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Does fluid-induced Eclogitization of Oceanic Crust generate Arc Signatures?

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A suite of co-genetic gabbros and eclogites from central Zambia has been used to investigate fluid-induced transformation processes and associated trace element mobilization. These rocks are relics of subducted lower oceanic crust and gradual stages of the prograde gabbro-to-eclogite transformation are preserved by disequilibrium textures of incomplete reactions. No evidence for prograde blueschist- or amphibolite-facies mineral assemblages was found in the eclogites. Instead, fine-grained intergrowths of eclogite-facies minerals replacing plagioclase indicate the direct eclogitization of gabbroic precursors. Eclogitization occurred at 630-690˚C and 2.6-2.8GPa and was accompanied by a channelized fluid flow that produced peak metamorphic veins. The aqueous fluids had variable salinities, ranging up to brine compositions. Based on textural and geochemical evidence, we hypothesize that these mafic rocks were subducted as a coherent slab, but gabbros were only eclogitized if they were infiltrated by fluid under eclogite-facies conditions. Hence, the eclogites and their veins represent relict fluid pathways through subducted oceanic crust, providing direct evidence of channelized fluid flow within a slab. The gabbros and eclogites have MORB-like trace element patterns and initial Nd and Hf isotope compositions. In some eclogites, however, the LREE have been strongly fractionated from the HFSE and HREE, an effect that cannot be of magmatic origin but must have occurred during metamorphism. Eclogitization was limited by fluid availability, and the fluid flow through the rock is the most likely mechanism for LREE fractionation. Model fluid-rock ratios suggest that the rocks depleted most in LREE reacted with an amount of fluid equal to 20-80% of their mass. The lower gabbroic part of the oceanic crust is an unlikely source for such a large volume of fluid and thus we hypothesize that the fluid originated in the underlying serpentinised lithospheric mantle. If, after triggering eclogitization, the

resulting LREE-rich, HFSE+HREE-poor slab fluid reaches the zone of partial melting in the mantle wedge, it may contribute significantly to the arc signature. We will evaluate whether the trace element mobilization during fluid-induced eclogitization could be generally responsible for producing the slab component in arc magmas.