

Spinel-rich feldspathic peridotites from the lower crust of the Bay of Islands ophiolite formed by hybridization between boninitic sills and tholeiitic host gabbros.

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The lower crust of the Bay of Islands ophiolite (Newfoundland) records emplacement of a laterally discontinuous boninite sill complex beneath an older tholeiitic gabbro complex composed of olivine gabbro, micro-gabbro, troctolite, gabbro-norite and ferro-gabbro. The basal ultramafic zone consists of interlayered pyroxenites and peridotites with a wide range of Ol/Opx/Cpx ratio. Field evidence shows many peridotites are sill-like syn-kinematic intrusions (1-40m thick). The youngest (least-deformed) sills range from dunite, to dunitic harzburgite with Opx primocrysts (grading up to olivine websterite), to wehrlitic facies (grading to clinopyroxenite). Most lherzolites and websterites represent hybrids of these lineages (e.g. Opx porphyroclasts in fine-grained wehrlites). Cm-scale high-Cr/Al chromitite reaction rims separate intrusive dunite from lowermost crustal pyroxenites, and formed through incongruent dissolution of Cr-rich pyroxene into chromite-saturated melts. The overlying mafic-ultramafic zone is constituted of peridotitic sills nearly identical to those of the ultramafic zone that inject syn-kinematically into the older tholeiitic gabbros. Field evidence shows feldspathic peridotites are hybrids generated by mixing primitive replenishments with host gabbros. Feldspar in these hybrid sills forms gabbroic lenses and is often amoeboid with low-Cr/Al spinel filling dissolution pits in plagioclase. Olivine is forsteritic (Fo 84-90) with unusually high NiO contents 0.25-0.35%, but each sample has a distinct population of plagioclase (An96 to An52). The more sodic feldspars overlap with compositions of plagioclase from distal tholeiitic ferrogabbros and gabbro-norites, and represent cases where the feldspar did not have time to re-equilibrate. Hybrid feldspathic peridotites generally contain 3-5% chromite (0.2-0.4 Cr₂O₃ wt%) but there are cm-scale chromitite schlieren, which likely represent disaggregated reaction rims. The chromite grains are relatively coarse (0.5-3mm), and our recovery tests indicate it represents a potential ferrochrome ore. Formation of spinel is locally inhibited by the presence of sulfides in host gabbros, as this lowers the oxygen fugacity and can remove chromite from the liquidus. Conversely, addition of sulfur to the boninitic magma appears to have triggered formation of Ni-rich sulfide globules, some with associated fine-grained Pt and Pd