Geophysical Research Abstracts
Vol. 17, EGU2015-8725-1, 2015
EGU General Assembly 2015

Geochronology and thermobarometry of the granitoid rocks within the Vaasa granite-migmatite complex, western Finland

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The Vaasa granite-migmatite dome in west-central Finland has been formed in the Svecofennian orogeny, after the main collisional stage at ∼1.9 Ga. The structure consists of a granite-migmatite core surrounded by metasedimentary rocks with outward decreasing metamorphic grade. The core comprises anatectic garnet-bearing granites, diatexites, pyroxene granites, and minor intrusive granodiorites. Geochemically, all of the rocks are peraluminous and magnesian. The Vaasa granites have close to average upper crustal compositions, and they show signs of titanite and plagioclase fractionation. The heavy REEs vary strongly according to garnet retention.

Zircon U-Pb ages for these rock types indicate crystallization at 1875 Ma for the diatexites and garnet-bearing granites and at 1870 Ma for the pyroxene granites. Melt-forming temperatures are estimated by zircon and monazite saturation temperatures, and by Al/Ti ratios. No clear difference in the melting temperatures of the various rock types could be detected. However, while the monazite and zircon saturation temperatures point to temperatures around 800 ˚C, the Al-Ti thermometer gives consistently about 100 ˚C degrees higher results. Given the anatectic and felsic nature of the rocks, the lower temperature estimates seem more probable.

Crystallization temperatures and pressures were calculated with the help of mineral chemical analyses. Garnet-biotite-plagioclase-quartz thermobarometry, and Al-in-hornblende barometry indicate pressures of 5.5-6 kbars for the diatexites, the pyroxene granites and an intrusive granodiorite. Significantly lower pressures of 2-4 kbars are recorded for the garnet-bearing granites. The garnet-biotite thermometer implies crystallization temperatures between 650 - 700 ˚C for the pyroxene granites and the diatexites, and upto 600 ˚C for the garnet-bearing granites. These results are markedly lower than those indicated by the whole-rock saturation temperatures of the same rocks. This may suggest that the melting has been non-saturated or that the post-crystallization leaching has affected the mineral compositions.