Ice-contact volcanism and hyaloclastite flow emplacement in the Vífilsfell region, SW Iceland

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Ice-contact volcanism, and specifically subglacial volcanism, can provide information about paleo-environments such as the extent and thickness of former glaciers and ice sheets. Ice-contact volcanism can produce hyaloclastite flows, composed of mobilized volcaniclastic glass originating from melt-water interaction; however, their preservation in the geological record is rare. The Vífilsfell region, located approximately 30 km SE of Reykjavík on the Reykjanes Peninsula, includes three principal landforms associated with ice-volcano interaction: Northern Bláfjöll, Vífilsfell, and Arnarþúfur. This study combines remote sensing classification of multispectral satellite imagery and field observations to determine the relationship between these features. The remote sensing analysis involves classification of discrete spectral clusters within SPOT 5 imagery using geographic information systems (GIS). Cluster analysis identifies 22 separable spectral signatures within the data set of which 15 are significant (cumulative proportion 94.67%). The spatial distribution of significant clusters provides direction for subsequent field investigation. Ground-truthing revealed that Northern Bláfjöll is a flat-topped volcano with basal pillow lavas, altered hyaloclastite (palagonite), breccia, welded scoria, and subaerial lava. Vífilsfell is a conical feature situated directly on top of Northern Bláfjöll and composed of palagonite with isolated welded scoria deposits, volcanic bombs, and dykes. Arnarþúfur consists of a series linearly oriented mounds with rhythmically layered beds of palagonite, glass clasts, and accretionary lapilli that contain flow indicators such as climbing ripples, cross-beds, and flukes. Northern Bláfjöll emerged from a deep englacial melt-water lake and is, therefore, a tuya. Vífilsfell is a subglacial mound (SGM) that formed beneath thin-ice conditions with episodic melt-water drainage during its emplacement. Arnarþúfur combines the characteristics of pyroclastic density currents, turbidites, and eskers and is a hyaloclastite flow deposit, not the in situ product of a subglacial fissure eruption. Hyaloclastite flows are volumetrically significant relative to the total volume of erupted material in subglacial environments and require more attention in models of ice-volcano interaction.