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G ULTRABASITES

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G 1

PETROLOGY AND GEOCHEMISTRY OF THE PYROXENITES IN THE SPINEL-LHERZOLITE ULTRAMAFIC COMPLEXES FROM LHERZ AND FRECHINEDE (FRENCH PYRENEES)

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The mineral assemblages of the layered pyroxenites in the spinel-lherzolite ultramafic bodies of Lherz and Frechinède (Ariège, French Pyrenees) range from spinel orthopyroxenites to spinel websterites and from garnet-poor spinel websterites to garnet-rich clinopyroxenites (Conquéré, 1977). Each paragenesis occurs as individual layers or grades to another in composite layers ; the wider layers show a symmetrical zoning parallel to the boundary. The present parageneses result from subsolidus recrystallization of primary assemblages as evidenced by some relic megacrysts of pyroxenes. Sophisticated mathematical methods allowed to reconstruct these primary assemblages, comprising Al-rich orthopyroxenes and clinopyroxenes in variable proportions with minor spinel and sometimes garnet. Temperatures et pressures estimated for equilibration of the primary parageneses (about 1400°C and 20 kbar) agree with data from similar experimented rocks. None of the reconstructed pyroxenite composition may represent those of the original liquids from which they formed by segregation of crystallizing phases through flow crystallization of basic liquids (Irving, 1980). The compositional characters of the basaltic parent-magmas have been estimated from the trace element geochemistry of the pyroxenites and their separated component phases.

G 2

THE METAMORPHIC EVOLUTION OF NORWEGIAN GARNET PERIDOTITES

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Integration of mineralogical and microstructural observations on the high P garnet peridotite assemblages variably preserved in alpine-type bodies within the Western Gneiss Region of Norway, indicates that these rocks have had a prolonged, 7-stage, metamorphic evolutionary history. The sequence of stable mineral assemblages was as follows:

I	$Ol + Opx_1 + Cpx_1 \pm Sp_1 \pm Amph_1$
II	$Ol + Opx_2 + Cpx_2 + Gnt_1$
III	$Ol + Opx_3 + Cpx_3 + Gnt_2 + Sp_2$
IV	$Ol + Opx_4 + Cpx_4 + Sp_3$
V	$Ol + Opx_5 + Amph_2 + Sp_4$
VI	$Ol + Opx_5 + Amph_3 + Chlorite$
VII	Serp + Talc + Chlorite

The T_{max} precursor assemblage (I) to the coarse grained P_{max} garnet lherzolite assemblage (II) is only rarely preserved but contains Al pyroxenes which have exsolved garnet and sometimes Al spinels with garnet coronas. The deformation induced assemblage (III) forms fine grained neoblasts in strikingly porphyroclastic textured samples. The intimately intergrown pyroxenes and spinels of assemblage (IV) are restricted to fine grained kelyphites which have replaced garnets and are frequently overgrown by coronas of coarser grained Opx + pargasitic Amph + Sp (assemblage V). The Cr depleted Gnt_2 neoblasts are considered to have predated kelyphite formation contrary to most previous interpretations. The development of the hydrous assemblages (VI & VII) has been largely controlled by the extent to which late stage deformation has permitted influx of hydrous fluids as these rocks were uplifted and cooled from their metamorphic 'high'. Since samples of these rocks may contain several different generations of certain mineral phases, notably orthopyroxene, caution must be exercised to ensure that phases belonging to the same stage in the metamorphic evolution are combined when applying element exchange mineral thermometers/barometers.

G 3

UPPER MANTLE VEIN PYROXENITES: EVIDENCE FOR NON-MAGMATIC ORIGIN

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Pyroxenites forming sheetlets and sheets (mostly between cm's and dm's in thickness) and commonly swarms of subparallel sheetlets in peridotites are widespread among mantle-derived ultramafic complexes and do also occur in upper mantle xenolites. They are currently interpreted as products of either magmatic accumulation or metamorphic accretive crystallization.

Our detailed study of pyroxenite veins from Zabargad Island, Red Sea, revealed the following results: (1) Pyroxenite veins occur exclusively in tectonized peridotites. (2) Thin veins (mm scale) commonly disintegrate into strings of single pyroxene neoblasts. (3) Pyroxenites are always coarser-grained than the host rock (cpx up to 3cm, opx up to 7cm). (4) All pyroxenes contain abundant exsolution lamellae of pyroxenes, spinel and plagioclase. (5) Pyroxenes are rich in Al_2O_3, Cr_2O_3, and Na_2O. (6) Pyroxenites are rich in halogens and have approximately chondritic Cl/I ratios. (7) REE contents are high (up to 8xCI), mostly LREE-depleted, and incompatible with pyroxene crystallization from a basaltic melt. (8) "Fluid" inclusions are abundant but consist solely of solids (NaCl, $MgCO_3$, sulfates)$\pm$ a gas phase (CO_2 or N_2 or mixtures).

Conclusions: Vein pyroxenites of Zabargad Island are of non-magmatic origin and apparently represent precipitates from fluids (high T-p conditions). The fluids were highly saline, moved through pathways opened by tectonization, and came from different mantle sources.

We believe that most vein pyroxenites of other occurences throughout the world are of similar origin as well as most other monomineralic vein rocks like olivinites, hornblendites, plagioclasites, phlogopitites, chromitites, garnetites and others.