High-pressure veins in eclogite from New Caledonia; Implications for fluid migration and seismic activity in subduction zones

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We describe the petrology and geochemistry of high-pressure veins that are hosted by eclogite from northern New Caledonia. The mafic host rock represents seafloor-altered fractionated MORB that underwent subsequent eclogite-facies metamorphism in a subduction zone. The veins are generally cm-thick garnet-quartz-phengite veins that are enveloped by a garnet-poor, omphacite-rich bleach zone. Petrography, thermometry, and oxygen isotope characteristics are used to show that the veins largely formed by fluid-mediated mass transfer for the bleach zones during prograde metamorphism. Vein garnets are inclusion free but preserve major and trace element zoning patterns that are indicative of progressive garnet growth during prograde metamorphism. We propose that the veins formed over a prolonged period during subduction by small-scale circulation of fluids that were sourced from prograde dehydration of minerals in the host rock. Fluid circulation was driven by pressure differentials around garnet porphyroblasts, which led to progressive lateral vein growth. Final interconnection of the vein network over a distance of at least several metres was most likely caused by fracture propagation between the veins. Mass balance calculations, oxygen isotope characteristics, and phengite trace element compositions require the additional of pelite-derived components to the veins, but not to the bleach zones. This indicates that once the veins formed a fluid channelway, the through-flow of externally-derived fluid was restricted to veins, whereas locally-derived fluids were drained out of the host rock and bleach zones.

This model for vein formation is consistent with previous studies that suggest fluid flow in subduction zones is highly restricted. The delay of fluid migration after hydrous mineral breakdown may provide an important source of water for arc magmas as free fluid is transported to deeper levels in subduction zones. Decoupling of fluid flow and mineral dehydration also implies that intraslab earthquakes may be more closely related to fluid migration in the slab, rather that the generally accepted relationship to mineral dehydration. Without the constraint of relating seismicity to mineral dehydration, subducted slabs may be warmer than some thermal models predict.

Sources of unique rhenium enrichment in the Kudriavy volcano, Kurile Islands

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The rhenium loss through magma degassing (Sun et al., 2003) could be partly balanced by rhenium enrichment in fumarolic magmatic gases and Re-bearing precipitates, as it is a case for the Kudryavy subduction zone volcano, Kurile Islands. The sources of this unusual Re enrichment could be elucidated using the Re-Os isotopic systematic. The relatively unradiogenic $^{187}Os/^{188}Os$ isotope ratios (0.122 up to 0.152) and high Os contents (averaging 0.6 ppb) of fumarolic gas condensates imply that a significant part of Re and Os was remobilised from depleted MORB mantle. Involvement of Re-rich component is evident from high Re concentrations in high-temperature gas condensates, ranging from 7 to 200 ppb. Indeed, the radiogenic Re-rich Os-poor components such as organic-rich subducted sediments (≥20%) and volcanic rocks (≥20%) do not shift significantly the isotopic composition of fumarolic products. The relatively radiogenic composition of the andesite-basaltic arc volcanics ($^{187}Os/^{188}Os$ ratio up to 0.58) could result in the significant Os (and Re) input from subducted sediments.

References

Sun W., Benett V.C., Eggins S..M., Kamenetsky V.S. and Arculus R.J. (2003). *Nature*, 422, 294-297.