Fluid inclusion and thermobarometric study of interaction between mafic xenoliths and plagiogranites in the Lotta River Area, Lapland Granulite Belt

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Thermobarometric data and fluid inclusions data of conditions of interaction between mafic granulite xenoliths and plagiogranites in the Lotta river area, Lapland Granulite Belt, confirm the conclusion that leucocratic garnet-bearing plagiogranites of the Lapland complex are associated with the anatexis of country khondalites during peak of metamorphism.

The formation of plagiogranitic magmas, probably, occurred at depths of about 25-30 km. As they ascended, they captured numerous xenoliths (Kozlov, Kozlova, 1998). The most remarkable of them are two-pyroxene-plagioclase granulite xenoliths (orthopyroxene ± clinopyroxene + plagioclase ± quartz + magnetite + ilmenite + pyrrhotite). The xenoliths show extensive amphibole formation, which is manifested as coronas of K-bearing pargasite-edenite amphibole and coarse-grained amphibole-quartz symplectites in contacts of pyroxenes, magnetite, ilmenite and pyrrhotite with plagioclase.

The more calcic composition of plagioclase and the lower Mg-number of pyroxenes in the amphibolized portions of xenoliths correspond to the amphibole formation via reaction: Opx + Ilm + Mt + Pl = Amph ± Qtz. Amphibole formation is locally accompanied by biotite, indicating the addition of potassium into the xenoliths.

A pressure of 6.0-6.4 kbar was estimated from the equilibrium of clinopyroxene + orthopyroxene + plagioclase + quartz in non-amphibolized portions of xenoliths. The corresponding temperatures 800-860°C are within the range of temperatures estimated for the plagiogranite crystallization (Kaulina et al., 2014) as well as peak temperatures of the M2 tectonic-thermal event in the Lapland complex (Mints et al., 2007). Amphibole-plagioclase equilibrium (Blundy, Holland, 1990) recorded the temperatures of the amphibole formation 740-780°C at a pressure of 5.0-5.5 kbar. Compositional variations of amphibole toward tremolite indicate further cooling. It was, probably, due to the interaction of an essentially aqueous fluid issued from plagiogranitic magma with xenoliths as they were captured and transported.

Indeed, xenoliths are crossed by plagiogranitic veins. Abundance of aqueous-salt (17-20 wt. % NaCl eq.) inclusions and the subordinate amount of carbon dioxide inclusions in plagiogranite minerals confirm this assumption. Thus, plagiogranites of the Lapland complex and associated fluids were formed inside the complex at P-T parameters comparable to the peak conditions of granulite
metamorphism. During ascension, these granite magmas could only produce fluid effects on the country rocks including xenoliths.