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Structural data from the Tröllaskagi peninsula, North Iceland

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Introduction

The Tröllaskagi peninsula is located just to the south of the junction between the Tjörnes fracture zone and the Kolbeinsey ridge. The area consists mainly of basaltic lava flows of Tertiary age, about 11-9 Ma old (Saemundsson, 1980), but Pleistocene lavas cover small areas in the western part of the peninsula. Two central volcanoes, Öxnadalur and Unadalur, in the southern part of the peninsula contain acid rocks that are absent elsewhere on the peninsula.

Two main seismic lineaments are connected with the Tjörnes fracture zone, the Husavik-Flatey fault and the Grimsey fault (Fig. 1). The Grimsey fault, which is located completely offshore and connected to the Krafla and Fremrinamur fissure swarms, has been seismically very active during recent years; two fault plane solutions indicate dextral strike slip (Einarsson, 1991). The Husavik-Flatey fault, which is located 40-50 km to the south of the Grimsey fault, is partly exposed on land on the peninsulas of Tjörnes (Gudmundsson et al., 1993) and Flateyjarskagi (Fjäder et al., 1993). The offshore part of this fault is marked by a negative gravity anomaly (Palmason, 1974). The part of the fault on the Flateyjarskagi peninsula is marked by steeply dipping lavas, numerous mineral veins, faults and dikes, and occasional zones of crushed rock (Fjäder et al., 1993). On the Tjörnes peninsula the Husavik-Flatey fault runs for 25 km to the southeast as a dextral strike-slip fault until it meets with, and joins, the normal faults of the Theistareykir fissure swarm (Gudmundsson et al., 1993).

This report is a by-product of a more comprehensive paper (Långbacka and Gudmundsson, 1993) containing an interpretation of the data and a model of the tectonic evolution of the area. The purpose of this report is to present all the measurements in a readily accessible form.

Methods

The main purpose of this project was to observe how the structure of the peninsula is affected by the stress field related to the junction of the Kolbeinsey ridge and the Husavik-Flatey fault; in particular, how far inland this stress field influences the crustal deformation.

The research area covers the northern part of the peninsula. In 28 profiles we measured the strike and dip of 70 lava flows, 564 dikes, 107 small-scale faults, 231 slickenside planes and 141 mineral veins. All these measurements are presented in this report. We divided the area into three swarms because it is too wide for all the dikes to belong to the same regional dike swarm, such swarms being usually 5-20 km wide (Gudmundsson, 1990). The location of the profiles and the subdivision of the area into three dike swarms are shown in Fig. 2. All profiles were measured along well-exposed coastal sections or along river gullies. The coastal section of profile F was inaccessible on foot and was therefore measured from a boat. In this profile the only measurements are the strike and dip of the dikes and these may not be as accurate as the measurements made in the other profiles. The accuracy of the attitude measurements is 1-2°; those of the dike thickness are 5% and of the fault throw 10%.

Lava pile

The dip of the regional Tertiary lava pile in Iceland is normally in the range 0-15°, but exceeds 15° nearby central volcanoes (Gautneb et al., 1989). The lava dips in the southern part of the research area are in this range; in the northernmost part of the research area there are, however, steeply dipping lava flows with a maximum dip of 36°. The dips in this part are in the same range as those in the northernmost part of the Flateyjarskagi peninsula, where the dips are affected by the Husavik-Flatey fault (Fig. 3). The average lava-dip in profiles A and B is 22°. The average dip for other profiles is only 9.8° (Fig. 4). The direction of the dip varies except in the northernmost part where it is uniformly to the southwest. All the attitude measurements of the lava pile are in Table 1.

Dikes

There are a few andesitic dikes, but all the others are basaltic (tholeiitic). Most are fine-grained and fresh although some thick dikes are coarse-grained. The strike is either N or NNE (Fig. 5). A measure of the dominant dike strike can be obtained in two ways: by the number of dikes striking within particular class limits, or by the cumulative thickness of dikes striking within those class limits. The most frequently occurring strike direction coincides with the maximum cumulative thickness in the Siglufjördur and Olafsfjördur swarms but in the Hrisey swarm there is a 10° difference (Fig. 6).

There is a noticeable concentration of dip toward the SE in profiles A and B. This is the area with abnormally steeply dipping lavas. In profile A only 3% of the dikes dip toward NW. This asymmetric dip direction is probably partly due to the tilting of the lava pile. The average dike dip in the swarms of Olafsfjördur and Hrisey is 82°-83° but in the Siglufjördur swarm it is only 73° (Fig. 7).

The average dike thickness in the research area is 5.9 m, with 29% of the dikes being less than 1 m thick. This is the highest average dike thickness measured so far in Iceland; next to this figure is the dike thickness on Flateyjarskagi, 5.2 m (Fjäder et al., 1993). The thickness distribution can be observed in Fig. 7. The thickest dike on Tröllaskagi is multiple and consists of three parts (in Table 3 it is represented by dikes 324-326) with a total thickness of 54 m. This is the thickest dike measured so far in Iceland.

The average crustal dilation caused by dikes was calculated for the coastal profiles (Table 2). The dilation was calculated by drawing a line perpendicular to the average dike strike and then projecting all the dikes onto this line. The dilation in a particular profile was then obtained from the cumulative dike thickness in that profile divided by the length of the profile (minus the cumulative dike thickness). Only profiles with good exposure were used. All the profiles except A, B and I have crustal dilations similar to, although slightly higher than, those in other Tertiary dike swarms in Iceland (Gudmundsson, 1990). The dilation in profiles A and B, 28%-31%, is the highest measured so far in the regional dike swarms of Iceland.

An attempt to take the tilting of the lava pile into consideration was made by rotating the dikes measured in profiles A and B around an axis specified by the average strike of the lavas in each profile (Fig. 8). The aim was to let equal numbers of dikes dip to the E and W. The best-fit rotation angle is slightly lower than the calculated average dip of the lavas (in profile A the rotation angle is 24° whereas the average dip is 24.4°; in profile B the rotation angle is 14° whereas the average dip is 17.7°). All the measurements of the dikes are presented in Table 3.

Small-scale faults

The majority of the faults are normal faults; few strike-slip and reverse slip faults were observed. The majority of the normal faults strike N, but NW striking faults also occur. The NW direction is limited to the northernmost part of the peninsula (Fig. 9). This is the same area where the steeply dipping lavas and shallowly dipping dikes occur. Only 5 dextral faults were observed and none of these strike as the suggested Dalvik fault (Fig. 1). There are indications of a sinistral fault in profile J, striking 17° (which fits with the general trend of the strike-slip planes), cutting dike 541 and displacing it 75 m. The continuation of this fault is, however, unclear and is not included in Table 4 which otherwise contains all the measured faults.

Slickenside planes

Numerous minor faults, with estimated displacements usually less than one meter, occur in the area. 51% of the slickenside planes have a dip-slip sense of movement, 33% strike-slip and 16% oblique-slip. The dip distribution of the striae is presented in Fig. 10. Practically none of the planes are parallel with the Husavik-Flatey fault. The main strikes of the normal planes (Fig. 11), which constitute 82% of the dip-slip faults, coincide with the strikes of the dikes, normal faults and partly the strike of lava flows. 69% of the normal faults were measured in five profiles (Fig. 12) between the towns of Olafsfjördur and Dalvik (profiles A1, A2, L, X and Q). 76% of the strike-slip faults have a sinistral sense of slip. These faults strike mainly N or NNE. 70% of the sinistral planes are located in four profiles (Fig. 13) between the towns of Olafsfjördur and Dalvik (profiles A1, G, L and Q). None of the dextral slickenside planes strike parallel with the proposed Dalvik fault (Fig. 1). All the measurements of the slickenside planes are presented in Table 5.

Mineral veins

Four sets of mineral veins were measured (Fig. 14). Sets 2, 3 and 4 strike subparallel with most dikes and some of the normal faults and slickenside planes. There is a noticeable concentration of dip toward the E in set 2. Set 1 strikes subparallel with the strike of the lavas. All measurements of the mineral veins are presented in Table 6.

References

Einarsson, P., 1991. Earthquakes and present-day tectonism in Iceland. *Tectonophysics*, 189: 261-279.

Fjäder, K., Gudmundsson, A. and Forslund, T., 1993. Dikes, minor faults and mineral veins associated with a transform fault in north Iceland. *J. Struct. Geol.* (in press).

Gautneb, H., Gudmundsson, A. and Oskarsson, N., 1989. Structure, petrochemistry and evolution of a sheet swarm in an Icelandic central volcano. *Geol. Mag*. 126: 659-673.

Gudmundsson, A., 1990. Dyke emplacement at divergent plate boundaries. In: A.J. Parker, P.C. Rickwood and D.H. Tucker (editors). *Mafic Dykes and Emplacement Mechanisms.* Balkema, Rotterdam, pp. 47-62.

Gudmundsson, A., Brynjolfsson, S. and Jonsson, M. T., 1993. Structural analysis of a transform fault-rift zone junction in north Iceland. *Tectonophysics* 220: 205-221.

Långbacka, B. and Gudmundsson, A. , 1993. Extensional tectonics in the vicinity of a transform fault in North Iceland. In preparation.

Saemundsson, K., Kristjansson, L., McDougall, I. and Watkins, N. D., 1980. K-Ar dating, geological and paleomagnetic study of a 5 km lava succession in northern Iceland. *J. Geophys. Res.* 85: 3628-3646.

Palmason. G., 1974. The insular margins of Iceland. In: C.A. Burke and C.L. Drake (editors), *The Geology of Continental Margins*. Springer, Berlin, pp. 375-379.

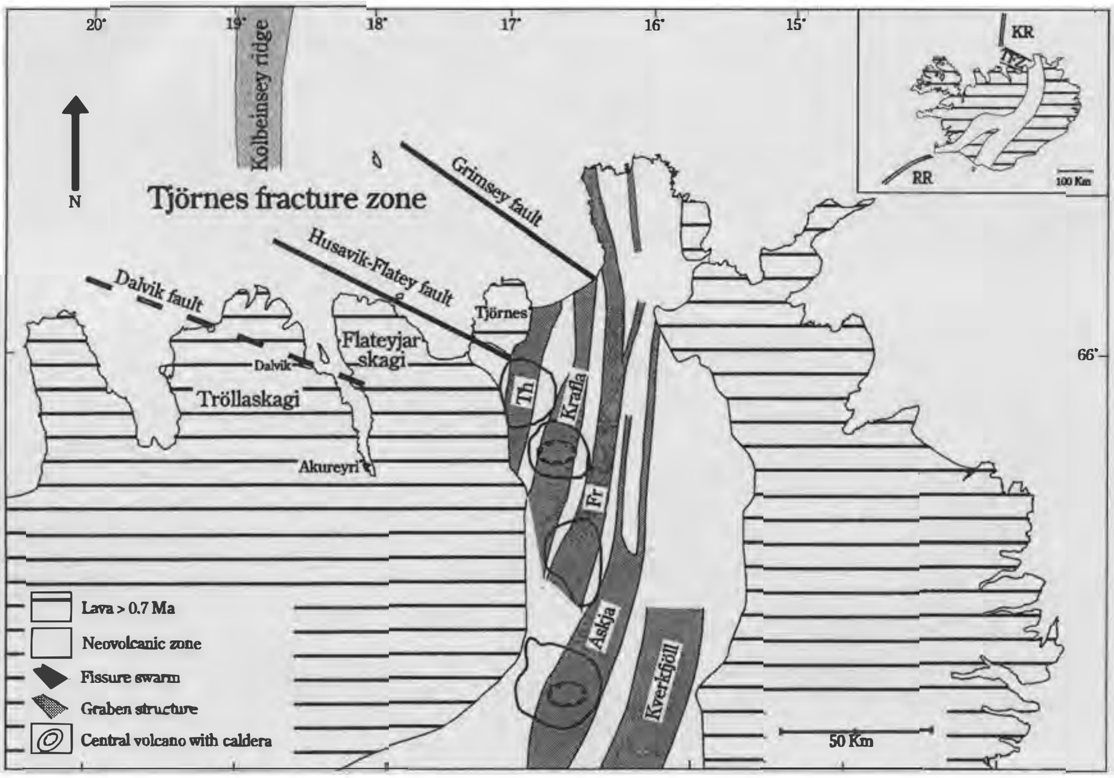

Fig. 1. Simplified map of the general geology of northeastern Iceland. The research area, south of the junction between the Husavik-Flatey fault and the Kolbeinsey ridge, covers the major part of northern Tröllaskagi. No field evidence exists for the proposed Dalvik fault. Th=Theistareykir Fr=Fremrinamur.

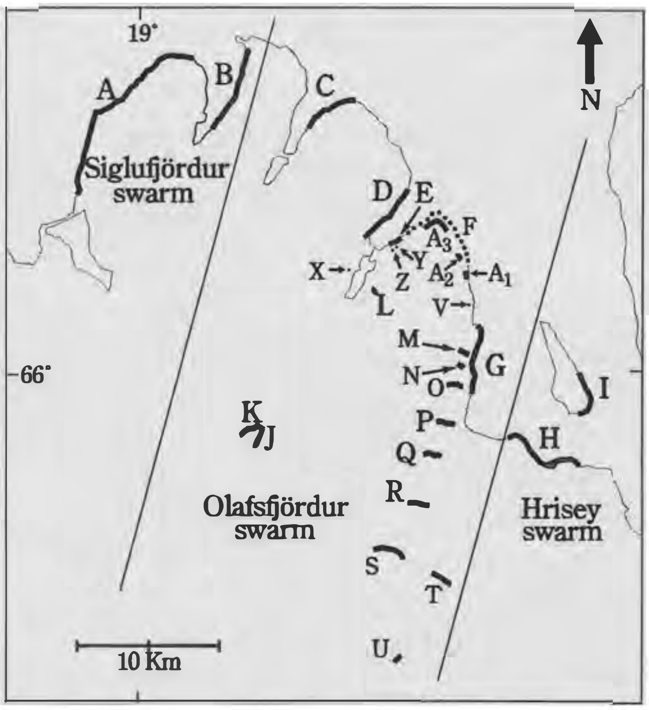

Fig. 2. General map of the research area showing the location of the profiles (A, B, C...) and the tentative subdivision of the area into three dike swarms. The data from profile F were obtained from a boat and consist only of the strike and dip of the dikes.

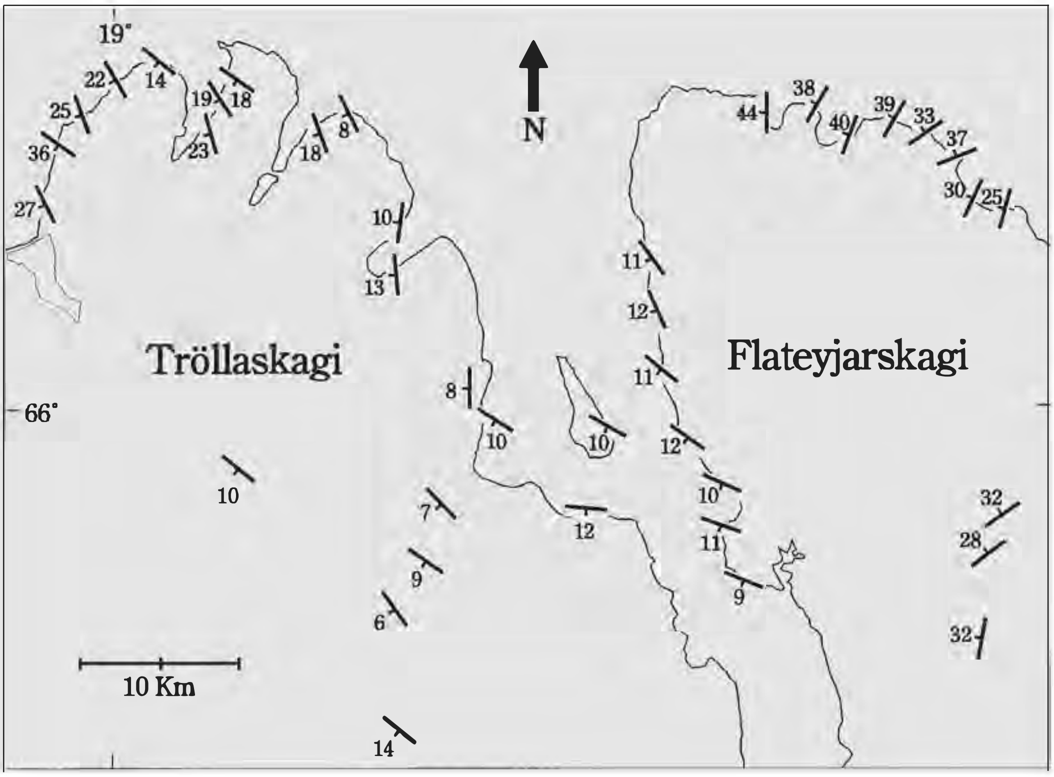

Fig. 3. Strike and dip of lavas on Tröllaskagi and Flateyjarskagi. The Husavik-Flatey fault comes on land at the northern coast of Flateyjarskagi. The steep dips of the lavas at the north coast of Tröllaskagi is due to the stress field associated with the junction of the Kolbeinsey ridge and the Husavik-Flatey fault.

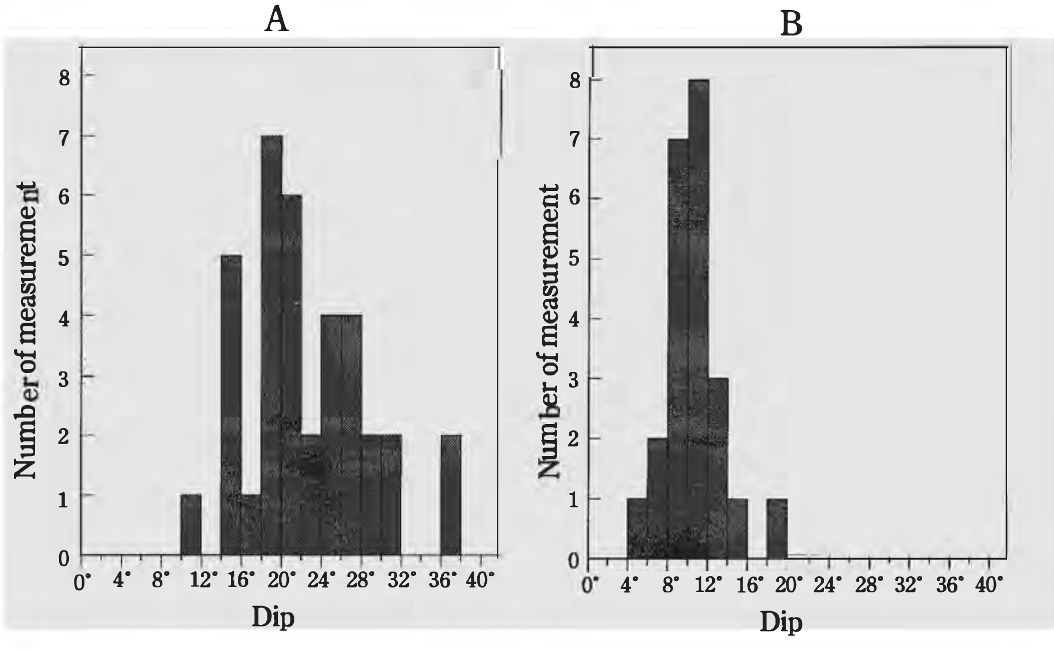

Fig. 4. Histograms showing the dip distribution of the lavas. A: measurements from profiles A and B combined; average dip is 22°. B: measurements from all other profiles combined; average dip is 10°.

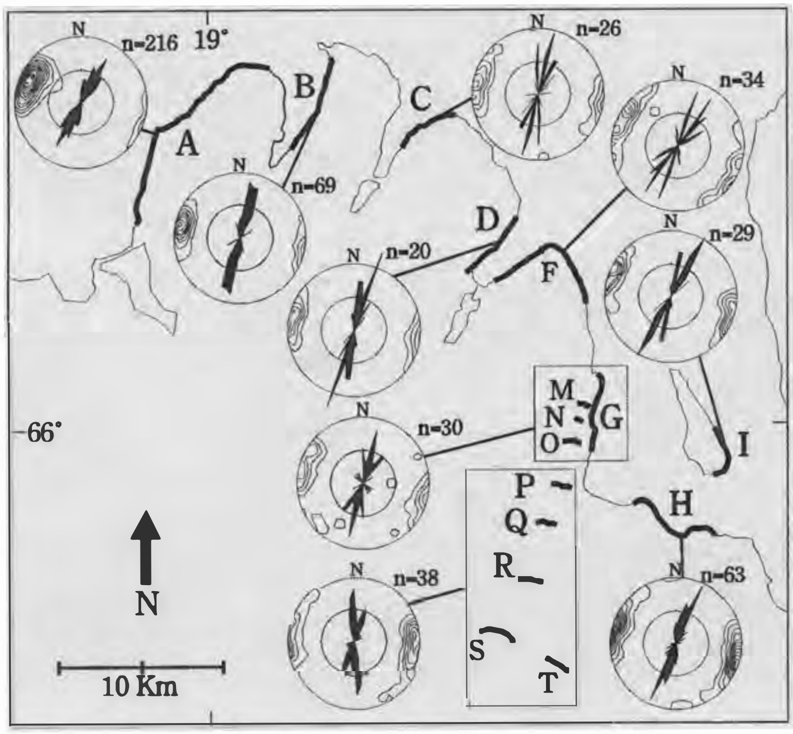

Fig. 5. Strike and dip of the dikes. These stereographic projections use a combination of rose diagrams and density contours of poles to dike planes. The concentration of dip toward southeast in profiles A and B occurs in the same area as the steeply dipping lavas.

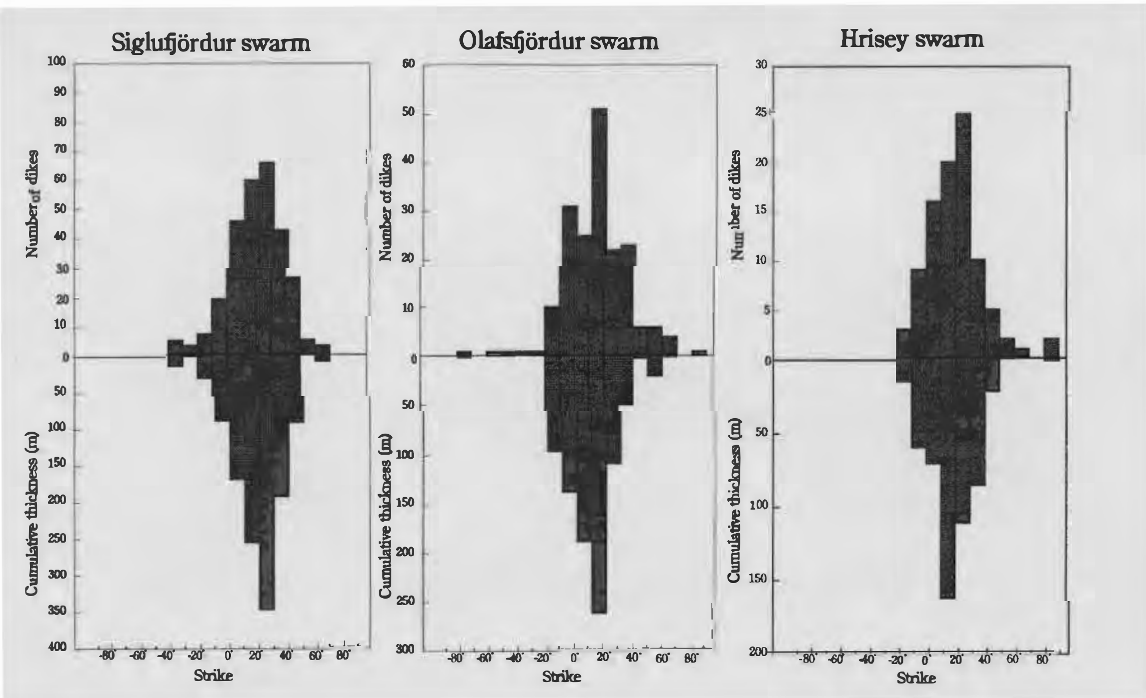

Fig 6. Strike distribution of the dikes. In the upper half of the histogram the data is presented as a frequency distribution; in the lower half as the cumulative thickness of the dikes within each class limits.

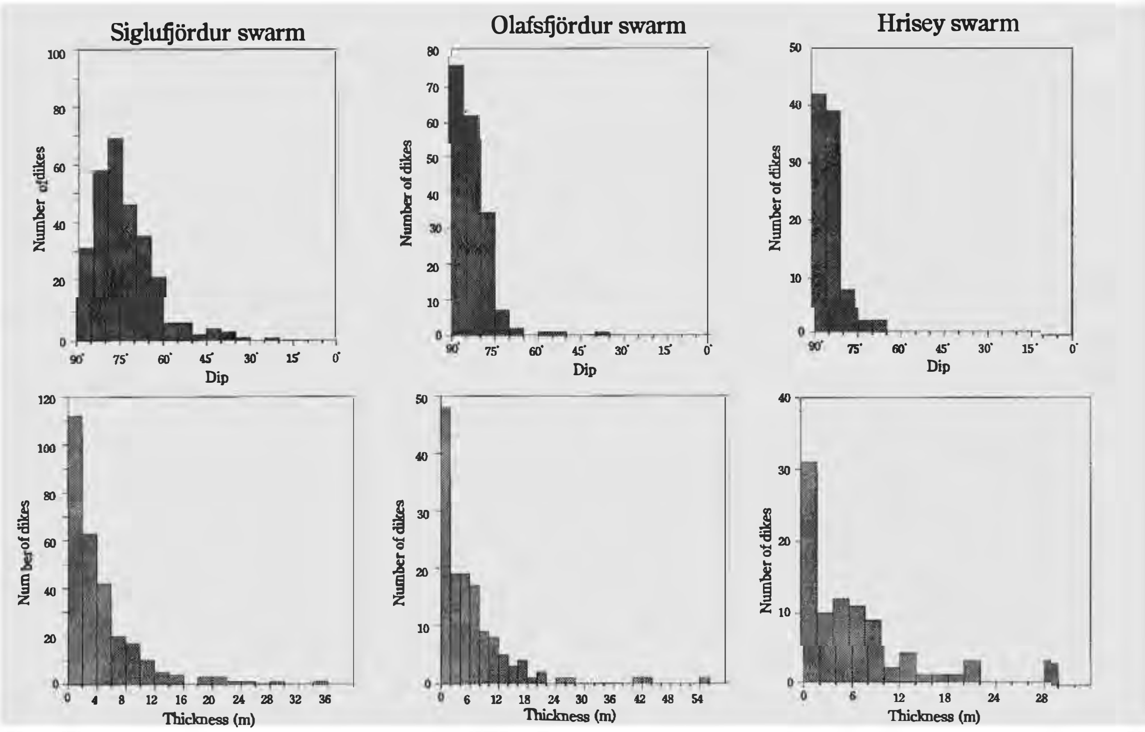

Fig. 7. Dip distribution and thickness distribution in the dike swarms. The dikes in the Siglufjördur swarm are dipping approximately 10° more shallowly than the dikes in the swarms of Hrisey and Olafsfjördur. The 54 m thick dike in the Olafsfjördur swarm is the thickest one measured in Iceland.

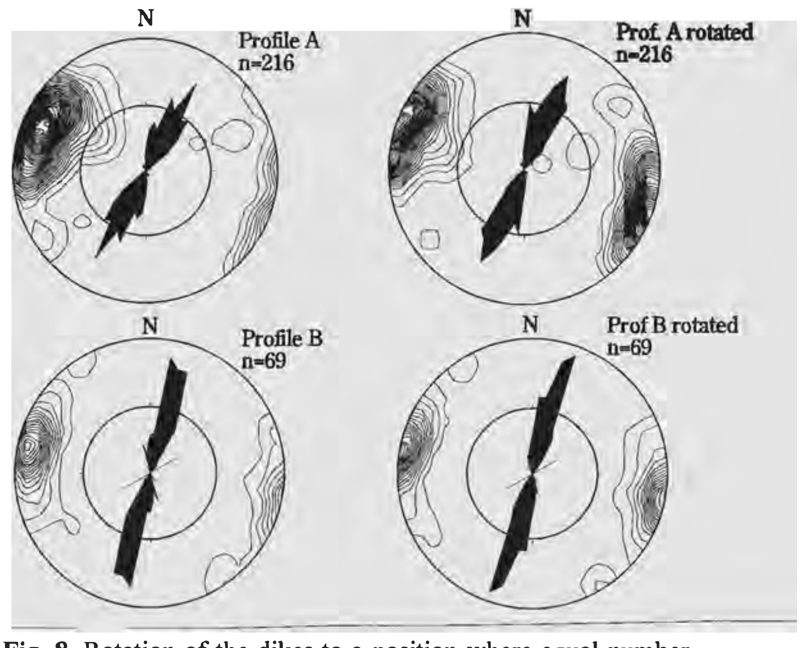

Fig. 8. Rotation of the dikes to a position where equal number of dikes dip to E and W. The strike of the rotation axis was determined from the average strike of the lavas in each profile. The data from profile A were rotated 24° around an axis striking 330° and the data from profile B were rotated 14° around an axis striking 320°.

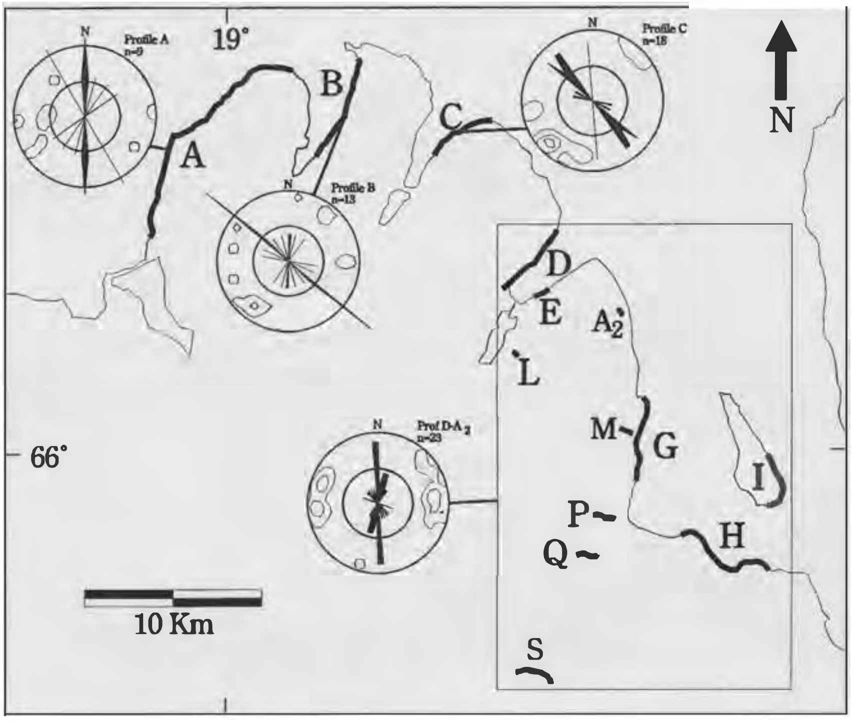

Fig. 9. Strike and dip of the normal faults. Profiles A, B and C are plotted individually, the measurements from the other profiles are combined. The northernmost profiles coincide with the area of steeply dipping lavas and contain northwest striking normal faults.

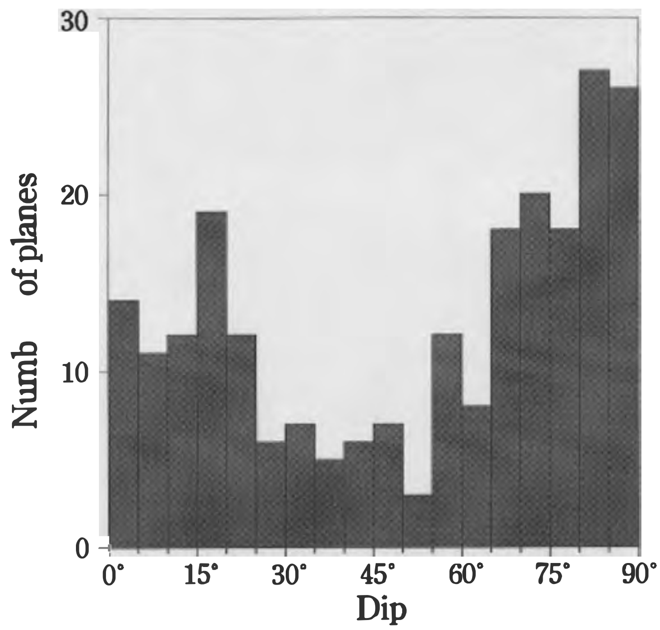

Fig. 10. Pitch of striae on the slickenside planes.

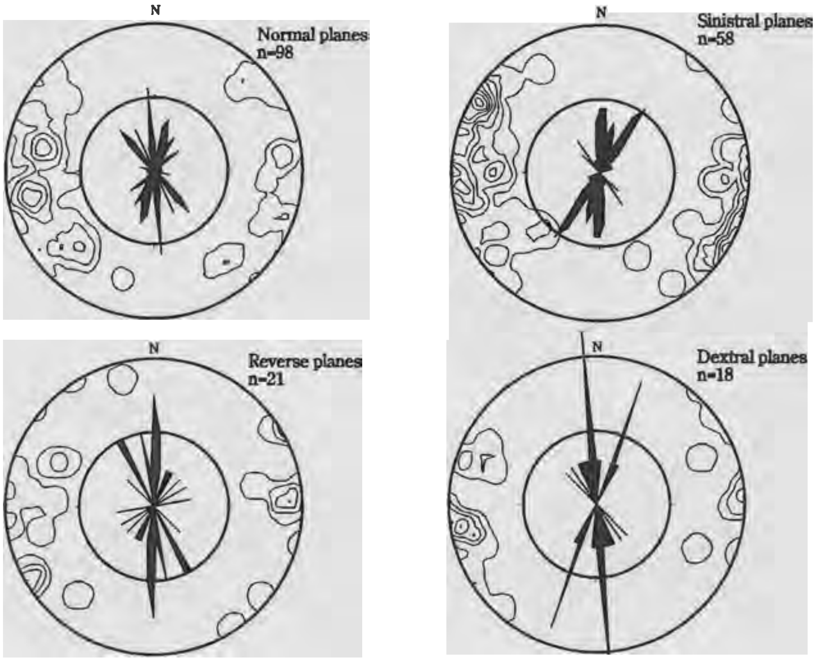

Fig. 11. Strike and dip of the slickenside planes. The main strike of the dip-slip planes coincides with the main strike of the dikes. 76% of the measured strike-slip faults are sinistral. No strike-slip planes are parallel with the suggested Dalvik fault.

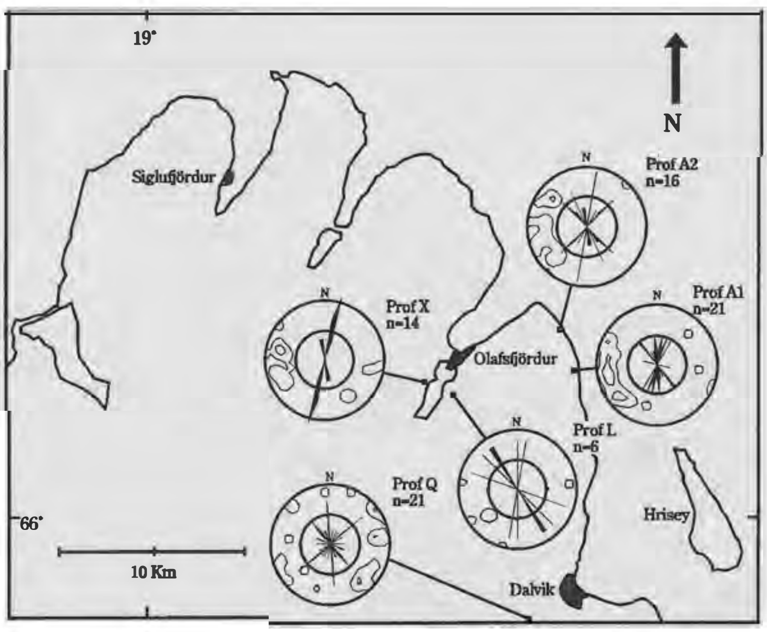

Fig. 12. Simplified map showing the location of the most frequently occurring normal slickenside planes.

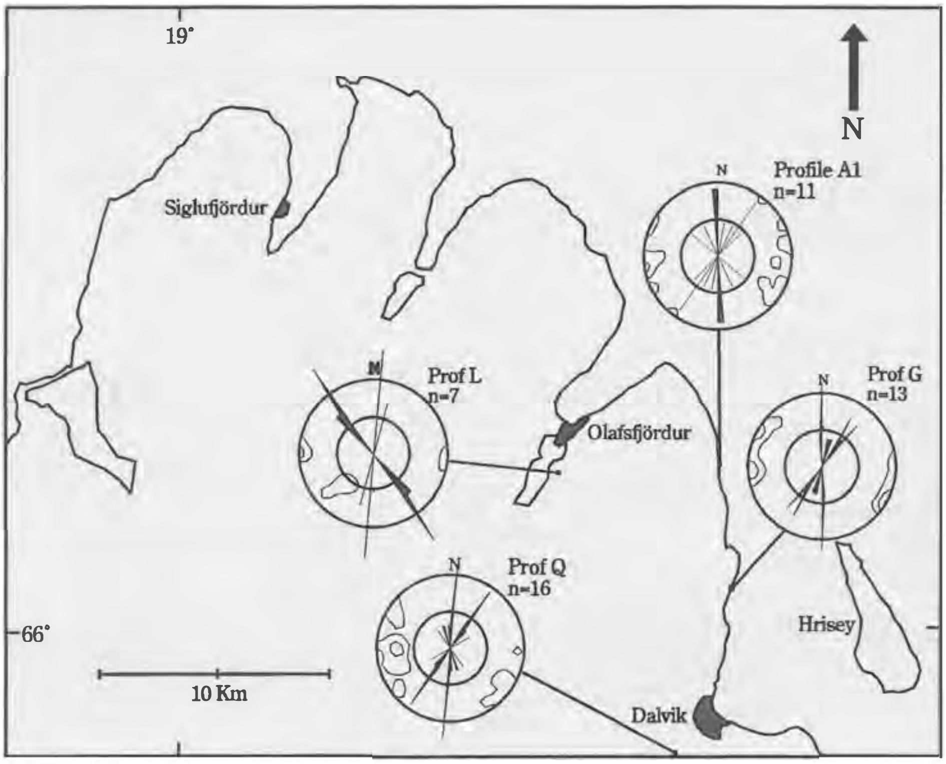

Fig. 13. Simplified map showing the location of the most frequently occurring sinistral slickenside planes.

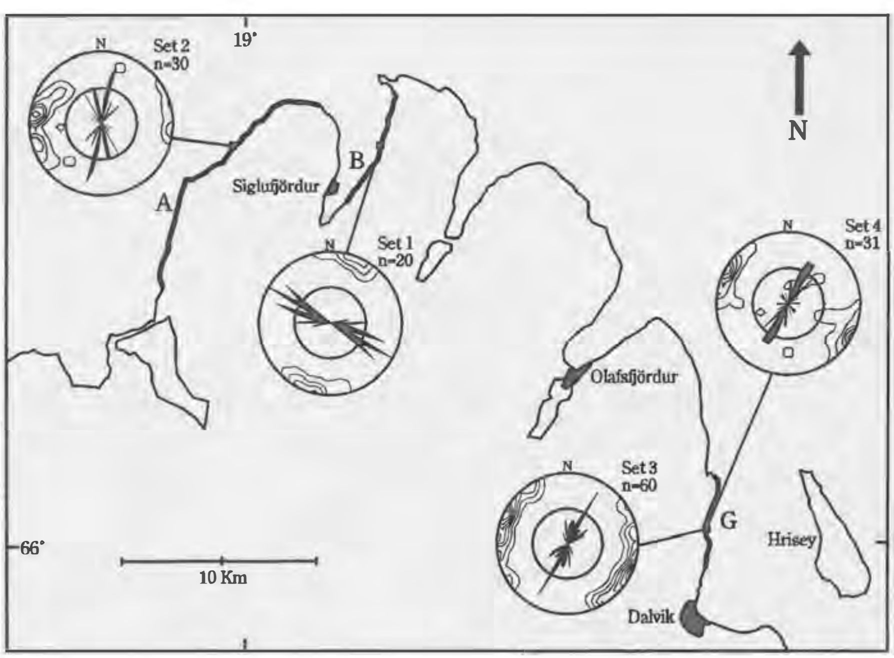

Fig 14. Simplified map showing the strike and dip of mineral veins and the location of the measurement sites. Set 2 shows, as do the dikes in this area, a concentration of dip toward east. Strike direction in set 1 is similar to the strike of lavas.

Table 1. Measurements of the attitude of lava flows. D=dike, F=fault. Quality of measurement: F=fine, G=good, R=reasonable and P=poor.

	Strike/dip	Located next to
Profile A	R (147/41)	D279
	R 147/30	
	F 155/27	D281
	F 173/30	D282
	R 175/21	D286
	G 127/36	D78
	G (250)/32	D89, 90
	R 195/29	D113
	G 166/26	D113
	R166/28	D121
	F 160/25	D121
	F 147/27	D131
	F 135/36	D134
	G 150/26	D154
	R 148/25	D156
	R 150/20	D157
	R 138/25	D170
	R 143/21	D181
	R 150/21	D183
	G 150/22	D185
	R 150/19	D206
	R (140/35)	D212
	G 153/21	D215
	G 163/21	D222
	G 135/11	
	G 135/14	D234
	F 130/14	D238
	R 143/(28)	D250
	G 160/24	D274, F32
Profile B	R 135/14	D35
	R 130/16	D44
	G 165/23	D44
	F 125/15	D47
	G 147/15	D49, Set1
	F 147/19	D51, F11
	F 139/19	D51, F11
	G 140/19	D55
	G 138/18	D63
	R 148/19	D66
	G 125/18	D67, F16

Profile C	F 160/18	D470
	F 133/11	D473
	F 134/9	D474
	G 152/12	D482
	F 154/8	D491
Profile D	R (255)/11	D300
	R 205/11	D300
	F 187/10	D304
Profile E	F 175/13	D311
Profile G	G123/10	D425
Profile H	G 95/12?	D364
	R- 90/9	D366
Profile I	R 120/10	D451
	R 115/5	D451
Profile J	R 135/8	D319
Profile K	R 130/10	D314
Profile M	R 142/8	D557
	(157/15)	D558
	(200)/8	D561
	F 180/8	D564
Profile O	R- 160/14?	D358
Profile Q	R 136/7	D550
Profile R	(R)148/11	D352
	R 155/11	D353
	F 125/9	D355
Profile S	R 145/6	D349
Profile T	R 187/23 ?	D331
	R 115?/23	D332
Profile U	R 130/14	D333
Profile V	P 175/8	

Table 2. Average crustal dilation due to dikes. The dilation in profile A is the greatest ever measured in a regional dike swarm in such a long profile in Iceland.

Profile	**Length (m)**	**Dilation (%)**
A	4450	27.7
B	475	31.0
C	1700	8.1
D	1150	11.0
G	575	7.0
H	4250	8.4
I	1150	17.9

Table 3. Measurements of the dikes; thickness is in meters. The missing data in the Table were either not obtained or not considered to be reliable (e.g. thickness in profile F)

Profile	Dike nr	Strike	Dip	Thickness
Profile B	1	28	76	2.80
	2	23	79	1.15
	3	18	70	0.30
	4	21	75	0.80
	5	18	78	0.30
	6	21	81	0.70
	7	16	77	0.60
	8	-3	76	1.60
	9	-13	67	20.50
	10	14	70	9.50
	11	18	75	0.30
	12	20	73	0.40
	13	18	83	1.40
	14	28	66	4.10
	15	9	79	14.70
	16	37	72	2.20
	17	22	75	1.30
	18	-8	83	0.04
	19	-19	84	0.13
	20	-5	88	0.12
	21	3	78	0.13
	22	-6	79	10.20
	23	5	76	1.40
	24	11	83	5.30
	25	19	76	1.50
	26	5	83	9.00
	27	21	81	0.70
	28	1	79	7.00
	29	-1	71	0.10
	30	10	85	0.10
	31	14	82	0.27
	32	7	70	1.30
	33	3	82	0.27
	34	4	86	0.10
	35	13	78	3.60
	36	25	82	2.60
	37	6	72	0.40
	38	19	84	9.00
	39	27	85	0.35
	40	10	75	0.25
	41	13	85	7.00

	42	15	77	2.40
	43	12	87	3.60
	44	5	76	4.00
	45	40	84	3.30
	46	26	85	2.20
	47	18	81	2.00
	48	6	74	3.50
	49	15	84	1.40
	50	-13	80	3.50
	51	-33	61	4.70
	52	55	77	0.05
	53			
	54			
	55	12	83	5.30
	56	33	87	0.24
	57	59	87	0.06
	58	12	89	1.20
	59	57	88	0.12
	60	9	88	1.20
	61	5	77	10.00
	62	18	81	0.35
	63	9	80	0.40
	64	5	82	1.10
	65	-18	87	1.40
	66	23	88	0.10
	67	9	80	6.00
	68	11	85	0.85
	69	-6	87	1.50
	70	-1	82	0.65
	71	-20	73	4.80
Profile A	72			
	73	6	77	3.20
	74			
	75	11	57	6.30
	76	20	69	3.10
	77	12	52	2.20
	78	15	53	5.50
	79	44	40	0.15
	80	9	61	4.10
	81	27	30	2.20
	82	25	50	12.00
	83	45	66	9.50
	84	42	27	2.95
	85	20	37	5.30
	86	63	69	7.50
	87	45	55	4.70

88	67	49	0.85
89	60	64	1.90
90	42	67	1.10
91	45	51	4.50
92	47	62	0.15
93	36	80	2.70
94	30	84	3.40
95	28	65	4.20
96	1	80	1.70
97	8	81	1.30
98	-20	60	2.80
99	-4	86	0.07
100	16	77	5.50
101	-9	80	3.00
102	9	77	0.50
103	39	79	2.50
104	14	60	6.50
105	3	75	0.85
106	-20	82	0.60
107	18	80	3.90
108	5	77	2.50
109	-34	78	0.13
110	-33	88	1.80
111	20	79	24.50
112	8	74	7.50
113	20	73	29.00
114	14	80	2.00
115	15	79	6.20
116	38	87	2.60
117	35	40	0.25
118	11	70	0.60
119	5	72	0.50
120	16	72	0.40
121	35	66	4.60
122	37	37	1.50
123	31	52	6.00
124	47	57	5.00
125	30	41	15.00
126	37	45	9.00
127	17	67	12.00
128	20	61	0.40
129	16	69	1.70
130	28	73	9.60
131	15	62	13.20
132	4	66	0.60
133	12	78	3.30

134	45	60	13.50
135	35	60	1.60
136	42	65	0.20
137	32	68	7.00
138	28	67	0.75
139	32	84	0.15
140	26	56	1.70
141	25	73	1.00
142	35	69	0.40
143	32	82	0.60
144	40	65	1.00
145	21	71	0.45
146	30	60	0.70
147	42	63	0.64
148	22	67	0.80
149	8	60	3.90
150	22	71	0.35
151	-3	80	0.06
152	-1	80	0.40
153	23	79	0.24
154	1	87	6.70
155	37	74	1.30
156	27	62	4.40
157	7	78	4.00
158	-8	85	1.30
159	8	64	1.60
160	-9	69	3.40
161	11	73	0.80
162	9	83	0.04
163	21	75	21.50
164	28	74	5.00
165	27	76	2.90
166	-3	81	3.00
167	35	79	2.80
168	41	74	10.00
169	53	40	0.55
170	16	76	4.70
171	1	81	0.70
172	19	76	2.90
173	28	80	4.80
174	29	70	4.00
175	-39	85	7.40
176	-5	76	0.35
177	20	70	4.30
178	17	72	11.00
179	17	78	3.00

180	6	84	3.50
181	1	85	3.90
182	36	65	1.30
183	26	74	20.50
184	23	72	1.00
185	28	76	0.43
186	25	78	14.50
187	35	65	10.00
188	29	73	9.00
189	22	67	4.40
190	6	68	4.50
191	27	75	1.90
192	45	83	5.00
193	39	58	8.50
194	31	60	8.60
195	19	65	10.80
196	10	69	0.70
197	-26	36	0.25
198	51	69	0.34
199	33	66	0.35
200	-5	81	35.00
201	30	60	11.20
202	24	72	0.34
203	38	64	2.60
204	-23	60	2.50
205	31	71	8.70
206	4	71	11.00
207	43	88	4.50
208	19	85	8.00
209	26	85	1.00
210	20	68	23.00
211	1	75	1.80
212	33	69	2.00
213	18	78	14.00
214	48	69	2.90
215	18	84	3.90
216	-10	82	5.50
217	32	76	2.50
218	49	73	4.00
219	33	55	3.50
220	21	80	3.60
221	44	74	4.80
222	27	75	10.00
223	19	67	4.00
224	31	73	8.30
225	38	79	7.00

226	25	69	2.70
227	26	77	9.30
228	39	80	8.00
229	29	81	3.80
230	27	82	1.10
231	20	73	4.40
232	25	81	7.00
233	19	86	2.70
234	40	84	3.10
235	-38	50	2.60
236	-1	84	3.20
237	33	77	4.00
238	7	77	1.80
239	33	75	9.60
240	13	82	5.90
241	26	79	4.10
242	12	75	1.00
243	25	73	5.50
244	34	79	6.00
245	28	73	3.50
246	25	75	7.50
247	18	83	7.80
248	14	78	5.00
249	20	84	1.10
250	28	73	3.50
251	29	79	5.00
252	36	66	11.50
253	35	82	1.20
254	37	70	0.50
255	48	86	0.15
256	44	78	0.60
257	1	73	0.13
258	21	77	3.60
259	22	72	2.50
260	35	77	4.00
261	1	61	2.70
262	19	75	2.90
263	41	70	2.00
264	1	77	6.50
265	43	77	1.10
266	42	81	2.00
267	32	72	3.00
268	19	80	4.00
269	34	75	4.80
270	22	85	4.00
271	27	88	6.50

	272	13	76	5.20
	273	27	77	18.00
	274	11	65	0.60
	275	1	75	8.50
	276	23	85	3.70
	277	40	67	3.10
	278			
	279			
	280	1	60	12.0
	281	-1	67	19.00
	282	18	73	7.00
	283	-30	78	0.30
	284	10	80	2.90
	285	6	83	0.35
	286	3	75	9.40
	287	8	73	2.00
	288	15	82	18.00
	289	17	73	2.10
Profile D	290	20	80	6.90
	291	1	86	9.60
	292	16	83	5.00
	293	29	83	0.11
	294	15	78	0.60
	295	39	86	1.00
	296	18	87	0.60
	297	28	87	12.00
	298	15	82	3.40
	299	17	87	0.70
	300	1	89	17.00
	301	8	87	4.40
	302	7	82	8.70
	303	10	82	5.10
	304	-5	88	11.00
	305	7	85	8.50
	306	2	87	12.50
	307	-10	84	0.25
	308	12	78	0.65
	309	-14	82	5.80
Profile E	310	17	81	6.40
	311	15	78	7.50
	312	31	80	6.40
Profile K	313	-3	87	5.50
	314	5	87	12.00
	315	12	82	6.50
	316	30	81	
	317	-4	89	6.00

	318	5	87	
Profile J	319	16	85	1.45
Profile P	320	-13	83	0.30
	321	-10	84	0.75
	322	12	79	0.50
	323	21	83	1.80
	324	34	88	
	325	16	78	54.00
	326	16	84	
	327	50	81	20.50
	328	-10	87	
	329	35	83	10.00
	330	14	87	11.00
Profile T	331	-4	77	
	332	-5	85	3.70
Profile U	333	-3	86	21.50
	334	16	87	7.50
	335	16	86	2.90
	336	10	85	2.00
	337	-20	86	13.00
Profile S	338	-16	83	10.00
	339	-10	85	5.50
	340	-7	81	13.40
	341	-2	83	11.00
	342	3	84	3.50
	343	65	80	0.85
	344	49	80	0.65
	345	10	85	17.50
	346	-10	76	0.80
	347	5	78	0.45
	348	-15	67	8.00
	349	7	83	
	350	-1	80	7.50
Profile R	351	4	79	4.30
	352	-1	88	6.40
	353	18	81	6.00
	354	2	86	3.00
	355	-3	79	0.15
Profile O	356	25	68	2.50
	357	20	84	16.00
	358	10	75	
Profile V	359	34	84	
Profile H	360	88	84	0.30
	361	13	78	
	362	57	80	0.40
	363	40	80	

364	10	86	3.80
365	31	81	8.00
366	13	88	16.00
367	7	84	9.00
368	24	83	7.50
369	18	73	5.40
370	25	81	20.00
371	32	86	2.50
372	15	84	31.00
373	3	85	9.90
374	15	86	6.50
375	4	81	
376	23	82	0.50
377	16	85	19.50
378	12	85	9.50
379	9	79	11.00
380	40	80	0.60
381	23	87	1.20
382	55	85	0.30
383	-1	82	4.80
384	24	88	0.80
385	14	87	1.90
386	23	87	8.00
387	-2	84	7.00
388	8	80	4.80
389	5	68	8.00
390	14	80	2.50
391	17	84	10.00
392	20	89	4.10
393	20	87	1.20
394	1	84	1.20
395	3	87	2.20
396	8	84	9.00
397	-12	77	0.30
398	-8	78	0.55
399	-8	80	2.75
400	39	84	0.15
401	7	86	5.90
402	13	84	12.00
403	-18	83	9.00
404	-5	84	30.50
405	23	88	6.60
406	-10	83	2.20
407	27	85	0.35
408	60	75	0.20
409	20	68	0.20

	410	20	83	0.18
	411	35	88	0.65
	412	5	87	0.28
	413	23	89	1.20
	414	18	86	0.85
	415	34	85	0.65
	416	15	86	4.00
	417	25	85	1.90
	418	44	86	3.70
	419	-5	84	0.70
	420	80	84	1.60
	421	-12	82	7.50
	422	24	87	5.80
	423	12	80	2.60
Profile G	424	22	71	9.00
	425	34	78	1.30
	426	-1	83	2.00
	427	57	79	0.45
	428	18	88	3.40
	429	8	73	1.30
	430	-4	88	2.50
	431	11	84	4.70
	432	11	89	7.60
	433	-50	80	0.12
	434	-60	58	0.10
	435	-39	74	0.05
	436	-26	82	0.11
	437	30	85	5.00
	438	7	80	42.00
	439	38	88	1.50
	440	1	89	6.80
Profile I	441	37	84	7.00
	442	23	83	21.50
	443	29	84	6.00
	444	3	72	0.15
	445	-4	87	1.10
	446	8	83	1.00
	447	16	84	
	448	30	80	7.00
	449	6	85	
	450	25	86	5.50
	451	10	81	7.00
	452	7	75	7.40
	453	20	88	4.60
	454	47	86	5.00
	455	27	77	0.65

	456	27	88	5.50
	457	35	85	20.00
	458	14	82	7.50
	459	30	87	31.50
	460	-10	79	12.00
	461	26	85	2.30
	462	20	82	4.60
	463	6	85	2.70
	464	27	87	1.50
	465	21	85	1.50
	466	14	83	12.00
	467	34	87	9.90
	468	10	85	12.50
	469	45	89	14.00
Profile C	470	29	75	8.00
	471	16	88	0.10
	472	36	77	1.30
	473	20	78	8.20
	474	-9	86	3.30
	475	12	83	4.30
	476	5	78	0.20
	477	-8	81	4.90
	478	12	88	2.60
	479	20	86	11.20
	480	-1	84	5.50
	481	13	77	7.00
	482	-5	88	0.25
	483	84	86	0.30
	484	8	81	24.70
	485	-4	80	1.00
	486	10	82	15.00
	487	25	86	1.10
	488	35	82	1.00
	489	21	75	2.70
	490	6	85	7.00
	491	10	86	1.15
	492	-1	86	5.00
	493	-16	81	6.90
	494	47	79	1.70
	495	26	82	2.50
Profile X	496	12	86	1.50
Profile F	497	10	87	
	498	44	84	
	499	15	82	
	500	17	80	
	501	62	87	

	502	65	84	
	503	43	85	
	504	12	82	
	505	-20	87	
	506	18	85	
	507	55	85	
	508	30	83	
	509	32	79	
	510	16	82	
	511	-10	88	
	512	-10	86	
	513	40	85	
	514	-1	80	
	515	37	83	
	516	55	81	
	517	34	87	
	518	10	85	
	519	33	88	
	520	50	84	
	521	62	88	
	522	30	78	
	523	55	50	
	524	23	82	
	525	36	75	
	526	37	87	
	527	41	87	
Profile Z	528	6	86	0.20
Profile A2	529	-3	87	14.50
	530	14	87	26.00
	531	20	76	0.65
Profile A1	532	35	87	7.00
Profile A3	533	14	76	11.00
	534	5	87	0.45
	535	-9	87	
	536	17	76	0.30
	537	10	78	4.00
	538	-8	77	4.30
	539	8	86	4.60
Profile J	540	2	81	
	541	-73	74	2.10
	542	-13	88	8.00
	543	12	77	4.10
Profile L	544	15	87	16.00
	545	20	83	5.00
	546	5	82	14.00
	547	10	74	1.80

	548	20	82	11.50
	549	12	78	18.00
Profile Q	550	27	77	2.50
	551	20	87	4.60
	552	28	78	0.30
	553	-13	74	41.00
	554	15	75	2.70
	555	-19	86	1.50
Profile P	556	22	87	
	557	10	78	6.80
	558	3	87	3.00
	559	-3	36	0.28
	560	37	70	0.06
	561	17	85	0.30
	562	16	85	0.20
	563	26	84	1.40
	564	34	83	9.90
Profile N	565	14	89	3.30
	566	37	84	

Table 4. Fault measurements. N=normal, R=reverse, D=dextral, S=sinistral, DIP=dip-slip, STRIKE=strike-slip, OBLIQUE= oblique-slip. Throw in meters. The throw column also contains some min-max values.

Profile	**Fault nr**	**Strike**	**Dip**	**Type**	**Throw**
Profile B	1	2	62	N	3
	2	-52	71	N	2
	3	-53	71	N	3.6
	4	-1	78	N	1.3
	5	34	74	N	2
	6	10	69	N	6
	7	-53	77	N	0.7
	8	-47	70	N	1
	9	-20	73	N	1
	10	7	83	D?	
	11	-52	70	N	5-6
	12	-53	62	R?	5-6
	13	-81	82	N	1
	14	-39	84	N	0.5
	15	-66	63	N	5-6
	16	-36	79	DIP	
	17	-40	72	DIP	
	18	-5	65		

Profile A	19	51	55	N	1
	20	50	49		
	21	-3	87	N	3.5
	22	-5	83	OBLIQUE	
	23	-11	66		
	24	-38	62	N	0.5
	25	11	45	N	0.3
	26	33	71	N	3
	27	2	45	N	1
	28	-26	81	?	>1
	29	-47	71	?	>2
	30	7	71	N?	5-6?
	31	-35	84	N	1
	32	-8	53	N	6
	33	-3	82	N	0.5
Profile D	34	-52	88	STRIKE	
	35	3	82	D	
	36	1	77	N	10?
	37	-75	79	N	5.5
	38	-40	70	N	8-10?
	39	-30	79	N	1.1
	40	-17	79	N	6.8-7
	41	-15	79	D	
Profile E	42	8	79	N	3.6
	43	10	89	D	
	44	23	67	N	4-5min
	45	-10	73	N	2.5min
Profile P	46	34	89	D	
Profile S	47	-10	67	N	5-10?
	48	-3	63	R	
	49	19	73	N	2min
	50	10	66	N	5
	51	-5	70	N	6-8?
Profile H	52	-13	66	N?	
	53	-3	64	N	2-3min
	54	26	76	N	3
	55	40	54	DIP?	
	56	18	72	N	
	57	-24	78	R?	12?
	58	30	71	N	9
	59	6	77	N?	>8?
	60	27	77		
	61	46	77	N?	6-8?
	62	17	58	R?	8-10?
	63	13	80	N	5
Profile G	64	41	81		

	65	30	81		
	66	22	89	S	
	67	40	86	D	
	68	39	85		
	69	-30	84	STRIKE	
	70	-10	79	N	5
Profile I	71	-50	85	STRIKE?	
	72	-23	85	S	
	73	-46	89	D?	
Profile C	74	-84	66	N	5?
	75	-70	60	N	
	76	-35	60		
	77	-40	84	STRIKE?	
	78	-64	84	N	
	79	-53	76	N	2
	80	-39	85	R	
	81	-76	70	N	
	82	-60	74	R	
	83	-43	71	N	1-1.5
	84	-10	83	N	5
	85	-43	88	N	
	86	-42	65	R	
	87	-25	74	R	2
	88	-65	82	R	
	89	-37	88	N	2
	90	-48	72	N	4
	91	-7	70	N	6-8
	92	-55	60	N	1.5
	93	-53	87	N	4-5
	94	-1	80	R	
	95	-40	76	N	6
	96	-50	75	N	4
	97	-42	77	N	3
	98	-36	79	N	1
	99	-10	79	N	0.8
Profile A2	100	-50	79	N	2
Profile L	101	28	78		
Profile P	102	5	77	N	3
	103	-7	70	N	0.5
	104	-2	79	N	5
	105	-5	83	N	5-6
Profile Q	106	50	75	N?	>6-8?
	107	23	85		

Table 5. Measurements of the slickenside planes. Types: n=normal, r=reverse, d=dextral, s=sinistral.

Profile	**Plane nr**	**Strike**	**Dip**	**Pitch**	**Type**
Profile B	1	17	78	55.1	s
	2	-14	86	59.6	d
Profile A	3	22	61	87.5	n
	4	36	48	69.6	r
	5	-45	68	81.7	n
	6	-50	67	86.7	r
	7	27	55	75.4	r
	8	40	84	65.1	r
	9	-72	72	59.6	r
	10	-9	81	57.4	n
	11	17	75	68.1	n
	12	23	70	38.1	s
	13	45	66	17.6	s
	14	66	52	26.5	s
	15	45	76	14.7	s
Profile D	16	-13	77	24.0	s
	17	13	82	17.7	s
	18	-80	88	75.0	n
	19	-4	49	83.6	n
	20	13	61	88.7	n
Profile E	21	-6	77	78.3	n
	22	16	57	14.6	s
Profile P	23	-3	87	4.2	d
	24	12	89	10.0	s
Profile S	25	-28	85	13.0	d
Profile O	26	15	86	62.7	r
	27	24	76	45.0	s
	28	28	72	85.4	n
	29	32	84	68.8	n
	30	22	63	82.8	n
	31	76	81	84.3	n
Profile H	32	3	68	70.0	n
	33	-8	72	73.8	n
	34	17	68	38.8	s
	35	-5	67	88.7	n
	36	27	83	14.0	s
	37	-10	72	15.5	d
	38	3	68	23.4	s
	39	24	63	2.7	d
	40	10	74	71.0	n
	41	3	56	87.7	r
	42	-11	59	75.7	r

	43	23	84	73.0	n
Profile G	44	-3	89	68.5	r
	45	-10	67	38.0	d
	46	18	77	18.3	d
	47	30	73	37.0	d
	48	76	77	52.5	r
	49	-7	85	3.0	d
	50	14	84	4.3	s
	51	19	88	16.3	d
	52	30	87	10.7	s
	53	26	87	2.6	s
	54	-10	84	15.4	s
	55	-13	80	17.2	d
	56	8	87	6.8	s
	57	27	86	13.3	s
	58	-3	81	15.7	s
	59	-2	89	8.0	s
	60	19	88	5.6	s
	61	45	74	34.0	s
	62	35	82	20.3	s
	63	35	81	14.0	s
	64	-10	70	77.6	n
	65	-3	78	30.7	s
	66	3	80	51.7	n
Profile I	67	26	73	10.0	s
	68	5	86	3.5	s
	69	13	73	2.3	s
Profile C	70	-50	75	67.2	n
	71	-60	78	56.0	n
	72	85	73	32.3	d
	73	-30	85	89.0	r
	74	-35	77	65.3	n
	75	85	70	83.0	n
	76	19	88	80.0	n
	77	-45	57	80.0	n
	78	-10	72	70.0	n
	79	-50	66	67.0	n
	80	-5	75	66.0	r
	81	-9	82	76.8	n
	82	-33	85	87.7	r
	83	-8	88	85.0	r
	84	29	72	15.0	d
	85	20	89	6.0	s
Profile X	86	60	70	21.3	s
	87	-30	57	83.0	n
	88	30	78	23.2	s

	89	9	65	77.7	n
	90	12	68	85.4	n
	91	-30	70	86.2	n
	92	10	55	76.0	n
	93	-11	80	72.5	n
	94	37	85	64.7	n
	95	53	63	86.2	n
	96	62	62	74.1	n
	97	13	65	62.7	n
	98	-68	77	58.4	r
	99	5	83	59.0	n
	100	19	71	83.9	n
	101	-10	48	86.7	n
	102	-19	68	88.3	n
	103	23	63	80.4	r
Profile Y	104	26	70	82.0	n
Profile A2	105	-50	87	24.6	s
	106	-48	84	40.5	d
	107	6	88	69.0	n
	108	-30	72	30.6	s
	109	-27	87	68.8	n
	110	-47	86	61.2	n
	111	-50	62	71.0	n
	112	-2	76	87.7	r
	113	35	64	74.2	n
	114	9	58	85.6	n
	115	-42	53	87.9	n
	116	-38	69	77.6	n
	117	-32	82	87.3	r
	118	-17	66	82.5	n
	119	-28	52	88.1	n
	120	43	58	81.8	n
	121	5	62	72.6	n
	122	26	80	78.0	n
	123	-10	60	78.4	n
	124	-15	80	77.0	n
	125	40	66	81.5	n
	126	2	78	73.3	r
Profile A1	127	15	63	82.9	n
	128	-20	71	70.3	n
	129	-9	83	73.0	n
	130	5	60	63.3	n
	131	40	78	10.3	s
	132	-76	64	72.0	n
	133	12	73	80.0	n
	134	2	76	76.9	n

	135	-15	73	73.7	n
	136	-5	65	70.6	n
	137	-38	72	79.4	n
	138	-52	69	82.3	n
	139	19	89	86.0	n
	140	30	58	22.7	s
	141	5	66	42.9	s
	142	-45	66	89.0	n
	143	-37	83	67.2	n
	144	-7	89	6.0	d
	145	-10	77	15.0	d
	146	-26	89	16.2	s
	147	-53	87	40.0	s
	148	-13	66	63.4	r
	149	-1	68	18.0	s
	150	-11	76	44.2	r
	151	-3	87	28.7	s
	152	-10	80	27.4	s
	153	-54	61	68.7	n
	154	-27	82	69.9	r
	155	-10	72	85.9	n
	156	-9	84	27.8	s
	157	8	76	57.9	n
	158	31	88	7.7	s
	159	21	87	4.1	s
	160	25	81	82.6	n
	161	-42	67	81.0	n
	162	27	80	83.8	n
	163	-26	72	87.8	n
Profile L	164	-20	69	5.3	d
	165	-80	70	34.3	d
	166	-49	46	6.0	s
	167	-87	55	44.9	d
	168	-38	77	29.5	s
	169	2	84	33.5	s
	170	-39	45	2.1	s
	171	1	82	18.8	s
	172	10	84	38.3	s
	173	-41	59	25.0	s
	174	7	82	44.4	n
	175	-4	75	60.4	n
	176	-24	66	24.0	d
	177	-75	85	48.8	n
	178	-35	81	45.0	n
	179	-47	54	89.0	n
	180	-38	58	77.9	n

Profile P	181	-60	72	57.6	n
	182	24	63	65.6	n
	183	43	84	59.4	n
	184	47	85	75.3	n
	185	14	72	74.5	n
	186	-11	75	5.3	s
Profile Q	187	8	62	81.8	n
	188	58	70	70.7	n
	189	-43	80	85.5	n
	190	45	88	78.7	n
	191	22	71	83.9	n
	192	33	66	87.5	n
	193	57	78	1.3	s
	194	43	87	1.7	s
	195	48	65	82.0	n
	196	43	74	81.7	n
	197	-72	66	65.9	n
	198	-15	72	81.3	n
	199	6	73	84.3	r
	200	47	69	75.3	n
	201	-10	62	57.7	n
	202	-39	79	20.0	s
	203	-68	80	73.6	n
	204	1	56	22.9	s
	205	-43	79	84.0	n
	206	34	83	22.4	s
	207	-37	89	2.5	d
	208	32	65	30.5	s
	209	1	80	1.6	s
	210	19	62	15.7	d
	211	29	68	1.6	s
	212	35	86	15.8	s
	213	3	75	47.4	r
	214	-37	84	61.3	n
	215	-47	52	51.8	n
	216	-24	84	49.0	n
	217	-6	72	71.4	n
	218	-19	72	16.0	s
	219	31	76	16.7	s
	220	-10	73	19.3	s
	221	4	63	10.7	s
	222	-3	57	20.3	s
	223	-30	88	47.0	n
	224	-25	54	14.8	s
	225	-80	68	48.3	r
	226	57	87	69.1	r

	227	86	75	58.9	n
	228	-8	79	65.5	n
Profile M	229	-1	87	5.3	d
	230	1	81	8.8	d
	231	19	75	19.8	s

Table 6. Measurements of the strike and dip of the mineral veins.

Set	Vein nr	Strike	Dip
set 1	1	-70	83
	2	-73	82
	3	-60	83
	4	-65	80
	5	-75	87
	6	-85	87
	7	-78	72
	8	-61	83
	9	-75	78
	10	-79	85
	11	-65	85
	12	-75	88
	13	-74	87
	14	-81	86
	15	86	83
	16	-86	84
	17	75	83
	18	-51	80
	19	-79	75
	20	86	75
set 2	21	12	78
	22	13	79
	23	10	75
	24	1	88
	25	43	55
	26	37	61
	27	10	72
	28	5	85
	29	-11	85
	30	2	82
	31	42	64
	32	8	82
	33	-48	59
	34	-35	73

	35	10	84
	36	-24	82
	37	-13	82
	38	-21	81
	39	-35	83
	40	9	76
	41	-20	81
	42	-20	79
	43	-32	89
	44	-19	82
	45	-69	71
	46	-7	47
	47	5	85
	48	24	77
	49	22	68
	50	29	62
set 3	51	27	80
	52	26	85
	53	-8	83
	54	-36	84
	55	-6	77
	56	44	88
	57	-11	82
	58	24	83
	59	52	75
	60	5	80
	61	62	76
	62	27	83
	63	62	82
	64	-30	89
	65	-33	80
	66	51	88
	67	13	85
	68	34	84
	69	40	88
	70	10	75
	71	52	79
	72	-1	84
	73	58	87
	74	19	89
	75	62	86
	76	67	74
	77	7	89
	78	28	89
	79	1	75
	80	57	82

	81	12	89
	82	15	81
	83	5	89
	84	50	81
	85	29	76
	86	45	83
	87	36	87
	88	58	88
	89	-10	84
	90	-13	87
	91	25	82
	92	4	82
	93	38	83
	94	-9	82
	95	8	86
	96	22	78
	97	27	79
	98	32	85
	99	13	80
	100	29	74
	101	19	89
	102	26	86
	103	21	89
	104	40	87
	105	2	85
	106	20	86
	107	29	89
	108	23	88
	109	37	80
	110	-26	86
set 4	111	31	85
	112	31	89
	113	18	82
	114	23	77
	115	-40	43
	116	-50	26
	117	89	57
	118	39	85
	119	56	84
	120	27	85
	121	33	89
	122	46	86
	123	41	88
	124	16	58
	125	40	77
	126	42	71

127	28	84
128	7	81
129	15	84
130	1	60
131	9	85
132	10	81
133	33	89
134	26	87
135	28	85
136	-17	33
137	1	88
138	23	86
139	23	88
140	20	42
141	83	19