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ABSTRACT BOOK

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The first part of this paper presents the levels of natural radionuclides in these NORM industries in order to compare with the obtained ones at the reference station and, based on the activity ratios of several measured radionuclides, to delimitate the origin of the aerosols existing in the air from these NORM industries. Based on these results, an estimation of the enhancement of radiological doses due to aerosol inhalation has been done in occupational workers from these plants. The results show that in the fertiliser plants there are enhancements in U-series radionuclides concentrations due to several internal activities as material transport, milling, etc., while in the pigment TiO2 one the enhancements founds come mainly from Th-series radionuclides. In both industries the radiological doses received by workers are negligible. * Author for correspondence: rafa.lozano@dfa.uhu.es

POSTERS IV - MEDICAL & ENVIRONMENTAL APPLICATIONS: 29

Behavior of U- and Th-Isotopes in Sediments from an Estuary Affected by Acid Mine Drainage

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The estuary formed by the Tinto and Odiel rivers is an ecosystem of great interest due to is very conditioned by two hydrochemical facts. The first one comes from both rivers are seriously affected by acid mine drainage (AMD) from long-term mining activities developed in the Iberian Pyrite Belt that produce in these rivers a high transport high of heavy metals due to their extremely low pH (2.5-3.5 depending of season raining). Secondly, in their mouths there is a large industrial complex which includes five phosphate rock processing plants that produce annually about 3 millions of tons of a byproduct called phosphogypsum (PG) containing high U-series radionuclides concentrations. Until 1998, about 20 % of the generated PG was discharged directly into the estuarine waters, while the remaining 80 % was pumped in suspension with sea water (20 % PG plus 80 % seawater) to be disposed in large piles located on the Tinto river salt-marshes. For these reasons, the estuary of Huelva is one of the most heavy metal and radionuclide polluted estuarine systems in the world.

Fifteen sampling stations along this estuary were selected to study this system, and for that we used sediment traps to take recent surface sediments during 2007 and 2008 years in four seasonal samplings. U and Th-isotopes activity concentrations were determined in these samples by alpha-particle spectrometry, using a sequential radiochemical method based on extraction chromatography (UTEVA resins). The annual average U-238 activity concentration at every sampling point increases depending on pH up to values around 1300 Bq/kg, while smaller Th-230 concentrations have been found (up to 160 Bq/kg). The maximum of concentration for thorium is produced for higher values of pH (about 7) that for uranium (around 4). We can affirm that U- and Th-isotopes activity concentrations of these elements along the estuary are very conditioned by the mixing processes existing in the estuarine waters (pH-induced and salt-induced), and for that reasons we can affirm that behavior of these isotopes is very dependent of pH and salinity of the estuarine water.

The general conclusion of this study is that the physicochemical characteristics of water masses and tidal activity are the main factors controlling the radionuclides transfers from water into sediment or particulate matter. In turn, the results have led us to hypothesize existence of different sources of radionuclide pollution (acid mine drainage and fertilizer factories), which will be confirmed by further study of water and suspended matter.

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Radionuclide measurements as tool for geophysical studies on Mt. Etna Volcano (Sicily)

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In the last ten years we carried out several radioactivity investigations on Mt. Etna with the main purpose to investigate precursors of geodynamic events. As known, many studies have shown that radon can be a precursor of geophysical events, most of them were performed either on tectonic area or on volcanic area. The peculiarity of our investigation lays on the choice of the etnean region, in which both tectonic and volcanic features are present. Mt. Etna is a complex volcano (more than 3300 m high and 40 km in diameter) with four summit craters and more than 300 lateral vents and cones on its flanks. Its actual volcanic behavior consists of fire fountains and lava flows from all four summit craters and eruptions from lateral vent fissures prevalently on south and east flanks. Volcanic activity could be preceded and accompanied by strong seismic swarm or increasing volcanic tremor. In order to characterize Mt. Etna features through in-soil radon gas investigation, two stations were located along the NE-SW direction on Mt. Etna. Each of the two stations was provided with a radon detection active system (composed by soil probe, aspiration pump and ionization chamber), 3D seismic device and meteorological station. The analysis of data, continuously acquired in more than two years, shown that the main active flank was the East one, where correlation between radon concentration trend and geodynamic activity, in particular the magma uprising, was found. Then, with the aim of choosing suitable sites for a continuous monitoring net, other investigations were performed on the East etnean area. The individuation of several sites for soil Radon monitoring could also become a very useful tool for understanding the volcano dynamism. In order to reach this purpose, both in-soil Radon measurements and laboratory analysis were performed. The in-soil measurements were performed by means of passive detectors, located, in each site, at five different depths. From the vertical concentration profile, the Radon diffusion coefficient was extracted. With the aim to characterize radiogeologically the east flank, laboratory analysis were performed on rock samples collected in the chosen sites, in order to determine both Uranium and Thorium contents and exhalation rate. Moreover, since Etna volcano is a tectonic area too, studies interested the investigation of active faults. For this purpose in soil investigations were carried out along the Pernicana fault. Three different methodologies were used to measure in-soil Radon, based on both passive and active detection techniques; soil carbondioxide(CO_2) efflux was determined too. Along the fault plane in-soil radon concentrations were measured at one meter depth and at different distances from the fault plane and were correlated to CO_2 flux values, as a tool to study diffusion process of radon and its role as tracer of geogas.

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Fate of Copper in an Ash and Sludge Plasma Melting Process

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Leachable copper in the laboratory waste incineration ashes and wastewater inorganic sludge frequently excesses the limit of the Taiwan EPA toxic characteristic leaching procedure (TCLP) (15 mg/L). To reduce the TCLP concentration of copper, the solid wastes were thermally stabilized by plasma melting. By X-ray absorption (near edge structure (XANES) and extended X-ray adsorption fine structure (EXAFS)) spectroscopy, it is found that the major copper species in the fly ashes are CuO (38%), CuS (2%), and CuSO4 (60%) while the sludge contains CuO (30%), CuS (50%), CuSO4 (2%), CuCl (6%), and Cu(OH)2 (12%). At the temperatures of 1673-1773 K, under the reducing environment, the ashes and sludge are converted to slag in the plasma melting chamber. To track speciation of copper during melting of the ash and sludge, representative slags from the melting chamber at four temperature zones between 1073 and 1773 K were sampled and studied by XRD, XANES, and EXAFS. At 1773 K, the slag contains mainly low oxidation state copper (Cu(0) (19%) and Cu(I) (51%)). As the slag is cooled down to 1073 K, Cu(0) is oxidized and forms Cu(I). Note that in the slag, copper is encapsulated in the SiO2 matrix, which also causes a reduction of the leachable concentration of copper from the slag by at least 60%. The Cu-O-Si species with bond distances of 1.99 Å (Cu-O), 2.14 Å (Cu-(O)-Cu) and 2.01 Å (Cu-(O)-Si) are also observed by EXAFS.

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Extraction of Arsenic from a Soil in the Blackfoot Disease Endemic Area with Ionic Liquids

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Speciation of arsenic extracted with room temperature ionic liquids (RTILs) ([bmim][BF4] (1-butyl-3-methylimidazolium tetrafluoroborate) and [bmim][PF6] (1-butyl-3-methylimidazolium hexafluorophosphate)) from an As-humic acid (As-HA) complex contaminated soil (As-HA/soil) in a blackfoot disease endemic area has been studied by X-ray absorption (near edge structure (XANES) and extended X-ray absorption fine structure (EXAFS)) spectroscopy. About 45% of arsenic in the As-HA/soil can be extracted with the [bmim][BF4] while the relatively less hydrophobic [bmim][PF6] extracts 25% of arsenic. The extracted arsenic in the [bmim][BF4] and [bmim][PF6] from the As-HA/soil possesses mainly As(III) species, suggesting that reduction of As(V) may be involved in the extraction process. Note that the As(III) species may form a chemical structure of HAsO2 confined in the matrix of the RTILs. The refined EXAFS spectra also indicate that the As(III) extracted in the RTILs has a tetrahedral structure with the As-O bond distances of 1.77-1.79 Å. This work exemplifies the use of EXAFS and XANES to reveal speciation and possible reaction pathways during extraction of toxic metals (i.e., arsenic) from a metal complex contaminated soil.