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Mechanisms controlling the emplacement of the Slaufrudalur Pluton, Southeast Iceland

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The Tertiary Slaufrudalur Pluton is the largest granitic intrusion in Iceland and one of the best exposed plutons worldwide. Five glacial valleys cut sections through the uppermost 900 m of the pluton, exposing its three-dimensional shape and the contact between pluton and basaltic host rock. The wall contacts are subvertical and sharp. Only in the northeast and southwest is the wall contact characterised by brittle faulting. The pluton roof is smooth on map scale, so that the overall cross-sectional shape of the pluton and its internal layering indicate emplacement by incremental cauldron subsidence/floor sinking. The nature and orientation of the wall contacts shed light on the kinematics of ring-faulting before subsidence of the pluton floor began. A pronounced elongation of the pluton parallel to the trend of regional fissure swarms indicates strong tectonic control of horizontal ring-fault propagation, whereas faulted wall contacts represent step-over structures between the earlier-formed ring faults. On outcrop scale, the roof contact, which originally exploited the layering of the basaltic host rock, exhibits numerous steps, faults, and apophyses; these are interpreted as signs of magmatic stoping caused by internal magma pressure and ancillary thermal shock, faulting due to regional extension and gravity, as well as dyking. Based on our knowledge of the three-dimensional shape of the pluton and its roof structure, we estimate that around 30% of the exposed volume of the pluton (8 to 10 km3) was emplaced by magmatic stoping.