro- and intermediate pores of montmorillonite, vermiculite and palygorskite are given. The surface and porosity of laminar silicates of rigid structure are interrelated with the grain size and perfection of the crystal lattice. The influence of exchange cations and acidic activation on adsorption properties of clay minerals was examd. The role of exchange cations in the binding of H_2O and other polar substances by natural silicates is not universal. A method is given for aquant. estn. of the effect of exchange cations on hydrophilic properties of clays.
KEY adsorbent, ion exchange, water

360 AUTH Pakholkov,V.S.
DATE 1967
TITL The problem of the uranium sorption mechanism on anion-exchange resins from uranyl fluoride solutions.
CITA Coprecipitation and Adsorption of Radioactive Elements, Akademiia Nauk USSR. Trans. from Russian by Israel Program for Sci. Trans., Ltd.: 183-187 (1967).
COUN USSR
ABST From determinations of the molar ratio of the amount of chlorine displaced from the anion-exchange resin to the amount of uranium sorbed on it, and the molar ratios F^-

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:UO_2^{2+} in the resin and filtrate, it was established that uranium is sorbed from stoichiometrically neutral uranyl fluoride solutions in the form of monovalent complex anions, $UO_2F_3^-$. At a certain stage of the sorption process, when the uranium concentration in the resin phase is high, the sorbed ions become complex as a result of hydrolysis and subsequent complex formation. The low degree of dissociation of UO_2F_2 in aqueous solutions and the breakthrough of uranium into the filtrate in the form of the most stable complex ions UO_2F^+ confirm the validity of the sorption mechanism derived from an analysis of the effluent curves. The neutral uranyl fluoride molecules attach themselves to the fluoride ions in the resin to form complex anions.

KEY ion exchange, uranium, adsorbent, concentration, analysis, filtration, chemistry, capacity

361 AUTH Pakholkov,V.S.
DATE 1967
TITL The sorption of uranium (VI) from HCl-HF solutions on anion exchange resins.
CITA Coprecipitation and Adsorption of Radioactive Elements, Akademiia Nauk, USSR. Trans. from Russian by Israel Program in Sci. Trans., Ltd.: 203-209 (1967).
COUN USSR
ABST The sorption of uranium (VI) from HCl-HF solutions on the AV-17, AV-16G, EDE-10P, and AN-2f anion-exchange resins was studied under dynamic conditions. It was found that the addition of hydrofluoric acid to uranyl solutions in HCl causes a sharp increase in the sorbability of uranium, which is due to the appearance of $UO_2F_3^-$ complex monovalent ions in the solutions. These anions are readily sorbed on the anion-exchange resins. It was found that uranium is not eluted from the anion-exchange resins by dilute HCl containing HF. Nitric acid and acidified ammonium nitrate solutions, however, readily eluted the sorbed uranium. The anion-exchange resins studied can be arranged in the following order according to their regeneration capacity: AV-17>AV-16P>EDE-10P>AN-2f.
KEY uranium, adsorbent, ion exchange, elution, analysis, concentration, capacity, chemistry

362 AUTH Pakholkov,V.S.
DATE 1967
TITL The sorption of uranium (VI) on anion exchange resins from H_2SO_4-HF solutions.
CITA Coprecipitation and Adsorption of Radioactive elements, Akademiia Nauk USSR. Trans. from Russian by Israel Program for Sci. Trans, Ltd.: 198-202 (1967).
COUN USSR
ABST A study of the sorption of uranium (VI) from H_2SO_4-HF

(CONT.)

solutions on the AV-17, EDE-10P and AN-2f anion-exchange resins was carried out under dynamic conditions. It was found that when hydrofluoric acid was added the sorbability of uranium increased to 2-3 times that from pure sulfuric acid. The increase in sorbability with the increase in the HF concentration may be due to the preferential sorption of uranium in the form of complex monovalent fluoride anions, $UO_2F_3^-$.

KEY adsorbent, uranium, ion exchange, extraction, concentration, analysis, capacity

363 AUTH Pakholkov,V.S.; Markov,V.F.; Zelenin,.V.I.

DATE 1977

TITL Sorption of uranium(6) from solutions of various electrolytes on granulated iron hydroxide.

CITA Sov. Radiochem. 19(5): 551-554 (1977).

COUN USSR

ABST Uranium sorption from solutions of UO_2SO_4, UO_2Cl_2 and $UO_2(NO_3)_2$ by ferric hydroxide granulated by gel freezing under dynamical conditions at different pH and content of $(NH_4)_2CO_3$, NH_4F, $(NH_4)_2SO_4$, NH_4Cl, NH_4NO_3 has been studied. The most effective sorption is found to proceed from hydrochloric acid media. In this case, the sorption for 4 M NH_4Cl, NH_4NO_3 and $(NH_4)_2SO_4$ solutions is shown to be 0.9, 0.65, and 0.45 mg-eq. UO_2^{2+} per gram of sorbent respectively. The sorption is quantitative in this process. The advantage of granulated ferric hydroxide is a high uranium selectivity and possibility to use it for uranium extraction even from rather dilute solutions.

KEY uranium, adsorbent, chemistry, extraction, capacity

364 AUTH Panse,M.; Khopkar,S.M.

DATE 1975

TITL Combined ion exchange solvent extraction.

CITA J. Sci. Ind. Res. 34(11): 612-614 (1975).

COUN India

ABST The combined ion exchange solvent extraction technique, "CIESE" introduced recently, has been described. The "CIESE" methods have been summarized. The advantages of these methods over others have been enumerated.

KEY ion exchange, extraction

365 AUTH Peercy,P.S.; Dosch,R.G.; Morosin,B.

DATE 1977

TITL Preparation and structural studies of the hydrolysis products of titanium, niobium, and zirconium alkoxides.

CITA Report SAND-76-0556: 35p. (1977).

COUN USA

ABST Raman scattering, anal., and x-ray techniques were used to study the structural units in amorphous hydrolysis poducts of the alkoxides of Nb, Ti, and Zr and in the

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corresponding sintered materials. These materials are used for ion exchange in the proposed radioactive waste disposal process. The starting soln. for the Nb system yielded crystals contg. $(Nb_{10}O_{28})^{6-}$ ions as the basic structural unit; however, this form for the polyniobate ion was not obsd. in any other stages of the synthesis or in any phase of the ion-exchange material after sintering. The 2 cryst. phases of the Nb ion-exchange material which occur on sintering were $Na_2Nb_4O_{11}$ and $Na_{13}Nb_{35}O_{94}$. No stable crystals were obtained for the initial Ti and Zr compds. so the initial ionic configurations could not be detd. Upon sintering, the Ti ion-exchange material exhibits 4 cryst. phases. The structure and ionic configuration of the 2 higher-temp. phases were $Na_2Ti_3O_7$ and $Na_2Ti_6O_{13}$. In contrast, the Zr ion-exchange material initially crystallizes in a cubic stabilized zirconia phase and at higher sintering temp. the structure converts to the monoclinic baddeleyite phase of ZrO_2. For each of the systems the only truly amorphous phase encountered was the final ion-exchange material.
KEY ion exchange, analysis, titanium

366 AUTH Pletnev,R.N.; Denisova,T.A.; Ivanki,A.A.
DATE 1977
TITL State of hydrogen in titanium hydroxide.
CITA Russ. J. Appl. Chem. 50(10): 2253-2255 (1977).
COUN USSR
ABST The results of the proton magnetic resonance (PMR) measurements on polycrystalline samples of $TiO_2.nH_2O$ ($n = 0.28-6.0$) show that titanium hydroxide is a compound of variable composition. Hydrogen ions are present in hydroxyl groups, H_2O molecules, and H_3O^+ ions. Dehydration of the samples is accompanied by oxolation and by a change in composition according to the scheme $2xH_3O^+ + xO^{2-} \rightarrow 3xH_2O$. The interproton distances in the H_2O and H_3O^+ groups, and also the distances between isolated protons were determined.
KEY titanium, adsorbent, chemical species, temperature, analysis

367 AUTH Rastogi,M.C.; Srivastava,B.S.
DATE 1973
TITL Studies on titanium dioxide sols. in the presence of surface active agents. I. pH, conductivity and zeta potential measurements.
CITA Indian J. Chem. 11(9): 913-921 (1973).
COUN India
ABST To assess structural changes in the double layer, systems of TiO_2 sols., with surface-active agents were studied by measuring the changes in pH and cond. Zeta potentials were also measured by microelectrophoretic

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techniques. Two max. occur in the pH and cond. curves (vs. log concn. of surface-active agent). The first max. was ascribed to ion exchange by adsorption from the Stern layer; the added ions are due to exchange release of OH^-, which are responsible for the increase in cond. Heats of ion exchange calcd. for different surface-active agents are $\sim$1 kcal/g-ion. Zeta potentials are practically const. in this region. The 2nd max. was assigned to further release of OH^- ions from the Stern layer due to the adsorption of surface-active agents with long chains. The concns. at wich the 2nd max. occur are nearly equiv. to those at which $\zeta = 0$. Heats of adsorption calcd. from electrophoretic data are 6-8 kcal/mole for different surface-active agents. A mechanism of interaction of the long-chain ions with the sol. are suggested.
KEY ion exchange, chemistry, titanium, analysis, adsorbent

368 AUTH Rawat,J.P.; Singh,J.P.
DATE 1977
TITL Synthesis and use of aluminium antimonate as an ion-exchanger.
CITA Chromatographia 10(4): 205-208 (1977).
COUN India
ABST A new inorganic ion-exchanger, aluminum antimonate, is described. It is the most stable of the antimonates so far studied as ion-exchangers. Exchange capacity and Kd values have been determined as well as the effect of heat, stability, etc. Important binary and ternary separations have been achieved. The material is weak cation-exchanger.
KEY capacity, ion exchange, adsorbent, temperature

369 AUTH Richard,C.F.; Gustafson,R.L.; Martell,A.E.
DATE 1959
TITL Stability of metal chelates of 8-quinolinol-5-sulfonate.
CITA J. Am. Chem. Soc. 81(2): 1033-1040 (1959).
ABST The interaction of Mn(II), Co(II), Ni(II), Cu(II), Zn(II), Mg(II), Fe(III), UO_2(VI), and Th(IV) ions with 8-hydroxy-quinoline-5-sulfonate has been investigated by potentiometric and spectrophotometric methods. Formation constants have been calculated for chelates containing 1:1, 2:1 and in some cases 3:1 and 4:1 ratios of ligand to metal ion. Comparison of these stability constants with those obtained for 8-quinolinol itself shows that the observed differences are essentially the result of the lower basicity of the sulfonated ligand. The hydrolytic behavior of Fe(III), UO (VI) and Th(IV) chelates containing two unfilled coordination positions has been investigated quantitatively. The hydrolysis and olation tendencies of the 3:1 thorium and 2:1 uranyl and ferric chelates were found to follow the order

(CONT.)
Fe(III) > Th(IV) > UO (VI).
KEY trace metals, analysis, concentration, chemistry

370 AUTH Richards,A.F.
DATE 1976
TITL Extracting energy from the oceans: a review.
CITA Marine Technology Society Journal 10(2): 5-24 (1976).
COUN USA
ABST Renewable energy resources are expected to minimize environmental impact and present none of the security and disposal problems associated with nuclear power plants. Eight methods, and a number of variants, of obtaining energy from the oceans are presented: ocean thermal, kelp bioconversion, ocean currents, salinity gradients, and ocean geothermal. Each method is discussed in terms of concepts, geographic areas applicable, and development schedule and costs insofar as information is available. None of these methods produce "excess" heat into the environment, as do fossil-fuel and nuclear-power generating plants. Most of the methods represent relatively new technologies.
KEY farming systems, platform systems, plant design, pumped system, climate, current, seawater, tidal system

371 AUTH Riedel,H.J.
DATE 1970
TITL Adsorption behavior of uranium dissolved in sea water on synthetic ultramarine.
CITA Kerntechnik 12(1): 16-19 (1970).
COUN W Germany
ABST Uranium dissolved in seawater as the tricarbonate complex is found in the oceans in a concentration of 3.3 µg/l, remarkably constant down to depths of at least 400 m. The total reserve is estimated at 4.16 Gt. The suitability of synthetic ultramarine as an ion exchanger for the extraction of this uranium was studied. A capacity for UO_2^{2+} ions of 0.1 mval/g was found. The ion exchange with Na^+ ions freely mobile in the ultramarine lattice follows the law of mass action. The uptake of UO_2^{2+} ions from the tricarbonate was found to be 0.03 mval/g after the pH of the seawater was adjusted to 5.
KEY uranium, seawater, concentration, extraction, capacity, chemical species, ion exchange, chemistry, adsorbent, titanium, elution

372 AUTH Riedel,H.J.
DATE 1970
TITL Separation of uranium from sea water.
CITA Ger. Offen. 1,928,864 (Cl. C 01g), Appl. 06 Jun 1969: 7p (1970).
COUN W Germany
ABST U occurring in sea water as tricarbonate complex was

(CONT.) sepd. in a UO_2^{2+} ion exchange process with ultramarine blue at pH ∿5. Thus, 10 g synthetic ultramarine blue of <0.2 mm grain size was added to 100 ml M NaCl and dried at 111°. Sea water (1 l.) enriched to 81.6 mg U content as tricarbonate complex and acidified with HNO_3 to pH 5 was added and stirred 2 hr to adsorb 52.6% of the U. The ultramarine was filtered and mixed with 1 l. M Na_2CO_3 to elute 97 and 99.6% of the adsorbed U after 2 and 4 hr, resp.

KEY uranium, seawater, ion exchange, adsorbent, chemical species, chemistry, temperature, elution, extraction

373 AUTH Riedel,H.J.
DATE 1973
TITL Method of extracting uranium from sea-water.
CITA U.S. Patent 3,721,533. Priority date 6 Jun 1969: 4p (1973).
COUN W Germany
ABST A method is presented for extracting uranium in the form of tricarbonate complexes of UO_2^{++} from seawater or other liquids rich in metal ions. The seawater is acidified to a pH of approximately 5 (e.g. with hydrochloric acid or HNO_3), and then is treated with ultramarine blue in an ion-exchange relationship until equilibrium is reached in the distribution of uranium between the ultramarine blue and the seawater. Elution of the uranium is carried out with an alkali carbonate solution.
KEY uranium, seawater, ion exchange, chemical species, chemistry, extraction, elution

374 AUTH Riedel,H.J.
DATE 1976
TITL Method of obtaining uranium from uranium compounds dissolved in sea water.
CITA German (F.R) patent 1928864/C/. Int. Cl. C01G 43/02: 3p (1976). (German).
COUN W Germany
ABST The patent deals with an ion exchange separation process for uranium compounds dissolved in sea water. The uranium is generally present here as tri-carbonato complex. Synthetic ultramarine blue is used for the exchange of the uranyl ions, which, compared to other ion exchange materials, has the advantage of favourable exchange kinetics and is also cheaper. The loading takes place at pH 5 with a ratio exchanger to seawater of 1:100. Alkali carbonate solution is used for the elution.
KEY ion exchange, uranium, seawater, chemical species, chemistry, elution, extraction

375 AUTH Ritcey,G.M.; Lucas,B.H.

(CONT.)
DATE 1974
TITL Co-extraction and separate recovery of uranium and thorium from acid solutions.
CITA U.S. Patent 3,835,213. Filed date 1 Oct 1971: 6p (1974).
COUN Canada
ABST A process is described for separating uranium and thorium from an aqueous acid solution containing them together with rare earth elements. The process comprises contacting the solution with a water-immiscible organic solution of a high molecular weight primary or secondary amine whereby the uranium and thorium values are co-extracted and separating the resulting uranium and thorium loaded amine solution from the aqueous solution. The uranium and thorium are then easily separated from the loaded amine solution either by selective stripping or co-stripping and selective extraction.
KEY uranium, water, extraction, trace metals

376 AUTH Robertson,D.E.; Carpenter,R.
DATE 1974
TITL Neutron activation techniques for the measurement of trace metals in environmental samples.
CITA National Academy of Sciences - National Research Council Report NAS-NS-3114: 84p (1974).
COUN USA
ABST Neutron activation techniques for measuring trace metals in fresh waters, seawater, marine organisms, sediments, and atmospheric particulates are discussed. Principles of neutron activation analysis, neutron irradiation facilities and procedures, and sample preparation including preconcentration and postirradiation separations are outlined.
KEY seawater, trace metals, marine organisms, analysis, water, particulate, sediments, extraction

377 AUTH Robertson,D.E.; Young,J.A.; Abel,K.H.; Crecelius,E.A.; Wilkerson,C.L.; Weimer,W.C.; Langford,J.C.; Vaughan,B.E.
DATE 1977
TITL Geochemical ocean sections study (GEOSECS). Chemistry of ocean solutions.
CITA Pacific Northwest Laboratory annual report for 1976 to the ERDA Assistant Administrator for Environment and Safety. Part 2. Ecological sciences. BNWL-2100(Pt.2): 7.10-7.25 (1977).
COUN USA
AREA US Coastlines, Pacific Northwest
ABST The GEOSECS project is a multi-institutional investigation of the geochemistry and mixing dynamics of the oceans. The objective of this study is to utilize the oceans' chemical and radionuclide constituents to

(CONT.)
characterize the biogeochemical and physicodynamic processes occurring in the oceans. Results are reported from the characterization of a large group of trace elements in the oceans, and the measurement and utilization of cosmic-ray and fallout radionuclides as tracers of aerosol deposition and ocean mixing processes. The radionuclide studies have now been completed and the program has been directed towards measurement of the distributions of trace metals of geochemical and environmental interest in the oceans utilizing the valuable inventory of well documented GEOSECS samples. The analyses of sea water from open ocean GEOSECS tracks are being supplemented by trace metal measurements of seawater samples collected on cruises extending from the coastlines of the U.S. to open ocean areas. These data will help define the natural and anthropogenic processes which create concentration gradients between the coastal and open ocean waters. The air-to-sea transfer of airborne trace metals to the coastal marine environment, the chemical species after dissolution, and subsequent chemical reactions which will affect bioavailability were also studied. The validity of ^{7}Be as a tracer for air-sea transfer of trace metals is being investigated presently. The distribution chemical/physical forms of plutonium in the Pacific Northwest coastal waters and sediments is also being studied to predict the future consequences of plutonium inputs to the coastal ecosystem.

KEY trace metals, seawater, chemical species, analysis, environmental impact, concentration, marine organisms, biological productivity, sediments, pacific northwest, geology

378 AUTH Rodriguez,P.M.; Uriarte,H.A.; Lopez,P.B.
DATE 1967
TITL Separation of uranium, plutonium, and fission products by synthetic inorganic ion exchangers.
CITA C.R. Colloq. Fr.-Espagnol Trait. Combust. Irradies. 1st: 201-220 (1967). (Spanish).
COUN Spain
ABST Silica gel and unfired Vycor glass were examd. as exchangers by using HNO_3 fuel dissoln. solns. Sepn. coeffs. for the title elements were obtained as a function of time of agitation, HNO_3 concn., and ion concn.
KEY uranium, ion exchange, concentration, trace metals, extraction

379 AUTH Roesmer,J.
DATE 1968
TITL Chemical aspects and approaches to mining the oceans for

(CONT.)
uranium.
CITA Westinghouse Electric Corp. Report WANL-TMI-1952: 18p (1968).
COUN USA
ABST A thorough survey on coprecipitation systems which have been used to collect and concentrate uranium traces in seawater is presented. A specific collection system, ferric hydroxide $Fe(OH)_3$ is recommended as suitable for scaling up into a production process. The ferric hydroxide coprecipitation system also removes many precious metals dissolved in seawater. Their recovery may improve considerably the economics of mining the oceans for uranium.
KEY uranium, seawater, economics, extraction, trace metals, adsorbent

380 AUTH Rona, Elizabeth.
DATE 1943
TITL Radioactivity of sea water.
CITA Grant No. 619. Yearbook American Philosophical Society: 136 (1943).
ABST The uranium content of ocean water samples of the northern Atlantic, taken off George's Bank, were determined, and the method presented. Uranium concentration varied from 0.75 to 1.00 micrograms/liter, and radium concentration varied from .014 pg/liter to .058 pg/liter.
KEY uranium, water, extraction, analysis, concentration

381 AUTH Rona,E.; Gilpatrick,L.O.; Jeffrey,L.M.
DATE 1956
TITL Uranium determination in sea water.
CITA Trans., Am. Geophys. Union 37(6): 697-701 (1956).
COUN USA
AREA North Atlantic, North Pacific, Gulf of Mexico, Straits of Florida
ABST Uranium analyses of sea-water samples taken from different locations were carried out by the isotope-dilution method. Uranium was separated by liquid-liquid extraction from 2000 ml of sea water, for each determination. The small residue of uranium resulting from the chemical separation was analyzed by mounting it on a tantalum filament and examining the UO^{2+} thermal ions in a Nier six-inch radius, 60° sector-type mass spectrometer. The results show a concentration of 3.1 to 3.5 micrograms of uranium per kilogram of sea water, with a uranium/salinity ratio of 9.0 to 9.8 x 10^{-3}.

KEY uranium, analysis, seawater, extraction, concentration, salinity, river, water, sediments, gulf of mexico, n atlantic, s atlantic, pacific northwest

(CONT.)

382 AUTH Rosenbaum,J.B.
DATE 1976
TITL Minerals extraction and processing: new developments.
CITA Science 191 (4228): 723 (1976).
COUN USA
ABST In southern Texas, loosely consolidated uranium bearing sand stone occurs at depths of 300 to 700 feet. Development of a successful in-place leaching technique could mean low capital and operating costs, minimum land-surface disruption and avoidance of disposal or storage of mill tailings. The clue to in-place leaching of the Texas uranium deposits without excessive reagent use and without plugging the ore formation appears in the use of extremely dilute alkaline leach solution with a low uranium-loading and a high circulation rate. For meeting the uranium requirements of nuclear power generation, 125 tons of U_3O_8 is roughly equivalent to the annual requirement of a 500-mega watt reactor.
KEY uranium, environmental impact, extraction, ion exchange, concentration, plant design, plant productivity

383 AUTH Rosenbaum,J.B.
DATE 1976
TITL Outlook for uranium demand and production capacity.
CITA Uranium Ore Processing, Proceedings of an Advisory Group Meeting, Wash. D.C., 24-26 Nov. 1975. IAEA, Vienna: 3-9 (1976).
COUN USA
AREA Texas
ABST Despite appreciable errors in recent forecasts of nuclear power growth rate, the amended estimates still show the required amount of uranium raw material for 1985 to be three to four times larger than the world's existing uranium production capacity, both operating and on standby. By expanding the existing production units and adding new units based on known ore reserves, the uranium demands of 1980 might be met. The number of production units in the world (except by China, the Soviet Union and the Eastern European countries) might increase from the current 45 to about 70. Substantial additional capacity based mostly on newly discovered ore resources would be necessary to meet the uranium demands of 1985.
KEY uranium, economics, plant productivity, environmental impact

384 AUTH Roslyakov,V.S.; Ezhova,M.P.
DATE 1966
TITL Concentration of U from large volumes of water directly at the source.
CITA Sov. Radiochem. 8(3): 332-333 (1966).
COUN USSR

(CONT.)
ABST A 20-l. sample of natural water is acidified with HCl (until the color of methyl orange turns pink), then neutralized to pH 4.5-5 (with urotropine), activated carbon is added to it (250 mg./l.) and mixed thoroughly. The U is sorbed on the carbon almost quant., and the carbon is sepd. by forced filtration of the soln. (by hydrostatic pressure) in a special app. which is described.
KEY water, uranium, chemistry, adsorbent, concentration, analysis

385 AUTH Rukihati
DATE 1975
TITL Uranium separation in nitric acid media (1:1) by ion exchange method.
CITA Report PPGM-L85-75: 7p (1975). (Indonesian).
COUN Indonesia
ABST Uranium separation from its mixture with other metals e.g. Co^{++}, Cu^{++}, Fe^{++}, Ni^{++}, and Pb^{++}, and from its ore which contain uranium less than 0.5% has been done by using the Amberlite IRA 400CP. 20-50 mesh anion exchange resin in the nitric acid medium (1:1). Basic peroxide spectrophotometric method by means of Na_2CO_3-NaOH-H_2O_2 is used for determining the separable uranium from either its mixture with other metals mentioned or its ore. The results of uranium analysis are compared with those of reference samples low grade uranium ore from IAEA. It is found that 75% of uranium can be separated.
KEY uranium, analysis, ion exchange, trace metals, extraction

386 AUTH Rupcheva,V.A.; Romanova,T.V.
DATE 1970
TITL Extraction of bromine from industrial waste waters.
CITA Sb. Nauch. Tr. Perm. Politekh. Inst. (71): 115-120 (1970). (Russian).
COUN USSR
ABST Complete anal. of industrial natural brine entering the oxidn. stage and waste waters was carried out. The absorption of Br^- from the natural brine on AV-17 anion exchange resin, silica gel, and Al oxide was studied. The AV-17 anion exchange resin charged into a Cl-form selectively sorbed the elementary Br from the waste natural brine by 100%; all other halogens including bound Br were not sorbed by resin. Silica gel sorbed both free and bound Br. Partial adsorption of Cl occurred also.
KEY water, adsorbent, ion exchange, extraction

387 AUTH Rupprecht,H.; Biedermann,M.
DATE 1974
TITL Anomalous sorption behavior of titanium hydroxide toward

(CONT.)
pharmaceutical cations in the presence of sulfate and phosphate ions.
CITA Colloid Polym. Sci. 252(7/8): 558-565 (1974). (German).
COUN W Germany
ABST The sorption of the cationic surfactant tetradecylpyridinium chloride on pyrogenic TiO_2 surfaces was studied in the presence of phosphate and sulfate ions at pH <6.5. The sorption was due to ion exchange of the surfactant cations with the primarily strongly adsorbed sulfate and phosphate groups. In satn., ion exchange is supplied by hydrophobic interactions in the sorption layers.
KEY ion exchange, titanium, adsorbent, chemistry

388 AUTH Ryabchikov,D.I.; Seniavin,M.M.
DATE 1955
TITL Chromatographic determination of uranium in various materials.
CITA Proc. UN Intern. Conf. Peaceful Uses At. Energy (Geneva) 8: 278-284 (1955).
COUN USSR
ABST The methods of preliminary isolation of pure uranium are very important (equally to selective methods of direct determination) for the quantitative analysis of materials, containing uranium. This report is devoted to the application of ion exchange and distribution chromatography for isolating uranium from various solutions.
KEY extraction, uranium, adsorbent, trace metals, ion exchange, chemistry, capacity, elution, water, analysis

389 AUTH Ryabinin,A.I.; Doroshenko,G.A.; Lazareva,E.A.
DATE 1974
TITL Sorption of uranium from sea water by titania gel. .
CITA Sov. Radiochem. 16(1): 113-114 (1974).
COUN USSR
AREA Black Sea
ABST Elastic Ti gels were formed by mech. mixing in a $TiCl_4.H_2O$ ratio of 0.32 and cooling to 0-2°; no gels were formed at ratios >0.32 and temps. >35°. The $Ti(OH)_4$ gel is an inorg. polymer, similar in structure to a SiO_2 gel, with stable O cross links between the Ti atoms. With gel aging, the hydrolysis of such chains form a 3-dimensional condensation, resulting in stable porous granules after the processing and drying. To prep. the gel for sorption, liq. $TiCl_4$ 150 ml was gradually added to 1 l. of water cooled to 0-2°. The gel, aged for 1 hr, formed granular material after being removed from the HCl hydrolysis soln. The resulting material was aged for 3 hr in a 1-2.5% NH_3 soln. and dryed at <100°. Sea water contg. 3.4-3.6 μg U_3O_8/l. and 18-19 g total salts/l. was filtered through a column filled with Ti

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gel. The Ti gel, up to breakthrough, contained 0.024 mg U_3O_8/g TiO_2. At a 0.29 µg U_3O_8/l. yield from the column, the sorbent reached 0.03 mg of U_3O_8/g TiO_2, for an equil. state between the sea water and the sorbent. The Ti gel was suitable for sepg. U from sea-water.
KEY titanium, uranium, seawater, temperature, adsorbent, concentration, capacity, economics, salinity, extraction

390 AUTH Ryabinin,A.I.; Lazareva,E.A.
DATE 1972
TITL Photometric determination of uranium in sea water.
CITA Sov. Radiochem. 14(6): 963-964 (1972).
COUN USSR
ABST The detn. of U in sea water was made by the $Fe(OH)_3$ and arsenazo III method (A.A. Nemodruk and R. Yu. Deberdura, 1966). But instead of extn., U was sepd. from Fe^{3+} by 2-stage carbonate leaching and photometry was done from 4-6M HCl with preliminary redn. of U(VI) to U(IV) with Zn. Methods described in the literature for the sepn. of U and Fe^{3+} in a carbonate medium from mixts. with Fe:U $\leq$200-600, were not suitable for a quant. sepn. of U and Fe from mixts. with Fe:U = 5 x 10^4, recommended for sepn. of U from sea water. A quant. sepn. of 1-4 γ of U_3O_3 from 50 mg of Fe, was carried out in a soln. of NH_4HCO_3 and NH_3 and a double fractional pptn. of $Fe(OH)_3$ carried out by heating over a boiling bath. Under these conditions, the carbonate acido-complexes of U(VI) were stable in contrast to Fe, remained in the soln.
KEY uranium, seawater, analysis, extraction, chemistry

391 AUTH Ryabinin,A.I.; Lazareva,E.A.; Doroshenko,G.A.
DATE 1973
TITL Sorption of uranium from Black Sea water by anionites.
CITA Sov. Radiochem. 15(3): 439-441 (1973).
COUN USSR
AREA Black Sea
ABST A possible com. method of recovery of U from sea water is described. The exchange capacity and the amt. of the extd. U_3O_8 from Black Sea Waters are given for 15 com. anion exchangers. The exchangers are divided into 3 groups according to their efficiency of extg. U. The exchangers AN-2F and AP-2-SP have the highest exchanger capacity for U (23 and 15µg U_3O_8/g, resp.) and are able to conc. the U by factors of 6.4 x 10^3 and 4.2 x 10^3, resp.
KEY uranium, seawater, capacity, ion exchange, adsorbent, extraction

392 AUTH Ryabinin,A.I.; Romanov,A.S.; Doroshenko,G.A.; Lazareva,E.A.
DATE 1973
TITL Sorption separation of uranium and other valuable metals

(CONT.)
from sea water.
CITA Sov. Radiochem. 15(6): 898-899 (1973).
COUN USSR
ABST The prepn. of a sorbent based on $Ti(OH)_4$ and an anion exchange resin for the extn. of U from sea water is presented. The dry sorbent, containing 15 wt.% $Ti(OH)_4$ was loaded in a glass column of height 60 cm and cross section area 230 cm^2, through which 130 m^3 of sea water was passed at 1-3 m^3/day. The sorbent extd. 28 mg U_3O_8 from 25 m^3 of sea water. The column was desorbed with a 30% soln. of HNO_3. Extn. with HNO_3 also produced 1 g of Cu, which indicated that the sorbent had a high affinity for Cu. Since $Ti(OH)_4$ is known as an effective sorbent for Co, Zr, Ag, In, Tl, Cd, and Hg, these metals were also extd. in various amts.
KEY uranium, seawater, titanium, ion exchange, trace metals, adsorbent, capacity, elution, extraction

393 AUTH Sackett,W.M.; Cook,G.
DATE 1969
TITL Uranium geochemistry of the Gulf of Mexico.
CITA Trans., Gulf Coast Ass. Geol. Soc. 19: 233-238 (1969).
COUN USA
AREA Gulf of Mexico
ABST The economic importance, the dissimilarity in chemical behavior of its two oxidation states and the unique usefulness of its radioactive daughter products make uranium and its geochemistry extremely interesting to earth scientists. The Gulf of Mexico (GOM) has the attractive feature of being a semi-closed system that offers the possibility of a complete monitoring of all inputs and removal processes for trace elements such as uranium. Experimental values obtained in this study of the geochemical cycle of uranium in the GOM are presented. High uranium concentrations in midwest U.S.A. rivers relative to other rivers of the world can be explained by solubilization of the uranium in phosphate fertilizers applied to the land surface. Estimated pre-fertilizer uranium input to the GOM is nearly balanced by uranium co-deposition with carbonates on the Yucatan shelf.
KEY uranium, gulf of mexico, economics, trace metals, concentration, river, analysis, water, salinity, estuary, sediments, geology

394 AUTH Sackett,W.M.; Mo,T.; Spalding,R.F.; Exner,M.E.
DATE 1973
TITL A revaluation of the marine geochemistry of uranium.
CITA From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-: 757-769 (1973).

(CONT.)
COUN USA
ABST Approximately 10^{15} μg/yr of dissolved uranium are being removed from the ocean by each of the generally accepted significant sinks for uranium-carbonate deposits and deep anoxic basin sediments. However, these sinks account for only 10% of the estimated present-day input of uranium. Possible explanations for this discrepancy are: contemporary input values are too high owing to a significant contribution from man's effects, such as uranium input via phosphate fertilizers or world-wide cultivation leading to premature leaching of uranium from soils; or there are other important uranium sinks such as the abundant siliceous oozes or continental shelf anoxic sediments.
KEY uranium, seawater, environmental impact, marine organisms

395 AUTH Saiki,M.; Lima,F.W.
DATE 1977
TITL Solvent extraction studies using tetracycline as a complexing agent Part 6. Separation of uranium and thorium with DTPA as a masking agent.
CITA Radiochem. Radioanal. Lett. 29(2): 67-72 (1977).
COUN Brazil
ABST Separation of thorium from uranium is accomplished by a solvent extraction technique using benzyl alcohol as an extractant and tetracycline as a complexing reagent and diethylenetriaminepentaacetic acid as a masking agent for thorium.
KEY uranium, extraction, chemistry

396 AUTH Sakamoto,F.; Tani,H.
DATE 1977
TITL Heavy metal adsorbing agent.
CITA Japan. Kokai 77 29,890 (Cl. C08G16/02), Appl. 75/106,616, 02 Sep 1975: 7p (1977).
COUN Japan
ABST A quinaldic acid deriv. and HCHO are polymd. with an acidic or alk. catalyst to obtain a heavy metal adsorbent. Thus, a 6,8-dihydroxyquinaldic acid-formaldehyde polymer [63713-30-4] was crushed and added to U-contg. seawater to adsorb 3.61 mg U/g resin compared with 1.02 mg/g for hydroxyquinoline resin.
KEY adsorbent, uranium, seawater, capacity, chemistry

397 AUTH Salutsky, M.L.; Dunseth,M.G.
DATE 1964
TITL Recovery of trace element cations.
CITA U.S. 3,155,454 (Cl. 23-1), Appl. Nov. 21, 1962: 3p (1964).
COUN USA
ABST Although metallic cations are satisfactorily removed

(CONT.)
from various types of brines, particularly sea water, as coppts. on addn. of the phosphate ion and NH_3 for control of scaling, this method is uneconomical where the trace elements are to be isolated for the prepn. of such materials as fertilizer and paint pigments. Cations including Al, Ba, Ca, Cd, Ce, Co, Cu, Fe, Pb, Mn, Ni, Ag, Sn, U, and Zn are removed more economically by percolating their dil. soln. through a bed of $MgNH_4PO_4$ $.H_2O$ in which the Mg is replaced.
KEY seawater, trace metals, uranium, extraction

398 AUTH Sani,A.R.
DATE 1966
TITL Uranium from seawater.
CITA Nucleus (Lahore) 3(4): 102-104 (1966).
COUN Pakistan
ABST Work done on the use of seawater as a source of uranium is reviewed. Two of the major obstacles are: the uranium is in a strongly complexed form at an extreme dilution in the presence of relatively high concentration of other ions, and any extractant that could be used must be brought into contact with a very large volume of water and must function efficiently at the pH of the seawater. The use of various organic and inorganic absorbants is discussed, specifically titanium hydroxide. The ion-flotation method is also considered. The use of activated charcoal for the recovery of uranium from seawater is currently being investigated.
KEY seawater, uranium, titanium, chemical species, concentration, chemistry, adsorbent, extraction

399 AUTH Sastry,V.N.; Doshi,G.R.; Krishnamoorthy,T.M.; Sarma,T.P.
DATE 1977
TITL Studies on adsorbents for uranium from sea water.
CITA Indian J. Mar. Sci. 6(1): 55-58 (1977).
COUN India
ABST Nineteen absorbents were tested to concentrate uranium from sea water. Mass distribution coefficients and percentage yields were determined for the adsorbents from low and high concentrations of uranium in the medium. Out of the adsorbents studied, hydrated titanium oxide showed a fast pick-up rate (T. 5-approximately 2 min) in the batch studies and a good yield of 92 +- 3% was obtained by the passage of 75 1 of sea water. Maximum amount of uranium that could be obtained on this bed was 1.4 mg U/g. This adsorbent could be utilized to concentrate uranium from sea water if the practical problems of compaction and algal growth are eliminated.
KEY adsorbent, uranium, seawater, concentration, titanium, capacity, particulate, chemistry, marine organisms

(CONT.)

400 AUTH Sato,T.; Nishida,T.
DATE 1974
TITL Extraction of uranium(VI) from hydrochloric acid solutions by tri-n-octyl phosphine oxide.
CITA J. Inorg. Nucl. Chem. 36(9): 2087-2089 (1974).
COUN Japan
ABST The distribution of uranium(VI) between hydrochloric acid solutions and kerosene solutions of tri-n-octyl phosphine oxide(TOPO) was investigated. The absorption spectra of both the aqueous and organic phases were examined, and the ir and NMR spectra of the organic phases were studied.
KEY extraction, uranium, analysis

401 AUTH Savel'eva,V.I.; Sudarikov,B.N.; Kireeva,G.N.; Ryzhkova,V.N.; Kandaryuk,V.V.
DATE 1976
TITL Investigation into sorption of uranium from its high-concentrated nitric acid solutions on resin AMP.
CITA Russ. J. Inorg. Chem. 21(3): 409-412 (1976).
COUN USSR
ABST Sorption of uranium has been studied on strongly basic anion-exchange resin from nitric acid solutions with concentration in metal 10-150 g/l in presence of sodium, calcium, and aluminium nitrates. Sorption of uranium from solutions has been performed by the static method with the aid of contacting the initial solution with air-dry resin for 4 hours, resin to solution ratio being 1:12.5. It has been established that sorption of uranium increases with a rise in concentration of salting out agents in the following order: $Al(NO_3)_3 > Ca(NO_3)_2 > NaNO_3$. It has been shown spectrophotometrically that in solutions of nitrates and HNO_3 with a concentration <6 mol/l, uranyl-ion is present, mainly, as neutral complex ions when its concentration is 100 g/l. The formation of anion complex uranyl-ions is observed when concentration of HNO_3 exceeds 6 mol/l.
KEY uranium, concentration, ion exchange, adsorbent, chemistry, analysis

402 AUTH Schmidt-Mende,P.
DATE 1974
TITL Possibilities of uranium production from North Sea water.
CITA Meerestech./Mar. Technol. 5(2): 61-63 (1974). (German).
COUN W Germany
AREA German North Sea
ABST Water samples from the areas of the German North Sea coast were analyzed to investigate possibilities of uranium production from the water of these areas. The uranium contents found were: Bay of Heligoland 3.6 μg

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U/l, river Elbe up to 8.2 μg U/l, river Weser approximately 3.3 μg U/l, and river Ems less than 1 μg U/l. The use of inorganic sorption material for the uranium enrichment appears to have the greatest chances of success. The production from sea water, however, cannot be carried out economically with the means known today.

KEY uranium, river, seawater, concentration, adsorbent, economics, analysis

403 AUTH Schoening,R.
DATE 1975
TITL Highly dispersive ion exchangers in the analytical chemistry of uranium, particularly regarding separation methods.
CITA INIS-mf-3441: 92p (1975). (German).
COUN W Germany
ABST The reaction of water-insoluble polyvinyl pyrrolidon with uranium VI was investigated and a determination method for uranium was worked out in which the polyvinyl pyrrolidon was used as specific exchanger. Good separations of uranium from numerous transition metal ions were achieved here. The application of this exchanger for a fast and simple elution and determination method was of particular importance. A possible sorption mechanism was suggested based on the capacity curve of uranium with polyvinyl pyrrolidon and nitrogen chloride content at maximum load. The sorption occurs by coordination of the carbonyl oxygen of single pyrrolidon rings with the protons of the complex acides and uranium. This assumption is supported by IR investigations. The sorbability of other inorganic acids was also investigated and possible structures were formulated for the sorption mechanism. In addition to this, ion exchangers were prepared based on cellulose by converting cellulose powder with aziridine and tris-l-aziridinyl-phosphine oxide. A polyethylene imine cellulose of high capacity was obtained in the conversion of cellulose powder with aziridine. This exchanger absorbs cobalt III very strongly. The exchanger loaded with cobalt III was used to separate the uranium as cyanato complex. The exchanger obtained in converting chlorated cellulose with tris-l-aziridinyl-phosphine oxide also absorbs uranium VI very strongly. Thus a separation method of high specificity and selectivity was developed.
KEY uranium, elution, capacity, analysis, adsorbent, ion exchange, chemistry

404 AUTH Schott,W.
DATE 1976
TITL Mineral (inorganic) resources of the oceans and ocean

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floors: a general review.
CITA Handb. Strata-Bound Stratiform Ore Deposits 3: 245-294 (1976).
COUN W Germany
ABST A review with 206 refs. is presented.
KEY uranium, sediments

405 AUTH Schulze,R.G.W.; Schulze,H.Y.
DATE 1977
TITL Substrates filled with phosphorus-containing ion exchangers.
CITA Ger. Offen. 2,614,356 (Cl. C01B25/26), Appl. 02 Apr 1976: 15p(1977).
COUN W Germany
ABST Porous substrates impregnated with P-contg. ion exchanger were prepd. by steeping the substrate with a sol. precursor and then converting it to the insol. exchanger by chem. treatment. Suitable substrates may consist of SiO_2, Al_2O_3, or Al and/or Mg silicate spheres or cylinders, 1-10 mm in size, with porosity >40%, such as 72% with av. pores of 125 Å. Useful ion exchangers are quadrivalent Ti, Sn, and Zr salts of phosphoric or phosphonic acid, and acid phosphate esters, or mixts. thereof. These are prepd., resp., by steeping the substrate in a soln. of a peroxytitanyl salt of phosphoric and/or phosphonic acid or salt thereof, and treating with a reducing agent such as HCHO, steeping with an acid soln. of $SnCl_4$ and the above P acids or salts and neutralizing with an alk. soln., and steeping with a soln. of Zr complex with tartaric, citric, oxalic or hydrofluoric acid and hypophosphites and/or phosphonates and treating with an oxidizing agent such as H_2O_2 and a mineral acid. The examples describe the prepn. of 12 ion exchangers and the partial removal of As, Sb, and Bi from a soln. from the electrolytic deposition of Cu. After use, the ion exchangers may be regenerated by treatment with aq. acid or alk. solns., including sequential treatments with some selective removal of the metal ions.
KEY ion exchange, adsorbent, chemistry, trace metals, titanium

406 AUTH Schwochau,K.; Astheimer,L.; Schenk,H.J.; Schmitz,J.
DATE 1977
TITL Method for recovering uranium from sea water.
CITA Ber. Kernforschungsanlage Juelich, Juel-1415: 71p (1977). (German).
COUN W Germany
ABST In view of the augmenting uranium demand for energy supply and of the anticipated depletion of the actually assured and economic uranium resources the possibility of recovering uranium from sea water receives increasing

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attention. It is the purpose of the present report to give a detailed discussion of fundamental problems involved and a critical survey of hitherto proposed processes of recovery and to recommend some general directives for further work.
KEY uranium, economics, seawater, extraction

407 AUTH Sekine,K.
DATE 1975
TITL Determination of traces of uranium in sea water after separation by froth flotation.
CITA Mikrokim. Acta 1: 313-319 (1975).
COUN Japan
AREA Pacific Coast
ABST Uranium in sea water is separated by froth flotation of the uranium(VI)-Arsenazo III-Zephiramine ion-adduct and then determined by neutron activation or spectrophotometric method using the uranium(VI)-Arsenazo III complex. Results of the analysis of Pacific coastal samples by the two methods are in good agreement; an average value of 3.0 μg U per liter was obtained.
KEY uranium, seawater, analysis, extraction, concentration

408 AUTH Sekine,K.
DATE 1976
TITL Separation and spectrophotometric determination of uranium(VI) by extraction with arsenazo III and zephiramine.
CITA Mikrochim. Acta (5-6): 559-568 (1976).
COUN Japan
ABST Microgram quantities of uranium(VI) can be determined at 655 nm after separation by chloroform extraction of its Arsenazo III complex with Zephiramine. The extracted uranium can be back-extracted with an aqueous solution of ammonium carbonate. Uranium can be separated from aluminium, iron(II), and some other elements. Probably the same species, i.e., the ion association compounds between the uranium(VI)-Arsenazo III complex and Zephiramine are involved during the extraction and the froth flotation.
KEY uranium, extraction, analysis, trace metals

409 AUTH Semenovskaya,T.D.; Deak,M.; Chmutov,K.V.
DATE 1975
TITL Ion exchange properties of amorphous titanium and zirconium hydrated oxides.
CITA Russ. J. Phys. Chem. 49(2): 266-269 (1975).
COUN USSR
ABST Two types of OH groups of hydrous TiO_2 and ZrO_2 are involved in the H-metal exchange. The $pK_1 = 6$ (8) and $pK_2 = 9$ (10.5) for the OH groups on hydrous Ti and Zr oxides. Relative amts. of these 2 OH groups are 1:2.

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The max. amt. of OH groups neutralized by titrn. with $Ca(OH)_2$ soln. is 4.5 mg equiv./g of the oxide. The extent of Ca^{2+} and Ba^{2+} sorption is equal on hydrous ZrO_2 at pH : 9-11. The sorbed amt. of Na^+ is approx. 25% of the Ca^{2+} and Ba^{2+} sorbed. The hydrous oxides lose 34 (Ti) and 48% (Zr) of the initial wt. after heating to 900°. H_2O bonded on the surface of hydroxides is lost at 200°. Further heating causes dehydroxylation of the surface and crystn. 1.0 G of the hydrous ZrO_2 contained 6.1 mg-atom of Zr and 10 mmole of H_2O replaceable at $\leq$ 270°.
KEY ion exchange, titanium, chemistry, capacity, temperature

410 AUTH Seno,S.
DATE 1977
TITL Collection of uranium in seawater.
CITA Japan. Kokai 77,135,814 (Cl. C22B60/02), Appl. 76/52,867, 11 May 1976: 5p (1977).
COUN Japan
ABST Natural foam on seawater is suctioned or scrubbed and filtered, and U in the filtrate is concd. by adsorption or foaming. U (3 μg/L) in seawater is concd. $\sim$10-fold in the foam. Thus, foam (1 m height) was collected, 7 m^3 was left to stand to obtain 10 L soln. and filtered to give a soln. contg. 30 μg/L. The residue (33 g) was leached with 500 mL hot 6N HCl to give 60 μg U.
KEY seawater, uranium, adsorbent, extraction, concentration, elution

411 AUTH Shabana,R.; Ruf,H.
DATE 1977
TITL Extraction and separation of uranium, thorium and cerium from different mixed media with HDEHP.
CITA J. Radioanal. Chem. 36(2): 389-397 (1977).
COUN W Germany
ABST Systematic studies were carried out on the extraction of U(VI), Th(IV) and Ce(III) with HDEHP from pure hydrochloric and sulfuric acid solutions as well as from their binary mixtures. The influence of water-miscible alcohols and acetone on the extraction of these elements was also investigated. Results were discussed and procedures for the separation of the concerned elements have been recommended. The removal of fission products (rare earths , etc.) from uranium is one of the most important separation problems in reactor chemistry. Ce(III) can be eliminated from U(VI) at 4.5M HCl or H_2SO_4 solutions as well as at 2.5M HCl in presence of 50% ethanol which is more plausible. For the stripping of U(VI) from the organic phase, successive with 11M HCl can be used. U-Th separation can be achieved by successive extraction at 11M HCl or 4.5M HCl in presence of 50% ethanol. Higher separation factors for these

(CONT.)
elements could be obtained when working in $HCl-H_2SO_4$ solutions. Thorium can easily be separated from Ce(III) at 4.5M HCl or at 5M H_2SO_4. The addition of isopropyl alcohol is recommended for the separation of Th-Ce(III). Quantitative separation for Th-Ce(III)can be achieved from $HCl-H_2SO_4$ media. A suggested extraction mechanism is presented in the light of the obtained results.
KEY uranium, extraction, chemistry, trace metals

412 AUTH Shaffer,J.H.; Shockley,W.E.; Evans,R.B.III.
DATE 1978
TITL Reaction of uranyl nitrate solutions with amberlite IRC-72 cation exchange resin at 30°C: a kinetic investigation for the HTGR fuel recycle plant.
CITA USAEC Report ORNL/TM-5866: 48p (1978).
COUN USA
ABST A kinetic investigation of the reaction of uranyl nitrate solution with Amberlite IRC-72 cation exchange resin was conducted at 30°C under conditions similar to those anticipated for a High-Temperature Gas-Cooled Reactor fuel refabrication facility. A simplified mass transfer analogue expression was developed to evaluate the effects of process parameters on the resin loading rate. Correlation of the experimental data with the integrated rate expression depended only on the determination of the reaction velocity constant and the limiting distribution coefficient for uranium in the system.
KEY uranium, ion exchange, temperature, capacity, adsorbent

413 AUTH Shaler,A.J.; McLean,D.C.
DATE 1977
TITL Adsorbent body.
CITA U.S. 4,061,807 (Cl. 428-36; B01D27/04), Appl. 656,551, 09 Feb 1976: 8p (1977).
COUN USA
ABST The porous adsorbent body comprises an array of granules of an adsorbent (active C, SiO_2 gel, Al_2O_3, ion exchangers) and particles of a thermoplastic polymer bonded to the granules, with at least some of the particles bridging contiguous granules, thereby bonding them together to form a selfsustaining body having interstices which open into each other for admission to fluid to the surface of the granules in the interior of the body. The adsorbent body is made by forming a uniform mixt. of the granular adsorbent and the polymer particles and heating the mixt. of a temp. above the softening temp. and below the melting temp. of the polymer to bond the granules together.
KEY adsorbent, temperature, ion exchange, temperature

414 AUTH Shevchenko,F.D.; Malysheva,A.N.; Kuzina,L.A.

(CONT.)
DATE 1974
TITL Extraction of uranium(IV) with dihexyl ester of phenylsulfonylamidophosphoric acid.
CITA Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol. 17(7): 970-972 (1974). (Russian).
COUN USSR
ABST Extractive properties of the uranium(IV) complex with dihexyl ester of phenylsulfonylamidophosphoric acid (I) have been obtained; the complex has a composition UO_2A_2 where A is the anion of (I). The stability constants of the uranium(IV) complexes with (I) were determined by the method of graphic differentiation; they are: 1 gβ_1 = 6.00 and 1 gβ_2 = 11.32; the complex distribution constant 1 gP_2 = 3.08, the extraction constant 1 gK_{ex} = 1.49 ± 0.03.
KEY uranium, extraction, analysis

415 AUTH Shibata,J.; Nishimura,S.; Mukai,S.
DATE 1975
TITL Separation and concentration of uranium by ion flotation method.
CITA Fusen 55: 1-6 (1975). (Japanese).
COUN Japan
ABST The concentration of uranium from seawater has been investigated from the viewpoint of adsorption method and coprecipitation method. In this study a procedure is described for the separation of uranium present as a stable uranyl cation or a tricarbonatouranyl anion by ion flotation which utilizes dicarboxylate and quaternary ammonium chloride as a collector, respectively. When dicarboxylate was used, uranium floated in the pH region 3 to 7 with a maximum recovery of 93% at pH 5. When quaternary ammonium chloride was used, uranium floated at pH values above about 4 and the maximum recovery was 95% at pH 8. The former has the highest concentration ratio because the floated uranium forms a scum, while the latter has the lower concentration ratio because uranium floats with foam.
KEY uranium, extraction, concentration, seawater, adsorbent, chemistry

416 AUTH Shigetomi,Y.; Kojima,T.
DATE 1976
TITL Extraction of uranium(VI) from sea water using titanium hydroxide-polyacrlyamide gel by batch method.
CITA Nippon Genshiryoku Gakkai-Shi 18(12): 796-799 (1976). (Japanese).
COUN Japan
ABST Studies have been made on the extraction of U(VI) from sea water by the adsorption on the gel particles containing titanium hydroxide. The adsorbents were prepared with acrylamide, N,N'-methylenebisacrylamide

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and titanium hydroxide. Uranium(VI) was able to be desorbed from the adsorbent with 1 M sodium carbonate or 1 M ammonium carbonate solution. The following various factors affecting the extraction of U(VI) were studied; the amount of adsorbent, the effect of temperature on the adsorption, the stirring time, the recycle usage of the adsorbent, etc. It was found that the adsorption of U(VI) tended to rise with the increase of shaking time, though it was not affected by temperature. When 25 g of adsorbent was added to 40 l of natural sea water, 84 µg of U(VI) was able to be extracted by slow stirring for 24 hr. It seems that the proposed method having the better selectivity of adsorption and separation is superior to the method using ion exchange resin.
KEY extraction, uranium, seawater, temperature, ion exchange, titanium, adsorbent, elution, capacity

417 AUTH Shigetomi,Y.; Kojima,T.
DATE 1977
TITL Basic study on uranium extraction from sea water. II. Extraction of uranium(VI) by polyacrylamide gel containing various metal hydroxides.
CITA J. Nucl. Sci. Technol. 14(11): 811-815 (1977).
COUN Japan
ABST U was recovered from seawater by adsorption on gel particles contg. various metal hydroxides, including $Ti(OH)_4$ and $Zn(OH)_2$, dispersed in polyacrylamide gel particles. The hydroxide adsorbent thus prepd. in gel form was packed in a column for processing the seawater. The U collected in the column was eluted with a 0.10M Na_2CO_3 soln. Of Fe, Pb, Mn, Ti, and Zn hydroxides, only $Ti(OH)_4$ functioned usefully as an adsorbent for the U. The degree of polyacrylamide crosslinking had no relation to adsorption performance, which, on the other hand, was significantly influenced by changes in $Ti(OH)_4$ in the gel. The amt. of U adsorbed reached a max. at 2 mg Ti/mL gel. Also, the adsorption improved with decreasing concn. of U contained in the original seawater, down to 10^{-6}M.
KEY uranium, seawater, adsorbent, titanium, elution, capacity, concentration, extraction

418 AUTH Shigetomi,Y.; Kojima,T.; Shinagawa,M.
DATE 1976
TITL Concentration of uranium from sea water by interfacial eletrolysis.
CITA Nippon Genshiryoku Gakkaishi 18(7): 452-457 (1976). (Japanese).
COUN Japan
ABST Artificial seawater contg. NaCl, $MgCl_2$, and U(VI) was brought into contact with isobutyl alc. A Pt anode and a stainless steel cathode were inserted into the aq. and

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org. phases, resp. Electrolysis was carried out at a const. current to conc. U in the $Mg(OH)_2$ ppt. formed at the interface of the 2 phases. The effects of the initial concns. of U, NaCl, and $MgCl_2$, the interfacial area, and the c.d. on the recovery of U were studied. U existing in seawater in a concn. of the order of 10 ^{8}M was completely recovered by electrolysis for 8 h with a c.d. of 0.52 mA/cm^2.
KEY seawater, uranium, concentration, extraction

419 AUTH Shtin,A.P.; Sharygin,L.M.; Gonchar,V.F.
DATE 1973
TITL Change in the structure and adsorption properties of titanium dioxide during hydrothermal treatment.
CITA Russ. J. Phys. Chem. 47(2): 278 (1973).
COUN USSR
ABST Addnl. data considered in abstracting and indexing are available from a source cited in the original document. An amorphous sample of TiO_2 was hydrothermally treated in an autoclave at 50-350° for 3 hrs. Both the phase compn. and the dimensions of the particles changed. Up to 50°, reduction of particle size prevailed, and this caused an increase in the sp. surface. On further temp. increase the sample was converted to anatase and particle size increased, causing surface area redn. These processes brought about changes in the pore dimensions while the sp. pore vol. remained nearly unchanged. The sorption of Cu^{2+} and Ca^{2+} changed with treatment temp. in the same manner as the surface area, which suggests that cation exchange on such sorbents involves OH-groups, since the no. of OH-groups is proportional to the surface area.
KEY titanium, temperature, ion exchange, adsorbent

420 AUTH Silvey,W.O.
DATE 1967
TITL Water supply paper.
CITA U.S.G.S. 1535-L: L22-L23 (1967).
COUN USA
ABST Concentrations of titanium, vanadium and fifteen other trace metals were measured in seawater and a common brown alga (Fucus). Vanadium shows a concentration factor of 790 in Fucus.
KEY seawater, vanadium, concentration

421 AUTH Singh,S.
DATE 1975
TITL Concentration of zinc and palladium by ion exchange.
CITA J. Radioanal. Chem. 24(1): 5-8 (1975).
COUN India
ABST The suitability of silica gel for the concn. of small quantities of Pd (20 μg in 500 ml.) and Zn (5 μg in 500

(CONT.)
ml.) was shown. The metals are taken up completely from their dilute solns. by silica gel, but the quantity of silica gel has to be increased with increasing vol. of the soln. contg. the trace metals. Complete elution (desorption) of the deposited ions was done with dil. HCl. The eluted Pd and Zn were detd. spectrophotometrically and radiometrically, resp.
KEY ion exchange, trace metals, elution, analysis

422 AUTH Skorik,Y.I.; Kachurina,N.V.; Korshak,V.V.; Zubakova,L.B.; Kalinin,A.I.
DATE 1975
TITL Grafting of poly(2-methyl-5-vinylpyridine)on the surface of some inorganic supports.
CITA Russ. J. Appl. Chem. 48(11): 2594-2596 (1975).
COUN USSR
ABST Poly(2-methyl-5-vinylpyridine) (I) (of mol. wt. 500,000) soln. in iso-PrOH or in iso-PrOH-AcOBu mixt. optionally contg. 10% SKN 40 rubber was grafted onto quartzsand, amorphous silica, Aerosil, or silicate glass substrates by thermal shock treatment, mechanochem. treatment, or by uv irradn. I retained its anion exchange properties even when its content was ~ 1 polymer repeating unit per 100 $\mathrm{\AA}^2$ of substrate surface area; however, in this case the total content of I in the mineral-org. sorbent should be ≤ 0.5 mmole/g.
KEY adsorbent, ion exchange

423 AUTH Solanke,K.R.; Khopkar,S.M.
DATE 1972
TITL Liquid-liquid extraction and spectrophotometric determination of uranium(VI) with thiothenoyltrifluoroacetone.
CITA Chem. Anal. (Warsaw) 17(5/6): 1175-1182 (1972).
COUN India
ABST U(VI) was extd. from pH 5.5-6 aq. soln. with 1,1,1-trifluoro-4-(2-thienyl)-4-mercapto-3-buten-2-one (I) in 7:3 CCl_4-BuOAc and detd. by measuring the absorbance of the U(VI)-I complex at 490 nm. Beer's law was obeyed for 4.5-54 μg U/ml. Cu, Pb, Pd, Co, and Ni interfere. Sb, Au, Ti, Fe, and V interferences can be eliminated by prior extn. The std. deviation is ±1%.
KEY extraction, uranium, analysis, chemistry, trace metals

424 AUTH Souka,N.; Farah,K.; Shabana,R.
DATE 1976
TITL Sorption behavior of some actinides on silica gel from mineral acids and alcoholic solutions.
CITA J. Radioanal. Chem. 34(2): 277-284 (1976).
COUN Egypt
ABST Sorption of Th, Pa, U, Np, and Pu on silica gel from HNO_3, HCl, and HCl-ROH solns. was investigated. Equil.

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studies indicated sorption varied with the acid used. In mixts. of HCl with different alcs., distribution coeffs. depended on alc. percentage and acidity. Conditions for possible sepns. are indicated. Emphasis is given to ^{231}Pa and ^{233}Pa.
KEY uranium, adsorbent, trace metals, chemistry

425 AUTH Spalding,R.F.; Sackett,W.M.
DATE 1972
TITL Uranium in runoff from the Gulf of Mexico distributive province: anomalous concentrations.
CITA Science 175: 629-631 (1972).
COUN USA
ABST Uranium concentrations in North American rivers are higher than those reported 20 years ago. The increase is attributed to applications to agricultural land of larger amounts of phosphate fertilizer containing appreciable concentrations of uranium. Experiments showing a constant phosphorous-uranium ratio for variuous types of fertilizers and for the easily solubilized fraction of 0-46-0 fertilizers support this view.
KEY gulf of mexico, uranium, concentration, river, environmental impact

426 AUTH Spence,R.
DATE 1968
TITL The uranium content of seawater.
CITA Talenta 15: 1307-1309 (1968).
COUN Ireland
ABST This report is a review of the literature on the uranium content of seawater. The author reviews past methods and results of analytical experiments, and points out that modern experiments have strongly indicated that the uranium content of normal seawater is constant, within the limits of experimental error, irrespective of location and depth.
KEY uranium, concentration, seawater, analysis

427 AUTH Spence,R.; Fox,A.C.; Streeton,R.J.W.
DATE 1964
TITL Resin exchange cells.
CITA British Patent 977,520 (Cl. C 02b), Appl. Feb 17, 1956: 5p (1964).
COUN UK
ABST A resin exchange cell applicable to the extraction of substances from any dilute solution is particularly suitable for extraction of U from sea water. The active substance is in the form of a film applied to a backing structure having a large surface to volume ratio and constructed to allow a through-flow of liquid in turbulent contact with the surface. The backing

(CONT.)

structure may take a variety of forms, e.g., corrugated sheets and flat sheets stacked alternately, a plurality of open ended tubes, or a continuous strip wound in a spiral.

KEY extraction, uranium, seawater, ion exchange

428 AUTH Spence,R.D.; Haas,P.A.

DATE 1978

TITL Tests of a Higgins contactor for the engineering-scale resin loading of uranium.

CITA Report ORNL/TM-5973: 57p (1978).

COUN USA

ABST The loading of U on weak-acid ion exchange resin is a basic step in the prodn. of fuel particles for high-temp. gas-cooled reactors. An engineering-scale continuous resin loader (2-in.-ID Higgins contactor) was tested with existing engineering-scale process equipment. The Higgins contactor was 1st successfully used to convert Na+-form resin to the H+-form; then it was evaluated as a U loader. The 2-in.-ID Higgins contactor can easily load 25 kg of U/day, indicating that a 4-in.-ID contactor could load 100 kg/day. Process control was achieved by monitoring and controlling the d., pH, and inventory vol. of the U feed soln. This control scheme is amenable to remote operation.

KEY uranium, ion exchange, chemistry, capacity

429 AUTH Spitsyn,V.I.; D'yachkova,R.A.; Kamenskaya,A.N.

DATE 1972

TITL Mechanism of the sorption of protactinium by silica gel.

CITA Radiokhimiya 14(2): 220-227 (1972). (Russian).

COUN USSR

ABST The sorption mechanism of ^{233}Pa by silica gel in 0.01-8M $HClO_4$ and HNO_3 (C_{acid}) was studied. Results were compared with sorption by anion- and cation-exchangers AV-17 and KU-2. The amt. of Pa adsorbed (α) in $C_{acid}<2M$ increased with pH. The existence of nonionic Pa at $[H^+]$ <0.2M was confirmed by the fact that α on AV-17 decreased at $[H^+]$ >0.2M. The distribution coeff. on silica gel decreases as on KU-2. At $[H^+]$ <1M, silica gel adsorbs $PaO(OH)^{2+}$ preferentially by the ion-exchange mechanism of replacing H^+ from the soln. and coupling with O atoms of the silanol group. At $[H^+]$ >1M, the cation form of Pa together with neutral complexes adsorbed by the gel, exhibit intradiffusion characteristics and α depends on the pore dimensions of the gel. The rate at which equil. is established depends on $[H^+]$ attaining a min. at 0.5-1.5M.

KEY adsorbent, ion exchange, chemistry

430 AUTH Stamberg,K.; Stamberg,J.; Katzer,J.; Prochazka,H.;

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Nemec,P.; Hulak,P.; Jilek,R.
DATE 1975
TITL The production of sorbents from mycelia of fungi.
CITA Brit. 1,417,901 (Cl. C12K), Appl. 7163/73, 14 Feb 1973: 4p (1975).
COUN Czech
ABST Reinforced fungal mycelia for use as sorbents to sep. metal ions, esp. U [7440-61-1] from soln., were prepd. by crosslnking mycelium biomass with a formaldehyde or high-mol-wt. material. E.g., mycelium of Penicillium chrysogenum was crosslinked with HCHO [50-00-0], heat cured, and crushed to a grain size of 0.3-0.75 mm; the capacity of the sorbent for U was 15.7 mg/g.
KEY uranium, trace metals, adsorbent, capacity, temperature, extraction, marine organisms

431 AUTH Starik,I.E.; Kolyadin,L.B.
DATE 1957
TITL The occurrence of uranium in ocean water.
CITA Geochemistry (3): 245-256 (1957).
COUN USSR
ABST The adsorption on glass, cationite or anionite, the ultrafiltration and electrophoresis of hexavalent uranium in oceanic water and solutions containing 2-50 . 10^{-6} U/l and 0.1 g U/l have been studied. The investigation has been carried out in the interval of pH 2-10. Conclusions on the forms of uranium occurrence in oceanic water at different pH values are drawn from the data obtained.
KEY uranium, seawater, adsorbent, chemistry, chemical species, extraction

432 AUTH Steinert,H.
DATE 1978
TITL Nuclear fuel from sea water.
CITA Archimedes (Pretoria) 20(1): 59 (1978).
COUN S Africa
ABST Published in summary form only.
KEY uranium, seawater, extraction, adsorbent, titanium, marine organisms

433 AUTH Strazhesko,D.N.; Skripnik,Z.D.; Strelko,V.V.
DATE 1969
TITL Properties of functional groups on the surface of active carbons and highly dispersed silicas and the electron structure of adsorbents.
CITA Adsorbenty, Ikh Poluch., Svoistva Primen., Tr. Vses. Soveshch. Adsorbentam, 3rd: 105-109 (1969). (Russian).
COUN USSR
ABST Oxidized, activated C and C blacks do not behave similarly to weakly acidic carboxyl cation exchanger resins in processes of cation exchange and heterogeneous

(CONT.)

acid catalysis. Comparison of the cation exchange capacities in relation to pH of the oxidized carbons OU and BAU_0 with that of the carboxyl ion-exchange resin KB-4P-2 showed that with increasing pH the exchange on the carbon began at pH = 1-2 vs. pH∿ 3 (the point at which dissocn. of COOH groups begins) for KB-4P-2. This indicated that groups more highly acidic than the ordinary COOH groups were present on the surface of the oxidized C. A study of the catalytic effects of the sulfonic resin KU-2, KB-4P-2, and OU in the inversion of sucrose, hydrolysis and formation of EtOAc, -and the pinacolin rearrangement showed that OU was more active than KU-2 in the reactions in question except that of the pinacolin rearrangement, while KB-4P-2 was practically inactive in all of them. The increased protogenic activity of acidic groups on the surface of oxidized C can be explained by a high concn. of electrons that form a neg. charge attracting free H^+ from H_2O or formation of H-bonds between COOH groups and phenol H groups. Forms of silica which do not contain delocalized electrons also show a high acidity in cation exchange reactions and impart an acidic reaction to salt solns. by replacing metal cations with H^+. An increase in the acidic range of adsorption with increasing radii of cations in the order $Mg^{2+} < Ca^{2+} < Sr^{2+} < Ba^{2+}$ showed that the SiO_2 centers responsible for cation exchange were strongly acidic. However, the adsorption capacity of silica gel was very low because of the small no. of SiO^-H^+ centers. The order of adsorption of cations on the Ca, Na, or similar forms of silica gel was inverted to $Be^{2+} < Mg^{2+} < Ca^{2+} < Sr^{2+} < Ba^{2+}$ because of the contribution of the covalent component of cations to the electrostatic interaction with the SiO_2 surface. On the surface, those cations must be most strongly adsorbed which compete most effectively with the Si atom for the electronic d. of O, i.e., the least basic cations. In alk. solns. a similar inversion took place for the adsorption on SiO_2 of alkali metal cations, so that the adsorption order $Li^+ > Na^+ > K^+ > Rb^+$ applied.

KEY adsorbent, ion exchange, capacity, chemistry, trace metals

434 AUTH Strazhesko,D.N.; Strelko,V.B.; Belyakov,V.N.; Rubanik,S.

DATE 1974

TITL Mechanism of cation exchange on silica gels.

CITA J. Chromatogr. 102: 191-195 (1974).

COUN USSR

ABST Potentiometric studies of the polymn. of H_4SiO_4 and the mechanism of cation exchange on different ionic forms of silica gel are considered in terms of modern concepts of the properties of siloxane bonds.

KEY ion exchange, adsorbent

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435 AUTH Streat,M.
DATE 1976
TITL Ion exchange materials.
CITA Brit. 1,456,974 (Cl. C08F2/44), Appl. 73/1,277, 10 Jan 1973: 4p (1976).
COUN UK
ABST Particulate ion exchangers with high sp. gr. were manufd. by heating an inorg. oxide gel to 100-550° to form a porous inert substrate onto which was adsorbed an org. monomer which was then polymd. Thus, 10 g SnO_2 gel manufd. from 500 g $SnCl_4.5H_2O$, 2.5 L H_2O, and 350 mL concd. NH_4OH was heated 24 h at 450°, cooled over $CaCl_2$, evacuated 2 h at 100°, and flushed with N. The particles were heated 30 min in CH_2:$CHCO_2H$ contg. 0.02 g AIBN, soaked 3 h in H_2O and washed to give $\sim$ 10 g particles with a porous substrate contg. acrylic acid-stannic oxide graft copolymer in the pores. The product was a weak carboxylic acid ion exchanger of capacity 0.65 meq/g. Two other ion exchangers were also manufd.
KEY ion exchange, capacity, temperature

436 AUTH Strelko,V.V.; Belyakov,V.N.; Rubanik,S.K.; Strazhesko,D.N.
DATE 1975
TITL The reasons of the inversion of trends in sorption of alkali- and alkaline-earth-metal series on different cation-exchange forms of silica gel.
CITA Adsorbtsiya Adsorbenty 3: 64-69 (1975). (Russian).
COUN USSR
ABST The trends of cation-exchange sorption are studied potentiometrically on H-form silica gel at a wide range of pH of CLO_4^- solns. The results are discussed considering $(p \rightarrow d)\pi$ conjugation of the siloxane chains and polarizability of the Si-O bonds.
KEY chemistry, adsorbent, ion exchange

437 AUTH Strelow,F.W.
DATE 1974
TITL Partly non-aqueous media for accurate chemical analysis by ion exchange.
CITA Ion Exchan. Membranes 2(1): 37-46 (1974).
COUN S Africa
ABST Cation exchange separation of elements of Group IIIA and some other cations has been completed in mixed solvent media. Cu(II) and U(VI) were separated selectively. Selectivity series and coefficients have been studied and extreme accuracy achieved. As an example of utilizing the HCl-HBr elution techniques in aqueous acetone solution a mixture of typical rock-constituents was separated. 10 to 70 mg Na, K, Ca, Mg, Mn, Fe, Al, Ti, plus trace amounts of V and Zr were used in the

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solution.
KEY ion exchange, uranium, trace metals, elution, extraction

438 AUTH Sugasaka,K.; Katoh,S.; Fujii,A.; Miyai,Y.; Takagi,N.
DATE 1976
TITL Preparation and properties of the aluminium-activated carbon composite adsorbent for extraction of uranium from sea water.
CITA Nippon Kaisui Gakkai-Shi 30(1): 43-49 (1976). (Japanese).
COUN Japan
ABST The effects of the hydrolysis pH and temperature of aluminium chloride in the presence of activated carbon on the properties of the products were studied to clear the preparation conditions of the composite adsorbent (C-Al-OH) for the extraction of uranium from sea water. Aluminium contents of the adsorbent increased when the hydrolysis pH and the temperature became higher. The adsorptive capacity for uranium was closely related to the physical and chemical properties of the adsorbent: the capacity increased in proportion to the mean pore size and the quantity of acid group, which was determined as alkaline consumption, whereas the capacity was inversely proportional to the specific surface area of the adsorbent. Most of the adsorbent was amorphous in X-ray diffraction pattern. Several adsorbents, which showed crystallinity in X-ray diffraction pattern, showed their low adsorptive capacity for uranium. The Freundlich's relationship was observed between the concentration and the capacity of uranium. Uranium uptake from natural sea water by the adsorbent was found to be 160-280 μg/g adsorbent after 30 days stirring.
KEY temperature, adsorbent, extraction, uranium, seawater, capacity, concentration, chemistry

439 AUTH Sugasaka,K.; Katoh,S.; Fujii,A.; Miyai,Y.; Takagi,N.; Miyazaki,H.
DATE 1976
TITL Extraction of uranium from sea water using a composite adsorbent. III. Preparation and properties of the aluminum-activated carbon composite adsorbent for extraction of uranium from sea water.
CITA Nippon Kaisui Gakkai-Shi 30(1): 43-49 (1976). (Japanese).
COUN Japan
ABST Activated C was soaked in an aq. soln. of $AlCl_3$. The soln. was neutralized with NaOH. The composite adsorbent of activated C and $Al(OH)_3$ was sepd. from the soln., washed with water and air dried. The properties of the adsorbent and its capacity for adsorbing U in sea water were studied under various conditions of prepn. The adsorption capacity was inversely proportional to

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the sp. surface area but proportional to the mean pore size, and had a max. when the adsorbent was neutralized to pH 7 at 40°. Freundlich's relation was obsd. between the concn. of U in sea water and the amt. of U adsorbed. The amt. adsorbed was 140-150 μg/g of adsorbent.

KEY adsorbent, capacity, uranium, seawater, concentration, chemistry, temperature, extraction

440 AUTH Sugihara,T.T.; James,H.E.; Troianello,E.J.; Bowen,V.T.

DATE 1959

TITL Radiochemical separation of fission products from large volumes of sea water. Strontium, cesium, cerium, and promethium.

CITA Anal. Chem. 31: 44-49 (1959).

COUN USA

ABST Chemical methods were used to isolate 28-year strontium-90, 30-year cesium-137, 280-day cerium-144, and 2.4-year promethium-147 from as much as 200 liters of sea water. Strontium separation involves precipitation of mixed strontium-calcium carbonates directly and in the presence of (ethylenedinitrilo)tetraacetate ion, precipitation of strontium nitrate, scavenging with ferric hydroxide-barium chromate, and conversion to strontium carbonate. Strontium-90 activity is measured by separating and counting the daughter yttrium-90 activity. Cesium is coprecipitated with dipotassium sodium cobaltinitrite, separated as cesium silicotungstate, converted to the perchlorate, and freed of trace potassium and rubidium by ion exchange. Rare earths are removed by initial coprecipitation on ferric hydroxide. Uranium, protactinium, and thorium are removed by ion exchange; radium and lead are scavenged with barium sulfate. The cerium fraction is obtained in pure form by separation as cerium(IV); promethium, by cation exchange.

KEY seawater, extraction, uranium, ion exchange, trace metals

441 AUTH Sugimura,Y.; Torii,T.; Murata,S.

DATE 1964

TITL Uranium distribution in Drake Passage waters.

CITA Nature 204: 464-465. Reprinted in: Geochemical Study of the Ocean and the Atmosphere, Geochemical Laboratory, Meteorological Research Institute, Tokyo, Japan: 313-315 (1964).

COUN Japan

ABST Water samples were collected along the transect of Drake Passage and the uranium content determined fluorometrically. An average value of 3.1 ± 0.2 ppb is obtained for the uranium content of surface water. In the vertical distribution, uranium tends to show a

(CONT.)
minimum concentration about the depth of 300-400 m, increasing at greater depths.
KEY uranium, seawater, analysis

442 AUTH Sulcek,Z.; Sixta,V.
DATE 1975
TITL Sorption of UO_2^{2+} and Th^{4+} ions on silica gel in the presence of some polyaminopolycarboxylic acids.
CITA Collect. Czech. Chem. Commun. 40(8): 2295-2302 (1975).
COUN Czech
ABST Distribution coefficients of UO_2^{2+} and Th^{4+} ions were determined for the system silica gel-aqueous solutions of several polyaminopolycarboxylic acids, citric acid and tartaric acid. The corresponding separation factors were calculated for $I \leq 0.1$ and $I = 1$.
KEY uranium, adsorbent, water

443 AUTH Sundar,P.; Elikan,L.; Lyon,W.L.
DATE 1976
TITL Coupled cationic and anionic method of separating uranium.
CITA US Patent 3,966,872. Int. Cl.B01D11/00: 2p (1976).
COUN USA
ABST Uranium is separated from contaminating metal ions in an aqueous feed liquor containing the uranyl ion. The liquor is extracted with a first, non-interfering water-immiscible, organic solvent containing a reagent which reacts with the uranyl ion to form a complex soluble in the organic solvent. The organic solvent is scrubbed with water if necessary, then stripped with a stripping liquor of an aqueous sulfuric acid liquor having a pH of about 0.5 to about 6 containing a reducing ion or an aqueous carbonate solution having a pH of about 9. If the sulfuric acid liquor is used, the stripped uranous ion is oxidized and the sulfuric acid liquor is diluted to prevent the precipitation of a uranium complex. The stripping liquor is extracted with an amine liquor comprising a second, noninterfering, water-immiscible, organic solvent and a tertiary or quaternary amine. The amine liquor is stripped with an ammonium carbonate solution to precipitate a uranium complex. The uranium complex is filtered off and may be calcined to produce U_3O_8 or UO_2.
KEY uranium, extraction, chemistry

444 AUTH Sundar,P.S.
DATE 1975
TITL Method of separation of uranium from metal ions of the groups II and III.
CITA German (F.R.) patent document 2440054/A/. Int. Cl. C01G 43-00: 15p (1975). (German).
COUN USA

(CONT.)
ABST In the known methods of separating uranium by means of solvent extraction (di-2-ethyl-hexyl phosphoric acid and tri-n-octyl phosphire oxide in kerosine) as complex compound from impurities (metal ions of the groups II and III), especially iron, and then precipitation with ammonium carbonate as ammonium uranyl tricarbonate, about 2 to 4% of iron (relative to uranium) cannot be separated. The new process alters the working conditions by washing the solvent with water before the precipitation with ammonium carbonate and/or bicarbonate ions with the addition of sulphide ions (H_2S and/or ammonium sulphide) where the impurity metal ions are precipitated as sulphide and can be filtered off. The ammonium uranyl tricarbonate after this separation is calcined to U_3O_8 or UO_2. The iron impurity is between 0.005 and 0.03% (relative to uranium). The method is described in detail and pH values, mole concentration, flow rates, etc. are given for each step.
KEY uranium, extraction, concentration, chemistry, trace metals

445 AUTH Sundar,P.S.; Elikan,L.; Lyon,W.L.
DATE 1975
TITL Method of separation of uranium from contaminating ions in an aqueous feed liquid containing uranyl ions.
CITA German (F.R.) patent document 2451596/A/. Int. Cl. C01G 43-00: 23p (1975). (German).
COUN USA
ABST A coupled cationic/anionic method for the separation of uranium from contaminated aqueous solutions which contain uranyl ions is proposed. The fluid is extracted using an organic solvent containing a reagent which, together with the uranyl ions, forms a soluble aggregate in that solvent. As an example, 0.1 - 1 Mol/l Di-2-ethyl-hexyl-phosphorus acid in kerosene is mentioned. The organic solvent is then treated with a sealing liquid (volume ratio 20 - 35). For separation, an aqueous carbonate solution or a sulfuric acid solution can be used; the most favorable pH-values and concentrations for both cases are mentioned. The U^{+4} -ion at the sulfuric acid separation is subsequently oxidized to the uranyl ion with air. In each case, an extraction with an amine follows; after that, the amine is separated using an ammonium-carbonate solution and the uranium aggregate is precipitated, for example as ammonium uranyl tricarbonate, and then further processed to uranium oxide. The solvents and fluids used are led back in closed circuit; a flow diagram is given.
KEY uranium, water, extraction, chemistry, concentration

446 AUTH Sutton,J.
DATE 1949

(CONT.)
TITL The hydrolysis of the uranyl ion. Part 1.
CITA J. Chem. Soc. 2: 275-286 (1949).
COUN UK
ABST Cryoscopic measurements prove conclusively that the hydrolysis of uranyl salts leads to the formation of the ions $U_2O_5^{++}$ and $U_3O_8^{++}$, and not $UO_2(OH)^+$ and $UO_2(OH)_2$. Measurements of pH of solutions of UO_3 in solutions of uranyl salts, pH titrations of uranyl perchlorate with sodium hydroxide, and the conductivity and absorption spectra of these solutions, point to the formation of further ions $U_3O_8(OH)^+$, $U_3O_8(OH)_2$, and $U_3O_8(OH)_3^-$. More highly charged anions may be formed but the evidence is still inconclusive. The equilibrium constants for the formation of some of these ions have been determined.
KEY chemistry, adsorbent, ion exchange, analysis

447 AUTH Swarup,R.; Patil,S.K.
DATE 1972
TITL Extraction of the actinides by long-chain amines.
CITA Proceedings of the Chemistry Symposium. Vol.II. Symposium held in Aligarh, India; 21 Dec 1972. Bombay; Dept. of Atomic Energy. See CONF-721239-P2: 199-205 (1972).
COUN India
ABST The extraction of Np(V) and Np(VI) and other hexavalent actinides (Pu, U) with TLA and Aliquot-336 was studied. Data obtained show that PuO_2^{2+} and NpO_2^{2+} are almost equally extractable into 10% TLA and Aliquot-336 nitrate and to a larger extent than UO_2^{2+}. The order of extraction is Np(VI) > Pu(VI) > U(VI).
KEY extraction, uranium, trace metals

448 AUTH Swarup,R.; Patil,S.K.
DATE 1977
TITL Extraction of actinides by long-chain amines.
CITA Radiochem. Radioanal. Lett. 29(2): 73-81 (1977).
COUN India
ABST The extraction of metal ions by long-chain amines has proved useful in separative and analytical work. The extraction of tetra- and hexavalent actinides by tetraheptyl ammonium nitrate was studied. ^{234}Th and ^{239}Np present in both phases at the end of the equilibration were determined by gamma-ray counting using a well-type NaI(Tl) scintillation counter. The equilibrium concentration of ^{230}Th, ^{233}U and plutonium in both phases was measured by alpha liquid scintillation counting.
KEY extraction, concentration, trace metals, analysis, uranium

449 AUTH Szekielda,K.H.
DATE 1975

(CONT.)
TITL General chemistry of the coastal waters of the Mid-Atlantic coast.
CITA Mar. Environ. Implic. Offshore Oil Gas Dev. Baltimore Canyon Reg. Mid-Atl. Coast, Proc. Estuarine Res. Fed. Outer Cont. Shelf Conf. Workshop 1974: 153-163 (1975).
COUN USA
AREA Mid-Atlantic Coast
ABST The character and circulation of the waters were detd.
KEY chemistry, seawater, concentration, m atlantic

450 AUTH Tabata,T.; Ikushige,T.
DATE 1976
TITL Method of recovering uranium.
CITA US Patent 3,965,238. Int. Cl.B01D11/04: 4p (1976).
COUN Japan
ABST Uranium values are obtained from phosphate rock by acidifying phosphate rock containing uranium and at least one other heavy metal with a mineral acid solvent extracting the thus obtained crude acid with an organic solvent so as to separate a raffinate from a relatively pure, wet process phosphoric acid and treating said raffinate with a base so as to raise the pH to 1-2 whereby uranium hydroxide or phosphate and other heavy metal hydroxides or phosphates are coprecipitated. The uranium content of the coprecipitate after drying is at least as high as 0.3 percent which is comparable to that of uranium ores of the highest quality.
KEY uranium, extraction, chemistry

451 AUTH Taguchi,A.; Uematsu,Y.; Hayashi,T.
DATE 1977
TITL Uranium from seawater.
CITA Japan. Kokai 77 09,614 (Cl. C22B60/02), Appl. 75/86,469, 14 Jul 1975: 6p (1977).
COUN Japan
ABST U absorber units are hung in seawater with ropes or chains from a raft kept at a desired depth by at least one buoy. The depth is controlled automatically.
KEY uranium, seawater, adsorbent, plant design

452 AUTH Takahashi,H.
DATE 1975
TITL Cation exchangers from phosphoric acid and complex oxides containing titanium.
CITA Japan. Kokai 75 32,099 (Cl. 15G0, 13(9)F12), Appl. 73 84,325, 25 Jul 1973: 4p (1975).
COUN Japan
ABST Complex oxides of Ti contg. Zn, Mg, Ca, and(or) Al are treated with H_3PO_4 to prep. cation exchangers. Thus, 80 parts anatase and 162 parts ZnO were milled, calcined 2 hr at 850, and ground to give Zn_2TiO_4. A mixt. of 4 moles H_3PO_4 per mole Zn_2TiO_4 was heated 2 hr at 120° to

(CONT.)
give a cation exchanger having exchange capacity 1.70 mequiv./g., wt. loss after 5 hr in 0.1N H_3PO_4 1. mg/g, and wt. loss after 5 hr in 0.1N Na_2CO_3 79 mg/g.
KEY titanium, capacity, ion exchange, temperature

453 AUTH Takai,N.; Takase,K.; Yamabe,T.
DATE 1971
TITL Separation of uranium from sea water by using hydroxylapatite.
CITA Seisan-Kenkyu 23(2): 76-77 (1971). (Japanese).
COUN Japan
ABST U in sea water was adsorbed on hydroxylapatite. The U concn. in the sea water decreased with increasing amt. of hydroxylapatite added. The adsorption (μg U/g hydroxylapatite) decreased with increasing amt. of hydroxylapatite added. The adsorptivity of hydroxylapatite was approx. 1/10 that of titanates. The adsorption was practically complete in 1 hr, and the temp. effect (0-50°) was small.
KEY uranium, seawater, concentration, temperature, adsorbent, capacity, extraction

454 AUTH Takai,N.; Yamabe,T.
DATE 1971
TITL Separation of uranium in seawater.
CITA Mizu Shori Gijutsu 12(4): 3-8 (1971). (Japanese).
COUN Japan
ABST Uranium is present in seawater as $[UO_2(CO_3)_3]^{4-}$. Methods of separation are coprecipitation, adsorption, ion flotation, solvent extraction, and biological. In the coprecipitation method, uranium is precipitated with $Fe(OH)_3$, $Al(OH)_3$, and $Ti(OH)_4$. However, the precipitation rate of the hydroxides is generally low. In the adsorption method, titanates, resorcinol, and arsonic acid resin are useful as adsorbents. Basic zinc carbonate, lead sulfide, and active carbon also show good adsorptivity. Estimated cost of uranium collected by this method is about 30 to 35 million yen per ton. In the flotation method, surface-active agents are added to seawater and air is blown in to form bubbles. Phosphoric acid esters show excellent bubbling effect in seawater. For the solvent extraction method, kerosene and dibutyl phosphate are possible solvents. Few studies have been made on concentration of uranium in seawater by microorganisms.
KEY chemical species, extraction, titanium, adsorbent, economics, uranium, seawater

455 AUTH Takebayashi,T.; Matsuda,H.; Umemoto,S.
DATE 1973
TITL Application of the fission-track technique to the determination of uranium in natural waters.

(CONT.)
CITA Talanta 20(9): 892-895 (1973).
COUN Japan
AREA Fukuoka City Rivers
ABST A procedure for the detn. of the U content of natural waters is presented. To 100 ml of natural waters, 200 ml concd. HCl is added and this soln. is passed through a 6-ml column of Dowex 1-X8. The U is eluted with 60 ml of 0.1M HCl, and the eluate is evapd. to dryness. The residue is subjected to the fission-track technique. The U content of the river waters in Fukuoka City was determined.
KEY uranium, water, analysis, ion exchange, elution

456 AUTH Takesute,E.; Miyamatsu,T.; Tsutsui,Y.
DATE 1977a
TITL Uranium collector.
CITA Japan. Kokai 77,114,510 (Cl. C22B60/02), Appl. 76/31,400, 24 Mar 1976: 4p (1977).
COUN Japan
ABST Phenol-HCHO resin (I) contains phosphonic acid groups in the Ph group. It absorbs selectively as little as <1 ppm U in seawater. Thus, I of 16µ filaments 50 was refluxed in PCl_3 100, anhyd. $AlCl_3$ 50, and CCl_4 1000 g for 5 h, heated at 100° for 5 h in 2N NaOH, washed successively with H_2O, 1N HCl, and H_2O, soaked in 30% HNO_3 at 30° for 1 h, and washed with H_2O to contain PO_3H_2 0.94 mmol/g. When seawater 150 mL contg. 1 ppm U adjusted to pH 8.1 with Na_2CO_3 was stirred with the resin 30 mg for 1 day, the U absorption was 3.24 mg/g.
KEY uranium, seawater, ion exchange, temperature, chemistry, capacity

457 AUTH Takesute,E.; Miyamatsu,T.; Tsutsui,Y.
DATE 1977b
TITL Uranium collector.
CITA Japan. Kokai 77,114,511 (Cl. C22B60/02), Appl. 76/31,402, 24 Mar 1976: 4p (1977).
COUN Japan
ABST A cation-exchange resin contg. COOH or SO_3H is coated with ≥ 1 of hydroxides or carbonates of TiO^{2+}, Ti^{4+}, Pb^{2+}, Al^{3+}, Fe^{2+}, Fe^{3+}, Cu^{2+} and Zn^{2+}. Thus, a column of SO_3 H-type resin of exchange capacity 3.2 meq/g and 60 µ -diam. x < 1.5 mm fiber was treated with aq. TiO_2 2.2 and H_2SO_4 3.6 g/L washed successively with H_2O, 1N NaOH, and H_2O to contain TiO_2 36.2%. When seawater 150 mL contg. 1 ppm U adjusted to pH 8.1 with Na_2CO_3 was stirred with the resin 30 mg for 1 or 5 days, the U absorption was 3.1 or 3.8 mg/g, vs. 0.2 without Ti.
KEY capacity, seawater, uranium, ion exchange, titanium, chemistry

458 AUTH Tamura,N.

(CONT.)
DATE 1976
TITL Cation exchange resins.
CITA Japan. Kokai 76 45,686 (Cl. B01J1/08), Appl. 74/118,696, 17 Oct 1974: 6p (1976).
COUN Japan
ABST Sulfonated styrene-titanium oxide graft copolymer (I) [59964-13-5] or a similar copolymer was prepd. and used as a cation exchanger. Thus, a mixt. of styrene 90, Ti oxide 100, and pentane 200 parts was milled for 42 hr to prep. 107 parts I, mixed (100 parts) with 300 parts fuming H_2SO_4 at $<80^o$, sulfonated at 80^o for 1.5 hr, cooled, filtered, washed, and immersed in aq. NaCl to prep. a cation exchanger.
KEY titanium, ion exchange, temperature

459 AUTH Tamura,N.
DATE 1976
TITL Cation-exchange membranes.
CITA Japan. Kokai 76 45,687 (Cl. C08J5/22), Appl. 74/118,697, 17 Oct 1974: 5p (1976).
COUN Japan
ABST TiO_2 is ground in the presence of styrene, and the TiO_2 -modified polystyrene (I) [9003-53-6] is sulfonated, blended with polypropylene (II) [9003-07-0], molded into films, and treated with hot H_2O or acid and base to give cation-exchange membranes. Thus, TiO_2-modified I contg. 90 parts I and 100 parts TiO_2 was treated with oleum (30% SO_3) to give a cation exchanger having exchange capacity 0.85 mequiv./g. A compn. of 60 parts of the above powder and 40 parts II (melt index 4) was rolled and pressed at $>200^o$ and >200 kg/cm to give a 0.45 mm film. The film was heated >1 hr in H_2O at $>95^o$ to give a cation-exchange membrane having exchange capacity 0.45 mequiv./g, Na^+ transport no. 0.92, and resistivity 670 ohm-cm.
KEY capacity, titanium, ion exchange, temperature

460 AUTH Tamura,N.
DATE 1976
TITL Heterogeneous cation-exchange membrane prepared from the sulfonated graft-polymers of titanium(IV) oxide/stryrene and polypropylene.
CITA Nippon Kagaku Kaishi (6): 973-977 (1976). (Japanese).
COUN Japan
ABST Polystyrene (I) [9003-53-6] prepd. in a vibration mill in the presence of TiO_2 powder (av. diam. 0.4 μ) was sulfonated and dispersed in polypropylene (II) [9003-07-0] films to give cation-exchange membranes having low resistivity and high transport no. The membrane was treated with hot H_2O to form cavities between sulfonated I and II. One of those membranes contg. 60 wt.% of sulfonated I-TiO_2 from 14:86 I-TiO_2

(CONT.)
powder had ion transport no. 0.91, resistivity 258 ohm-cm, salt splitting capacity 0.64 mequiv./g dry membrane, and H_2O content 22 wt.%.
KEY ion exchange, titanium, capacity

461 AUTH Tamura,N.; Tanaka,K.
DATE 1977
TITL Ion exchangers.
CITA Japan. Kokai 77 35,780 (Cl. C08J5/22), Appl. 75/111,763, 17 Sep 1975: 6p (1977).
COUN Japan
ABST Ion exchangers having good electrochem. properties at high ion concns. were prepd. from polypropylene (I) [9003-07-0] 25-60, powd. sulfonated divinylbenzene-styrene copolymer (II) [9003-70-7] or epichlorohydrin-Epikte 828-pentaethylenehexamine copolymer [56727-51-6] 40-75, and carbon black, talc, Ti oxide, or colloidal $CaCO_3$ 5-30%. Thus, an ion exchange film contg. I 38, a sulfonated 8:92 II 57, and carbon black 5% had ion transfer 0.86 and sp. resistance 130 ohm-cm, compared with 0.8 and 115, resp., for a film contg. 40% I and 60% sulfonated II.
KEY titanium, ion exchange

462 AUTH Tani,H.; Kojima,M.
DATE 1978
TITL Heavy metal adsorbents.
CITA Japan. Kokai 78 05,091 (Cl. B01D15/00), Appl. 76/80,185, 05 Jul 1976: 6p (1978).
COUN Japan
ABST A porous substrate is impregnated with a titanic acid ester soln., then the substrate is exposed to an atm. contg. $\geq$1% moisture to hydrolyze and condense the ester. The product is used as a heavy metal adsorbent, esp. for U. For example, a poly(vinyl acetal) substrate was immersed in a tetra-Bu titanate-MeOH soln., then hydrolyzed to prep. the U adsorbent.
KEY adsorbent, trace metals, titanium, uranium, extraction

463 AUTH Taniguchi,H.; Nakayama,H.; Tani,H.
DATE 1978
TITL Heavy metal adsorbents.
CITA Japan. Kokai 78 28,692 (Cl. C08G8/20), Appl. 76/102,981, 27 Aug 1976: 4p (1978).
COUN Japan
ABST HCHO is reacted with a catechol deriv. in an alk. or acid medium to prep. a heavy metal adsorbent which is useful for extg. U from seawater. Thus, 3-nitrocatechol was reacted with HCHO in a HCl soln. to prep. 3-nitrocatechol-HCHO resin [67696-57-5] which was used for U adsorption from seawater. The adsorbed U was desorbed with HCl, H_2SO_4, Na_2CO_3, etc. The U adsorption

(CONT.)
was 50%.
KEY adsorbent, trace metals, uranium, extraction, seawater, elution, capacity

464 AUTH Taniguchi,H.; Nakayama,H.; Tani,H.
DATE 1978
TITL Heavy metal adsorbents.
CITA Japan. Kokai 78 31,792 (Cl. C08G16/04), Appl. 76/106,897, 06 Sep 1976: 7p (1978).
COUN Japan
ABST A condensate of a hydroxybenzoic acid deriv. and HCHO is halogenated, then reacted at $\geq 10^{\circ}$ with an amino acid or hydroxylamine deriv. in the presence of H^+ or OH^- catalyst. The product is used for U adsorption. Thus, a reaction product of p-hydroxybenzoic acid HCHO, EtOH, HCl, and water was chlorinated with $SOCl_2$ then with glycine in a NaOH soln. to prep. a water-insol. polymer for U adsorption from seawater or water.
KEY adsorbent, trace metals, uranium, seawater, water, temperature

465 AUTH Taniguchi,K.; Nakajima,M.; Yoshida,S.; Tarama,K.
DATE 1970
TITL Properties of metal ions caught on silica gel surface by ion exchange.
CITA Nippon Kagaku Zasshi 91(6): 529-533 (1970). (Japanese).
COUN Japan
ABST The phys. chem. properties of metallic ions caught on the surface of silica gel by ion exchange were studied by the electronic spectra, x-ray diffraction, and the magnetic anal. The metals were Mn, Co, Ni, Cu, and Zn. When the surface concn. of these metals was <1.2 wt.%, the measurements of magnetic susceptibilities showed that these metal ions are divalent and in high spin states. The uv spectra showed that Mn(II) and Ni(II) ions were in an octahedral ligand field, Cu(II) ion in a square planar, and Zn(II) and Co(II) in a tetrahedral. When the surface concn. was >70% exchange level (80 wt.%), some of Ni(II) ions aggregated to form metallc particles on the surface. Co(II) ions were stable up to 90% exchange level.
KEY ion exchange, trace metals, adsorbent, analysis

466 AUTH Taniguchi,K.; Nakajima,M.; Yoshida,S.; Tarama,K.
DATE 1971
TITL Acidity and the catalytic activity of metal ion-exchanged silica gel.
CITA Bull. Jap. Petrol. Inst. 13(2): 196-200 (1971).
COUN Japan
ABST Broensted and Lewis acid strengths of gels were estd. by the ir spectrum of pyridine adsorbed on the samples. Predominantly Broensted acidities at 100° decreased in

(CONT.)
the order Zn >> Cd > Co > Ni, Cu > Mn, Ca, Mg. Lewis acidities at >250° decreased in the order Zn > Cu > Cd, Ni > Co > Mn > Ca, Mg. Butene isomerization activities were in the order Zn > Co >> Ni > Mn.
KEY ion exchange, chemistry, temperature, trace metals

467 AUTH Taniguchi,K.; Nakajima,M.; Yoshida,S.; Tarama,K.
DATE 1971
TITL Coordination states of some metal ions on silica gel surface.
CITA Bull. Inst. Chem. Res., Kyoto Univ. 49(4): 212-221 (1971).
COUN Japan
ABST At room temp. in aq. solns. with initial pH 8.0 contg. NH_4OAc and the metal chloride or nitrate, Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, and Zn^{2+} exchanged with the H^+ ions of the surface silanol groups of the silica gel (prepd. by hydrolysis of Et orthosilicate) to form siloxane ions. Mn^{2+}, Co^{2+}, and Cu^{2+} were coordinated by 1 siloxane ion, and Ni^{2+} and Zn^{2+} by 2 siloxane ions. Each metal ion was stabilized in a divalent, high-spin state at concns. of <1.2%. NO_3^- anions were easily removed from the silica gel surface by evacuation at 300°, whereas Cl^- anions were not. The magnetic moments of the metal ions on silca gel were 6.0, 4.8, 3.2, 1.9, and 0 μB for Mn^{2+}, Co^{2+}, Ni^{2+}, Cu^{2+}, and Zn^{2+}, resp. In the evacuated silica gel samples Mn(II) and Ni(II) were in octahedral, Cu(II) in tetragonal, Co(II) in both octahedral and tetragonal, and Zn(II) in tetrahedral ligand fields. Electronic absorption and ESR spectra, and magnetic susceptibility data are given for the metal ion-exchanged silica gels.
KEY trace metals, chemistry, temperature, ion exchange, water

468 AUTH Tatatru,S.; Filip,Gh.; David,B.
DATE 1969
TITL Adsorption of uranium by ion-exchange resins in presence of chlorate and perchlorte.
CITA Rev. Roum. Chim. 14(5): 599-604 (1969). (French).
COUN Romania
ABST Amberlite IRA-400, having been treated (under dynamic conditions) successively with 4% HCl, H_2O, 2% NaOH, H_2O, 4% HCl, and H_2O, was satd. with U by 4 repeated contacts for 30 min. each (under static conditions) between 3 cc. resin and 230 cc. $Na_4[O_2U(CO_3)_3]$ contg. 0-1.5 g. $KClO_3$ or $KClO_4$/l. Increase of the $KClO_3$ concn. increased the amt. of U remaining unadsorbed in the effluent, the resin adsorbing progressively less U. The amt. of U adsorbed decreased as well for each $KClO_3$ concn. with increase in the no. of contacts or with increase in the amt. of ClO_3^- and $[UO_2(CO_3)_3]^{4-}$ passed by the resin.

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The U adsorption in the last stages of contact decreased as a function of the initial KClO$_3$ concn. in the soln. Despite the redn. of the amt. of U adsorbed in each satn. stage, the adsorption capacity of the resin increased after each contact with the soln. contg. KClO$_2$.

Under the conditions considered, even in the course of the last contact, the U desorption did not exceed its adsorption by the resin. The values established for the adsorption capacity decreased, however, with increase of the ClO_3^-concn. in soln. from 93.2 mg. U/resin at 0 g. KClO$_3$/l. to 55.1 at 1.5. The ClO_4^- decreased the adsorption of U by the resin much more strongly. Even at cocns. as low as 0.25-0.5 g. KClO$_4$/l., the concn. of U in the effluent exceeded its concn. in the influent at the last stages of satn., signifying that ClO_4^- elutes the U adsorbed before. The intensity of the desorption depended on the ClO_4^- concn. in the soln. Both ClO_3^- and ClO_4^- had a new effect on the U adsorption on the resin, but while ClO_3^- only decreased it, ClO_4^- eluted the U adsorbed before. This was explained on the basis of several reaction equil. and affinities of ions for the resin. Although ClO_4^- suggests itself as and efficient eluent of U from resins employed in extn. of U from leach liquo, its possible oxidizing effect on the org. part of the resin argues against it; hence, ClO_3^- and ClO_4^- should be avoided in uranifous solns. subjected to ion-exchange treatment.

KEY uranium, capacity, adsorbent, ion exchange, elution

469 AUTH Tatsumoto,M.; Goldberg,E.D.
DATE 1959
TITL Some aspects of the marine geochemistry of uranium.
CITA Geochim. Cosmochim. Acta 17: 201-208 (1959).
ABST The uranium concentrations in marine calcareous material of a biological origin varied between 0.0X and 0.X p.p.m. with the exception of corals which had concentrations of several p.p.m. The aragonitic oolites and aragonite precipitated from sea water had values similar to those of the corals. A geochronology based on the growth of ionium (thorium-230) from uranium is applicable not only to corals, as previous investigators have pointed out, but also to oolites. Several examples of "oolite ages" are given. The uranium content of ferromanganese minerals from pelagic deposits is of the order of from 4 to 5 p.p.m.
KEY uranium, concentration, sediments, trace metals, seawater, geology, analysis

470 AUTH Taylor,K.(Group Leader); Walford,F.J.(Analyst).
DATE 1974
TITL Uranium from seawater: an energy cost study.
CITA Programmes Analysis Unit, Chilton (UK); Tidal or Pumped

(CONT.)
Schemes R14/74: (1974).
COUN UK
AREA Menai Straits
ABST A meeting was held in Economics and Programmes Branch, UKAEC, on 10th May 1974 to review the current position on the technology of extraction of uranium from seawater. The possibilities of both tidal and pumped schemes were discussed, and though it was agreed that the latter had advantages in flexibility of location, some concern was expressed at the large quantities of pumping energy required. It was decided therefore that the PAU should be invited to carry out an initial energy costing exercise on the pumped scheme, taking account not only the direct energy requirements, but also the indirect inputs needed to produce the capital equipment, operating materials, etc. The total energy input could then be compared with the energy released from the extracted uranium, which is used as fuel in a thermal reactor. The present report begins with a discussion of the technique of energy accounting, and the merits and limitations of the two principal approaches are compared. These are respectively, Process Analysis and Input-Output Analysis, otherwise referred to as the "Energy Cost of Materials" and "Energy Cost of Money", respectively. A "Best Estimate" is compiled which calls on both the tidal and pumped schemes, and this indicates that on an energy cost basis the pumped scheme is three times as expensive as the tidal scheme. In conclusion a point is made that while an energy costing exercise can be very instructive, care is needed in defining the system boundary. Equally important is the use of the true opportunity cost of energy consumed in the system under review. This is particularly important when examining schemes making use of new sources of power like tidal forces.
KEY economics, extraction, uranium, seawater, tidal system, pumped system

471 AUTH Terada,K.; Hayakawa,H.; Sawada,K.; Kiba,T.
DATE 1970
TITL Silica gel as a support for inorganic ion-exchangers for the determination of cesium-137 in natural waters.
CITA Talanta 17(10): 955-963 (1970).
COUN Japan
ABST The prepn. and characteristics of NH_4 molybdophosphate (I) and K or NH_4 hexacyanocobalt ferrate supported in silica gel, and their application to the detn. of ^{137}Cs in natural waters are described. Use of columns of the materials gives better recovery of ^{137}Cs from natural waters (in comparison with copptn. with I), requires less exchanger, so raising the gamma-counting efficiency of ^{137}Cs, and permits elimination of other radionuclides

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by washing with HF.
KEY water, adsorbent, ion exchange

472 AUTH Thurber,D.L.
DATE 1964
TITL The uranium content of sea water.
CITA Trans. Am. Geophys. Union 45: 119- (1964).
COUN USA
AREA Arctic, Atlantic, Caribbean
ABST The uranium concentration of sea water samples from the Arctic Ocean, the South Pacific, the Atlantic, and the Caribbean has been determined using a tracer technique. The values range from 1.5 to 3.3 μg/l. These variations confirm the findings of Miyake who reported a similar range of values. The activity ratio of U-234/U-238 does not appear to vary within the limits of measurement from a value of 1.15.
KEY uranium, seawater, concentration

473 AUTH Tinney,J.F.
DATE 1977
TITL Hydrogeochemical and stream-sediment reconnaissance program at LLL.
CITA Lawrence Livermore Lab. Report UCRL-79243: 18p (1977).
COUN USA
AREA Arizona, California, Idaho, Nevada, Oregon, Utah, Washington
ABST The Lawrence Livermore Lab is conducting a survey in Arizona, California, Idaho, Nevada, Oregon, Utah, and Washington as part of a systematic nationwide study of the distribution of U in surface water, groundwater, and stream sediment. The overall objective is to identify favorable areas for U exploration. The topics discussed are geol. and sample acquisition, sample prepn. and anal., and data-base management.
KEY sediements, uranium, water, interstitial water, analysis

474 AUTH Titaeva,N.A.
DATE 1967
TITL Association of radium and uranium with peat.
CITA Geochem. Int. 4: 1168-1174 (1967).
COUN USSR
ABST U is considerably more mobile than radium in surface waters containing small amounts of calcium bicarbonate. Radium is readily solved by clays as well as by peat. In peat, uranium is bound to the humic and fulvic acids soluble in alkali, whereas the radium is associated with the insoluble residue. Under oxidizing conditions, the elements appear to be retained by ion exchange, but in the presence of high concentrations of calcium in the water, the radium in the peat and in the insoluble residue becomes nearly unexchangeable. The

(CONT.)
exchangeability of that radium bound to the humic acid is, however, retained.
KEY uranium, ion exchange, water, adsorbent

475 AUTH Tominaga,H.; Kaneko,M.; Ono,Y.
DATE 1977
TITL Cation exchange of surface protons on silica gel with cupric ions.
CITA J. Catal. 50(3): 400-406 (1977).
COUN Japan
ABST The exchange of surface protons on silica gel with Cu^{2+} ions was investigated under 2 different conditions. The equil. const. was detd. and the mechanism of the exchange was suggested. In aq. NH_3, 2 protons exchange with 1 $Cu(NH_3)_4^{2+}$ and form 2 NH_4^+ ions. In acidic soln., where 1 proton exchanges with 1 Cu^{2+}, the apparent equil. const. increases with an increase in the amount of Cu loading. The structure of surface species on silica gel was suggested from the mechanism of the exchange and from ESR study. The surface species prepd. in acidic soln. is changed into the 1 prepd. in aq. NH_3 by exposure to NH_3. The change in the structure of surface species by the adsorption of foreign mols. was also studied.
KEY ion exchange, adsorbent

476 AUTH Tominaga,H.; Ono,Y.; Keii,T.
DATE 1975
TITL Spectroscopic study of copper(II) ions supported on silica gel by the cation exchange method.
CITA J. Catal. 40(2): 197-202 (1975).
COUN Japan
ABST The ESR and the elec. spectra of cupric ions introduced on silica gel by cation exchange between surface hydroxyl groups of silica gel and tetrammine cupric ions were investigated. The cupric ions in the initial state had the distorted octahedral configuration of which coordinated ammonia mols. were less than four. The evacuation treatment at temps. over 200° led to desorption of ammonia and to change in configuration of Cu ion to tetrahedral. For samples treated below 400°, the subsequent exposure to ammonia restored the original coordinate environment. Two different ESR parameters were obsd. with the water adsorption, and one was assigned to the distorted octahedral and the other to the tetrahedral configuration. The former disappeared by evacuation at room temp. The elec. spectrum also suggested the existence of the tetrahedral cupric ions. The ESR parameters of cupric ions depended on the adsorption temp. of pyridine. At lower temp., the configuration of cupric ions was similar to that of the ammoniated cupric ions. When the adsorption temp. was

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raised to 200-300^{0}, the marked decrease of the hyperfine splitting of cupric ion was obsd. indicating the distortion of the configuration of cupric ion from octahedral towards tetrahedral.

KEY analysis, ion exchange, adsorbent, temperature, elution

477 AUTH Torii,T.; Murata,S.

DATE 1964

TITL Distribution of uranium in the Indian and the Southern Ocean waters.

CITA Ken Sugawara Festival Volume: 321-334 (1964).

COUN Japan

ABST The content of uranium in sea waters collected respectively on the route from Japan to Antarctica was determined. Uranium was analyzed by the fluorometric method using transmission type fluorometer after separation with solvent extraction and fusion with sodium fluoride. The analytical results showed that uranium content in surface water respectively ranged from 2.7 to 3.2 x 10^{-6}g/l in the Indian Ocean Basin in the Antarctic Ocean, 2.7 to 3.5 x 10^{-6}g/l in the Drake Passage, 2.5 to 3.5 x 10^{-6}g/l in the Indian Ocean and 2.5 to 3.3 x 10^{-6} g/l in the South China Sea. Judging from the mean value of 0.5 x 10^{-13}g/l for radium in the Indian Ocean, the ratio of radium to uranium may be 4 to 6 per cent of the secular equilibrium amount.

KEY concentration, uranium, seawater, analysis, extraction, trace metals

478 AUTH Traut,D.E.; Nichols,I.L.; Seidel,D.C.

DATE 1976

TITL Design criteria for uranium ion exchange in a fluidized system.

CITA Trans. Soc. Min. Eng. AIME 260(1): 24-28 (1976).

COUN USA

ABST A fluidized countercurrent ion-exchange system was developed, operated, and evaluated by the Bureau of Mines. The system consisted of integrated multiple-compartment adsorption and elution columns in which the solution flows are continuous except for short periods when resin increments are withdrawn. The exchange of uranyl sulfate between a simulated acid leach uranium solution and a strong-base, ion-exchange resin together with the subsequent elution with an acidified sodium chloride solution was studied. The effects of the number of sections, section heights, amount of resin withdrawal, and solution flow rates were investigated. Also examined were the kinetic and equilibrium relationships for the adsorption step. The experimental data indicate a strong interdependence between variables. Solution retention time appears to be a major limiting variable. The column was efficient

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over a range of conditions, but close control was needed for optimum operation.
KEY ion exchange, elution, uranium, adsorbent

479 AUTH Traut,D.E.; Nichols,I.L.; Seidel,D.C.
DATE 1978
TITL Design requirements for uranium ion exchange from acidic solutions in a fluidized system.
CITA U.S., Bur. Mines, Rep. Invest., RI 8282: 29p (1978).
COUN USA
ABST Integrated multiple-compartment absorption and elution columns were used in which the soln. flows were continuous, except for short periods when resin increments were withdrawn. Soln. retention time is a major limiting variable in the absorption process, while resin residence time is the detg. factor in the elution process. As the soln. flow-rate increases, more of the column is used to obtain the same amt. of U extn. from the soln. There is a compromise between the effects of soln. residence time per stage and the no. of stages in the column. Obtaining higher grades of eluate and/or lower exiting resin values requires a taller column to provide longer resin residence time. The min. eluant flow rate of 2-2.7 gal/mm/ft^2, which allows the max. resin residence times, is optimum to obtain good elution of the resin and reasonable eluate grades. The min. aq.-to-resin ratio for good elution is ∿4:1.
KEY uranium, ion exchange, adsorbent, elution, extraction

480 AUTH Traut,D.E.; Nichols,I.L.; Seidel,D.C.
DATE 1978
TITL Design requirements for uranium ion exchange from ammonium bicarbonate solutions in a fluidized system.
CITA U.S., Bur. Mines, Rep. Invest., RI 8280: 27p (1978).
COUN USA
ABST A fluidized countercurrent ion-exchange system was developed. The system consisted of integrated multiple-compartment absorption and elution columns in which the soln. flows were continuous except for short periods when resin increments were withdrawn. The exchange of uranyl carbonate between a simulated in situ U leach liquor and a strong-base ion-exchange was studied. The effects of the no. of sections, section height, amt. of resin withdrawal, soln. flow rate, and column diam. were investigated. The kinetic and equil. relations for the absorption and elution steps were examd. The data indicated a strong interdependence between variables. Soln. retention time appears to be a major limiting variable in the absorption process, while resin residence time is the detg. factor in the elution process. The column was efficient over a range of conditions, but close control was needed for optimum

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operation.

KEY uranium, ion exchange, adsorbent, elution

481 AUTH Tret'yakov,S.Ya.; Sharygin,L.M.; Egorov,Yu.V.; Kurushin,S.P.

DATE 1976

TITL Study of the physicochemical properties of silica gel modified by titanim dioxide.

CITA Kinet. Katal. 17(5): 1357 (1976). (Russian).

COUN USSR

ABST Modification with hydrated TiO_2 was done in a vacuum adsorption app. by treating silica gel with $TiCl_4$ vapors followed by hydrolysis. The modified samples were studied by adsorption, x-ray, and ion exchange methods. The sp. surface and pore vol. were decreased, but the effective size of the pore opening remained const. The decrease in the sp. surface was due to increase in the size of primary particles and the decrease of the surface near the contacts for particles as the modifier's granules grew over it. Thermal treatment of the modified silica gel shifted the phase conversions for the TiO_2 towards higher temps. The ion exchange capacity increased with an increase in the TiO_2 concn., for sorption of Cu ions from acid solns.

KEY ion exchange, capacity, titanium, adsorbent, temperature

482 AUTH Tsvetkov,V.K.; Pak,V.N.; Aleskovskii,V.B.

DATE 1976

TITL Study of products of the ion-exchange stage of cobalt(II) sorption by the surfaces of silicon dioxide ($SiO_2.nH_2O$), aluminum oxide($Al_2O_3.nH_2O$), titanium dioxide ($TiO_2.nH_2O$), and antimony pentoxide ($Sb_2O_5.nH_2O$) using diffuse reflection spectra.

CITA Zh. Prikl. Khim. (Leningrad) 49(3): 519-524 (1976). (Russian).

COUN USSR

ABST The active solid products were studied by diffuse reflection spectra. The sorption was carried out in the fraction of air-dry gels with particle size 0.2-0.3 mm. Half of the obtained product was washed by H_2O to remove NH_3 and dried in air, the other part was dried without removing NH_3. In the products of the sorption contg. NH_3, Co^{2+} ions are in tetrahedral coordination on the surface of SiO_2, Al_2O_3, and TiO_2 and octahedral on Sb_2O_5. Reaction with H_2O changes the coordination of Co^{2+} ions on the surfaces of $SiO_2.nH_2O$ and $Al_2O_3.nH_2O$; the coordination is tetrahedral on the $TiO_2.nH_2O$ surface and octahedral on $Sb_2O_5.nH_2O$.

KEY ion exchange, titanium, adsorbent

483 AUTH Uchida,T.; Sakamoto,M; Masatsuyo; Asano,K.

DATE 1976

(CONT.)
TITL Titanium dioxide pigment.
CITA Japan. Kokai 76,147,499 (Cl. C01G23/04), Appl. 75/70,902, 13 Jun 1975: 6p (1976).
COUN Japan
ABST Titanium dioxide was coated with Na silicate (I) in the presence of Amberlite IR 120B cation exchanger, (II) [39288-69-2] to prep. pigments having good weather resistance. Thus, 80 mL I soln. contg. 100 g/L SiO_2 was added to 1 L slurry contg. 200 g rutile and NaOH at pH 9.5 and 60° during 60 min, stirred for an addnl. 10 min, mixed with 100 mL 900 g/L II to pH 3.5 during 2 h, heated to 90°, stirred for 30 min, sepd. to remove II, adjusted to pH 6 with NaOH, filtered, washed, dried, and pulverized to prep. a pigment.
KEY titanium, ion exchange, chemistry, temperature

484 AUTH Umezawa,K.; Yamabe,M.; Kojima,M.
DATE 1976
TITL Uranium from sea water.
CITA Japan. Kokai 76 67,217 (Cl. C22B60/02), Appl. 74/141,725, 09 Dec 1974: 5p (1976).
COUN Japan
ABST Sea water is passed at >0.5 m/sec through sheets carrying 0.1-10 mm diam. U adsorber at 2-50 mm distance. Thus, activated C of 0.1, 3, 10, or 15 mm diam. was soaked in 10% $TiCl_4$ in 5N HCl for 24 hr, dried at 60° for 1 hr, dipped in aq. NH_3 to contain 50% TiO_2, coated on both sides of poly(vinyl chloride) sheets with epoxy resin, 40 sheets were fixed at 5 mm distance, and placed in flowing sea water for 2 days to adsorb 3.3, 3.8, 3.4, or 2.1 g U, vs. 0.9 with 0.01 diam. C.
KEY seawater, uranium, adsorbent, titanium, temperature, capacity

485 AUTH Van Der Sloot,H.A.
DATE 1976
TITL Neutron activation analysis of trace elements in water samples after preconcentration on activated carbon.
CITA Vrije Universiteit (Amsterdam): (1976).
COUN The Netherlands
ABST In this thesis, the use of activated carbon for the determination of trace elements in sea and fresh water is studied. Activated carbon, if pure, appears very usable for the preconcentration of trace elements in water. Because of its simplicity, the analysis can be performed at the sampling site itself. The absorbed elements are then determined through neutron activation analysis. The scope of this study is limited to: V, Cr, Co, Cu, Zn, Se, Mo, Cd, W, Hg and U.
KEY seawater, water, adsorbent, analysis, trace metals, uranium

(CONT.)

486 AUTH Van Der Sloot,H.A.; Massee,R.; Das,H.A.
DATE 1975
TITL Determination of uranium in sea and surface waters by neutron activation analysis after adsorption on charcoal.
CITA J. Radioanal. Chem. 25(1): 99-105 (1975).
COUN The Netherlands
ABST The determination of uranium in sea and surface water samples after a preconcentration with activated charcoal by neutron activation analysis is described.
KEY uranium, seawater, water, analysis, concentration

487 AUTH Vasilenko,I.P.; Medvedev,P.I.
DATE 1976
TITL Ion-exchange equilibrium on titanium(IV) hydroxide in magnesium(2+)-calcium(2+) and magnesium(2+)-zinc(2+) systems.
CITA Ukr. Khim. Zh. (Russ. Ed.) 42(1): 37-41 (1976). (Russian).
COUN USSR
ABST Ti(IV) hydroxide (I) was obtained by reaction of $TiCl_4$ with NH_4OH at pH 8. After washing free of Cl- and satg. with Mg^{2+}, the displacement of Mg^{2+} by Ca^{2+} and Zn^{2+} was studied under static conditions. The selectivity (K^1) for Ca^{2+} increased with decreasing concn. of Ca^{2+} and decreased with increased temp. The selectvity for Zn^{2+} passed through a max. with concn. and increased with temp. By using a corrected selectivity coeff., the free energy, enthalpy, and entropy of exchange were calcd. ΔH and ΔS were both pos. for Zn^{2+} and neg. for Ca^{2+}. ΔG was neg. in both cases.
KEY ion exchange, titanium, adsorbent, temperature, chemistry, concentration

488 AUTH Vernon,F.; Eccles,H.
DATE 1976
TITL Chelating ion-exchangers containing N-substituted hydroxylamine functional groups. Part IV. Column separations on a hydroxamic acid resin.
CITA Anal. Chim. Acta 83: 187-193 (1976).
COUN UK
ABST Ion exchange separations on a new hydroxamic acid ion exchanger are described. Quantitative separation of iron(III) from various salts and from several analytical standards has been achieved, and sources of interference in the colorimetric determination of iron with thioglycollic acid can be eliminated. Quantitative separations of copper from iron and from cobalt and nickel are possible. Recoveries and separations of iron and uranium from simulated sea-water samples are demonstrated.
KEY ion exchange, uranium, seawater, adsorbent, analysis,

(CONT.)
trace metals, extraction

489 AUTH Vernon,F.; Kyffin,T.W.; Nyo,K.M.
DATE 1976
TITL The spectrophotometric determination of uranium with 8-hydroxyquinoline.
CITA Anal. Chim. Acta. 87(2): 491-493 (1976).
COUN UK
ABST To an aliquot contg. 250 μg U, 50 mL deionized water was added, the pH was adjusted to 0.85 with H_2SO_4, the mixt. was extd. with two 25-mL portions of 0.1M trioctylamine in pretroleum ether contg. 2 vol.% 2-octanol, the U was back-extd. with 0.2M HNO_3, the mixt. was neutralized with NH_4OH, and the pH was adjusted to 8.8. Then 5 mL 0.02M EDTA di-Na salt was added, and the soln. was extd. with 1% (w/v) 8-hydroxyquinoline soln in CCl_4. The absorbance was detd. in a 1-cm cell at 400 nm against a reagent blank.
KEY uranium, water, chemistry, analysis, extraction

490 AUTH Vigvari,M.; Erdelyi,M.; Czegledi,B.
DATE 1974
TITL Countercurrent elution of uranium(VI) and iron(III) from an anion-exchange resin.
CITA J. Chromatogr. 102: 433-436 (1974).
COUN Hungary
ABST A countercurrent elution method for the separation of uranium and iron was developed. The separation is based on changing the solution composition along the anion-exchange column and on the difference in the stability constants and the ion-exchange distribution coefficients of the sulfate complexes of uranium and iron.
KEY elution, uranium, ion exchange, extraction, trace metals

491 AUTH Villard,R.
DATE 1966
TITL Hydrometallurgy for treatment of low-grade ores: copper and uranium.
CITA Sci. Progr., Nat. (Paris) (3372): 138-144 (1966). (French).
COUN France
AREA Gueugnon (Saone-et-Loire)
ABST For the recovery of U, capillary leaching is followed by extn. by ion-exchange resins. The recovery from Bauzot ores, near Gueugnon (Saone-et-Loire) is described, as well as the possibilities of recovery of U by bacterial leaching and from the oceans.
KEY uranium, extraction, ion exchange, seawater

492 AUTH Vol'khin,V.V.; Onorin,S.A.
DATE 1976

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TITL Sorption properties of hydrated titanium dioxide and its dehydration products.
CITA Izv. Akad. Nauk SSSR, Neorg. Mater. 12(8): 1415-1418 (1976). (Russian).
COUN USSR
ABST The cation exchange properties of $TiO_2.xH_2O$ are detd. by the presence of OH groups with $pK_1 = 5.0 \pm 1.0$, $pK_2 = 7.9 \pm 1.7$, and $pK_3 = 10.6 \pm 0.4$ at total ion exchange capacity 0.48 mequiv./mmole TiO_2 (6 mequiv./g). The exchange capacity decreases in the order $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$ and is related to the channel structure in the exchanger. Heating $TiO_2.xH_2O$ in the H-form increases condensation of OH groups resulting in loss of ion exchange properties. The Li-form has higher thermal stability; after heating to 480-520°, Li^+ selectivity is acquired.
KEY titanium, ion exchange, chemistry, capacity, adsorbent, temperature, trace metals

493 AUTH Vol'khin,V.V.; Onorin,S.A.; Leont'eva,G.V.; Khodyashev,N.B.
DATE 1977
TITL Some ways of modifying ion exchangers based on manganese dioxide and titanium dioxide.
CITA Russ. J. Appl. Chem. 50(4): 719-722 (1977).
COUN USSR
ABST X-ray diffraction showed that heating or a treatment of MnO_2 or TiO_2 ion exchangers by 75-100 g/l solns. of LiOH modified the structure of the oxides. A cold or 50-70° treatment with LiOH increased exchange capacity and increased their selectivity to Li^+.
KEY titanium, ion exchange, temperature, capacity

494 AUTH Wald,M.; Wiegand,G.
DATE 1973
TITL Determination of nanogram uranium content in solutions by the fission track method.
CITA Radiochim. Acta 19(1): 37-40 (1973).
COUN W Germany
ABST A fission track method was adapted for the determination of uranium in nanogram quantities in solutions, without any preliminary chemical treatment of the solution. Polycarbonate foil was used as a fission track dectector. Experimental conditions were worked out to accommodate the method for as small volumes of uranium solutions as 1 ml. The uranium solution was either directly contacted with the detector foil, or after being fixed on Bio-Gel matrix. A proper arrangement of the foils for the sparking process leads to very small spark holes, considerably improving the detection. The fraction of the tracks that may be rendered visible due to etching and sparking was found to be of a constant

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value for given irradiation conditions and matrix. The intensity of gamma radiation existing in the irradiation position of the reactor influences significantly the value of this fraction.
KEY uranium, analysis

495 AUTH Wallace,R.A.P.
DATE 1975
TITL Removing concentrated solutions of ionizable compounds from aqueous solutions.
CITA Brit. 1,410,188 (Cl. B01D), Appl. 48,436/72, 20 Oct 1972: 22p (1975).
COUN UK
ABST A method for removing concd. solns. of ionizable compds. from aq. solns. involves contacting the aq. soln. with an inorg. oxide gel between ion-permeable membrane walls under an applied elec. field, allowing the ionizable compd. to be sorbed by the gel, and collecting the concd. soln. of the ionizable compd. exuded after the gel is satd. The method was applied to the desalination of brine solns., the removal of excess citric acid [77-92-9] from orange and grapefruit juice, the removal of radioactive compds. from waste streams, the removal of excess H_2SO_4 [7664-93-9] and $Fe_2(SO_4)_3$ [10028-22-5] from acid mine drainage streams of low pH and high hardness, the recovery of concd. sulfites from spent pulping liquor in the paper industry, and the removal of zinc chloride [7646-85-7] from aq. acidic solns. as used in the leather tanning industry. Typical inorg. oxide gels used were those derived from silicic acid, V_2O_5 [1314-62-1], ferric arsenate [10102-49-5], zirconium borate [39322-05-9], and ferric phosphate [22047-20-7]. An app. for the method was described.
KEY water, adsorbent, chemistry

496 AUTH Wang,L.C.; Lee,H.C.; Lee,T.S.; Lai,W.C.; Chang,C.T.
DATE 1978
TITL A novel method for the preparation of uranium metal, oxide and carbide via electrolytic amalgamation.
CITA J. Inorg. Nucl. Chem. 40(3): 507-508 (1978).
COUN Taiwan
ABST A solid uranium amalgam was prepared electrolytically using a two-compartment cell separated with an ion exchange membrane for the purpose of regulating pH value within a narrowly restricted region of 2 to 3. The mercury cathode was kept at -1.8V vs SCE during electrolysis. The thereby obtained amalgam containing as high as 1.9 gm U/ml Hg is easily converted into uranium metal by heating in vacuo above 1300° C. Uranium dioxide and uranium monocarbide could be easily obtained at relatively low temperature by reacting the amalgam with water vapor and methane.

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KEY uranium, chemistry, capacity, temperature, extraction

497 AUTH Wastler,T.A.; de Guerrero,L.C.
DATE 1970
TITL Estuarine and coastal pollution in the United States.
CITA FAO Technical Conference on marine pollution and its effects on living resources and fishing. Rome, Italy. 9-18 Dec 1970. FIR:MP/70/R-11: 42p (1970).
COUN USA
AREA Atlantic Ocean, Pacific Ocean, Gulf of Mexico, Caribbean, Alaska, Pacific Islands
ABST In 1966 the U.S. Congress directed that a comprehensive study of coastal pollution be undertaken and that recommendations be made to them for a national coastal zone management program to preserve and use these areas for the continuing benefit of the entire Nation. The Federal Water Quality Administration of the Dept. of Interior submitted to the Congress in November 1969 the definitive report of the National Estuarine Pollution Study, which was the first comprehensive appraisal of coastal pollution in the U.S. This review of estuarine and control pollution in the U.S. is based on these three years of intensive investigation and presents not only the pollution problems themselves, but also some of the concepts and techniques developed during the study.
KEY n atlantic, m atlantic, s atlantic, pacific northwest, pacific southwest, gulf of mexico, alaska, pacific islands, caribbean, estuary, current, river, sediments, climate, tide, offshore, marine organisms, nearshore, organics, temperature, environmental impact

498 AUTH Weaver,J.N.
DATE 1974
TITL Rapid, instrumental neutron activation analysis for the determination of uranium in environmental matrices.
CITA Anal. Chem. 46(9): 1292-1294 (1974).
COUN USA
ABST To det. >25 ppb U in environmental materials, samples were irradiated 4-8 hr in a flux of 3×10^{13} neutrons/cm /sec, and after 48 hr decay, the ^{133}I activity was measured with a low-energy photon detector coupled to a multichannel analyzer. The photopeaks at 14.4, 18.32, 106.80, and 109.32 keV were used; the ratios between the peaks were used to eliminate interference by other isotopes. The technique was demonstrated by analyses of orchard leaves, beef liver, coal, sea water, Cu ore, and mud samples. The precision was approx. 10 and approx. 5% for detns. of 100 ppb and 1 ppm U, resp., in the leaves.
KEY uranium, seawater, analysis

499 AUTH Weigand,N.; Sebestian,I.; Halasz,I.

(CONT.)
DATE 1974
TITL New types of cation exchangers based on silica gel. I. Preparation and properties.
CITA J. Chromatogr. 102: 325-332 (1974). (German).
COUN W Germany
ABST The prepn. and properties of cation exchangers based on silica gel modified with alkyl groups (brushes with $\equiv$Si-C$\equiv$ bond) are described. A max. exchange capacity with a min. cleavage of the $\equiv$Si-C$\equiv$bond was obtained by sulfochlorination by a gas-solid reaction. The exchange capacity depends on the sp. surface of the silica gel carrier (250 μequiv./g with 300 m^2/g). The cation exchangers are stable against high pressure, and neither swell nor shrink. The bed vol. is independent of the pH and the ionic strength is independent of the eluent. The exchangers are stable at pH range 0-8, and are temp.-stable.
KEY ion exchange, capacity, chemistry, elution, temperature

500 AUTH Weissbuch,H.; Botezatu,E.; Gradinaru,M.
DATE 1978
TITL Spectrophotometric method for the simultaneous determination of uranium and thorium in natural water.
CITA J. Radioanal. Chem. 42(2): 385-391 (1978).
COUN Romania
ABST The method is based on the separation of uranium from thorium and on their subsequent purification on strong basic anion exchange resin. Increased chemical yield, precision and selectivity can be achieved. The assay is performed spectrophotometrically in the form Arsenazo III complexes. By this way the difficulties of the fluorimetric method can be easily avoided. The sensitivity is claimed to be 0.02 $\mu g/cm^3$; the accuracy is 10%, the chemical yield is 75-80% and the time requirement is 30 hours for 5 simultaneous samples. No proposal is made on the application of the method on sea-water.
KEY uranium, analysis, water, extraction, ion exchange

501 AUTH Wesolowski,K.; Ryczek,M.
DATE 1965
TITL Heavy metal concentrates from dilute waste solutions.
CITA Pol. 50,128 (Cl. C01g), Appl. Feb 12, 1964: 3p (1965).
COUN Poland
ABST The concentrates are obtained by adsorption on humins of heavy metals whose high-valence ions have acid properties. The ions are absorbed from dil. solns. obtained during purification of industrial gases and mine waters. For this purpose, humins were heated to 250° in a neutral or reducing atm., and the moisture was 2-5% by wt. Next, the humins were treated with alk. earth hydroxides and used as absorber. Absorption of

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each metal should be performed at appropriate pH: V(V) at pH 1.5-2, V(IV) 3, U(IV) 4, U(VI) 2.5, Ge(II) 4.5, Ge(IV) 1.5-2.0, Ga(III) 5-5.5, Mn(II) 4, and Mn(VII) 1.8-2.2.
KEY trace metals, adsorbent, temperature, chemistry, uranium

502 AUTH Wilson,A.; Iseri,K.T.
DATE 1969
TITL River discharges to the sea from the shores of the conterminous United States.
CITA U.S. Dept. of the Interior, Geological Survey, Hydrologic Investigations Atlas No. HA-282: (1969).
COUN USA
AREA USA
ABST The river discharge into the oceans from United States runoff is tabled and mapped.
KEY river, water

503 AUTH Wilson,J.D.; Webster,R.K.; Milner,G.W.C.; Barnett,G.A.; Smales,A.A.
DATE 1960
TITL A comparison of three methods of determining the concentration of uranium in sea water.
CITA Anal. Chim. Acta 23: 505-514 (1960).
COUN UK
AREA English Channel, Bay of Biscay
ABST A stable isotopic dilution method and a fluorimetric method for the measurement of the concentration of uranium in sea water are described. In both methods the uranium is extracted from the sea water into chloroform using 8-hydroxyquinoline. ^{237}U is used as a tracer in the fluorimetric method. The results obtained by these two methods and by a pulse polarographic method are compared, and give a mean value of 3.3 ± 0.08 µg per 1 for the uranium content of samples of English Channel and Bay of Biscay water. The precision of the methods improves in the order fluorimetry, pulse polarography, isotopic dilution.
KEY concentration, uranium, seawater, analysis, extraction

504 AUTH Wodkiewicz,L.; Dybczynski,R.
DATE 1974
TITL Anion-exchange behavior of some elements on a weakly basic anion exchanger in hydrobromic acid medium.
CITA J. Chromatogr. 102: 277-285 (1974). (French).
COUN Poland
ABST The adsorbability of several elements was studied in the system: weakly basic anion exchange resin Amberlite IRA-68 (Br^-)-HBr+ Br_2. Distribution coefficients of more than 30 elements were determined by batch equilibration in HBr concentration range 0.01 to 12M. In most instances the distribution coefficients increase

(CONT.)

with increase in acid concentration. Some elements, such as Cu, Co, Fe, Mn, In, Ga, and U, are adsorbed only at acid concentrations greater than 4 M. Pt, Hg, Ag, and, to a somewhat smaller extent, Au, Tl and Re, show high distribution coefficients in dilute HBr solution. In general, the adsorbabilities of elements on Amberlite IRA-68 in the bromide system are lower than the adsorbabilities in analogous system with strongly basic Dowex 1 resin. The observed differences in distribution coefficents are high enough for some interesting separations to be obtained. The possibility of column separations of several mixtures, such as Eu-U, Zn-Cd-Hg and Cu-Ag-Au, was demonstrated. The influence of temperature on the separation of the latter mixture was studied, and the most important chromatographic parameters (distribution coefficients, separation factors, resolutions, and plate heights) were calculated.

KEY ion exchange, concentration, uranium, temperature, trace metals, adsorbent, extraction

505 AUTH Woodroof,J.G.; Young,C.T.

DATE 1967

TITL Ocean raw materials.

CITA Kirk-Othmer Encyclopedia of Chemical Technology, Second Edition, 14: 150-157 (1967).

COUN USA

ABST The oceans of the world cover nearly three-quarters of the surface of the earth to an average depth of over 12,000 ft. The presence of this vast quantity of water gives our planet a special position in the solar system. No other is believed to have substantial quantities of liquid water. The economic uses of the ocean are even now, quite impressive. It has been estimated that the annual value of oceanic activities (not including transportation, conventional recreation, most naval operations) is more than $7.6 billion and that the growth rate of ocean-connected market is close to 15% each year. In addition to being a source of raw materials, the oceans serve as a major heat sink, as an artery of commerce, as a source of fresh water, and as a repository for the waste products of mankind. The present annual value of the production of raw materials and products from the ocean is given, excluding fish or marine mammal products. These materials are produced from seawater, beach sands, the surface and beneath the surface of the continental shelf. The water of the oceans is quite probably the most complex solution that will ever be encountered. More than 77 elements have been found dissolved in seawater. The technical chemistry of seawater, despite the complexity of the solution is determined by the nine major components and

(CONT.)
it is from these nine that industrial products are now recovered. Cations include sodium, magnesium, calcium, potassium, and strontium. Anions include chloride, sulfate, bicarbonate, and bromide. All other constitents of seawater total less than 1% of the weight of the dissolved materials.
KEY water, economics, marine organisms, seawater, trace metals, adsorbent, extraction, uranium, ion exchange

506 AUTH Wooten,M.J.; Hirayama,C.; Panson,A.J.; Patton,J.T.
DATE 1976
TITL Uranium recovery from seawater. Final report.
CITA Electric Power Research Institute Report EPRI NP-132, Project 450-1 Gov. Rep. Announce. Index (U.S.) 76(17): 90 (1976).
COUN USA
ABST The objective of this study was to assess the feasibility of an electrochemical method of extracting uranium from seawater by laboratory experiments and analysis. The study also was directed at defining prospects for acquiring uranium by methods that result in very low environmental insult. The report describes in Section 1 the results of the experimental evalutation of electrolytic methods for obtaining uranium from sea water and in Section 2, the results of an assessment of alternative low environmental insult methods for acquiring uranium.
KEY uranium, seawater, analysis, environmental impact, extraction, concentration, chemical species, titanium, adsorbent, tidal system, multi-purpose process, economics, plant productivity

507 AUTH Yamabe,M.; Kojima,M.
DATE 1977
TITL Heavy metal adsorbent.
CITA Japan. Kokai 77 29,480 (Cl. B01D15/08), Appl.75/106,297, 01 Sep 1975: 5p (1977).
COUN Japan
ABST Fine pore-contg. materials are dipped in an acidic aq. soln. of titanic acid or titanate and treated in NH_3 to give heavy metal adsorbents, esp. useful for recovery of U from sea water. Thus, nonwoven wool cloth (10 x 20 x 0.2 cm) was dipped in an aq. soln. contg. $TiCl_4$ 15 and HCl 12% for 5 min, kept in NH_3 gas for 60 min, and washed with water to obtain a sheet-like adsorbent. When the adsorbent was dipped in seawater for 24 h, it adsorbed 200 µg U.
KEY uranium, seawater, adsorbent, trace metals, titanium, capacity

508 AUTH Yamabe,M.; Kojima,M.
DATE 1977

(CONT.)
TITL Uranium adsorption from seawater.
CITA Japan. Kokai 77 29,479 (Cl. B01D15/08), Appl. 75/106,296, 01 Sep 1975: 6p (1977).
COUN Japan
ABST A porous poly(vinyl acetal), av. pore diam. 20-1000μ and void 50-90%, is immersed in a soln. contg. titanic acid or titanate, then treated with NH_3 or NH_4OH to obtain an adsorbent for U. Thus, a porous poly(vinyl acetal) sheet, av. pore diam. 120μ and void 91%, was immersed in a HCl-$TiCl_4$-H_2O soln., and the sheet was exposed to NH_3 to obtain the adsorbent. Seawater was passed through a column contg. the adsorbent. The adsorption capacity was 270-330 μg U/25 cm^2 in 5 adsorption-desorption cycles.
KEY uranium, seawater, adsorbent, capacity, titanium, elution

509 AUTH Yamabe,M.; Kojima,M.
DATE 1977
TITL Uranium from seawater.
CITA Japan. Kokai 77 37,506 (Cl. C22B66/02), Appl. 75/114,067, 19 Sep 1975: 3p (1977).
COUN Japan
ABST U-absorbers are floated on seawater surrounded by a fence. Thus, absorbers in any form were fixed with rope to a net, and moved by waves and/or wind. No practical data.
KEY uranium, seawater, adsorbent, net systems

510 AUTH Yamabe,M.; Kojima,M.; Umezawa,K.
DATE 1976
TITL Uranium from sea water.
CITA Japan. Kokai 76 67,216 (Cl. C22B60/02), Appl. 74/141,724, 09 Dec 1974: 6p (1976).
COUN Japan
ABST Sea water is passed through sheets of U adsorbent with tubular or columnar projections between as a current disturber. Thus, TiO_2 of mean diam. 250μ , obtained by heating $Ti(SO_4)_2$ was coated on both sides of a stainles steel plate, 50 sheets were fixed with 60 glass beads of 5mm diam. between each 2 sheets, and sea water contg. 3.2 μg/l. U was passed through a 102 cm/sec for 2 days to adsorb 8.3 g U, vs. 4.9 without the glass beads. Polyamidoxime on polyacrylonitrile filament taffeta and galena on polypropylene sheet were also used as adsorbents.
KEY seawater, uranium, adsorbent, titanium, concentration, capacity

511 AUTH Yamabe,T.; Takai,N.
DATE 1969
TITL Separation of trace elements, particularly uranium, from

(CONT.)
sea water.
CITA Seisan Kenkyu 21(9): 530-535 (1969). (Japanese).
COUN Japan
ABST A general explanation was given to the sepn. of U from sea water by ion exchange, adsorption pptn., and foam sepn. methods. Possible difficulties of the sepn. were also discussed.
KEY uranium, seawater, ion exchange, extraction, trace metals

512 AUTH Yamabe,T.; Takai,N.
DATE 1970
TITL Separation of uranium from sea water by precipitation method.
CITA Nippon Kaisui Gakkai-Shi 24(1): 16-19 (1970). (Japanese).
COUN Japan
ABST In the method described, artificial seawater was prepared so as to contain 1 mg/l of uranium, and uranium was determined by the colorimetric method using Arsenazo III. The separation of uranium was carried out by formation of insoluble substances with phosphate. By this procedure, about 90% of the uranium in the seawater was collected into precipitates of phosphate. This method proved useful for the separation of uranium from seawater.
KEY seawater, uranium, concentration, extraction, analysis

513 AUTH Yamanouchi,A.
DATE 1978
TITL Uranium collection from seawater by adsorption.
CITA Japan. Kokai 78 05,090 (Cl. B01D15/00), Appl. 76/78,980, 05 Jul 1976: 4p (1978).
COUN Japan
ABST U in seawater is adsorbed on a magnetic adsorbate which is collected magnetically. The adsorbate consists of spheres made up of a magnetic Fe oxide core, corrosion-resistant shell, and adsorbate exterior (titanic acid). Optionally the corrosion-resistant compd. and magnetic Fe oxide powder are formed as the core.
KEY uranium, extraction, seawater, adsorbent, titanium

514 AUTH Yamashita,H; Ozawa,Y.; Nakajima,F.; Murata,T.
DATE 1978
TITL Collection of uranium from sea water with hydrous oxide adsorbents. I. Ion exchange properties and uranium adsorption of hydrous titanium(IV) oxide.
CITA Nippon Kagaku Kaishi (8): 1057-1061 (1978). (Japanese).
COUN Japan
ABST The adsorption of U, dissolved in seawater, on hydrous TiO_2 and the mechanism of this adsorption was studied.

(CONT.)
Hydrous TiO_2 was prepd. by pptn. from $TiCl_4$ and aq. NH_3 at different temps. The amt. of OH groups on the surface of hydrous TiO_2 crystallites, which was measured by adsorption of F-, decreased with increasing prepn. temp. K adsorption increased linearly with the amt. of surface OH groups of hydrous TiO_2. The reverse relation existed between the amt. of U adsorbed and the surface OH groups. The enthalpy change (ΔH) was -3.4 kcal/mol and 11.1 kcal/mol for the K adsorption and the U adsorption resp.
KEY extraction, uranium, seawater, adsorbent, ion exchange, titanium, temperature

515 AUTH Yamazaki, Y.; Ito, H.; Kantake, Y.
DATE 1977
TITL Porous adsorbent for uranium compound adsorption.
CITA Japan. Kokai 77,114,585 (Cl. B01D15/00), Appl. 76/31,397, 24 Mar 1976: 5p (1977).
COUN Japan
ABST A monomer mixt. (100 parts) consisting of a vinyl monomer contg. ≥ 1 hydrophilic groups/mol. 10-99.9, other vinyl monomer ≤ 89.9, and cross-linking agent contg. ≥ 2 vinyl groups/mol. 0.1-90% is polymd. in the presence of 20-200 parts of a nonpolymg. compd., the nonpolymg. compd, is extd. to obtain a porous polymer, and the polymer surface is converted to a U comd.-adsorbing surface. Thus, 100 parts of monomer mixt. contg. 80% 2-hydroxyethyl methacrylate and 20% of ethylene glycol dimethacrylate was polymd. in the presence of 55 parts nonyl alc. and 0.6 part benzoyl peroxide, and the alc. was extd. to obtain a porous polymer. The polymer was reacted 0.5 h with $TiCl_4$, and immersed in boiling water to obtain an adsorbent which adsorbed 400 μg U compds./g from seawater.
KEY uranium, adsorbent, seawater, extraction, titanium, capacity

516 AUTH Yokoyama,R.; Tabata,H.
DATE 1975
TITL Heavy metal removal from sea water or brine.
CITA Japan. Kokai 75 70,539 (Cl. C02B, B01D, J01J), Appl. 73 120,905, 28 Oct 1973: 3p (1975).
COUN Japan
ABST $MgCO_3$ [546-93-0] slurry is added to sea water or brine contg. heavy metals; Ca [7440-70-2] in the treated water is pptd. as $CaCO_3$ together with the heavy metals. Thus, 1380 l. of $MgCO_3$ slurry ($Mg:CO_2$= 1:0.83, 2.4% solids) was added to 40 m^3 of sea water (Hg [7439-97-6] 2, Au [7440-57-5] 0.000004, Ag [7440-22-4] 0.0003, U [7440-61-1] 0.003 ppm) at 60° and the mixt. was stirred for 3 hr. The supernatant contained U trace and no Hg, Au, or Ag and had pH 4.8. The supernatant evapd. in a

(CONT.)
steel evaporator without scale formation or erosion.
KEY seawater, uranium, trace metals, temperature, chemistry, extraction

517 AUTH Zaki,A.B.; Morsi,S.E.
DATE 1975
TITL Particle diffusion of an anionic uranium-(+6) sulfate complex in Wofatit SBW ion-exchange resin.
CITA Ion Exch. Membr. 2(2): 123-125 (1975).
COUN Egypt
ABST The kinetics of anion exchange between $[UO_2(SO_4)_2]^{2-}$ and SO_4^{2-} on Wofatit SBW were studied under static conditions favoring a particle diffusion mechanism. The interdiffusion coeff. was estd. Equil. and times were calcd.
KEY ion exchange, uranium

518 AUTH Zhorov,V.A.; Barannik,V.P.; Lyashenko,S.V.; Kirchanova,A.I.; Kobylyanskaya,A.G.
DATE 1976
TITL Use of adsorption colloidal flotation for separating trace elements from sea water.
CITA Izv. Vyssh. Uchebn. Zaved., Tsvetn. Metall. 6: 12-16 (1976). (Russian).
COUN USSR
ABST The colloidal flotation of Cu, Mo, and U from sea water by means of hydrated Fe oxide as sorbent, stearic acid and indolylbutyric acid as collectors, and Stearox 6 as foaming agent was studied. Optimal conditions were detd. The applicability of the sorption isotherm equation was shown. The process obeys the law of mass action in the limits of pH 0.5-0.7 and sorbent mass of 0.1-5 mg.
KEY seawater, uranium, extraction, chemistry, trace metals, adsorbent

519 AUTH Zhorov,V.A.; Bezborodov,A.A.; Barannik,V.P.
DATE 1975
TITL Coprecipitation of trace amounts of copper and zinc from sea water on titanium hydroxide.
CITA Dopov. Akad. Nauk Ukr. RSR, Ser. B (9): 782-784 (1975). (Ukrain).
COUN USSR
AREA Black Sea
ABST Factors affecting the copptn. of Cu [7440-50-8] and Zn [7440-66-6] from Black Sea water by $Ti(OH)_4$ [12651-23-9] were studied. The expts. were carried out directly in the sea water by introducing $Ti(SO_4)_2$ and NaOH. Complete Cu pptn. is obtained at pH 7 and Zn at pH 8. The pptn. by $Ti(OH)_4$ is considered to take place by an ion-exchange path, i.e., through a surface mechanism.
KEY seawater, ion exchange, trace metals, titanium,

(CONT.)
extraction, chemistry

520 AUTH Zimmermann,U.
DATE 1974
TITL Procedure for separating ionized substances distinguished by chemical and physical properties, out of an aqueous solution.
CITA German (FRG) Patent 2,326,224/A/: (1974). (German).
COUN W Germany
ABST The method uses low molecular complexing agents to obtain heavy metals, e.g. also uranium, from sea, sweet-water or waste water using 8-hydroxychinoline. Cells from organisms, e.g. erythocytes, are added as complexing agents in bubble form to a solution whose osmolarity is lower than the cell content. After balancing the osmolarity of the cell content and the solution, these osmotic active substances such as calcium, potassium, and sodium ions are added and the osmolarity is further increased until the original osmolarity of the cells is reached again. The separation of the bubbles follows which are then put into an aqueous solution. Due to the permeability of the bubble skin, the heavy metal ions, e.g. nickel, can diffuse from the solution into the bubbles and be converted there by the complexing agents into hard-to-dissociate insoluble complexes. The cells are separated by flotation, sedimentation, filtration, or centrifuging.
KEY uranium, seawater, water, extraction, trace metals, chemistry, marine organisms

521 AUTH Zimmermann,U.
DATE 1975
TITL Method to separate ionized substances with special chemical or physical characteristics from an aqueous solution.
CITA German (FRG) Patent 2,326,224/B/: (1975). (German).
COUN W Germany
ABST Ionized substances may be separated from aqueous solutions containing at least 0.5 mm Mg and/or Ca or K ions with the aid of complexing agents which form compounds hard to dissociate or dissolve with the substances to be separated. The present method uses bubbles of living cells (e.g. bacterial cells) containing complexing agents, whose osmolarity is different from that of the aqueous solution. Mass transfer takes place through the cell membrane. Separation is carried out by well-known processes (flotation, sedimentation, filtration etc.). The varying osmolarity of the successive process steps is achieved by adding osmotically active substances. It is one of the main advantages of the process that the

(CONT.)

acidity of seawater need not be changed in the case of substances dissolved in seawater. Also, raw materials can be regained from waste water in an economical way. For different ionized substances to be extracted and separated from each other, suitable complexing agents may be used one after the other or in separate chambers. The process also works with low-molecular complexing agents (e.g. uranium extraction from seawater using 8 -hydroxychinoline). When using bacterial cells, the process is carried out at temperatures between 15°C and 40°C, pH 8, with addition of the potassium salt of ethylene diamine-tetracetic acid and lysozyme. The example given in the paper describes a solution for the extraction of nickel.

KEY marine organisms, uranium, seawater, extraction, trace metals, chemistry, filtration, temperature, water

CHAPTER 3

APPENDICES

3.1 AUTHOR INDEX

The following listing is a compilation of the bibliography according to the last name of all the authors. Following each author's name are each of the citation numbers and references for that author found in Chapter 2.

AUTHOR - TITLE INDEX

3.2 COUNTRY OF AUTHOR INDEX

The following listing is a compilation of the bibliography according to the country of the author. For each country, entries are listed by the citation number and name of authors, as found in Chapter 2.

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3.3 KEYWORD INDEX

The following listing is a compilation of the bibliography according to various keywords. Under each keyword, the citation numbers, as found in Chapter 2, are listed.

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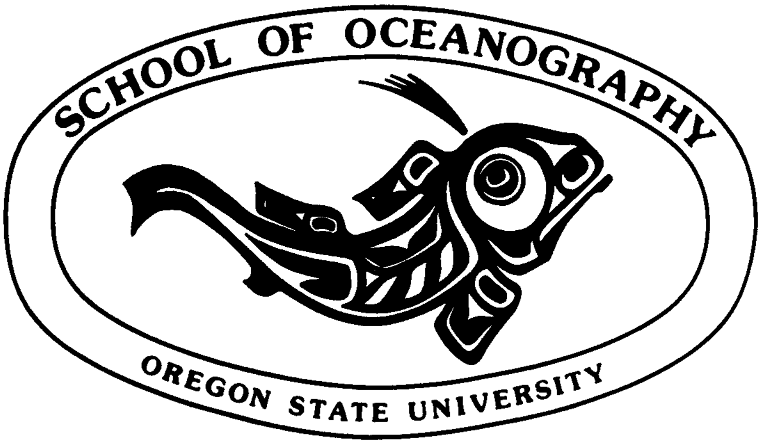
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