SEG 2017 Conference

Silicate liquid immiscibility in the Upper Zone of the Bushveld Complex

Lennart A. Fischer*, Olivier Namur, Meng Wang, Francois Holtz, Bernard Charlier

*Leibniz Universität Hannover, Hannover, Germany, Email: l.fischer@mineralogie.uni-hannover.de

The Bushveld Complex (South Africa) is the largest layered intrusion on Earth and plays a considerable role in our understanding of magmatic differentiation and ore-forming processes. In this study, we present new geochemical data for apatite-hosted multiphase inclusions in gabbroic cumulates from the Bushveld Upper Zone. Inclusions re-homogenized at high-temperature (1060–1100 ◦ C) display a range of compositions in each rock sample, from iron-rich (35 wt.% FeOtot; 28 wt.% SiO_2) to silica-rich (5 wt.% FeOtot; 65 wt.% SiO_2). This trend is best explained by an immiscible process and trapping of contrasted melts in apatite crystals during progressive cooling along the binodal of a two-liquid field. The coexistence of both Si-rich and Fe-rich immiscible melts in single apatite grains is used to discuss the ability of immiscible melts to segregate from each other, and the implications for mineral and bulk cumulate compositions. We argue that complete separation of immiscible liquids did not occur, resulting in crystallization of similar phases from both melts but in different proportions. However, partial segregation in a crystal mush and the production of contrasting phase proportions from the Fe-rich melt and the Si-rich melt can be responsible for the cyclic evolution from melanocratic (Fe–Ti–P-rich) to leucocratic (plagioclase-rich) gabbros which is commonly observed in the Upper Zone of the Bushveld Complex where it occurs at a vertical scale of 50 to 200 m.