The pressure and temperature conditions, and timing of glass formation in mantle-derived xenoliths from Baarley, West Eifel, Germany: the case for amphibole breakdown, lava infiltration, and mineral-melt reaction

Cliff S.J. Shaw[1] and Andreas Klügel[2]
1. Department of Geology, University of New Brunswick, Fredericton, NB E3B 5A3, Canada <cshaw@unb.ca> ¶ 2. Andreas Klügel, Fachbereich Geowissenschaften, Universitaet Bremen, Germany

Mantle-derived xenoliths from Baarley in the Quaternary West Eifel volcanic field contain 6 distinct varieties of glass in veins, selvages, and pools. 1) Silica-undersaturated glass that forms jackets around, and veins within, the xenoliths. This glass is compositionally similar to groundmass glass in the host basanite. 2) Silica-undersaturated alkaline glass associated with amphibole in peridotites. This glass locally contains corroded primary spinel and phlogopite. 3) Silica-undersaturated glass in partly to completely broken down amphibole grains in clinopyroxenites. 4) Silica-undersaturated to silica-saturated, potassic glass in microlite-rich fringes around phlogopite grains in peridotite. 5) Silica-undersaturated potassic glass in glimmerite xenoliths. 6) Silica-rich glass around partly dissolved orthopyroxene crystals in peridotites.

Clinopyroxene - melt thermobarometry shows that Cr-diopside - type 2 glass pairs in harzburgite formed at 1.4 to 1.1 GPa and ~ 1250 °C whereas Cr-diopside - type 2 glass pairs in wehrlite formed at 0.9 to 0.7 GPa and 1120 – 1200 °C. This bimodal distribution in pressure and temperature suggests that harzburgite xenoliths may have been entrained at greater depth than wehrlite xenoliths.

Glass in the Baarley xenoliths has three different origins: infiltration of an early host melt different in composition from the erupted host basanite; partial melting of amphibole; reaction of either of these melts with xenolith minerals. The composition of type 1 glass suggests that jackets are accumulations of relatively evolved host magma. Mass balance modelling of the type 2 glass and its microlites indicates that it results from breakdown of disseminated amphibole and reaction of the melt with the surrounding xenolith minerals. Type 3 glass in clinopyroxenite xenoliths is the result of breakdown of amphibole at low pressure. Type 4 and 5 glass formed by reaction between phlogopite and type 2 melt or jacket melt. Type 6 glass associated with orthopyroxene is due to the incongruent dissolution of orthopyroxene by any of the above-mentioned melts.

Compositional gradients in xenolith olivine adjacent to type 2 glass pools and jacket glass can be modelled as Fe-Mg interdiffusion profiles that indicate melt - olivine contact times between 0.5 and 58 days. Together with the clinopyroxene - melt thermobarometry calculations these data suggest that the glass (melt) formed over a short time due to decompression melting of amphibole and infiltration of evolved host melt. None of the glass in these xenoliths can be directly related to metasomatism or any other process that occurred *in situ* in the mantle.