Anorthositic melts – quenched fluid?

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The Upper Cretaceous ophiolite of Cyprus includes rare anorthositic dykes. Mineral phases in the dykes include dendritic plag (An90-99), sparse calcic pyx, and abundant czo. Normative bulk compositions range around 90% plag. Melting experiments of such compositions show that even under fluid-saturated conditions, temperatures required for whole-sale melting are well above 1250 °C at 500 MPa, which is unrealistic for a derivative melt. From crosscutting relations with basaltic sheeted dykes, it is inferred that the anorthosite dykes must represent a very late magmatic event.

The working hypothesis is that the dykes may represent the solute of a magmatic fluid that exsolved from an H_2O-saturated basaltic melt at shallow crustal levels. Manning [1] suggested that the critical curve between basalt and fluid may be continuous, and that fluids exsolving from a silicate liquid at magmatic temperature and medium pressure can be quite enriched in silicate and oxide solutes, comparable in composition to silicate melts.

Controlled decompression-crystallization experiments are performed to test this proposition. A tholeiite glass from the upper pillow lavas of Cyprus is doped with excess H_2O (10 wt.%) and several trace elements whose partitioning behaviour may be diagnostic of fluid-melt equilibrium. The charges are equilibrated in Pt capsules at 1 GPa and 1150°C, decompressed isothermally to 250 MPa, slowly cooled at 250 MPa to 650°C (0.3 °C/min), then quenched. Experimental products return three pyx generations in an apparent glassy matrix; a low-Ca opx followed by a high-Ca cpx, and finally by a subcalcic pyx generation with XCaTs component as high as 10 %. The interstitial material, seemingly a glass, is greatly enriched in CaO and Al_2O_3, Na_2O-poor, almost FeO-MgO free, and it is peppered with volatile bubbles. EPMA totals suggest a H_2O-content as high as 11 wt.%. In terms of composition, the glasses are very close to the compositions of the anorthosite dykes. We argue that the dykes may represent escape channels, of magmatic fluids that exsolved from basaltic melts at depth and precipitated their solute as calcic plag and potentially CaTs-enriched pyx during passage to the upper crust. The primary agent that triggered fluid saturation in the first place may have escaped as a vapor phase, as a hydrothermal solution, or may have been consumed by alteration reactions.

[1] MANNING, C.E., 2004, The chemistry of subduction-zone fluids. *EPSL* **223**, 1-16.