Fate and geochemical imprint of deeply subducting sediments: Evidence from HP/UHP metamorphic suites

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Existing geochemical data for HP/UHP metasedimentary suites serve in characterizing ways in which sedimentary geochemical signatures are conveyed to, and modified and redistributed at, great depths in subduction zones. Greater understanding of these processes is required in efforts to understand the origin of the commonly presumed sedimentary signatures in arc lavas, arc volcanic gases, and OIB [1].

Devolatilization (and fluid-rock interactions involving externally-derived fluids) and partial melting (water-saturated and dehydration-driven) can produce “fluids” with sedimentary element and isotopic signatures, with HP/UHP metasedimentary rocks representing residues of this release. Studies of HP/UHP metasedimentary rocks demonstrate impressive retention of trace elements thought to be relatively fluid-mobile (B, Cs, N), perhaps to depths of 90 km [1, 2].

In mélange units, sedimentary contributions are preserved in major/trace element and Sr-Nd-Pb isotope compositions of mélange matrix [3]. Mélange formation produces hybridized bulk compositions, with sedimentary, mafic, and ultramafic characteristics, capable of exerting their influence on the compositions of “fluids” with which they interact. One theme emerging from work on HP/UHP metabasalts concerns the addition of sedimentary signatures (Ba, Pb, Th, B, N, LREE, and isotopic compositions) to mafic rocks via fluid-rock interactions. Metasomatized metabasalts could thus convey these signatures to greater depths, affecting profiles of release of sedimentary “fluids” across individual arc-trench systems.

This work requires detailed petrologic investigation to determine prograde P-T trajectories and extents of overprinting resulting from protracted exhumation history [1]. Future research should prioritize study of UHP metasedimentary suites that experienced partial melting at >100 km, with the goal of better characterizing sediment "fluid" additions to arcs and the compositions of residues that could impact geochemistry of OIB source regions.

[1] Bebout (2007) *Earth Planet. Sci. Lett.* **260**, 373-393.
[2] Busigny *et al.* (2003) *Earth Planet. Sci. Lett.* **215**, 27-42.
[3] King *et al.* (2007) *Chem. Geol.* **239**, 305-322.

Biogeochemistry of POM in lakes of different trophic levels

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Biomarker composition of particulate organic matter (POM) from the oligotrophic Lake Brienz and the eutrophic Lake Lugano (both in Switzerland) are compared. Differences in primary production and water-column stratification are responsible for the anoxic bottom water below 70-m in Lake Lugano and for the well-oxygenated bottom water of Lake Brienz. These differences are reflected by enhanced alkalinity, TOC, and sulfate and chloride concentrations of Lake Lugano. POM at 10, 40, 70, 100, 150, and 200-m water depths was filtered. Enhanced mineralisation of OM within Lake Lugano is indicated by lower $\delta^{13}C$ values of dissolved inorganic carbon.

Lower concentrations of total fatty acids (TFAs) are obtained from Lake Brienz at all water depths, and during fall as compared to the spring contents of both lakes. Fatty acid (FA) distribution patterns indicate a predominant autochthonous OM source (algae, zooplankton, bacteria) and generally minor contributions from aquatic macrophyte and land plants. Differences in OM degradation are reflected by water-depth profiles of relative proportions of saturated *n*-FAs, mono- and polyunsaturated *n*-FAs, and branched-chain FAs. The results indicate enhanced bacterial activity in the water column of Lake Lugano at and below the chemocline and intensified degradation of OM during fall in both lakes.

The composition of *n*-alkanols indicate algal and bacterial sources with minor contributions from land plants. The occurrence of branched alcohols (C_{13}-C_{19}) argues for *in situ* microbial synthesis. Phytol is the dominant branched alkenol in POM of near-surface waters. Depth profiles are characterised by increasing proportions of *n*-alkanols in Lake Brienz, and during fall in Lake Lugano. POM from spring water samples of Lake Lugano show maximum relative proportions of sterols close to the chemocline. Inputs of OM from diatoms are reflected by highly-branched isoprenoid (HBI) alkenes and C_{28}-sterols (brassicasterol, dihydrobrassicasterol). Sitosterol and stigmasterol are attributed to vascular plant inputs, but may be also derived from algae and cyanobacteria. Very high relative proportions of cholesterol in the fall samples may indicate increased inputs from zooplankton grazing on the phytoplankton in the water column.