This paper was published in 1996. An enlarged copy of Fig. 8 is at the end.

Stratigraphy and Paleomagnetism of the Lava Pile South of Ísafjarðardjúp, NW- Iceland

Leó Kristjánsson

Science Institute, University of Iceland, Dunhaga 3, 107 Reykjavík

Haukur Jóhannesson

Icelandic Institute of Natural History, Hlemmi 3, 105 Reykjavík

Abstract – *A composite 2.6 km stratigraphic section has been constructed from 12 well-exposed lava profiles in the fjords on the south side of Ísafjarðardjúp, in the Vestfirðir peninsula of NW-Iceland. Its age is around 13 Ma. Oriented cores for paleomagnetic measurements were collected from 307 lava sites, 225 of them in the composite section. The lavas carry a stable primary remanence, and ten or more reversals of geomagnetic polarity are recorded in the composite section. There is also evidence for extended excursions (periods of instability) of the geomagnetic field, with some 15 lavas in the section being erupted during one of these.*

The paleomagnetic polarites are used along with geological information for correlation with the composite section of McDougall et al. (1984) along the western side of the Vestfirðir peninsula. Sediments correlated with the Brjánslækur sedimentary horizon occur near the top of the Ísafjarðardjúp section. We suggest that the two sections mapped by McDougall et al. on the western and eastern sides of the peninsula fail to overlap, possibly by over 1 km of lava thickness.

INTRODUCTION

Scope of the present study

In Iceland, the chief difficulties in regional stratigraphic mapping include the episodic character of the volcanism, and tectonic complications connected with shifts in the position and direction of the volcanic zones. The coverage of extended stratigraphic sections is sparse, and few radiometric age determinations are available. These circumstances make long-distance correlations by conventional mapping methods quite uncertain, so it is becoming necessary to develop new and improved methods.

Under favorable circumstances, lava sequences can furnish important data on the age of geomagnetic chron boundaries, to supplement and confirm similar data available from sediments and ocean-ridge anomaly inversion. The chief requirements are a constant rate of build-up of a lava pile, preferably without any breaks exceeding 10,000 years, and accurate radiometric dating. In the nineteen-sixties good progress was made world-wide in establishing the age of some Quaternary reversals, and it seemed reasonable to expect that a complete geomagnetic polarity time scale would be established before long. Unfortunately, complications including the presence of numerous short chrons and variable fidelity of the available "tape recorders" have turned up. In spite of individual successes such as the dating of Gilbert subchrons in Iceland by McDougall *et al.* (1977), the various approaches to a polarity time scale have still not converged sufficiently.

The Vestfirðir (Western fjords) peninsula of NW-Iceland is a region very suitable for detailed stratigraphic studies and for age dating of chron boundaries. It is a basalt lava pile of 15 - 8 Ma age, largely free of disturbance from tectonics and from hydrothermal effects of volcanic centers. Good access to the lava pile is provided by the numerous fjords and valleys of the peninsula.

The present project of stratigraphic mapping was in part initiated to test the use of paleomagnetic polarity zones for correlation over distances of up to 50 km or more. This can be done by comparing the pattern of polarity reversals in a composite WNW-ESE section through the tributary fjords south of Ísafjarðardjúp (Fig. 1) with a pattern previously obtained from profiles along the western side of the NW-peninsula (McDougall *et al.* 1984). The paleomagnetic directions from the lavas in the section can also be used for statistical studies of the geomagnetic secular variation, and some such studies using the directions from the present collection have already been published (Kristjánsson and Jóhannesson 1989; Kristjánsson 1995).

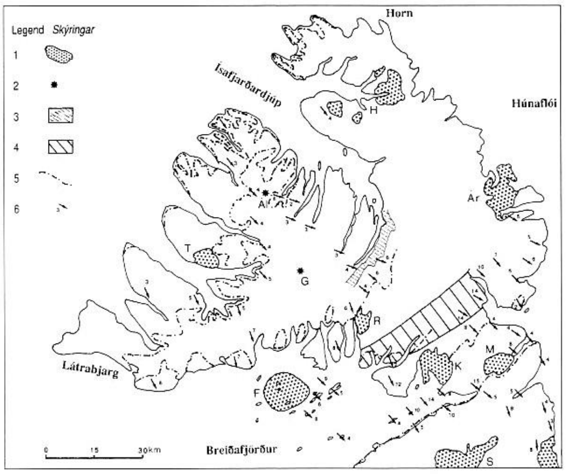

Fig. 1. Schematic geological map of the Vestfirðir peninsula, NW-Iceland. 1 Exposed central volcano, 2 Down-dip central volcano, 3 Series of compound lava flows in Ísafjarðardjúp, 4 Flexure zone, 5 Unconformity, 6 Dip and slopę. H Hrafnfjörður central volcano, Ál Álftafjörður c.v., T Tjaldanes c.v., G Gláma c.v., F Flatey c.v., R Reiphólsfjöll c.v., Ár Árnes c.v., K Króksfjörður c.v., M Mókollsdalur c.v., S Sælingsdalur c.v. and P Prestbakki c.v.

1. mynd. Einfaldað jarðfræðikort af Vestfjörðum. Megineldstöðvar eru merktar með bókstöfum. Syrpa dyngjuhrauna við innanvert Ísafjarðardjúp er sýnd sérstaklega, svo og hallabelti og mislægi. Strik og halli jarðlaga eru gefin á allmörgum stöðum.

General geological setting of the Vestfirðir peninsula

Iceland is sitting on a divergent plate boundary in the North Atlantic Ocean. The rift axis branches through Iceland from southwest to northeast, joining the ridge segments southwest and north of Iceland. The basalt plateau of Iceland consists predominantly of tholeiitic basalt lava flows which have been erupted within a rift zone and subsequently drifted away to the east and west. The currently active rift zone structure is a relatively recent phenomenon: the main part of the lava pile in NW-Iceland was produced by an older rift zone which was located west of the present one (Sæmundsson 1979, Jóhannesson 1980) and became extinct about 6-7 million years ago. The extinct zone (named the Snæfellsnes rift zone) can be traced as a syncline structure running obliquely across the Snæfellsnes peninsula from SW to NE and continuing east along the Hvammsfjörður Bay. Farther to the east the structure takes a northerly trend to join the Kolbeinsey ridge north of Iceland.

The geology of the Vestfirðir region is relatively poorly known. The lava succession is 4-5 km thick and consists mainly of tholeiitic lava flows intercalated with thin (1 m or less) sedimentary beds, usually red lateritic paleosoil. A few thicker sedimentary horizons do occur within the succession representing times of very slow or no volcanic activity (Sæmundsson 1979). These horizons are usually accompanied by minor unconformities. The sedimentary horizons are a few tens of m in thickness and some are rich in plant impressions (Friedrich 1966) which give indications about the climate of the time when they were formed.

The lava flows in the western coastal region of the Vestfirðir peninsula have a gentle (often 2-3°) southeasterly dip. The dip increases gradually towards the southeastern part of the peninsula until it reaches about 15° in a monoclinic flexure zone which stretches from Þorskafjörður to Steingrímsfjörður. Central volcanoes are buried within the succession and 7-8 have been identified (Fig. 1) but there is evidence for a few more down-dip. Results of mapping have been published for only one volcanic center, the Króksfjörður volcano in the southeastern part of the area

(Hald *et al.* 1971). Irregularities in dip and strike occur around the central volcanoes; they usually display a great compositional variety in rock types and the thickness of individual rock series increases towards them.

Previous work on stratigraphic sections

Kristjánsson *et al.* (1975) mapped a 2-km section in the Arnarfjörður area. Jóhannesson (1980) mapped a section from the Króksfjörður central volcano to the southeast into the Dalir district.

Extensive stratigraphic mapping was carried out by McDougall *et al.* (1984) on a composite section through the Vestfirðir in two parts, lower and upper. The base of the 4-km lower section is at Súgandafjörður and Skálavík, with the section running south from there to Arnarfjörður and ending in the eastern part of Barðaströnd. An isolated segment of two profiles was also mapped farther east. The base of the 3-km upper section is at Reykjarfjörður on the east side of the Vestfirðir peninsula, with profiles stretching south along the coast to Hrútafjörður. Included in the work of McDougall *et al.* (1984) were a number of K/Ar-age determinations of basaltic lava flows.

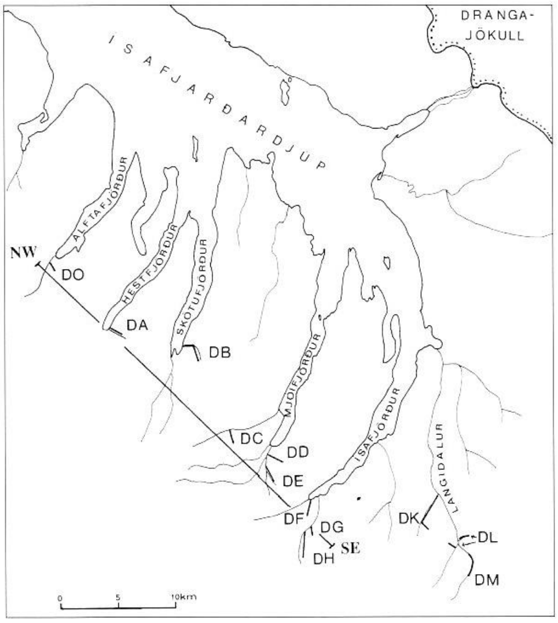

Fig. 2. Location of profiles sampled for paleomagnetic measurements. See Table 1. NW-SE line: cross-section of Fig. 9.

2. mynd. Staðsetning sniða til sýnatöku vegna bergsegulmælinga, sjá 1. töflu. Þverskurður eftir NV-SA línu er sýndur á 9. mynd.

GEOLOGICAL METHODS AND RESULTS

Field methods

The mapping involved definition of lava type, measurements of the thickness of individual lava flows and sedimentary beds, identification of secondary mineralization, measurements of magnetic polarity by portable fluxgate magnetometer and determination of strike and dip.

The lava flows were classified according to a modified Walker's (1959) classification scheme. The rock types are as follows: tholeiite, olivine basalt (single flows), compound flows (lava shields), feldspar-porphyritic lavas, basaltic andesite (i.e. basaltic icelandites), andesites (i.e. icelandite), dacite and rhyolite. Ignimbrites are classified separately. The sedimentary beds in Ísafjarðardjúp are commonly thin red lateritic beds believed to be paleosoil, with lake sediments (mostly siltstone), acid tuff and conglomerates also occurring. The sedimentary beds are usually few tens of cm thick but they can reach 10 m thickness or more.

Stratigraphic profiles and correlations between them

Twelve profile sections (DO, DA,.... DM) comprising 320 lava flows of 3900 m total thickness were sampled. The location of the profile sections is shown in Fig. 2. Individual sections are shown in Figs. 3-7 and a 2600 m thick composite section in Fig. 8. Correlations between neighboring sections were relatively easy to trace in the field, even up to distances of the order of 10 km. The correlations are based both on petrographic characteristics of the lava flows and on their paleomagnetic polarity.

The most common rock types are tholeiites and olivine basalt amounting to 30% each of the total thickness. Compound lava flows are 22% and porphyritic flows 11%, the latter group including the two ankaramitic flows DL9 and DL9A. Sedimentary beds are only 4% of the section and most of the beds belong to a sedimentary horizon in the uppermost profiles, especially in section DL. If the thick sedimentary horizon is excluded the sedimentary beds make up only 1-2% of the lava succession. The average thickness of lava flows varies by type. The compound flows are on the average 18 m thick, olivine basalt flows 12 m, porphyritic flows 10 m and tholeiite flows 8 m thick, respectively. The sedimentary beds are on the average 0.4 m thick, ranging from 5 cm up to 30 m.

Close to the base of section DO (Figs. 2,3), between flows 18 and 19, is a minor unconformity (see Fig. 1) marking the upper limit of the lava flows which belong to the Álftafjörður central volcano. Some of the lava flows in sections DO, DA and DB are very conspicuous due to unusual thickness and structure and can be traced visually for tens of kilometers. In the upper part of section DF and in the lower part of DG is a pronounced group of compound lava flows (Fig. 1) which is an ideal marker horizon. Close to the top of our section is a 30 m thick sedimentary horizon (between DL 2 and DL 3) which also may be a good marker horizon. The present authors consider it to be contemporaneous with the Brjánslækur sediments which occur between flows JF 46 and JF 48 of McDougall *et al.* (1984).

Tectonics and alteration

The general strike of the lava flows is NE-SW in the area south of Ísafjarðardjúp (Fig. 1) but changes to

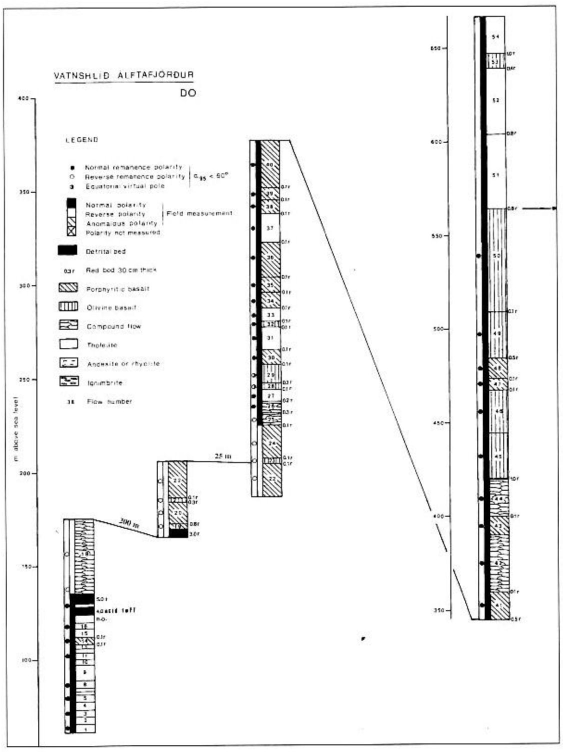

Fig. 3 / *3 mynd*

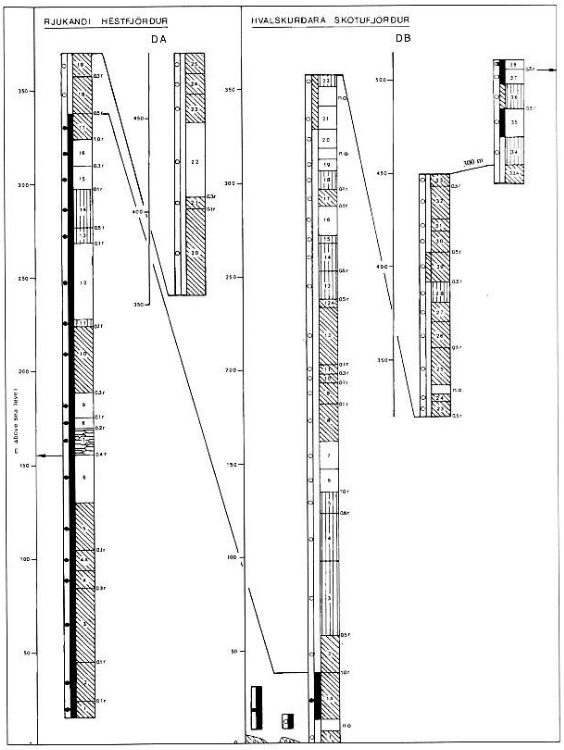

Fig. 4 / *4. mynd*

Fig. 3-7. Detailed stratigraphy of the sampled Ísafjarðardjúp profiles of Fig. 2. The paleomagnetic polarity (both from field and laboratory measurements) is shown. Explanations are in Fig. 3.

3.-7. mynd. Gerð jarðlaga í sniðum á 2. mynd. Sýnt er fyrir hvert hraunlag hvort segulstefna hefur mælst "rétt" eða "öfug".

NNE-SSW north and east of it. Dykes in the research area are few and they trend NE-SW.

Secondary mineral assemblages of the lava succession were classified according to Walker (1960). The alteration stage of the lava pile in Ísafjarðardjúp is low and the basalt flows are relatively fresh. Fig. 9 shows a transection of the mapped area and the zeolite zones. In the western part of the area the topmost zone, the zeolite-free zone, can in places reach 600 m thickness which is unusual. The underlying chabazite zone which is exposed in Álftafjörður, is missing in Skötufjörður and Hestfjörður but appears again in Mjóifjörður. The reason for the rise in the upper limit of the chabazite zone at both ends of the section is presumably their closeness to the down-dip Álftafjörður central volcano to the west and the Reiphólsfjöll central volcano to the southeast.

PALEOMAGNETISM

Previous work

Kristjánsson (1968) carried out a preliminary paleomagnetic survey on a few short profiles to the west of Álftafjörður. Kristjánsson *et al.* (1975) sampled a 400-m lava profile in Arnarfjörður. This sampling was greatly expanded in the 1975-78 collection by McDougall *et al.* (1984) of cores from 1261 flows in composite sections on the west, south and east coasts of the peninsula. No paleomagnetic measurements have been made previously on samples from the area between profiles DO and DM, nor has any sampling for such work been done so far on the northeastern side of Ísafjarðardjúp.

Sampling and measurements

Paleomagnetic core samples of 24-25 mm diameter were collected using a portable gasoline-powered drill, in 1982-85. They were oriented by geographic or

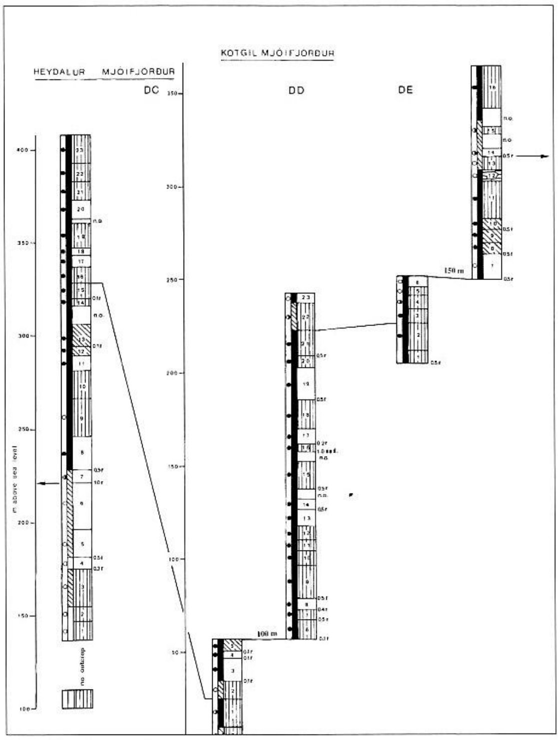

Fig. 5 / *5. mynd*

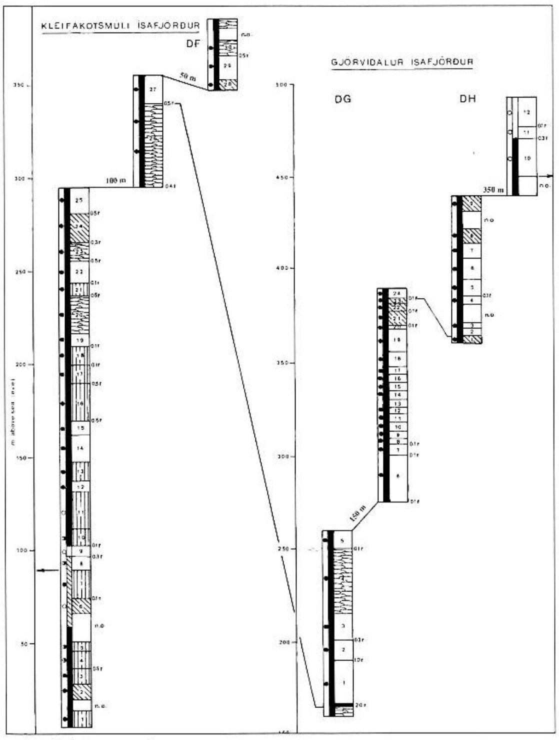

Fig. 6 / *6. mynd*

sun sightings, with an estimated random error of 2° in azimuth and 1° in inclination. Most commonly, four samples were taken from each flow, distributed laterally across several meters of a lava face. A 21- mm specimen was cut from each core and measured in an "Institut Dr. Förster" static fluxgate magnetometer with a four-probe arrangement. Measurements were made on the natural remenence and after alternating field (AF) demagnetisation in a two-axis tumbler. Demagnetisation steps for all specimens were at 10, 15, 20 and 25 mT peak field, with 30 mT also included if necessary. Lightning effects were noted in two flows, DG 9 and DH 9.

The remanence intensity of the lavas is similar to that in other collections from Iceland, averaging 3.3 A/m after 10 mT AF treatment. The stability of primary remanence directions is generally very good, when Brunhes age viscous remanence has been eliminated (usually after 10 or 15 mT treatment). However, about 20 specimens were unstably magnetised or otherwise anomalous, and these were discarded before statistical analysis. As the sampling was carried out in four field seasons, there was opportunity to resample some of the flows which had given unsatisfactory results.

The most reliable estimate of the paleomagnetic direction within each lava is selected as the direction which yielded the maximum resultant from unit vectors (all specimens being demagnetised at the same alternating field). These directions and other parameters are listed in Table 1. Tectonic tilt corrections, using tilt values measured in the field, have been applied to all the directions. The tilt values are listed at the end of Table 1.

Some flows were not accessible for coring, and

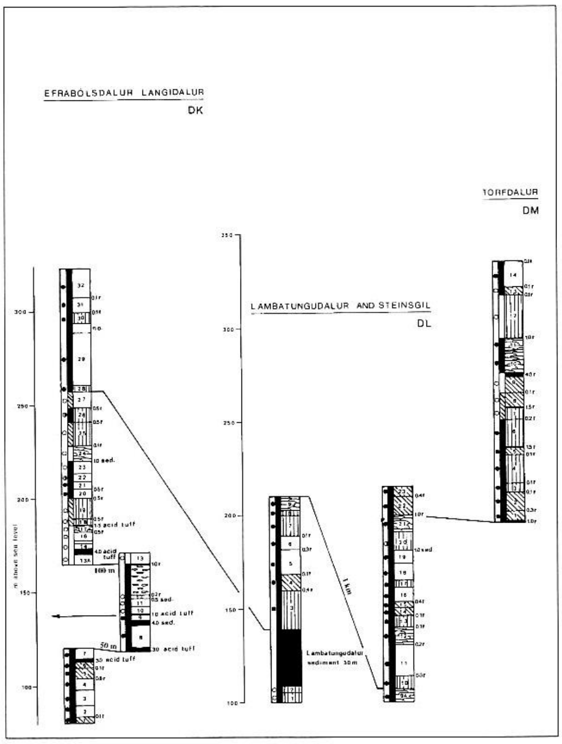

Fig. 7 / 7. mynd

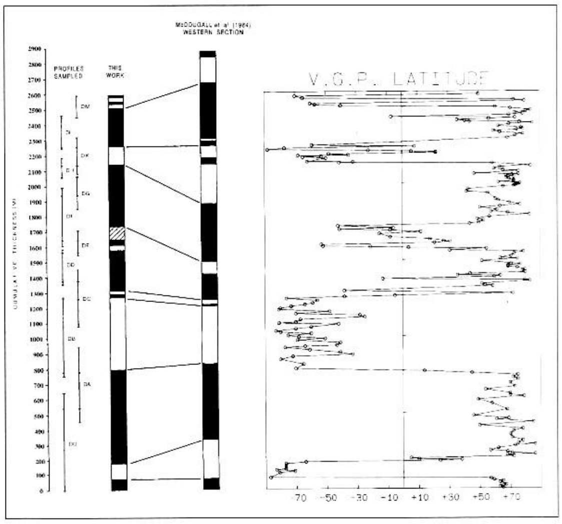

Fig. 8. Paleomagnetic polarity in the Ísafjarðardjúp composite section constructed from twelve measured profiles DO to DM on left, along with the polarity time scale of the western composite section of McDougall *et al.* (1984). Black indicates normal polarity, white indicates reverse polarity and shaded indicates the upper portion of a prolonged period of field instability. The latitudes of virtual geomagnetic poles (V.G.P.) for lavas in the Ísafjarðardjúp section are shown on the right.

8. mynd. Breiddargráða sýndarsegulpóls í samsettu sniði jarðlaga við Ísafjarðardjúp. Sýnd er skörun sniðanna, kaflar með réttri og öfugri segulstefnu, og tenging við samsvarandi kafla í vestara sniði McDougall o. fl. (1984).

others were omitted because they were thin or crumbly. In compound flows such as DO 18 and DF 26 only one or two flow units were sampled. The total number of units in Table 1 is 303. Four sites which were later thought to represent duplicate sampling of a flow already cored (DB 0A, DB 0B, DK 13A, DL 9A) have been left out. Two lavas, DC10 and DK 21, were also discarded from the calculation of average properties of the collection due to their large within-flow scatter of directions (alpha95 > 23.5°). The quality of directional results in the remaining 301 lavas, as measured by the within-site alpha95, is excellent: the rms value of this parameter is less than 7°.

Mean fields and dispersions

Statistical parameters for the mean fields and virtual poles from the Ísafjarðardjúp area were computed using Fisher's statistics. After inversion of reverse magnetic directions, the mean field of all lava flows (except the six duplicate or discordant flows mentioned above) has D = 357°, I = 74.3°, vector sum R = 264.3 with N = 301, yielding a circular standard deviation (theta63) of 28.6°, uncorrected for within-flow scatter. The 95% confidence circle has a radius of about 3°, so that the mean direction is not significantly different from a geocentric axial dipole field (D = 0°, I = 77.3°).

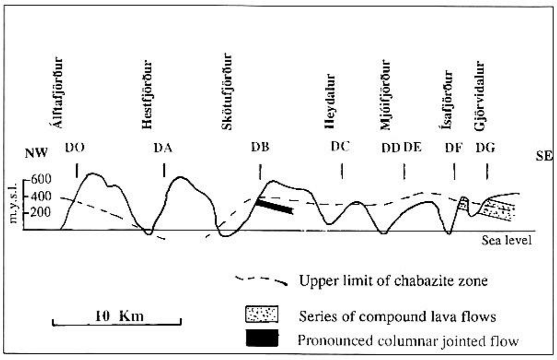

Fig. 9. A simplified transection of the lava succession south of Ísafjarðardjúp showing the zeolite zoning of the lava flows. Also shown is the series of compound lava flows in sections DF and DG. A columnar basalt in the northern part of Skötufjörður can be traced over a wide area; however, it is thin or absent in our profile DB.

9. mynd. Einfaldað þversnið gegnum firðina sunnan Ísafjarðardjúps, með ummyndunarbeltum og staðsetningu dyngjusyrpu í sýnatökusniðum DF og DG. Einnig er merkt þykkt stuðlað hraunlag sem sést vel í klettabeltinu norðantil í Skötufirði og víðar.

Carrying out the same statistical procedures on the virtual geomagnetic poles, we obtain a slightly far-sided mean pole position at 87.5° N, 165°E, with R = 242.6, theta63 = 36.3°. Similar results are obtained if only the 225 flows in the composite section are used, or if profiles SZ and SF of McDougall *et al.* (1984) are included (see Kristjánsson and Jóhannesson 1989).

The circular standard deviation of the directions or poles in this area is unusually large for Icelandic lavas. The present authors have observed (Kristjánsson and Jóhannesson 1989; Kristjánsson 1995) that a long-term decrease in this statistical property has taken place within the past 14 Ma. It is suggested that the decrease is largely caused by an increasing stability with time of the geomagnetic field during reversal transitions and major excursions during this period. There are at least three episodes in the composite section in Ísafjarðardjúp where the virtual poles are changing erratically through a sequence of several lava flows. One is at the R to N transition in flows DB 37-38 and DC 6 -10. Another is a prolonged excursion or series of short polarity reversal events at DD 21-23, DE and up to DF 12. The third episode is at DK 20-28, perhaps including also DL 1-2. Similar but possibly shorter episodes in other paleomagnetic collections in Iceland are mentioned by Kristjánsson and Jóhannesson (1989, p. 130). This type of behavior is less pronounced in studies on younger lava flows in Iceland which also yield lower between-lava circular standard deviation values. Various world-wide paleomagnetic studies on Quaternary sediments in the literature display erratically varying pole positions which may also be due to geomagnetic instabilities. An instability episode at 16.2 Ma is recorded by the Steens Mountain lava sequence in the western U.S.A. (Coe *et al.* 1995).

MAIN RESULTS ON STRATIGRAPHY

The polarity column of Ísafjarðardjúp and to the west

After elimination of overlapping parts of adjacent

Lava	N	n	D	I	Lon	Lat	Alf	J100	Pol
DO VATNSHLID ALFTAFJORDUR									
DO 1	4	0	345	61	184	65	2	2.10	N
DO 3	5	0	354	58	168	63	3	6.37	N
DO 5	5	0	1	60	154	65	4	8.13	N
DO 8	4	0	359	61	159	67	4	9.87	N
DO 11	5	0	26	62	111	63	4	5.01	N
DO 14	5	0	33	66	96	65	8	7.74	N
DO 16	5	1	325	61	213	59	6	3.34	N
DO 17	4	0	322	60	215	57	8	4.75	N
DO 18	4	0	185	-79	198	-87	3	4.40	R
DO18E	4	0	165	-81	127	-81	3	2.51	R
DO 19	5	0	152	-69	37	-71	7	1.12	R
DO 20	4	0	175	-73	358	-83	3	2.71	R
DO 21	4	0	200	-72	280	-77	4	9.87	R
DO 22	4	0	195	-71	295	-77	4	11.31	R
DO 23	4	0	165	-71	18	-77	3	3.38	R
DO 24	4	0	156	-73	46	-77	3	6.28	R
DO 25	4	0	290	-88	165	-64	3	2.30	R
DO 26	4	0	84	42	62	24	14	0.48	NT
DO 27	6	0	52	43	93	38	3	2.33	NT
DO 28	4	0	200	52	320	10	3	2.40	E
DO 29	4	0	190	47	328	5	8	1.85	E
DO 30	4	0	48	78	39	72	2	0.94	N
DO 31	4	0	49	75	56	68	10	2.56	N
DO 32	4	0	350	78	258	86	3	1.89	N
DO 33	4	0	2	65	152	71	5	3.49	N
DO 34	4	0	15	64	128	68	4	3.78	N
DO 35	4	0	1	53	155	57	7	5.41	N
DO 36	4	0	212	88	331	62	5	9.08	N
DO 37	4	0	315	81	289	73	6	13.85	N
DO 38	4	0	359	80	334	86	5	2.03	N
DO 39	4	0	321	81	287	75	3	3.19	N
DO 40	4	0	336	82	305	78	3	3.06	N
DO 41	4	0	9	65	137	71	6	2.64	N
DO 42	4	0	346	65	185	70	5	1.57	N
DO 43	4	0	317	75	257	72	6	3.19	N
DO 44	4	0	333	81	293	78	3	8.37	N
DO 45	4	0	174	82	340	50	6	6.67	N
DO 46	4	0	349	78	267	85	6	9.13	N
DO 47	4	0	266	82	305	61	3	5.70	N
DO 48	4	0	298	86	316	69	4	5.57	N
DO 49	4	0	95	70	34	46	6	3.91	N
DO 50	4	0	62	87	353	68	6	2.22	N
DA RJUKANDI HESTFJORDUR									
DA 1	7	0	67	79	29	66	4	5.31	N
DA 2	4	0	70	75	40	61	6	6.01	N
DA 3	4	0	341	67	196	70	8	3.19	N
DA 4	9	0	133	87	345	62	4	3.07	N
DA 4A	5	0	319	61	222	57	6	2.03	N
DA 5	4	0	320	61	219	58	5	3.44	N
DA 6	4	0	53	57	84	49	4	4.14	N
DA 7	4	0	356	83	332	79	7	5.39	N
DA 8	4	0	303	83	302	70	8	2.18	N
DA 9	4	0	322	72	238	70	12	4.09	N
DA 10	4	0	307	63	236	54	6	3.55	N
DA 11	5	0	333	70	219	73	3	4.20	N
DA 12	4	0	336	68	208	70	4	7.00	N
DA 13	4	0	321	78	271	75	7	7.95	N
DA 14	4	0	315	78	272	72	3	6.68	N
DA 15	4	0	38	77	51	75	5	4.28	N
DA 16	5	0	295	58	243	45	5	2.41	N
DA 17	4	0	125	49	24	14	4	2.46	NT
DA 18	4	0	237	-64	253	-54	5	1.10	R
DA 19	4	0	125	-76	88	-67	4	2.19	R
DA 20	4	0	148	-75	66	-76	3	4.69	R
DA 21	4	0	254	-67	234	-50	5	8.82	R
DA 22	4	0	257	-58	240	-40	2	6.86	R
DA 23	4	0	265	-65	228	-43	3	7.51	R
DA 24	4	0	171	-78	83	-86	3	4.85	R
DA 25	4	0	160	-77	71	-82	6	7.06	R
DB HVALSKURDARA SKOTUFJORDUR									
DB 0	4	0	117	68	22	36	6	0.23	NT
DB 1	4	0	244	-63	247	-50	3	1.92	R
DB 1A	5	1	63	20	88	20	17	0.21	NT
DB 2	4	0	177	-64	343	-70	6	1.29	R
DB 3	4	0	138	-69	54	-65	5	2.28	R
DB 4	4	0	168	-72	17	-80	6	2.14	R
DB 5	4	0	136	-77	86	-72	4	5.16	R
DB 6	4	0	238	-39	268	-33	3	3.80	RT
DB 7	4	0	260	-60	235	-41	5	2.59	R
DB 8	4	0	246	-74	226	-61	4	3.21	R
DB 9	5	0	154	-74	56	-77	6	3.94	R
Lava	N	n	D	I	Lon	Lat	Alf	J100	Pol
DB 10	5	0	159	-61	13	-64	6	2.19	R
DB 11	4	0	161	-37	1	-43	3	2.87	R
DB 12	4	0	160	-34	3	-41	2	3.13	R
DB 13	4	0	129	-77	89	-69	5	2.05	R
DB 14	4	0	118	-63	66	-51	3	1.92	R
DB 15	4	0	137	-72	64	-68	5	5.38	R
DB 16	4	0	145	-76	73	-75	5	8.22	R
DB 17	5	0	181	-55	335	-60	3	6.21	R
DB 18	4	0	179	-72	340	-80	4	3.54	R
DB 19	4	0	189	-74	298	-83	4	4.78	R
DB 20	5	0	176	-65	345	-70	9	7.39	R
DB 21	4	0	209	-60	290	-60	5	2.41	R
DB 22	4	0	108	-58	70	-42	7	1.96	R
DB 23	4	0	173	-82	146	-81	3	5.17	R
DB 24	4	0	144	-71	54	-70	5	1.16	R
DB 25	4	0	139	-70	55	-67	6	1.74	R
DB 26	4	0	288	-55	216	-25	3	1.70	RT
DB 27	4	0	290	-59	212	-28	3	2.41	RT
DB 28	4	0	229	-76	231	-70	3	6.11	R
DB 29	5	0	199	-44	311	-48	3	1.09	R
DB 30	4	0	161	-81	115	-81	7	4.45	R
DB 31	4	0	156	-80	102	-80	4	5.28	R
DB 32	4	0	138	-83	126	-73	3	12.63	R
DB 33	4	0	219	-66	268	-64	5	6.45	R
DB 34	4	0	119	-70	75	-59	4	8.45	R
DB 35	4	0	155	-55	15	-56	3	5.52	R
DB 36	4	0	212	-76	244	-76	4	1.57	R
DB 37	4	0	53	-71	122	-38	5	1.13	RT
DB 38	4	0	291	-8	226	5	4	3.35	E
DC HEYDALUR MJOIFJORDUR									
DC 1	4	0	183	-62	332	-67	5	3.30	R
DC 2	4	0	187	-65	324	-71	5	7.87	R
DC 3	4	0	142	-50	29	-48	3	3.48	R
DC 4	4	0	147	-83	124	-76	4	4.23	R
DC 5	5	0	196	-75	269	-82	4	3.75	R
DC 6	4	0	67	-71	113	-41	10	0.47	R
DC 7	4	0	50	-39	112	-5	2	1.37	E
DC 8	4	0	313	79	278	72	3	1.19	N
DC 9	4	0	136	-39	33	-38	7	0.47	RT
DC 10	5		SCATTERED RESULTS				>60	0.29	(?)
DC 11	4	0	81	77	30	59	5	0.92	N
DC 12	4	0	275	74	280	54	6	0.85	N
DC 13	4	0	270	74	282	52	2	5.59	N
DC 14	4	0	15	75	85	83	6	3.54	N
DC 15	4	0	8	72	129	80	4	8.70	N
DC 16	4	0	7	71	137	79	6	5.59	N
DC 17	5	0	10	67	134	72	6	6.21	N
DC 18	4	0	303	73	260	64	5	2.57	N
DC 19	4	0	296	72	262	60	3	4.94	N
DC 20	5	0	42	64	89	60	4	2.96	N
DC 21	5	0	138	79	358	48	7	3.18	N
DC 22	4	0	29	74	77	76	4	5.92	N
DC 23	4	0	9	63	141	68	5	1.08	N
DD KOTGIL MJOIFJORDUR									
DD 0	4	0	96	-59	82	-38	11	0.43	RT
DD 1	6	0	92	-17	69	-9	13	0.25	E
DD 2	4	0	87	-29	77	-13	11	0.34	RT
DD 3	4	0	115	85	356	60	2	1.08	N
DD 4	4	0	92	86	358	64	3	1.50	N
DD 5	4	0	244	68	292	36	4	0.77	NT
DD 6	4	0	65	57	72	44	3	0.98	N
DD 7	4	0	13	72	115	80	5	5.28	N
DD 8	4	0	349	71	188	78	5	4.68	N
DD 9	4	0	10	83	352	80	6	6.09	N
DD 10	4	0	13	69	126	75	3	4.55	N
DD 11	4	0	20	66	118	69	8	3.51	N
DD 12	4	0	16	65	126	69	4	4.03	N
DD 13	4	0	344	71	201	77	5	3.01	N
DD 14	4	0	350	65	178	71	2	5.09	N
DD 15	4	0	135	82	357	52	5	1.89	N
DD 16	4	0	23	71	98	75	6	4.06	N
DD 17	4	0	350	60	174	64	5	2.98	N
DD 18	4	0	7	65	143	71	3	7.75	N
DD 19	4	0	329	72	229	73	5	4.70	N
DD 20	4	0	8	71	132	79	6	3.62	N
DD 21	4	0	99	57	42	31	5	1.85	NT
DD 22	4	0	326	-35	189	1	10	1.29	E
DD 23	4	0	110	-13	52	-14	12	0.26	RT
DE KOTGIL MJOIFJORDUR									
DE 2	4	0	89	55	52	33	4	3.81	NT
DE 3	4	0	110	80	10	55	7	1.86	N
DE 4	4	0	328	-30	188	4	17	0.42	E

Table 1. Paleomagnetic directions, intensities and virtual pole positions for lava flows in all the Ísafjarðardjúp profiles. Profile coordinates and tectonic tilt correction values are at the bottom of the table. – **N** number of samples collected from each lava flow – **n** number of samples discarded before computation of mean field. – **D, I** declination (degrees East) and inclination (positive down) of best mean field direction, after correction for tectonic tilt. – **Lon, Lat** East longitude and North latitude of virtual magnetic pole corresponding to the mean field direction. – **Alf** 95% confidence angle of the mean remanence (pale-

Lava	N	n	D	I	Lon	Lat	Alf	J100	Pol
DE 5	4	0	112	-26	53	-21	8	0.31	RT
DE 6	4	0	236	-62	256	-52	7	0.57	R
DE 7	4	0	242	-65	246	-53	6	2.00	R
DE 8	5	0	159	63	353	21	5	1.28	NT
DE 9	4	0	156	70	354	31	6	1.78	NT
DE 10	6	1	349	7	170	27	12	0.43	NT
DE 11	4	0	74	24	76	18	2	1.66	NT
DE 12	4	0	173	-70	357	-77	4	0.62	R
DE 13	4	0	209	-33	301	-38	8	0.88	RT
DE 14	4	0	308	-37	205	-5	5	1.01	E
DE 15	4	0	329	-37	186	1	9	2.01	E
DE 16	4	0	211	59	313	18	4	0.87	NT
DF KLEIFAKOTSMULI ISAFJORDUR									
DF 1	4	0	295	42	235	32	8	0.67	NT
DF 2	4	0	154	70	355	31	5	2.51	NT
DF 3	4	0	205	77	324	42	4	1.01	N
DF 4	5	1	337	-26	180	9	5	0.34	E
DF 5	5	1	83	-22	78	-8	7	0.80	E
DF 6	4	0	288	-42	221	-15	4	0.72	RT
DF 7	4	0	324	-15	194	12	4	2.04	NT
DF 8	5	0	313	-43	199	-8	5	1.45	E
DF 9	4	0	128	-47	44	-41	5	0.74	R
DF 10	4	0	124	14	33	-6	12	0.25	E
DF 11	4	0	184	-33	332	-42	4	1.62	RT
DF 12	4	0	56	53	84	44	6	0.67	N
DF 13	4	0	43	54	97	50	6	1.38	N
DF 14	4	0	29	53	115	53	9	0.57	N
DF 15	4	0	111	76	16	49	7	2.65	N
DF 16	4	0	24	56	120	57	10	0.45	N
DF 17	4	0	5	73	134	83	2	2.25	N
DF 18	5	0	54	78	40	69	2	1.99	N
DF 19	4	0	300	69	253	58	6	3.32	N
DF20A	6	1	309	70	246	62	4	5.59	N
DF 21	4	0	219	81	320	51	5	0.70	N
DF 22	4	0	344	60	185	64	8	2.87	N
DF 23	4	0	34	79	39	77	6	4.14	N
DF 24	4	0	36	71	81	70	7	5.46	N
DF 25	4	0	34	64	98	63	5	3.59	N
DF 26	4	0	112	85	357	61	7	1.16	N
DF26E	4	0	148	84	348	56	4	7.43	N
DF 27	4	0	13	83	352	78	5	0.85	N
DF 28	4	0	302	87	322	69	4	5.77	N
DF 29	4	0	48	84	7	72	11	3.25	N
DF 30	4	0	9	71	131	79	4	7.63	N
DG GJORFIDALUR ISAFJORDUR									
DG 1	4	0	11	75	97	84	5	2.35	N
DG 2	5	0	230	86	326	61	4	2.42	N
DG 3	5	2	61	77	39	66	7	0.80	N
DG 4	4	0	328	73	238	74	4	2.38	N
DG 5	4	0	312	47	220	42	12	2.68	N
DG 6	4	0	313	47	218	43	10	2.09	N
DG 7	4	1	326	67	221	66	8	3.42	N
DG 8	5	0	41	76	55	73	5	2.84	N
DG 9	4	1	35	75	65	74	7	(5.34)	N
DG 10	4	0	15	70	118	76	5	4.37	N
DG 11	4	0	15	69	120	75	4	10.99	N
DG 12	5	0	14	70	121	77	6	5.00	N
DG 14	4	0	32	64	102	63	4	4.56	N
DG 15	4	0	37	74	68	73	6	3.97	N
DG 16	4	0	42	78	47	73	4	2.80	N
DG 17	4	0	37	74	67	73	2	2.93	N
DG 18	4	0	43	74	63	70	3	2.96	N
DG 19	4	0	47	74	60	68	5	2.82	N
DG 20	5	0	42	77	49	73	3	3.66	N
DG 21	4	0	23	66	112	68	4	3.45	N
DG 22	4	0	26	70	98	72	3	2.76	N
DG 23	4	0	19	71	107	76	2	2.18	N
DG 24	5	0	27	59	115	59	2	1.85	N
DH GJORFIDALUR ISAFJORDUR									
DH 1	4	0	23	71	98	75	5	4.08	N
DH 3	6	0	18	42	133	47	7	0.85	N
DH 4	4	0	328	75	248	76	4	2.53	N
DH 5	4	0	320	89	337	66	10	1.70	N
DH 6	4	0	276	79	292	60	5	2.07	N
DH 7	4	0	304	74	260	64	7	3.77	N
DH 8	4	0	349	76	222	84	3	3.17	N
DH 9	6	0	11	54	139	59	14	(4.21)	N
DH 10	5	0	177	-56	343	-61	6	1.12	R
DH 11	4	0	201	-70	287	-74	13	2.95	R
DH 12	4	0	207	-60	292	-61	9	2.69	R
DK EFRABOLSDALUR LANGIDALUR									
DK 1	4	0	308	82	295	71	3	3.80	N
DK 2	4	0	359	65	160	71	6	2.98	N
DK 3	4	0	2	65	153	71	4	2.99	N
DK 4	4	0	47	70	73	64	5	2.53	N
DK 5	4	0	30	71	90	72	8	2.30	N
DK 6	4	0	351	66	177	71	4	3.25	N
DK 7	4	0	11	70	127	78	5	2.76	N
DK 8	4	0	347	74	209	82	5	1.42	N
DK 9	5	0	329	-21	188	10	12	0.16	NT
DK 10	5	1	207	-37	303	-41	13	1.61	R
DK 11	6	2	210	-22	302	-32	6	1.06	RT
DK 12	6	2	97	-81	118	-62	19	0.35	R
DK 13	4	0	281	-75	203	-50	5	3.39	R
DK 14	4	0	14	-89	157	-65	7	2.72	R
DK 16	6	0	286	-78	195	-53	6	2.75	R
DK 17	5	0	228	-74	241	-68	9	1.86	R
DK 18	4	0	254	-51	247	-35	3	2.16	RT
DK 19	4	0	238	-58	258	-48	4	1.15	R
DK 20	6	0	340	-2	179	22	17	0.61	NT
DK 21	7	0	316	9	206	22	38	0.41	NT*
DK 22	4	0	317	-22	200	6	12	0.68	E
DK 23	6	0	28	-63	136	-22	23	0.39	RT
DK 24	4	0	185	-77	253	-88	5	5.57	R
DK 25	4	0	206	-74	261	-77	10	5.41	R
DK 26	4	0	234	41	289	8	5	0.60	E
DK 27	5	0	163	-56	5	-59	5	1.76	R
DK 28	4	0	22	62	119	64	5	5.62	N
DK 29	5	0	21	61	121	64	3	2.97	N
DK 30	4	0	339	59	193	61	5	4.20	N
DK 31	4	0	342	78	260	83	7	3.01	N
DK 32	4	0	352	62	173	68	4	5.66	N
DL LAMBATUNGUDALUR/STEINSGIL									
DL 1	4	0	147	-62	33	-62	19	1.60	R
DL 2	5	1	129	-38	40	-35	19	0.40	RT
DL 3	4	0	9	64	141	69	6	3.63	N
DL 4	4	0	354	67	172	74	6	4.36	N
DL 5	4	0	8	71	134	79	3	3.24	N
DL 6	4	0	345	60	184	64	8	1.08	N
DL 7	5	0	346	56	180	60	4	3.62	N
DL 8	4	0	349	68	185	75	8	9.59	N
DL 9	4	0	24	75	75	79	4	1.07	N
DL 10	4	0	29	77	59	78	2	5.83	N
DL 11	4	0	338	61	196	63	7	9.74	N
DL 12	4	0	342	66	194	70	7	4.97	N
DL 13	4	0	349	76	223	85	8	4.17	N
DL 14	5	0	340	83	316	77	4	5.67	N
DL 15	4	0	292	59	248	44	10	3.92	N
DL 16	4	1	289	56	248	41	9	4.90	N
DL 17	4	0	276	57	261	36	5	2.19	NT
DL 18	4	0	122	84	358	57	5	0.51	N
DL 19	5	0	8	86	342	74	6	2.91	N
DL 20	4	0	127	15	31	-7	10	0.24	E
DL 21	4	0	324	71	234	70	7	3.61	N
DL 22	4	0	345	72	204	78	5	3.84	N
DL 23	4	0	342	75	230	81	3	2.05	N
DM TORFDALUR									
DM 1	4	0	2	83	341	79	5	1.69	N
DM 2	4	0	339	70	208	74	4	3.01	N
DM 3	4	0	357	82	332	81	7	1.65	N
DM 4	4	0	6	80	0	84	4	6.94	N
DM 5	4	0	20	67	116	71	2	0.69	N
DM 6	4	0	35	62	99	61	4	3.75	N
DM 7	4	0	273	-65	222	-40	2	2.53	R
DM 8	4	1	312	-84	173	-57	3	3.51	R
DM 9	4	0	307	-86	171	-60	4	3.91	R
DM 10	4	0	357	71	166	80	3	0.50	N
DM 11	4	0	0	66	159	73	6	1.05	N
DM 12	5	0	200	-62	301	-65	8	0.34	R
DM 13	4	1	222	-74	245	-70	11	0.77	R
DM 14	4	0	357	44	162	50	7	2.09	N

COORDINATES AND MEAN DIP, ISAFJARDARDJUP

Prof.	Lat.	Long.	Dip	Downd.
DO 1-18	65.95	-23.1	6.5	105
DO 19-50	65.95	-23.1	2.5	105
DA	65.9	-22.95	3.0	105
DB	65.9	-22.8	3.0	105
DC	65.85	-22.7	3.0	105
DD,DE	65.8	-22.65	2.5	105
DF	65.75	-22.6	4.0	105
DG,DH	65.75	-25.55	4.0	105
DK	65.75	-22.35	6.0	105
DL	65.75	-22.3	6.0	120
DM	65.7	-22.3	3.5	120

ofield) direction. – **J100** mean remanence intensity of the samples from each flow after 10 mT (100 Oe) alternating field treatment, A/m. – **Pol** magnetic polarity: normal (N) if Lat > 10°, reverse (R) if Lat <-10°, transitional (T) if the numerical value of Lat is between 10° and 40°, equatorial (E) if Lat is less than 10° N or S.

1. tafla. Segulstefnur ásamt óvissu, staðsetning sýndarpóla, og meðalstyrkur segulmögnunar í hraunlögum sunnan við Ísafjarðardjúp. Í aftasta dálki er sýnt hvort segulstefna hrauns sé rétt (N) eða öfug (R). Neðst eru hnit og lagahalli hvers sniðs.

profiles, we are left with the following lava flows in a composite section of about 2600 m total thickness: DO 1-50, DA 5-17, DB 2-37, DC 7-15, DD 2-21, DE 3-11, DF 5-26, DG 5-23, DH 2-9, DK 10-27, DL 3-21 and DM 1-14. The profiles are generally steep and well exposed, so that there are no major gaps in the sampling of this sequence.

The paleomagnetic pole latitudes in the composite section are shown as function of stratigraphic height in Fig. 8. A simplified polarity column, constructed from these latitudes using the criteria of McDougall *et al.* (1984, p. 7041) is also shown.

The compound flow DO 18 near the base of our Ísafjarðardjúp composite section (Fig. 3) was linked to the compound flow SB 24-29 in the profile of McDougall *et al.* (1984) in Mt. Búrfell. This link which made use of the magnetic polarity of the lava flows and their petrography, has been confirmed in the field by careful mapping. At both localities the compound flow is underlain by acid tuff. We correlate the long normally magnetised zone between DO 26 and DA 17 with that in profiles JA and JB of McDougall *et al.* (1984), which is along the estimated strike direction. The normal zone in the upper part of our profile DC would then correlate with the normally magnetised flows in McDougall *et al.*'s JA through KD, and the normal zone from DF 12 to DH 9 may correspond to the upper part of their JD and all JE. The correlation between the two composite profiles is satisfactory, especially in the lower half of the section. The total thickness is comparable but individual magnetic polarity chrons vary in thickness as can be expected due to lateral and/or down-dip variations.

The sediment horizon between lavas DL 2 and 3 is below a zone of normal magnetisation, which is also the case with the Brjánslækur sediments at JF 46-48 in McDougall *et al.* (1984). The sediments are not seen at DK 27-28 as would be expected but such sedimentary horizons often vary greatly in thickness and may be missing altogether in places. Above DM 6, four reversals occur in the eight lava flows we cored, which does not correspond with the polarity sequence in the uppermost part of profile JF. This may be because of a slowing up of the rate of eruptions in the area of profile DM. Alternatively, this part of the profile which is on a rather flat plateau, may be affected by faults hidden by overburden. The total number of reversals in the composite section is at least ten, but there is uncertainty how the episode of unstable field directions and the reversals at the top of the section should be counted.

Age range of the composite section

Using the correlations above, we can obtain the age of our composite section from the K/Ar dates published by McDougall *et al.* (1984). The base of the section is close to the base of McDougall *et al.*'s profile SB, of about 13.7 Ma age. The top of profile DM may be expected to lie in the top reverse zone of their profile JF, i.e. at about 12.0 Ma. This yields a mean rate of buildup of the lava pile of 2600 m/1.7 Ma, or 1500 m/Ma which is not very different from the 1820 m/Ma found for McDougall *et al.*'s western section.

McDougall *et al.* (1984) sampled two profiles named SZ and SF in Kvígindisfjörður and Kollafjörður, southwest of our profiles DK to DM. No radiometric dates were obtained on these profiles, but they were expected to correspond approximately to JF. We correlate tentatively the normal zone in SZ with that in our profiles DL and DM, but additional mapping is required.

Our polarity column does not exhibit straightforward correspondence with previous published geomagnetic polarity time scales. A similar statement was made by McDougall *et al.* (1984, p. 7056) on the polarity column of their western section. The most likely reason for this may be that in the interval before 10 or 12 Ma ago the field changed polarity more often than is generally acknowledged, possibly exceeding 8 reversals per Ma. In oceanic anomaly lineations of this age the magnetic signal will be attenuated, as is evident north of Iceland (Vogt *et al.* 1980). However, the observed field variations are still being interpreted in the literature in terms of magnetic chrons of average length 0.2- 0.4 Ma. In the lava series, on the other hand, the episodic nature of the volcanism will create fairly thick piles during some chrons while others are not recorded at all.

McDougall *et al.* (1984, Fig. 8) concluded from their mapping and dating results on the east coast of

NW-Iceland that the lower boundary of the long "Anomaly 5" chron was at least 11.1 Ma old. This is about 0.7 Ma greater than the age found previously in two other composite sections in Iceland, a difference which is well beyond analytical uncertainties in the dating. Tauxe *et al.* (1985) suggested that some of the ages from the McDougall *et al.*'s (1984) eastern NW-peninsula section are too high, preferring a value of 10.0 Ma for the lower boundary of Anomaly 5. In the new ocean-floor geomagnetic polarity time scale of Cande and Kent (1995) the age of Anomaly 5 is however estimated to be from 10.95 to 9.75 Ma ago, a swing back towards the results of McDougall *et al.* (1984). It is necessary to date outcrops of Anomaly 5 in other locations in the country to help settling the question of its age.

Trends in magnetic anomalies and dykes

Kristjánsson *et al.* (1983) observed that the strike of aeromagnetic anomalies measured in 1972-74 by Sigurgeirsson (1984) over the northwestern peninsula appears to bend from a northeasterly direction to a northerly direction (characteristic of rifting on the Kolbeinsey Ridge), as one moves from the south coast of the peninsula to its northeast coast. This change of strike can be seen in the colour maps of Jónsson *et al.* (1991) and Kristjánsson and Jónsson (1996). Over the area of our profiles DK to DM the anomalies have a NNE-SSW direction, in agreement with the observed strike of the lava pile.

The number of magnetic anomaly lineations over the NW-peninsula (see Jónsson *et al.* 1991) is much less than the number of polarity zones in the lava pile. The problem of correlating these has been discussed by Kristjánsson and Helgason (1988). The local topography does not affect the aeromagnetics much, except that a small positive anomaly seems to follow Skötufjörður, and a small negative anomaly runs along Ísafjörður.

A gradual change in dominant dyke trends, from ENE-WSW in the southwestern part of the peninsula to NNE-SSW farther north and east, is seen in Fig. 1 of Guðmundsson (1984) and Fig. 1 of McDougall *et al.* (1984).

New interpretation of stratigraphy

The K/Ar dates from two sides of the NW-peninsula as processed by McDougall *et al.* (1984) indicated that the eastern composite section overlapped with the uppermost part of the western one by about 0.8 Ma, i.e. down to 0.5 km or more below the Brjánslækur sediments. The inferred presence of the overlap agreed with the estimate by these authors of a general northeasterly strike between Brjánslækur and Reykjarfjörður. However, from our observations of a NNE strike in Ísafjörður, we infer that the strike direction rotates towards the north across the peninsula. This is supported by the regional anomaly and dyke trends mentioned above, as the strike of anomalies and dyke swarms is known to generally agree with that of the lava pile elsewhere in Iceland. A tectonic tilt of 4-6° in Ísafjörður indicates (unless much repetition by faulting occurs) that there is a thickness of 1 km or more of lavas between the top of profile DM and the base (in Reykjarfjörður) of the eastern composite section of McDougall *et al.* (1984). The unmapped segment of the lava pile may be accessible in the coastal region north of the Árnes central volcano.

Long-distance paleomagnetic correlations

It is important for various studies in the historical geology and tectonics of Iceland to establish definite correlations between stratigraphic horizons in different parts of the country. The only magnetic polarity chron in the age range 5-15 Ma which has so far been of practical use for this purpose is "Anomaly 5". Other anomalies are generally too short, in relation to local variations in build-up rates, to be reliably identified.

Kristjánsson and Jóhannesson (1989) point out that the long episode of geomagnetic field instability in profiles DD to DF is probably also seen within profile JD of McDougall *et al.* (1984) as may be expected from the above stratigraphic ties. It should be noted that the within-lava directional uncertainties in some of the lavas in profile JD are rather large, and detailed correlations cannot be attempted. The above authors suggested that this period of geomagnetic instability is possibly recorded in the lava pile in Watkins and Walker's (1977) profiles G and H at Gerpir, the easternmost promontory of Iceland. Another possibility for correlation with Eastern Iceland is that this period of unstable directions is recorded in lavas at the top of the Dalatangi profile DB of Kristjánsson *et al.* (1995).

SUMMARY AND CONCLUSIONS

Paleomagnetic directions in twelve lava sections totalling 3.9 km in thickness were measured along a 35 km stretch (Fig. 2) on the southern coast of Ísafjarðardjúp in the Vestfirðir peninsula. A composite section of 2.6 km thickness was established for the area. The lava flows which make up 96% of the succession are entirely basaltic in composition. The primary paleomagnetic signal in most of the lavas is very stable and the within-lava agreement of directions is excellent. This is probably related to the fact that the profiles are situated away from major volcanic centers and geothermal alteration has at most reached only the chabazite zeolite stage.

The primary geomagnetic polarity which reversed at least ten times during the build-up of this part of the lava pile has been used for correlations between profiles. The polarity zones and other stratigraphical evidence also allow correlation with profiles SB to JF in the composite section of McDougall *et al.* (1984) where detailed K-Ar dating is available. The age range of the Ísafjarðardjúp composite section can thus be estimated as being 13.7 to 12.0 Ma. We conclude that sediments in our section DL correspond to the Brjánslækur sediments. Instead of overlap of western and eastern composite sections of McDougall *et al.* (1984, see their Fig. 8) on the peninsula, there is a stratigraphic gap of over 1 km. This is a consequence of strike directions around the eastern end of Ísafjarðardjúp being more northerly than assumed by McDougall *et al.* (1984).

The mean geomagnetic field direction during the emplacement of the Ísafjarðardjúp section was very close to that of a central axial dipole field. The secular variation of paleomagnetic virtual poles around their mean is unusually large for Icelandic lava sections, due in part to a zone of some 15 lavas with erratically varying directions in profiles DD, DE and DF (Kristjánsson and Jóhannesson 1989).

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Ágrip

Jarðlagaskipan og segulstefnur í hraunastaflanum sunnan Ísafjarðardjúps

Höfundar hafa mælt upp 2600 m langt samsett jarðlagasnið sunnan við Ísafjarðardjúp, frá Vatnshlíð í Álftafirði að Torfdal inn af Langadal við Ísafjörð. Hraunlög eru þar öll úr basalti, og eru þóleiít og ólivínþóleiít algengust. Millilög eru oftast þunn, en eitt 30 m þykkt setlag kemur þó fyrir innst í Langadal. Miðað við mörg önnur svæði landsins af tertíerum aldri, sem kortlögð hafa verið á undanförnum áratugum, er staflinn sunnan Djúps mjög reglulegur og ummyndun bergsins lítil, einkum í Skötufirði og Hestfirði. Boruð voru kjarnasýni til segulstefnumælinga úr 307 hraunlögum í 12 sniðum: oftast voru tekin 4 sýni úr hverju lagi. Gott innbyrðis samræmi er í niðurstöðum þeirra mælinga.

Segulskaut jarðar hafa snúist við a.m.k. 10 sinnum á meðan þessi stafli var að myndast. Segulskiptin má nota ásamt öðrum jarðfræðigögnum til tenginga við samsett snið McDougalls og samstarfsmanna (1984) milli Skálavíkur og Vatnsfjarðar. Með hliðsjón af aldursgreiningum þeirra má áætla að samsetta sniðið við Djúp nái yfir tímabilið fyrir 13.7-12.0 milljónum ára síðan. Dreifing segulstefna um meðaltals-stefnu sína er hér meiri en fundist hefur í öðrum sambærilegum rannsóknum á Íslandi, sem virðist að hluta stafa af því að á þessu tímabili hafi megin-segulsvið jarðar nokkrum sinnum verið í óvenju óstöðugu ástandi.

Strikstefna jarðlaga við innanvert Ísafjarðardjúp er norðnorðaustlæg fremur en norðaustlæg eins og

McDougall o.fl. (1984) töldu, og þykka setlagið neðst í sniði DL í Langadal er að líkindum jafngamalt hinum þekktu steingervingalögum við Brjánslæk. Það lítur því út fyrir að ekki sé skörun milli samsettra sniða þessara höfunda vestan og austan megin á Vestfjörðum, heldur geti vantað um eða yfir einn km af stafla inn í. Af því mun leiða, að annað hvort hafi aldursgreiningar þeirra sunnantil í vestara sniðinu gefið of lágan aldur eða greiningar í eystra sniðinu of háan aldur. Þetta þarf að kanna með nýjum rannsóknum.