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High-pressure fluid-rock interaction as the cause of bulk rock compositional changes in blueschists and eclogites

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Blueschists and associated eclogites represent parts of ancient subducted slabs. They are thus the obvious targets for obtaining constraints on the P-T conditions, compositions, and type of slab-derived fluids responsible for high-pressure bulk compositional changes (metasomatism) in subduction zones since they are the only direct witnesses of such processes. Solute-poor, aqueous fluids, derived by prograde high-pressure metamorphic dehydration reactions in subducted slabs, are generally believed to be responsible for trace element transfer between the slab and mantle wedge. At greater depths in subduction zones at ultrahigh-pressure conditions, solute-rich transitional fluids (intermediate between hydrous silicate melts and aqueous fluids), or hydrous silicate melts are thought to become more important with regards to element mobilization and transport. Petrological and fluid inclusion data suggest that solute-poor aqueous fluids (solute $< \sim 30$ wt. % of fluid) mainly dominate the fluid budget during high-pressure metamorphism of oceanic and continental crust in subduction zones (70 to 40 km depth). This is supported by experimental data favoring the presence of an aqueous fluid under high-pressure conditions in cold subduction zones. These fluids are regarded by some researchers as being relatively inefficient in mobilizing and transporting elements, as, for example, has been suggested by experimentally determined fluid-mineral partitioning data. This is in agreement with some fluid inclusion, stable isotope, and bulk compositional studies of high-pressure veins, which suggest a locally highly-restricted fluid flow and thus only small-scale element transport. However, significant trace element changes have been reported for metasomatic aureoles surrounding eclogite-facies dehydration veins, which form major conduits of channelized high fluid flow during prograde high-pressure metamorphism or for zones of high fluid-rock ratios and fluid flow. Consequently, understanding of the metasomatic processes leading to the mobilization and redistribution of major and trace elements within high-pressure rocks in subduction zone environments is crucial for evaluating bulk compositional changes, which occurred under blueschist- and eclogite-facies conditions.