Geophysical Research Abstracts
Vol. 19, EGU2017-17590, 2017
EGU General Assembly 2017

Diffusion controlled corona growth in mafic dykes from Southern Granulite Terrain, India and their petrological implications

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Diffusion controlled corona growth in mafic dykes from Southern Granulite Terrain, India and their petrological implications

Metamorphosed garnetiferous mafic dykes from Southern Granulite Terrain (SGT) are found intruding the high grade Archaean-Palaeoproterozoic felsic orthogneiss and their retrogressed equivalent. They contain phenocrysts of clinopyroxene (Cpx) and plagioclase (Pl) that preserve ophitic, subophitic and intergranular textures. The clinopyroxene contains closely spaced cleavage-parallel exsolution lamellae of orthopyroxene (Opx) and tiny rods of Fe-Ti oxides. Orthopyroxene is also found around clinopyroxene as granular exsolution. Large grains of Fe-Ti oxides occur within the interstitial space. Garnet (Grt) and quartz (Qtz) form at the contact of plagioclase and clinopyroxene. The product minerals are found as symplectite and/or corona rimming the reactants. In the corona, quartz always occurs near clinopyroxene whereas garnet forms close to the plagioclase. The proportions of garnet and quartz in symplectite are fairly constant and range from 75:25 to 70:30 (vol %). Similar coronitic texture is exhibited by amphibole (Amp) and quartz. Thin amphibole+quartz corona forms between plagioclase and clinopyroxene where amphibole occurs near plagioclase and quartz near clinopyroxene, though the rock is dominated by garnet over amphibole in the corona. Corona of garnet/amphibole is also found on Fe-Ti oxides at the contact of plagioclase and the products show TiO_2 enrichement when they occur near Fe-Ti oxides. Formation of hydrous amphibole from anhydrous minerals necessitates the system to be open to H_2O. Additionally, balanced chemical reactions for Pl+Cpx=Grt+Qtz and Pl+Cpx=Amp+Qtz require Fe+2 incorporation to explain the observed volume proportion of the product minerals. Formation of garnet/amphibole near plagioclase and quartz near clinopyroxene indicate restricted mobility of Al and Si within the reaction domain. Preferential enrichment of TiO_2 in the products near Fe-Ti oxides also testifies to relative immobility of small cations with high charges. This can be interpreted as steady state local equilibrium accompanied by grain boundary diffusion for the mineral (product) growth. Geothermobarometric calculations using garnet-clinopyroxene-plagioclase assemblage indicate $\sim$7.5$\pm$1 kbar pressure and $\sim$650$\pm$50ºC for the corona growth. Al in amphibole barometry also yields similar pressure. Preservation of igneous texture and delicate reaction textures like symplectite and corona emphasizes that these rocks did not suffer any significant deformation after its emplacement and subsequent metamorphism. The metamorphic changes clearly demonstrate that fluid acted as a carrier (for garnet formation) for cations or as a reactant (for amphibole formation). These events can be related to the Pan-African orogeny which is the last major tectonic event reported from SGT. The dykes could have intruded their host rock during the orogeny whereas the fluid aided metamorphism had occurred as a part of late to post tectonic events. The P-T conditions from this study fit well with the estimates reported from SGT during Pan-African orogeny.

Keywords: Pan-African orogeny, Southern Granulite Terrain, Corona, Diffusion, Symplectite.