Evidence for early liquid immiscibility in the Skaergaard intrusion, East Greenland

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Exsolved ferrobasalt and rhyolite liquids in melt inclusions in apatite and olivine in the Upper Zone of Skaergaard intrusion, East Greenland imply immiscibility in evolved tholeiitic magmas [1]. The onset of unmixing is, however, not yet well defined. To constrain the start of unmixing we have studied: i) plagioclase-hosted melt inclusions, and ii) partial melting experiments of Skaergaard cumulates.

Early plagioclase traps numerous melt inclusions from the top of the Lower Zone (F= ~67 %) and upwards in the Layered Series. The inclusions are fully crystallized and comprise augite, plagioclase, apatite, and accessory phases. Large variations in modal proportions of daughter phases and contrasting chemical compositions of homogenized inclusions are consistent with heterogeneous trapping of immiscible melts.

Partial melting experiments were performed on 1.5-cm cubes of Middle and Upper Zone gabbros in an 1-atm. Deltech furnace to determine the composition of late stage liquids [2]. The cubes were heated in N_2 at temperatures from 1100° C to 1175° C. After more than 24 hours, the samples were removed from the furnace. The proportion of melt (quench glass) varies with temperature from 14 to 52 vol. %. Melting is observed mostly along grain boundaries of intercumulus augite and Fe-Ti oxides. The glasses show heterogeneous textures and strong compositional gradients ranging from extreme ferrobasaltic composition (43 wt.% SiO_2 and 19 wt. % FeO_t) to Si-rich compositions (65 wt.% SiO_2 and 7 wt.% FeO_t). The distribution of major oxides in the glasses is consistent with liquid-liquid element partitioning.

Our results demonstrate that liquid immiscibility may have started in Skaergaard at the LZ-MZ transition close to the first appearance of liquidus magnetite. Thus, immiscibility is likely to play an important role in the petrogenesis of the Skaergaard intrusion, and could be significant during the evolution of tholeiitic magmas.

Reference

[1] Jakobsen, Veksler, Tegner and Brooks (2005) *Geology* **33**, 885-888

[2] McBirney A.R. and Naslund H.R. (1990) *Contrib. Mineral. Petrol.* **104,** 235-240