The Paleoproterozoic Rooiberg Group, Kaapvaal Craton, South Africa: New insights into the formation of silicic large igneous provinces (SLIPs)

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With an estimated erupted volume of 300,000 km^3[2] and areal extent of ca. 200,000 km^2, the Paleoproterozoic (2.06 Ga) silicic volcanics of the Rooiberg Group (Kaapvaal Craton) in northern South Africa form one of the largest and oldest silicic large igneous provinces (SLIPs) known. These rocks can be sub-divided into four formations[1]: the Dullstroom, Damwal, Kwaggasnek and Schrikkloof Formations. Despite the uniqueness of these rocks and their scientific importance regarding the formation of SLIPs worldwide, the Rooiberg Group received little attention in the past. Therefore, a geochemical and petrological study was initiated to further investigate the petrogenesis of the Rooiberg Group, provide constraints on the magma forming processes and to come up with an explanation for the wide extent of its rhyolitic lava flows.

The Loskop Dam area, Mpumulanga province, ca. 120 km east of Pretoria, and one of the type localities for the Rooiberg Group, was found suitable as study area because of its good outcrop conditions and the fact that most of the formations can be found here.

The studied rocks vary from dacites to rhyolites. Comparison of major, trace andrare earth elements of the Rooiberg Group with other SLIPs around the world show remarkable similarities thus suggesting similar magma sources for the different SLIPs.

[1] Hatton, C.J. and Schweitzer, J.K. (1995), Evidence for synchronous extrusive and intrusive Bushveld magmatism. *Journal African Earth Sciences* **21**, 579-594. [2] Twist, D. and French, B.M. (1983), Voluminous acid volcanism in the Bushveld Complex: A review of the Rooiberg Felsite. *Bulletin Volcanologique* **46** (3), 225-242.

Diffusion of titanium in forsterite

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Titanium diffusion in cubes of synthetic, pure forsterite has been determined as a function of chemical activity, oxygen fugacity (fO_2), crystal orientation, temperature and time at 1 atmosphere. Experimental run products were analysed using both LA-ICP-MS with a scanning rectangular beam, and EPMA in line profile mode. Experiments were conducted between 1300-1500°C, and diffusivity was shown to be positively temperature-dependent.

The experiments consistently produce non-Fickian diffusion profiles that do not fit an error function, hence diffusivity was determined from penetration distance of above-background Ti into the cubes.

In order to fix chemical activity in a three component system (SiO_2, MgO, TiO_2), the sources of Ti were four different three-phase buffers (forsterite–qandilite-periclase, forsterite–qandilite-geikielite, forsterite–geikielite-karooite, forsterite-karooite-enstatite). These were powdered and coupled to polished [001], [010] and [100] crystal faces. In all experiments, a strong positive dependence of diffusivity on silica activity was observed, with fastest diffusion in the presence of enstatite and slowest diffusion in buffers containing periclase. This result agrees with those of Ni, Co and Y diffusion in forsterite [1,2], suggesting Ti is predominantly diffusing on the M site.

Oxygen fugacity was fixed using either CO_2/CO mixtures or air, and experiments were run between $fO_2=10^{-0.7}$ and 10^{-12}. A large negative dependence of diffusivity on fO_2 is observed (slower diffusion in more oxidising conditions), possibly related to the Ti^{4+}/Ti^{3+} transition. In addition, Ti solubility at the buffer-crystal interface increases as fO_2 decreases.

Diffusion is anisotropic; fastest along the *c* axis and slowest along the *a* axis. Contrasts between these findings and a recently presented data set in the same system [3] are currently being investigated.

[1] Zhukova et al. (2012) IGC abstract [2] Crepisson et al. (2012) EMC^2 abstract [3] Cherniak et al. (2012) Eos. Trans. AGU.

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