Split-stream ICPMS migmatite geochemistry: significance for the rheologic evolution of the Western Gneiss Region, Norway

S.M. GORDON[1], D.L. WHITNEY[2], C. TEYSSIER[2], H. FOSSEN[3] AND J. DESORMEAU[1]

[1]Geological Sciences, U of Nevada, Reno, NV, USA, staciag@unr.edu
[2]Earth Sciences, U of Minnesota, Minneapolis, MN, USA
[3]Earth Science, U of Bergen, Bergen, Norway

Exhumed ultrahigh-pressure (UHP) terranes document the subduction of crustal material to mantle depths and its return to the Earth's surface. The Western Gneiss Region (WGR), Norway, is one of the two largest UHP terranes on Earth and consists of a UHP eclogite terrain and a HP granulite terrain that may represent overprinted eclogite; these are separated by a major strike-slip shear zone. To evaluate the geochemical and age relationships of migmatite and mafic pods in both regions, we obtained LA-ICP-MS U-Pb dates and trace-element analyses for zircon from a variety of textural types of leucosome associated with mafic pods. Five leucosomes within highly deformed migmatite in the HP granulite terrain reveal U-Pb lower-intercept ages from ca. 405 to 409 Ma and upper-intercept Proterozoic dates. The Caledonian zircons all have flat Eu anomalies and weakly steep HREE patterns, suggesting HP crystallization. Similar results were obtained from zircon rims extracted from the UHP terrain, with garnet-present ± plagioclase-absent REE patterns and dates as old as 410–406 Ma. The new U-Pb dates suggest a similar melt crystallization history that was coeval with previously determined ages of (U)HP metamorphism of WGR eclogite. Results are consistent with the presence of partially molten crust in a large part of the WGR at HP or UHP conditions. The decreased viscosity and increased buoyancy and strain weakening induced by partial melting may have assisted rapid ascent of HP/UHP rocks from mantle to crustal depths.

Formation mechanisms of reaction zones in Mélange zones: Evidence for mechanical mixing

J.K. GORMAN[1*], S. PENNISTON-DORLAND[1], R.J. WALKER[1], AND H. MARSCHALL[2]

[1]Department of Geology, University of Marlyand, College Park, MD 20742, (*email: jgorman1@umd.edu)
[2]Department of Geology and Geophysics, Woods Hole Oceanographic Institution, Woods Hole, MA 02543

Three mechanisms have been proposed to operate within mélange zones to form metasomatic reaction zones between mafic rock and adjacent peridotite. These mechanisms are: 1) mass transfer by fluid flux, likely parallel to reaction zone contacts, 2) mass transfer by diffusion through an intergranular fluid perpendicular to reaction zone contacts, and 3) mechanical mixing of adjacent lithologies. This study utilizes the broad concentration ranges of highly siderophile elements (HSE) across lithologic contacts to elucidate peridotitic contributions to reaction zones. Ultimately this data can help determine the extent of mechanical mixing contribution to reaction zone formation.

Rinds from two amphibolite grade traverses from the Catalina Schist (CA) are enriched in Os, Ir, and Ru relative to the block. Initial $^{187}Os/^{188}Os$ ratios are distinctly lower in the rinds (0.13–0.18) compared to the blocks (0.43–2.23). Lower grade lawsonite-blueschist facies rinds have similar HSE systematics with high $^{187}Os/^{188}Os$ ratios (0.24–0.33) for mafic block cores and lower ratios (0.12) for the rinds. Similar to the Catalina traverses, the Stavros traverse (Syros, Greece) has very high $^{187}Os/^{188}Os$ ratios for the block (4.1–16.6), a low ratio for serpentinite (0.12) and an intermediate ratio for the reaction zone (0.29). $^{187}Os/^{188}Os$ ratios for the Lia Beach traverse (Syros, Greece) are high in the metabasalt (0.32), whereas the nearby serpentinite has the lowest ratio (0.13). The blackwall zone (thought to be formed by diffusion through an intergranular fluid) has variable ratios (0.16–0.80). Concentrations of Os in the blackwall are lower than both the core and serpentinite.

In order to produce the elemental and isotopic variations seen in the rind in the Catalina traverses and the outermost rind of the Stavros traverse, we suggest initial mechanical mixing of block and peridotite to create rind-like material on the edges of the block. The Lia Beach traverse Os data may indicate initial mechanical mixing as well as a combination of metasomatic flux parallel to the contact and diffusion across the contact. In all traverses, concentrations of other elements suggest a later-stage infiltration of fluids after peak metamorphism.

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