Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 588

Melt Variations in the Oslo Rift as Recorded by Melt Inclusions Hosted by Pyroxene Phenocrysts

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Melt inclusions in primary phenocryst phases are thought to preserve the history of a magmas evolution and so can provide information regarding source heterogeneity and/or mixing during the growth of phenocryst phases. These phenocrysts are commonly hosted in what appear to be homogenous flows when erupted. The analysis of melt inclusions has become a useful tool in attempting to understand the dynamics and complexities of mantle melting. In this contribution we present data from the Permo-Carboniferous Oslo magmatic system in an attempt to understand the initial phases of magmatism. Some of the earliest volcanism associated with the Permo-Carboniferous rifting event in the Oslo region is preserved at Skien, southern Norway. The rock types are predominantly nephelinites and basanites (SiO_2: 38 - 46 wt%) and are distinguished by a pyroxene dominated phenocryst assemblage. Melt inclusions hosted by pyroxenes with compositions of Cr-diopside (Mg # 80 - 92) and Ti-augite (Mg # 70 - 80) were rehomogenised using a melting stage and the major elements analysed by microprobe.

The results of the melt inclusion analyses from the two pyroxene types are easily distinguished, and within each pyroxene type subdivisions can be identified.

Cr-diopsides. The melt inclusions hosted by the Cr-diopsides can be divided into two groups primarily on the basis of FeO and TiO_2 at similar Mg #. These are termed the 'Cr-high Fe' and 'Cr-low Fe' to highlight the fact that they are melts hosted by the Cr-diopsides. These two groups form subparallel trends in plots of CaO, Al_2O_2, K_2O and to a lesser extent Na_2O, P_2O_2 versus Mg # with the Cr-low Fe group containing higher SiO_2, Al_2O_2, Na_2O, K_2O and P_2O_2 abundances than the Cr-high Fe group. The Cr-high Fe melts plot close to the primitive end of the array (high Mg #) of melts analysed from the titan-augites.

Titan-augites. The melt inclusions analysed from the pyroxenes of titan-augite composition tend towards lower magnesium numbers and plot on a continuum of the Cr-high Fe data trend, particularly in terms of CaO, Al_2O_2, FeO and TiO_2. Notable exceptions are found in terms of Na_2O, K_2O and P_2O_2 where there are clear differences within the dataset obtained from the melts hosted by the titan-augites. The melt inclusions can be divided into two groups on the basis of these elements, with one group plotting at higher abundances of Na_2O, K_2O and P_2O_2, similar to the concentrations in the Cr-high Fe melts, than the other. These are termed the TA - high Na and TA - low Na groups. The TA - high Na group also contain the highest amounts of measured volatiles (F and Cl) and do not have good totals, whereas the TA - low Na group have very consistent totals and almost undetectable levels of F and Cl.

Data from the analyses of melt inclusions in this tectonic setting indicate that the melting process is complex, with melts that form in different mantle stability fields trapped simultaneously by the developing Cr - diopside phenocrysts. Source heterogeneity occurs on the scale of millimeters.