

PRELIMINARY U ISOTOPIC DATA IN THE CÁDIZ COASTAL AREA (SW SPAIN) AS PROXY FOR COASTAL GROUNDWATER DISCHARGE

Rodrigo, J.F.^{1,2}, Martínez-Ramos, C¹, Barbero, L², Casas-Ruiz, M¹, Baskaran, M³, Ketterer, M⁴

¹Department of Applied Physics, Cádiz University, Av. República Saharaui s/n, 11510, Puerto Real, Cádiz, Spain.

juanfrancisco.rodrigo@uca.es, celia.martinez@uca.es, melquiades.casas@uca.es.

²Department of Earth Sciences, Cádiz University, Av. República Saharaui s/n, 11510, Puerto Real, Cádiz, Spain. luis.barbero@uca.es.

³Department of Geology, Wayne State University, Detroit, MI 48202, USA. Baskaran@wayne.edu.

⁴Department of Chemistry, Northern Arizona University, Box 5698, Flagstaff, AZ 86011-5698, USA. Michael.Ketterer@nau.edu.

Abstract - Sampling was performed at points in the Bay of Cádiz in order to obtain activity ratio $^{234}\text{U}/^{238}\text{U}$ and the concentration of U in each of the sampling points. These samples were analyzed through ICP-MS (Inductively Coupled Plasma Mass Spectrometry) [1]. The results indicate that many of the activity ratios are very close to the seawater ratio. The U concentrations are very similar to those expected for average seawater, though some stations are evident lower.

Keywords: ICP-MS, $^{234}\text{U}/^{238}\text{U}$ activity ratios, coastal aquifers, SGD.

INTRODUCTION

Recently there has been a growing interest in knowing the concentration of various radionuclides that can affect directly human health [2]. There are few studies of this kind in the area of the Bay of Cádiz, SW of Spain. Therefore, we feel necessary to study and establish existing levels of U and $^{234}\text{U}/^{238}\text{U}$ activity ratios in water from wells in this area. From this, in a future work, we will also characterize submarine groundwater discharge (SGD) in this zone [3].

MATERIALS & METHODS

Several seawater and groundwater samples (500 mL) have been taken with the aim of estimating the $^{234}\text{U}/^{238}\text{U}$ activity ratios and U concentrations in Cadiz coastal zone.

By ICP-MS techniques a solution of U prepared from modern coral (exhibiting a seawater ratio of 1.148 ± 0.002) was used as a control to correct for the observed mass discrimination. Three blanks (composed of deionized water) were prepared and analyzed along with the samples. The analyses of these blanks reveal no significant contribution in either the activity ratio or the concentration data though appropriate blank subtractions.

RESULTS AND DISCUSSION

Given that the accepted $\text{AR}_{234/238}$ value for seawater is 1.148 ± 0.002 and the one- σ uncertainties in U concentrations are conservatively estimated as $\pm 0.05 \mu\text{g/L}$, the detection limit for determination of U in water by this procedure (after 100x dilution) is about $0.02 \mu\text{g/L}$.

Obtained results indicate that many of the activity ratios are very close to the seawater ratio. The range of obtained values ranged from 1.135 ± 0.015 to 1.336 ± 0.030 . In the case of wells present in coastal aquifers, it has been found that are apparently exhibiting ratios slightly higher than seawater, though this could be clarified with more precise data.

CONCLUSIONS

The U concentrations are very similar to those expected for average seawater, though in wells closest to the coast are evident lower.

There is some evidence of the existence of submarine groundwater discharge (SGD) based on the hydrologic input-output balance performed in the area by the Spanish Geological Survey.

Future work include the comparison of the obtained results with radio isotopes data and re-performing these measurements with greater precision making a new laboratory protocol and interpret these data against the general objectives of the seawater – groundwater mixing research.

REFERENCES

- [1] Halicz, L., Segal, I., Gavrieli, I., Lorber, A., Karpas, Z., Determination of the $^{234}\text{U}/^{238}\text{U}$ ratio in water samples by inductively coupled plasma mass spectrometry, *Analytica Chimica Acta*, 2000. 422: 203 – 208.
- [2] Henderson, G.H. Seawater ($^{234}\text{U}/^{238}\text{U}$) during the last 800 thousand years, *Earth and Planetary Science Letters*, 2002. 199: 97 – 110.
- [3] Suksi, J., Rasilainen, K., Pitkänen, P., Variations in $^{234}\text{U}/^{238}\text{U}$ activity ratios in groundwater. A key to flow system characterization?, *Physics and Chemistry of the Earth*, 2006. 31: 556 – 571.

Table 1. $\text{AR}_{234/238}$ and U concentrations for each of the sampling stations

Sample Id.	$\text{AR}_{234/238}$ *	U ($\mu\text{g/L}$)**
1	1.143 ± 0.013	3.34
2	1.148 ± 0.013	3.36
3	1.149 ± 0.010	3.37
17	1.158 ± 0.003	3.39
4	1.151 ± 0.007	3.38
5	1.149 ± 0.011	3.39
6	1.155 ± 0.011	3.52
7	1.154 ± 0.018	1.10
8	1.215 ± 0.013	2.17
18	1.216 ± 0.009	2.28
9	1.181 ± 0.010	2.91
10	1.167 ± 0.008	3.23
11	1.135 ± 0.015	3.45
12	1.336 ± 0.030	1.22

*The accepted $\text{AR}_{234/238}$ value for seawater is 1.148 ± 0.002 .

**The one- σ uncertainties in U concentrations are conservatively estimated as $\pm 0.05 \mu\text{g/L}$. The detection limit for determination of U in water by this procedure (after 100x dilution) is about $0.02 \mu\text{g/L}$.

