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# Pseudopillow fracture systems: Insights into cooling mechanisms and environments from lava flow fractures

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We present field observations of lava flow structures within the remarkably well-exposed flow front of a flow-banded trachyandesite lava at Djúpalón on the coast of the Snæfellsnes peninsula, west Iceland. New discoveries from this lava flow reveal additional scales of complexity in pseudopillow fractures and give an enhanced understanding of these fracture systems and their association with particular environments containing water, ice or snow.

The flow interior is characterised by large curviplanar master fractures with many smaller subsidiary fractures perpendicular to them. Such structures have previously been called pseudopillows or pseudopillow fractures. They have been recognised in a range of lava compositions from basalt to rhyolite. We propose the term pseudopillow fracture systems to emphasise the consistent package of different fracture types that occur together. All documented occurrences of these fracture systems are in lavas that have interacted with some type of an additional coolant (i.e. water, ice, snow). Thusfar little has been understood about the formation mechanisms of these fractures and the reason for their association with particular environments.

We identify three distinct types of master fracture on the basis of their fracture surface texture (fractography) and orientation in relation to flow banding; and two different types of subsidiary fractures based on their shape. Surface features used to identify fracture mechanisms include straight and curved chisel marks (or striae), cavitation dimples, river lines and rough and smooth fracture surface textures. Using these fracture surface features we infer that master fractures can form by both brittle and ductile fracture, whereas subsidiary fractures only form by brittle fracture. Glass very commonly occurs in association with pseudopillow fracture systems in the Djúpalón lava flow, providing evidence of rapid cooling during their formation.