ABSTRACT

Structure and Products of Subaquatic Volcanoes in Iceland

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Iceland provides a unique opportunity to study the mechanism of subaquatic eruptions. The Neovolcanic zone dissecting the country from NE to SW has been volcanically active since the end of the Tertiary, and a large number of eruptions have occurred under glaciers where melt water provided a subaquatic environment.

The subaquatic volcanic piles have a regular structural sequence consisting of pillow lavas at the base covered by pillow breccias and glassy tuffs. This regularity is believed to result from external conditions rather than changes caused by variations in endogenic forces. The effective chilling of the lava surface as it enters the water prevents the natural degassing of the material under the prevailing hydrostatic pressure. The interior parts of a pillow continue to degass, however, creating gas pressures within each unit representing the amount of exsolved gases at magmatic temperature. The amount of exsolved gases is ultimately controlled by the hydrostatic pressure and pillow stability is thus a function of water depth above the volcanic vent. As the volcanic vent comes closer to the surface, a larger part of the dissolved gases will exsolve and pressures will be created within each glass encrusted unit which eventually are capable of exploding the material into fine-grained tuffs.

A subaquatic lavaflow tends to form a thick pile instead of spreading out because of the effective chilling of flow fronts. This pile, consisting to a large extent of pillows, is eventually covered with layers of glassy tuffs. These tuffs are characteristically altered into palagonite. The alteration process neither can be related to immediate reactions between the hot melt and water,

nor can this large-scale alteration be explained as a continuous weathering process under prevailing climatic conditions. It is suggested that a subaquatic volcanic structure is somewhat similar to a geothermal field during the period of cooling, where the pillow pile serves as a heat source and the tuffs provide the confining walls and cover. The palagonitization is thus considered to represent mild hydrothermal alteration in a short-lived thermal system.