The differentiation of a flood basalt sequence modeled using the Magma Chamber Simulator

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The Magma Chamber Simulator (MCS) [1] models the phase equilibria, mineral chemistry, major elements, trace elements, and radiogenic isotopes through mass and enthalpy balance in a multicomponent-multiphase magma + wallrock system. Here we utilize MCS to quantify the differentiation history of a continental flood basalt sequence from the Antarctic portion of the Karoo large igneous province. Typical of flood basalts, this suite is characterized by a strong crustal geochemical signature.

Our modeling shows that assimilation of partial melts of sialic crust has a profound impact on the composition of the parental magma. We show that isobaric and continuously assimilating models fail to produce the observed lava compositions. Instead, the primitive magmas must have assimilated crust at depths of ~15–20 km, where orthopyroxene and olivine are stable phases. Most of the subsequent fractional crystallization, however, took place at lower pressures in the upper crustal feeding systems without significant additional assimilation. Our example illustrates a fraction of the capabilities of MCS, and we encourage utilisation of MCS for open-system magmatic systems in different igneous environments and tectonic settings to build crustal-scale images of magmatic storage and transport zones.

[1] Bohrson et al. (2018). *J. Petrol*. **55**:1685–1717 https://doi.org/10.1093/petrology/egu036