2 Outline of the geology of Iceland

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GENERAL ASPECTS

Vertical sections of the volcanic sequence in Iceland expose up to 1500 m of rocks below which lie at least another 2—5 km of extrusives. At this depth seismic layer 3 (Vp=6.5 km/s) is reached which possibly constitutes the base of extrusive rocks. Deep drilling in Reykjavík, near Akureyri in northern Iceland, and in Reydarfjördur in eastern Iceland has confirmed a minimum 4 km thickness of the lava pile.

The exposed volcanic pile is built predominantly of basalt (80—85%) and acidic including intermediate rocks constitute about 10%. The amount of sediment of volcanic origin is in the order of 5—10% in a typical Tertiary lava pile but much higher in Quaternary rocks.

Among the basalts three main lava types have been recognized in the field. 1) compound flows of olivine tholeiite, 2) simple flows of tholeiite with little or no olivine and 3) flows porphyritic in plagioclase and/or pyroxene. Gradations exist between the three but as a rule they are distinctive enough in the field to provide mappable stratigraphic units. Certain lava types are characteristic for distinct types of lava morphology. Thus the olivine tholeiite often produces lava shields which are seen in the lava pile as thick pahoehoe flows consisting of numerous thin flow units. The olivine poor tholeiite is characteristic of fissure erupted aa lavas. Central volcanoes erupt both types but the latter is more abundant forming unusually thin flows, free of phenocrysts, possibly erupted in a superheated state. The porphyritic lavas are more often produced from fissures and range among the most voluminous flows erupted in single eruptions. In outcrop they are usually distinctive in their thickness and massive appearance.

Of the acidic rocks some 60—70% are lavas and intrusions. 30—40% consist of pyroclastic material deposited as agglomerate in vent regions, as ash flow tuff sheets or as airfall tuff beds carried downwind from the source for long distances. Some of the ash flow tuff sheets constitute easily mapped marker horizons in the volcanic pile. They are commonly welded and individual sheets seldom exceed 5 km^3 by volume.

Alkalic rocks are limited to branches of the neovolcanic zones that are termed flank zones, and are superimposed on the tholeiite rocks that build up the lava pile.

The lavas of the pile dip gently on a regional scale, generally towards the central part of Iceland (Fig. 1). The dips increase gradually from near zero at the highest exposed levels of the pile to about 5—10° at sea level. The increase in dip is matched by individual lava groups thickening down the direction of dip (Fig. 2). The regional tilt thus must have been imparted to the pile during its growth, which takes place within axial rift zones that are stationary for long periods of time. Extension and subsidence in these zones was matched by dyke injections and lava pouring out at the surface. Lateral transport due to crustal spreading would gradually remove the growing pile away from the zone of accretion and no more lavas would add to it. At this point erosion begins to modify the topography by carving out valleys and exposing the internal structures of the pile.

Structural relationships indicate that the lava pile grew as lenticular units from elongate volcanic systems which included swarms of dykes and fissures usually localized about central volcanoes. These units attain their greatest thickness in the area of the central volcanoes which are also marked by the occurrence of acid and intermediate rocks among the copious basalt outpourings (Fig. 3). They commonly develop calderas. Intrusive bodies, up to 10 km^2 in area, of dolerite, gabbro and/or granophyre are exposed in most eroded central volcanoes studied to date. The roots of the latter are also invaded by intrusive sheet complexes which