Geophysical Research Abstracts, Vol. 9, 02508, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02508

Melt and fluid migration through fore-arc mantle in Sapat (Kohistan-Pakistan)

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Characterizing the fore-arc mantle is an open question because fore-arc mantle xenoliths brought-up in volcanic rocks and ultramafic rocks from fore-arc IODP cores are scarce. The Sapat complex occurs at the bottom of the Kohistan, Jurassic-Cretaceous island arc, which has been obducted during the Himalayan orogenesis in north Pakistan. The ca.12km long and up to 700m thick harzburgite-dunite body of Sapat likely represents the fore-arc mantle. Harzburgite metamorphosed under amphibolite facies conditions is the dominant rock. Orthopyroxene is generally altered into tremolite + talc + clinopyroxene associations; olivine is usually fresh but locally recrystallised in antigorite. Dunites are mostly fresh. They predominantly occur in the upper part of the ultramafic body but are also found within the harzburgite. Few cm thick dykes of olivine-bearing clinopyroxenite are common. Both harzburgites and dunites show mantle textures. Trace elements patterns of harzburgites and dunites are similar, with a low REE contents, a highly fractionated HREE segment (Tb_N/Lu_N= 0.06), and a slightly enriched LREE segment (La_N/Sm_N= 3.25). The Sapat rocks compare well to Izu-Bonin and Sandwich Islands fore-arc ultramafic rocks, and with New Caledonia ophiolitic peridotites. Tension gashes are filled by gem olivine containing inclusions of borate, and euhedral magnetite, calcite and clinochlorite. O and C isotopic values of gem olivine and calcite point to crystallization from slab-related fluids in mantle environment (δO^{18}_{calc}=10, δC^{13}_{calc}= -3; δO^{18}_{ol}=5.2). These fluids may be responsible for the metamorphic assemblages of the ultramafic rocks. Several approx. 100 m wide areas in the ultramafic contain clinopyroxene-rich reaction zone interfingered with strongly REE-depleted tholeiitic gabbros are interpreted as the fluid-impregnated crust/mantle

transition at the top of the mantle-derived ultramafic body.