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Subduction of shallowly formed arc cumulates: Evidence from clinopyroxene compositions of garnet peridotites in the Rio San Juan Complex, northern Dominican Republic

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Garnet peridotites are very rare in oceanic subduction complexes, with only two reported occurrences. One is in the Sambagawa metamorphic belt in Shikoku, Japan, and the other example is in the southern part of the Rio Juan Complex, northern Dominican Republic. In both locations, garnet peridotite occurs in close association with eclogites in high metamorphic grade of the terranes. The Rio Juan Complex represents rocks formed during the southwestern subduction of the Proto-Caribbean oceanic plate below the Carribean Plate during late Cretaceous to early Eocene. Garnet peridotites (clinopyroxene[Cpx]-bearing dunite, wehrlite, olivine clinopyroxenite) occur as large (< 4 m) boulders along a narrow (<10 m) stream together with boulders of metagabbro, eclogites, and serpentinites. Garnet peridotite is composed of garnet with kelphytic rims, Cpx (partially altered to amphibole), olivine (partially altered to serpentine) and Al-spinel. The rocks are all low in Ir-group PGE (Ir, Ru, Os), indicating that they are cumulates of a melt, since these remain in the residue during partial melting. A cumulate origin of the ultramafic rocks is consistent with relatively low Mg contents of olivine (Fo 74-83) compared to olivine in mantle peridotites. Extended trace element plots of the bulk rocks show a so-called "arc geochemical signature" with high fluid-mobile element concentrations, such as Sr, U, and Pb, and low HFSE, such as Nb and Zr, indicating that formation of the parental magmas were related to subduction.
Two representative garnet-bearing samples (wehrlite and clinopyroxenite) were selected for trace element analysis of Cpx grains using a LA HR ICP-MS. The data show a negatively sloped normalized pattern of REE; low contents of light REE (0.1-0.3 of the primitive mantle values) and similar concentrations of middle to heavy REE (1-2 of the primitive mantle values). Extended trace element patterns of Cpx are similar between two samples and also to that of the bulk rocks, with low Nb and Zr and high fluid-mobile elements. The Y and heavy REE patterns of Cpx do not show anomalies between the samples. As these elements would be preferentially incorporated into garnet, the lack of anomalies indicates early crystallization of Cpx and later garnet formation under high pressures. The geochemical data suggest that Cpx-rich cumulates formed at a relatively shallow level in the mantle wedge, and subsequently drug towards the subduction plane by mantle flow, followed by metamorphism that formed garnet in the subduction channel