

Oxygen isotope profile of the lower ocean crust: an in-situ study by UV-laser-ablation oxygen isotope microprobe

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Systematic analysis of mineral oxygen isotope compositions in gabbro has the potential to find out whether and under what conditions seawater interacts with plutonic rocks from the deeper part of the oceanic crust to constrain both the nature of oceanic crust that is recycled into the mantle through subduction, as well as the cooling history of the lower ocean crust. So we have measured 10 representative samples of gabbro from Hole 735B of Leg 176 by UV-laser oxygen isotope microprobe for the oxygen isotopic compositions of their constituent minerals.

Plagioclase-pyroxene pairs of Hole 735 B gabbro show disequilibrium pattern in the $\delta^{18}\text{O}$ space for their oxygen isotope composition. Plagioclase has an overall $\delta^{18}\text{O}$ enrichment through the depth, while $\delta^{18}\text{O}$ values of clinopyroxene show decrease with depth. The contrast behaviour between plagioclase and clinopyroxene suggests that the gabbroic crust has encountered a two-stage alteration during its cooling history. Considering the relatively unaltered constant $\delta^{18}\text{O}$ values of olivine and clinopyroxene, the modification of the O-isotope composition of plagioclase must occur at a temperature that is higher or equal to the closure temperature for O-isotopes in plagioclase but lower than that for olivine and clinopyroxene. This may reflect the melt mixing or external fluid infiltration during cooling.

Contrast to the depletion patterns of most other lower oceanic crust, Hole 735B gabbros show an enrichment of $\delta^{18}\text{O}$, this may reflect the difference in hydrothermal activation associated with different spreading rate.

References

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Geochemical self-organization of mixed siliciclastic-carbonate sediments in estuarine-like systems

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The dissipative structures concepts are usually addressed to study the evolutionary behaviour in complex, open far from equilibrium systems when they approach to a steady state configuration. This may result in the emergence of spatial and temporal macroscopic patterns expressed as functional or morphological aspects of the system. In this study, the mixing processes taking place between siliciclastic and carbonate sediments in an estuarine-like environment (Ria de Vigo, NW Spain) have been analysed following that point of view. The main goal is to evaluate how local variations in parameters, as specific solubility or grain size of minerals, result in the formation of macroscopic patterns by coupling with sediment dynamics.

The work was firstly based on an accurate study of the mineral contents in sediments from 13 gravity corers sampled every 5cm up to 25 cm. Quantification of identified phases was carried out using the Rietveld method and applied to perform both surface and deep maps, relating space-distributions of minerals. Firstly, surface maps were used to relate the specific percentage amount between mineral pairs, to the grain size distributions following defined sections of the study area. A coupled behaviour was found for the particular case of plagioclases and carbonates. This is characterized by a cross-linked distribution for the relative amounts on each mineral, indicating a straightforward relation with the grain size for the plagioclase curve and opposite for the carbonate one (García *et al.*, 2000). Secondly, the surficial and deep maps have been compared in order to evaluate the extent of preservation of the surface mineral configuration into the depth. This allows us to obtain a three-dimensional view of the chemical transformation processes in the sediment during the burial, taking into account both the diffusion and the advection mechanisms.

As a result, this study shows the existence of geochemical organised patterns which in surficial sediments manifest through opposite abundances between certain minerals from both fractions controlled by the dissolution kinetics according to the grain size, whereas with burial are driven vertically by the diffusion-reaction processes taking place during early diagenesis. As a consequence, characteristic 3D-patterns resulting from the coupling between the surface distribution and the sequence of diagenetic reactions involving clays, sulphides, feldspars and carbonates have been analysed.

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