The main MORB crustal contaminant: Geochemistry of magma chamber roof experimental anatectic melts, and residues

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Mid-ocean ridge basalt (MORB) is the most abundant magma type at the Earth's surface. It is widely studied to infer mantle compositions and melting processes. However, MORB liquids are also the complex end-product of a variety of intra-crustal processes such as fractional crystallization, melt-rock interaction, and contamination. Deciphering the relative contribution of these processes is of first-order importance. Contamination at ocean crustal levels is likely, and may occur at magma chamber margins where fresh magmas can interact with previously hydrothermally altered rocks. Characterizing the composition of this crustal contaminant component is critical if we are to understand the relative importance of each component in the resulting MORB liquid.

In this contribution we present the results of experiments that reproduce the natural processes occurring at oceanic magma chamber roofs, by melting a representative sample of the sheeted dike complex. Anatectic melts thus produced represent the main MORB crustal contaminant. We characterize these melts for major and trace elements, showing them to be enriched in B, Zr, Hf, and depleted in Sr, Ti, V. In comparison to MORB series, we also document relative element fractionations, with enrichments of: Th relative to Ba; U relative to Nb; Nd relative to Sr; and Hf relative to Sm. We derive bulk partition coefficients for element partitioning during magma chamber roof anatexis; those are valuable tools for tracking MORB contamination.

Comparison with natural samples from the East Pacific Rise and the Oman ophiolite shows that anatectic melts can crystallize *in situ* to form oceanic plagiogranite intrusions, and that residual assemblages associated with the hydrous partial melting stage are represented by the granoblastic dikes and enclaves (also named beerbachites) commonly recognized at the root of the sheeted dike complex at present-day and fossil oceanic spreading centers.

Balancing chemical and physical erosion in the Ganga basin

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River basins at various scales undergo both physical and chemical erosion that should be balanced over long time scale. At short time scale of few years to tenth of years, it is however unlikely that steady state of erosion is verified. More likely, under variable climatic or geomorphologic conditions one term of erosion may be favoured over the other. Testing such imbalance is difficult because it requires to compare fluxes of weathering from both dissolved and particle phases.

Here we examine modern budget of erosion of three imbricated Himalayan basins: the Khudi river that is a small stream on south Himalayan flank, the Narayani drainage of central Nepal and the whole Ganga basin. Areas vary from 153 to 872000 km2. This approach is based on daily sampling of suspended sediments that allow refine estimates of average composition of the dissolved and particle loads. We then compare direct weathering fluxes of Na and K deduced from dissolved load to weathering fluxes deduced from the comparison between estimated source rock and exported sediments. Uncertainties are principally linked to the net sediment flux determinations and to the knowledge of average source rock composition. For both Ganga and Narayani, the estimates tend to indicate that physical erosion and chemical erosion are close to balance within uncertainties. In contrast, the Khudi basin show clear imbalance in favour of physical erosion. This is likely due to the exceptional intensity of landslide erosion than to intensified soil erosion in this basin.

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