Anthropogenic natural radionuclide activity ratios as chronological markers in sediments from the Huelva Estuary

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Since the middle of the 1960's, it is located on the margins of the Huelva estuary (SW Spain), a large industrial complex which include two plants producing phosphoric acid. These plants have discharged historically large amounts of wastes into the estuary, highly enriched in uranium series radionuclides, especially ^{226}Ra, ^{230}Th, ^{210}Pb and ^{210}Po.

Additionally, significant heavy metal polution is affecting the Huelva estuary. Two are the main sources of this pollution. A long-term component due to extensive mining activities for more than twenty centuries in the basins of the two rivers discharging their waters in the estuary, and a short-term component coming from a plant located in the estuary that extracts Cu from pyrites.

In order to distinguish the different sources of heavy metal pollution in the estuarine sediments and to connect the evolution of the heavy metals and other pollutants with the history of mining and industry, much attention need to be paid to sediment dating. However, the radioactive contamination affecting some layers of the sediment cores hinders the application of the ^{210}Pb method in full extent.

In our studies of a good collection of sediment cores taken in the Huelva estuary, we have found the uselfuness of the the ^{226}Ra/^{228}Ra and ^{230}Th/^{232}Th activity ratio profiles to stablish well resolved chronological marks in them. These marks have been validated by using the well-stablished ^{137}Cs dating technique and allow the determination of average sedimentation rates in the radionuclide contaminated zones of the sediment cores, as well as the proper implementation of the ^{210}Pb dating method in the uncontaminated sections. Then, a confident chronology covering the last 100-125 years can be established.

In this communication a description of the mentioned dating approach will be performed and its implementation in several sediment cores of the estuary will be discussed.

Migration and accumulation of ultra-depleted subduction-related melts in the Massif du Sud ophiolite (New Caledonia)

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The Massif du Sud is a large ophiolitic complex that crops out in the southern region of New Caledonia (SW Pacific). It is dominated by harzburgite tectonite that locally shows a transitional gradation to massive dunite up section. Clinopyroxene, orthopyroxene and plagioclase progressively appear in dunite up to the transition to layered wehrlite and orthopyroxene-gabbro.

Highly depleted modal, mineral and whole-rock compositions indicate that harzburgites are residues after high degrees (20-30%) of partial melting mainly in the spinel-stability field. Dunite formed in the Moho transition zone by reaction between residual mantle harzburgite and olivine-saturated melts that led to pyroxene dissolution and olivine precipitation. Locally, rare clinopyroxene and plagioclase crystallized in interstitial melt pores of dunite from primitive, low-TiO_2, ultra-depleted liquids with a signature transitional between those of island arc tholeiites and boninites.

Ascending batches of relatively high-SiO_2, ultra-depleted melts percolated through the Moho transition zone and generated wehrlite by olivine dissolution and crystallization of clinopyroxene, orthopyroxene and plagioclase in variable amounts. Similar but distinct magmas ascended to the lower crust where they generated ultra-depleted gabbroic cumulates with subduction-related affinity. Thus, the ultramafic and mafic rocks in the Moho transition zone and lower crust of the Massif du Sud ophiolite are results of percolation and accumulation of different liquids in a multi-stage evolution.

Extreme partial melting in the mantle section, and migration and accumulation of ultra-depleted subduction-related melts in the Moho transition zone and lower crust support that the Massif du Sud ophiolite is a portion of forearc lithosphere generated in an extensional regime during the early phases of the subduction zone evolution.