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Variation in explosive eruption style and magma composition during the 10th century Eldgjá fissure eruption, southern Iceland

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The 10th century Eldgjá basaltic flood lava eruption in southern Iceland erupted up to 19.7 km^3 of magma, 1.3 km^3 dense rock equivalent (DRE) as tephra. Explosive activity took place in at least 16 discrete phases along a partly subglacial, partly subaerial fissure system which produced a composite tephra stratigraphy. Estimates of eruption source parameters based on the tephra deposit indicate that individual explosive phases were capable of producing 10 to 20 km high eruption columns in strong subplinian to Plinian-scale events. Vesicle-size analyses in combination with grain-size analyses reveal that the contribution of external water in subglacial phases was limited to thermal granulation.

By mapping the deposits from individual phases to reconstruct the sequence of activity and then chemically analysing this stratigraphy it has been possible to constrain the evolution of the magma source both temporally and spatially. The Eldgjá products are on the primitive end of the Katla volcanic system's (the system of which Eldgjá is included) compositional spectrum. The Eldgjá products show a compositional evolution with time, a trend which conflicts with the model of extracting magma from a compositionally-zoned magma chamber. Further, detailed isopach maps of the Eldgjá tephra deposits demonstrate that activity did not simply propagate along the fissure but instead focused around one spot and made repeated switches to and fro across this region. Of the 4 known subglacial recursions, two of them are associated with minor silicic units within the Eldgjá stratigraphy which may record interaction between Eldgjá's plumbing system and magma stored beneath the Katla caldera.