Liquid immiscibility at <850°C: Evidence from melt inclusions in zircon of the basal Bushveld Complex

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We have investigated melt inclusions in zircon from a fine-grained, quenched norite of the Marginal Zone in the Eastern Bushveld Complex. The norite was sampled from a chill zone close to the floor rocks and has a high-Mg andesitic composition corresponding to the B1 magma [1], the supposed parent magma for the Lower and Lower Critical Zones. Zircon occurs in melt pockets between elongated cumulus orthopyroxene crystals in assemblage with quartz, alkali feldspar, plagioclase, biotite and minor rutile [2]. The majority of melt inclusions are colorless-transparent and are completely crystallized to quartz, alkali feldspar, plagioclase and biotite. They have been re-homogenized in an internally heated pressure vessel and display a rhyolithic composition with SiO_2 >73 wt.%.

A minor group of melt inclusions, however, are characterized by a reddish-dark color and by the presence of Fe-rich amphibole and phyllosilicate (cryptocrystalline), as well as Fe-Ti oxide daughter crystals. Here, homogenized melt inclusions reveal a (ultra)mafic, Fe-rich composition with SiO_2 <45 wt.%, FeO_{tot} >18 wt.%, and MgO <7 wt.%. In rare cases both types of melt inclusion are observed within a single grain indicating that two immiscible melts were trapped during zircon growth. Ti-in-zircon geothermometry provides evidence that all inclusions investigated in this study were trapped at <850°C [2]. Previous studies have experimentally demonstrated that liquid immiscibility along tholeiitic lines of descent starts at ≥1000°C and may be still present at 940°C [3]. However, our results indicate that immiscible melts may coexist at even lower temperatures.

[1] Wilson (2015) *J. Petrol.* **56** No. 2, 347-388; [2] Zeh *et al.* (2015) *EPSL* **418**, 103-114; [3] Charlier & Grove (2012) *Contrib. Mineral. Petrol.* **164**, 27-44