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Dunites in the Balmuccia Peridotite Massif (Western Italian Alps): their origin by focused percolation of pyroxenite-derived melt.

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In the Balmuccia Massif, an Alpine peridotite thought to represent part of the subcontinental mantle, a 50 m thick and 150 m long dunite body, which occurs as a subconcordant, tabular structure, has been recently recognised. The contacts with the host spinel-facies depleted lherzolite are sharp. The dunite body is composed of spinel-rich dunite containing centimetre-size lenses of relict Cr-diopside websterite, spinel-poor granoblastic dunite and virtually monomineralic Cr-spinel layers exhibiting flow structures. Orthopyroxene is a minor, relict phase in all the lithologies; clinopyroxene is intergranular and amphibole is a minor accessory phase. Overall the dunite body is fairly refractory (Fo in olivine: 90.7-93.8). Strontium and neodymium isotope ratios of clinopyroxene separates from the dunitic body resemble those of a Cr-diopside websterite suite that forms a series of dykes cutting the main peridotite host. It is proposed that the dunites were generated in a part of the mantle veined by early Cr-diopside websterites by a three-stage process involving partial melting of pyroxenite, infiltration of the pyroxenite-derived melt into the depleted lherzolite and its consequent open-system partial melting and focused flow of the resultant partial melts leading to the production of reactive dunite channels through both peridotite and pyroxenite. This process has been simulated using pMELTS assuming that the pyroxenite partially melts at 1.5 GPa and focused melt transport occurs at pressures greater than 0.7 GPa. The results show that, depending on the focusing factor assumed, dunite can form from peridotite at $P < 1.2$ GPa and from pyroxenite at $P < 1.1$ GPa, in both cases over a large pressure range. The model accounts for specific characteristics of the dunite, such as its refractory composition, the presence of orthopyroxene relics, the occurrence of relict websterite lenses in the spinel-rich dunites and the flow structures in the Cr-spinel layers. The proposed mechanism allows dunite formation to occur well within the spinel stability field, and therefore at greater depth than dunites in ophiolites, which generally formed within the plagioclase stability field. The aggregated model melts extracted from the segments where dunite forms are high-Mg alkali basalts resembling, after olivine fractionation, the compositions of enriched-type mid-ocean ridge basalt from slow- and ultraslow-spreading ocean ridges.