



Successive reactive liquid flow episodes in a layered intrusion (Unit 9, Rum Eastern Layered Intrusion, Scotland)

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We will present a detailed microstructural and geochemical study of reactive liquid flow in Unit 9 of the Rum Eastern Layered Intrusion. In the study region, Unit 9 comprises an underlying lens-like body of peridotite overlain by a sequence of troctolite and gabbro (termed allivalite), with some local and minor anorthosite. The troctolite is separated from the overlying gabbro by a distinct, sub-horizontal, undulose horizon (the major wavy horizon). Higher in the stratigraphy is another, similar, horizon (the minor wavy horizon) that separates relatively clinopyroxene-poor gabbro from an overlying gabbro. To the north of the peridotite lens, both troctolite and gabbro grade into poikilitic gabbro.

Clinopyroxene habit in the allivalite varies from thin rims around olivine in troctolite, to equigranular crystals in gabbro, to oikocrysts in the poikilitic gabbro. The poikilitic gabbros contain multiple generations of clinopyroxene, with Cr-rich (~ 1.1 wt.% Cr_2O_3), anhedral cores with moderate REE concentrations (core1) overgrown by an anhedral REE-depleted second generation with moderate Cr (~ 0.7 wt.% Cr_2O_3) (core2). These composite cores are rimmed by Cr-poor (~ 0.2 wt.% Cr_2O_3) and REE-poor to moderate clinopyroxene.

We interpret these microstructures as a consequence of two separate episodes of partial melting triggered by the intrusion of hot olivine-phyric picrite to form the discontinuous lenses that comprise the Unit 9 peridotite. Loss of clinopyroxene-saturated partial melt from the lower part of the allivalite immediately following the early stages of sill intrusion resulted in the formation of clinopyroxene-poor gabbro. The spatial extent of clinopyroxene loss is marked by the minor wavy horizon. A further partial melting event stripped out almost all clinopyroxene from the lowest allivalite, to form a troctolite, with the major wavy horizon marking the extent of melting during this second episode. The poikilitic gabbro formed from clinopyroxene-saturated melt moving upwards and laterally through the cumulate pile.

The Rum layered intrusion is an open intrusive complex, composed of individual partially molten zones, evolving independently. The Rum layered intrusion offers a direct overview of processes taking place in shallow intra-plate and ridge magma chambers. Intrusion of hot magma into a pre-existing cumulate pile results in the modification both the incoming liquid and the host-rock cumulates. Our study highlights the necessity of considering this type of process when modelling the geochemistry of lavas erupted from magma chambers subject to repeated replenishment.