U behaviour under acid mine drainage conditions: Preliminary results from an experimental approach in Río Tinto area (Spain)

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Preliminary results show that dissolved U and Th concentrations in water samples collected from río Tinto area is 2-3 orders of magnitude higher than that in the environmental base-levels in undisturbed areas with 234U/238U activity ratios (UAR) much higher than 1, thus indicating a strong disequilibria. Taking into account that under low pH conditions, congruent dissolution rates are high, this disequilibrium is surprising. Different waste pile rocks that include bedrock Fe oxi-hydroxides, gossans and country rocks have been used for conducting a set of leaching experiments. Results indicate that: 1) Distilled water leaching, although creating an acidic media very rapidly, do not generate leachates with UAR higher than 1.8 in most cases UAR being close to unity; 2) Leaching with different mixtures of acetic acid and ammonium oxalate lead to very high UAR ratios in leachates from Fe-bearing ochre bedrock sediments; 3) Sulphuric acid leaching experiments also generate leachates with high UAR ratios in Fe-rich materials, this not being dependent on acid concentration; and 4) Sulfuric acid leaching after annealing of Fe-oxi-hydroxides at 800ºC during several hours results in leachates with UAR close to unity. All these results indicate that not only the leachant but also the extent (?) of radiation damage in Fe-oxi-hydroxides play an important role in the origin of U isotope disequilibrium under acidic conditions.

Melting of an hybryd source below the Danakil Region

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The Danakil region is a modern example of rifting located atop a mantle plume. Along the rift system, a large number of shield volcanoes erupted large volumes of tholeiitic magmas with a wide compositional range, generally enriched in incompatible and trace elements, reflecting the source heterogeneity and the variability of melting processes that contributed to their generation. The Danakil lavas represent the combined product of continental rifting and ascending mantle plume processes.

Major and trace elements were analyzed in modern lavas sampled from the Erta Ale Chain and the Asal region and compared to literature data. Although highly enriched in trace elements, our lavas are significantly different when compared to the Oligocene main lava suites generated in the earliest stages of mantle plume activity. Based on La/Sm, Rb/Sr and Zr/Nb ratios and REE abundances they are intermediate between the high-Ti primitive lavas and the low-Ti tholeiitic basalts erupted 30 Ma ago due to the arrival of the plume-head. Trace elements abundances and geochemical modelling indicate that our lavas derive from a “hybrid” source characterized by a great complexity, possibly a metasomatized sublitospheric-mantle component that includes hydrous phases and melting at depths lower than those that generated the Oligocene lavas.

The wide compositional range of the Afar lavas suggests that those modern lavas erupted along the rift are not simply the product of melting of a deep mantle plume but derive from a composite source resulting from the interaction between the plume tail and the surrounding sublithospheric mantle previously metasomatized by the plume activity. As a consequence, this very complex and heterogeneous source undergoes extremely variable melting processes as testified by the characteristic chemistry of each volcanic complex.

Further geochemical and isotopic investigations will help to better constrain the signature and contribution of each of the reservoirs and to what extent the mantle is metasomatized by hydrous phases below the Afar region.

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