Geophysical Research Abstracts
Vol. 16, EGU2014-3971-1, 2014
EGU General Assembly 2014
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Experimental approach to form anorthositic melts: phase relations in the system CaAl2Si2O8 - CaMgSi2O6 - Mg2SiO4 at 6 wt.% H_2O

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Massive anorthosite dykes are documented for the first time from the Limassol Forest Complex (LFC) of Cyprus, the LFC being a deformed equivalent of the Troodos ultramafic massif. Both the Troodos and LFC complexes are part of the Tethyan realm consisting of Cretaceous oceanic crust that formed within a backarc basin 90 Ma ago and was obduced during late Miocene.
From crosscutting relations with the sheeted dyke complex, it follows that the anorthosites belong to one of the latest magmatic events on Cyprus. In hand specimen, the rocks appear massive and unaltered, although in thin section magmatic plagioclase (An93) is partially replaced by albite and thomsonite (zeolite). Where magmatic textures are preserved, plagioclase forms cm-sized, acicular, radially arranged crystal aggregates that remind of spinifex textures.
Six major types of anorthosite occurrences have previously been described, none of them matching with the above described anorthosite dykes [1]. The origin of these anorthosite dykes remains poorly understood. Even though they occur as intrusive dykes, it is evident that they cannot represent liquidus compositions, at least under dry conditions. Whole-sale melting of pure An93 would require temperatures in excess of 1450 °C, which is a quite unrealistic temperature of the modern Earth's crust.
The working hypothesis is that boninitic melts with approximately 4 wt.% H_2O, as found in the cyprian upper pillow lavas (UPL), could produce such rocks by olivine-pyroxene fractionation. Indeed, experiments indicate that such lithologies can be generated by medium-pressure fractional crystallization of hydrous basaltic melts followed by decompression-degassing. High pH_2O stabilizes olivine but tends to suppress plagioclase as the highest polymerized phase. Hence the An component is accumulated in the (late-stage) melt. When such a system experiences sudden decompression, the aqueous phase will exsolve and will trigger massive precipitation of anorthite.
Experiments at various temperatures are being performed in the ol-cpx-plag-H_2O system, with olivine from a xenolith (Fo95) and anorthite and diopside glasses as starting materials. The materials are ground and mixed in the desired proportions, then equilibrated with 6 wt. % H_2O at 0.5 GPa total pressure in a piston-cylinder press. A phase diagram of the Fo-Di-An-H_2O system at 0.5 GPa will be constructed to outline the precise phase relations and fractionation paths are high H_2O partial pressure. Aim is to delineate the anorthite saturation field in the ol-cpx-plag-H_2O system, and to assess to which extent plagioclase can be suppressed as a liquidus phase when a basaltic melt fractionates under hydrous conditions.

[1] Ashwal, L. D. (1993). Anorthosites, Springer-Verlag.