Geophysical Research Abstracts
Vol. 19, EGU2017-15960, 2017
EGU General Assembly 2017

Petrology of ultramafic and mafic xenoliths from Ruddon's Point, Fife, Scotland

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The studied xenolith suite comprise of anhydrous spinel lherzolites, wehrlite, ol- clinopyroxenite, clinopyroxenite and websterite. Peridotites have porphyroclastic texture and consist of forsterite-rich olivine (Fo87-90), Al-rich pyroxenes (0.25-0.31 apfu in Cpx and 0.15-0.19 apfu in Opx) and Cr-poor spinel (Cr-number=0.15-0.20, Mg-number=0.70). Wehrlite has cumulative texture with cumulus olivine (Fo83-84) and intercumulus clinopyroxene (Mg-number=0.83-0.86, Al=0.23-0.29 apfu). Clinopyroxenites and websterites have adcumulative textures, and often contain pseudomorphs after mica (?). Olivine in clinopyroxenites and ol-clinopyroxenites is low magnesian- Fo78-82, clinopyroxenes have Mg-number from 0.75 to 0.85 with Al ranging from 0.17 to 0.30 apfu. Clinopyroxene-orthopyroxene equilibrium in most of peridotites was achieved in temperatures from 960 to 1010°C, in websterite it was 970-990°C (Brey and Köhler, 1991).

Clinopyroxene forming peridotites is characterized by flat HREE and is slightly depleted to slightly enriched in LREE ((La/Lu)N=0.4-2.5). The only significant anomalies in clinopyroxene's multi-trace element patterns occur at Th-U (positive) and Nb-Ta (negative) contents. Orthopyroxene in peridotites contains elevated amounts of Th, U, Zr, Hf and Ti. Clinopyroxene in clinopyroxenites has concave downward REE pattern ((La/Lu)N=2.3-2.4 in clinopyroxenites and ((La/Lu)N=4.8 and 8.7 in ol-clinopyroxenite and websterite, respectively) and has slight negative Ti anomaly in olivine clinopyroxenite and websterite.

The lherzolite xenoliths represent upper mantle rocks. Composition of clinopyroxene suggests the peridotites to suffer from 1 to 7% of melt extraction, composition of orthopyroxene points to higher degrees of depletion (10-15%; Upton et al., 2011). Peridotites have been metasomatised by subduction-related hydrous fluids enriching pyroxenes in Th and U. Clinopyroxene in wehrlite is texturally later than olivine, but strictly follows the general trace element characteristic of peridotites, thus may represent precipitate from the metasomatic melt. Subduction-related metasomatism seems to be widespread in Scottish lithosphere south from Moine Thrust Zone, but with numerous local variations (Bonadiman et al., 2008; Hughes et al., 2015; Upton et al., 2011). The ol- clinopyroxenites and clinopyroxenites are considered to have originated by crystal settling from an alkaline silicate melt. Their formation is possibly related with Carboniferous, rifting-controlled volcanism.

This study was possible thanks to project NCN UMO-2014/15/B/ST10/00095 from the Polish National Centre for Science.

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