The provenance of the lithospheric mantle in continental collision zones: petrology and geochemistry of peridotites in the Ulten-Nonsberg zone (eastern Alps)

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Petrography, modal data and major and trace element analyses of whole rocks and minerals for 36 spinel and garnet-spinel peridotites from the Ulten-Nonsberg Zone (UNZ) in the eastern Alps in Italy are used to constrain the origin and evolution of their mantle source region. The samples (large, modally homogeneous rocks from six sites) range from coarse to dominant fine-grained peridotites affected by syntectonic recrystallization and formation of amphibole ± chlorite as well as late-stage alteration (LOI 0.3–8.6%). They show a limited major oxide range, e.g. 1.8–2.8% Al_2O_3 in ⅘ of the samples, and include neither very fertile, nor highly refractory peridotites. Their range and averages are distinct from those in several massifs and groups of small bodies from the Alps, further indicating mantle heterogeneity in the region, in line with the plate boundary setting where mantle domains of different origins may juxtapose. Comparison of the Al-Fe-Mg relationships in the peridotites with experimental data together with REE modelling indicate that their protoliths were formed by ~10–20% of polybaric melting in upwelling mantle that began at 2–4 GPa and ended close to the surface, likely in an oceanic setting. The melting started in the presence of garnet, but mainly proceeded in the spinel stability field. Some UNZ peridotites are enriched in silica relative to continental off-craton xenoliths and experimental dry melting trends at similar Al_2O_3 and MgO. These enrichments are similar to those observed in supra-subduction zone peridotites suggesting links of their origin and/or evolution with subduction-related settings. Modal and cryptic metasomatism is widespread in the UNZ suite. It took place mainly in the mantle wedge above a subduction zone, in line with low HFSE and high LREE, Th, U, Ba and Pb, and likely incorporated slab components mainly hosted by amphibole ± chlorite and garnet formed during tectonic recrystallization and hydrous modal metasomatism.