

Power and pitfalls of trace element geochemistry in zircon from high-temperature–high-pressure rocks: Some examples from NW Spain

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The linkage between zircon zones, petrogenetic processes and U-Pb ages classically relies on Th/U ratios and on the textural features unveiled by cathodoluminescence (CL). However, these tools can be misleading when dealing with zircon from complex metamorphic rocks, where several magmatic and metamorphic events might be preserved. In such cases, the information provided by the trace element (TE) geochemistry in zircon can be pivotal to recognize accompanying metamorphic phases (garnet and plagioclase) or to estimate temperatures of zircon formation.

In the high-temperature–high-pressure (HT–HP) unit of the Cabo Ortegal Complex (NW Spain), zircon from a mafic eclogite boudin yielded 395 Ma. CL images reveal textures typical of magmatic zircon (oscillatory zoning) and Th/U ratios higher than 0.1, suggesting magmatic growth conditions. However, flat HREE patterns and the absence of an Eu anomaly clearly indicate zircon growth with garnet and no plagioclase (eclogitic conditions).

In spite of its advantages, TE geochemistry in zircon must be used with caution when the host rocks crystallize in settings where magmatic and metamorphic conditions are difficult to distinguish. An ultramafic rock from the HT–HP unit crystallized under eclogitic conditions and yielded two distinct ages (396±3 Ma and 390±2 Ma), similar to other metamorphic ages obtained in that unit. Most of the analyzed spots have fractionated HREE and their chemistry indicate a magmatic origin. However, the absence of an Eu anomaly, the Ti-in-zircon temperatures, too low for an ultramafic rock, and the evolution of the HT–HP unit suggest that zircon grew under high temperature eclogitic conditions.

This sample poses a question on the magmatic or metamorphic nature of zircon grown in igneous rocks crystallized under HT–HP metamorphic conditions.

Iron isotope-fractionation in coastal aquifers from the Grado-Marano lagoon, Adriatic Sea (Italy): preliminary results

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The iron isotopic systematics have been applied to study the interconversion between soluble reduced species and insoluble oxyhydroxides due to redox boundaries in groundwaters from the Grado-Marano lagoon, northern Adriatic Sea (Italy), an area characterized by ferrous iron-rich coastal aquifers. Groundwaters for isotopic analysis were flushed through piezometers, filtered and immediately acidified to prevent the effects of oxidation reactions. The $\delta^{56}\text{Fe}$ value ranges between -7.70 ± 0.38 and $+0.50\pm 0.28$, showing a progressive increase approaching the shoreline. Nevertheless, the Fe isotopic fractionation does not correlate with the chloride content, as would be expected, if the seawater-groundwater interface beneath the coastline played a major role in the iron oxidation rate. A trend of decreasing $\delta^{56}\text{Fe}$ with decreasing $\text{Fe (II)}_{(\text{aq})}$ activity is observed, and the water sample with the higher iron concentration among those studied (212 $\mu\text{M/L}$) shows the $\delta^{56}\text{Fe}$ value approaching the iron isotopic composition reported for rocks and soils. A lithogenic source for iron is suggested; the observed isotopically very light aqueous iron and the variation in the $^{56}\text{Fe}/^{54}\text{Fe}$ ratio are interpreted as reflecting redox cycling, with progressive isotopic fractionation during Fe (II) adsorption onto newly formed ferric iron oxyhydroxides which precipitate to form immobile particles in the sediments.