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# A detailed palaeomagnetic study of the oldest (≈15 Myr) lava sequences in Northwest Iceland

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## SUMMARY

We have determined the directions of primary remanence in over 400 lava flows in the northwestern peninsula of Iceland (near 66.1°N, 23.3°W). These lavas were sampled in 16 profiles spread across 75 km, at the stratigraphic level of the oldest (approximately 15 Myr in age) of several distinctive lignite-bearing sediments in the peninsula. We find that the pattern of polarity reversals in the lava pile is broadly similar in these profiles but it is generally not possible to trace short polarity zones and excursions over more than a few kilometres laterally. Our results, which also include measurements on the lignite sediments at three sites, are consistent with previous suggestions that these sediment beds represent a time gap of the order of 0.2 Myr between the lavas above and below. The mean virtual geomagnetic pole of this collection is 'far-sided' by approximately 7°, and the scatter of individual poles is greater than that in palaeomagnetic surveys on younger lava series in Iceland.

**Key words:** Cenozoic, Iceland, igneous rock, palaeomagnetism, sediments.

## 1 INTRODUCTION

### 1.1 General

Iceland owes its presence to a combination of crustal generation by sea floor spreading and the activity of a mantle plume. Outside of the regions generated during the last couple of Myr under glacial conditions, the exposed formations consist primarily of subaerially erupted lava flow sequences. The lavas originate partly in fissure eruptions and partly within central volcano complexes. Judging from the results of extensive radiometric dating in different areas of Iceland, any two adjacent Tertiary lava flows may be expected to be 5–10 kyr apart in time on average (see table 1 of Kristjansson & McDougall 1982), and the average thickness of a lava flow is of the order of 10 m (e.g. Walker 1959; Kristjansson & Johannesson 1996). The lavas can usually be distinguished from each other as their topmost parts tend to be scoriaceous. Interbasaltic red-brown volcanogenic sediments less than 0.5 m thick are also generally present.

Research on the remanent magnetization of Icelandic lavas was initiated on a small scale around 1930. Since 1950, this research has led to several important discoveries regarding the history of the geomagnetic field, including the first records of 'intermediate' directions at polarity zone boundaries, *cf.* the review by Kristjansson (1993a). The lava pile of Iceland presents virtually unlimited opportunities for palaeomagnetic research. Areas may be chosen where the lavas have suffered a minimum of thermal and tectonic disturbance, with good accessible exposures of stratigraphically overlapping profiles, each containing up to 50 or more lavas. In many areas of the country no stratigraphic mapping or palaeomagnetic studies have yet been carried out, and only preliminary work has been done in many other areas. The usefulness of past and future palaeomagnetic results from the lava pile may be greatly augmented by improved techniques of radiometric age determination, e.g. in accurate dating of geomagnetic reversals at favourable sites.

To this date, palaeomagnetic studies in Iceland have mainly been carried out for two purposes.

(i) In local stratigraphic correlations. In stratigraphic work, geologists have partly relied on tracing sediment beds, as well as groups of several lavas having abundant feldspar phenocrysts or other easily recognizable characteristics (Walker 1959). In East Iceland some of these lava groups may extend over tens of kilometres but others are less distinct, interfingering with the tholeiites which are the most common lava type. Chemical analyses have so far hardly been tested at all in stratigraphy in Iceland. A zone of constant palaeomagnetic polarity in the lava pile typically consists of 10–25 lava units (Kristjansson & McDougall 1982) and such zones therefore provide a useful supplement to the geologist's mapping methods. Polarities can in many cases be measured on hand samples with a magnetometer in the field, but this method is not recommended due to the frequent presence of viscous remanence (VRM) and other disturbing factors such as induced magnetization and shape effects.

(ii) As a means of inferring the behaviour of the palaeomagnetic field. This work has largely concentrated on various overall properties of the field. The time interval between flows is variable