RELATIVE LOCATION OF EARTHQUAKES IN THE TJÖRNES FRACTURE ZONE

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ABSTRACT

The seismicity of the Tjörnes Fracture Zone is distributed over a zone 150 km long and 80 km wide. Teleseismic locations of earthquakes within this zone show a diffuse pattern of epicenters that does not easily lend itself to tectonic interpretation.

An attempt was made to locate the earthquakes of 1968 and 1969 relative to one reference earthquake by using relative P-wave arrival times at a fixed set of stations. To ensure consistent picking of the arrival times at a given station, the P-wave signals were correlated visually with the P-wave of the reference earthquake. This method of analysis reduces the errors in the locations caused by source and station irregularities and mis-picking of arrival times of small earthquakes. The method further reduces the scatter of the epicenters introduced by using different sets of stations to locate the different earthquakes.

The relocated epicenters appear to define a narrow seismic zone, possibly a fault, with a WNW trend. The absolute location of this proposed fault cannot be accurately determined, but most probably it passes within a few kilometers of the island Grímsey. A focal mechanism solution of one of the earthquakes shows strike-slip motion along the fault in a right-lateral sense. The sense of motion and the strike of the fault is therefore similar to that of the Húsavík fault about 40 km to the south.

Some significant seismic activity is known to have occurred close to but distinctly off these two faults, notably the magnitude 6¼ earthquake that caused extensive damage in the village of Dalvík in 1934. It is suggested here that the Dalvík earthquake occurred on a fault parallel to the Húsavík fault, but 30 km to the south.

The transform motion between the submarine Kolbeinsey Ridge and the volcanic zone in northern Iceland is thus demonstrated to occur along two, and possibly three or more, parallel strike-slip faults.

INTRODUCTION

The Tjörnes Fracture Zone is associated with a zone of seismic activity off the northern coast of Iceland. The purpose of this paper is to try to relate the earthquake activity to the structure and tectonic setting of the Tjörnes Fracture Zone.

Epicenters determined by Sykes (1) for the period 1955–1963 and by the World Wide Network of Standardized Seismographs (taken from the Preliminary Determinations of Epicenters) for the period 1963–1974 are listed in Table 1 and plotted in Figure 1. The seismic zone so delineated is approximately 150 km long and 80 km wide, elongated in the E-W direction. The eastern end of the zone is connected to the axial rift zone in northern Iceland and the western end joins with the submarine Kolbeinsey Ridge. The Kolbeinsey Ridge is a typical segment of the Mid-Atlantic Ridge, spreading at a rate of 0.8 cm/year (2). The geometric configuration of presumed spreading centers and seismicity together with a focal mechanism solution for one earthquake led to the interpretation of the Tjörnes zone as a transform fault (3). This interpretation was supported by Ward (4), who noted that the transform motion probably took place over a broad zone, the southwestern edge of which was exposed on land on Tjörnes. The name of the Tjörnes Fracture Zone comes from this interpretation and is therefore based more on the seismicity than topographic features.

Saemundsson (5) described the structure of the Tjörnes zone as consisting of several N-S trending ridges and troughs arranged *en echelon* within a WNW trending zone. Saemundsson furthermore demonstrated right-lateral displacement along the Húsavík faults which, according to him, form the southern boundary of the Tjörnes Fracture Zone.

The Húsavík faults form a distinctive fault swarm exposed on the Tjörnes peninsula. The fault swarm can be traced from the shore east-south-eastwards into the axial rift zone of Iceland. Off shore the faults can be traced as a topographic offset of the Grímsey shoal (5) and a strong, negative anomaly in the free air gravity field (6).

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extruded basalts along the Reykjanes Ridge to the south-west of Iceland are considered to be evidence for the existence of a mantle plume of material ascending under Iceland and spreading laterally outwards (7). Along the Kolbeinsey Ridge to the north of Iceland, however, no such smooth changes are observed. Instead, the chemistry of the basalts changes abruptly as the Tjörnes Fracture Zone is crossed (8). The fracture zone thus appears to disturb the horizontal flow of mantle material.

The connection between the seismic activity and the geological structure as described by Saemundsson (5) is not clear. Large earthquakes are known to have been associated with the Húsavík faults, notably the earthquakes of 1260, 1755 and 1872 (5,9). Not all earthquakes in the Tjörnes Fracture Zone, however, occur on the Húsavík faults or their seaward extension. The scatter of epicenters in Figure 1 is too large to be caused by location errors only. The

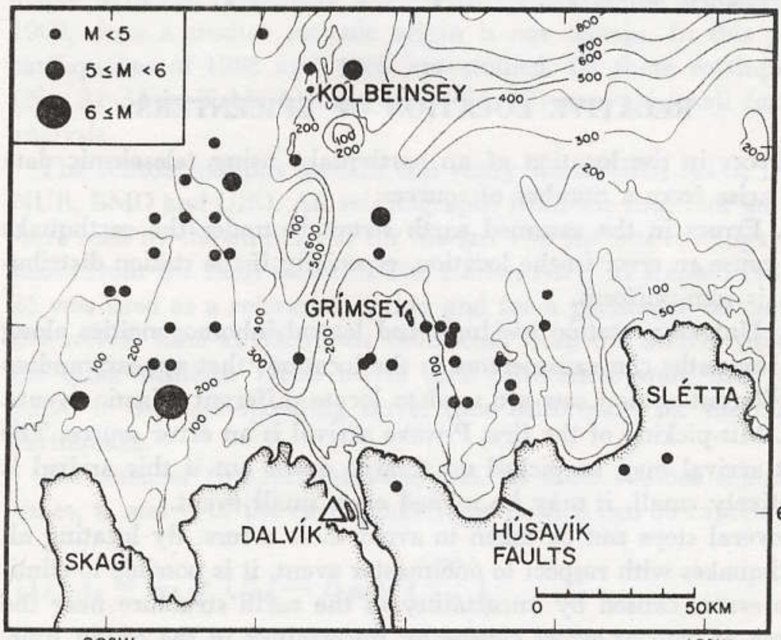

Fig. 1: Map of the epicenters from Table I (filled circles). The epicenter of the 1934 Dalvík earthquake is marked by a triangle. Bathymetric contours (in meters) are taken from Saemundsson [1974].

earthquakes evidently occur on more than one fault. This view was expressed by Tryggvason (9).

The epicenters shown in Figure 1 are not located accurately enough to reveal any detailed tectonic pattern such as faults. In this paper an attempt is made to remove some of the major sources of errors in epicentral locations by locating the epicenters relative to one another. Epicenters of events that occurred in 1968 and 1969 were relocated in this way. These epicenters appear to define a WNW striking fault near the island Grímsey. The focal mechanism solution for one earthquake indicates strike-slip motion in a right-lateral sense. This fault parallels the Húsavík faults and is situated approximately 40 km to the north of them.

Some evidence is found for a parallel strike-slip fault to the south of the Húsavík faults. The transform motion between the axial rift zone of Iceland and the Kolbeinsey Ridge thus appears to be taken up by possibly three or more parallel strike-slip faults.

RELATIVE LOCATION OF EPICENTERS

Errors in the location of an earthquake using teleseismic data can arise from a number of sources:

1. Errors in the assumed earth structure under the earthquake can cause an error in the location, especially if the station distribution is non-uniform.

2. Unknown station residuals and lateral inhomogeneities along the ray paths can cause errors in the locations that appear random if different station sets are used to locate different seismic events.

3. Mis-picking of the first P-wave arrival is an error source. The first arrival may be picked on a large event but if this arrival is relatively small, it may be missed on a small event.

Several steps can be taken to avoid these errors. By locating all earthquakes with respect to one master event, it is possible to eliminate errors caused by uncertainty in the earth structure near the source as well as errors caused by uncertainty in the origin time. Travel time differences between stations are observed and compared with the travel time differences for the master event. By observing only travel time differences the origin time is eliminated as a varie than one fault. This view was e 1 are not located accurately onic pattern such as faults. In nove some of the major sources locating the epicenters relative that occurred in 1968 and 1969 epicenters appear to define a d Grímsey. The focal mechan- ndicates strike-slip motion in a llels the Húsavík faults and is e north of them.

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able. To avoid errors caused by station residuals and lateral inhomogeneities along the rays it is important to use always the same station set for the locations.

To assure a consistent picking of the P-wave arrival the wave trains of all events as recorded at one station were correlated visually with the P-wave train of the master event. A corresponding arrival was then picked for all events. This procedure was found to improve significantly the quality of the locations. Inherent in this method are the assumptions that all events occurred at approximately the same depth and had similar focal mechanism. Earthquakes on the Reykjanes Peninsula in SW Iceland occur mostly at depths of 2–5 km (10) and earthquakes in the Tjörnes Fracture Zone can be expected to occur at similar depths. The assumption of similar focal mechanism limits the applicability of this method. It is, for example, not safe at the present time to locate the earthquake sequence of October 1973 with respect to the sequences of 1969, since a similar tectonic origin is not certain. In this paper earthquakes of 1968 and 1969 are studied. Of these earthquakes (No. 21–31 in Table 1) only one (No. 30) was too small for this analysis.

The seismic stations used in this study were AKU, KTG, UME, NUR, BMO and UBO. All seismographs from the first four stations were read by the author but for the last two stations readings were taken from the EDR bulletin. The station AKU in Iceland (Figure 2) was used as a reference station and for a particular earthquake the arrival time at AKU was subtracted from the arrival times at the other stations. These travel time differences were then compared to the corresponding travel time differences for the master earthquake.

We consider two stations, A and B. At these stations the travel times, t_A and t_B of the earthquake to be located can be expressed as

$$(1)\quad t_A = t_{MA} + (\Delta_A - \Delta_{MA}) \left(\frac{dT}{d\Delta}\right)_A$$

$$t_B = t_{MB} + (\Delta_B - \Delta_{MB}) \left(\frac{dT}{d\Delta}\right)_B$$

t_{MA} and t_{MB} are the travel times for the master event to the stations, Δ_A and Δ_B are the distances of the earthquake from the stations, Δ_{MA} and Δ_{MB} are the distances of the master event from the stations and $\left(\frac{dT}{d\Delta}\right)_A$ and $\left(\frac{dT}{d\Delta}\right)_B$ are the ray parameters corresponding to the distances at the master event from the stations. These equations are valid as long as the earthquake to be located is close to the master event.

We have then

$$(2)\quad \Delta_A\left(\frac{dT}{d\Delta}\right)_A - \Delta_B\left(\frac{dT}{d\Delta}\right)_B =$$
$$= (t_{MB} - t_{MA}) - (t_B - t_A) + \Delta_{MA}\left(\frac{dT}{d\Delta}\right)_A - \Delta_{MB}\left(\frac{dT}{d\Delta}\right)_B$$

In this equation all the quantities on the right side are known or observable. The only unknows are Δ_A and Δ_B. Equation (2) therefore gives a locus of possible epicenters which can be easily found graphically. Using different station pairs it is then possible to determine the epicenter and estimate the accuracy of the location.

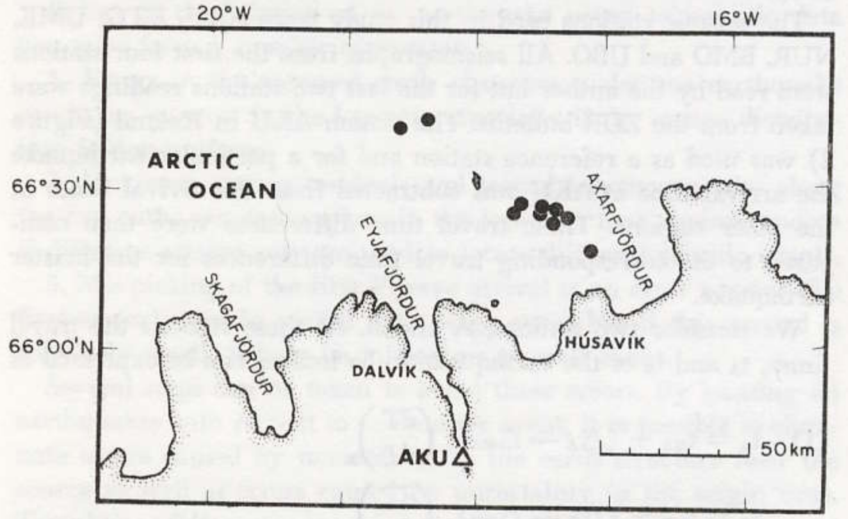

Fig. 2: Relocated epicenters from Table 2. The epicenters are located relative to one another. The relative position of the epicenters is more reliable than the position of the pattern of epicenters as a whole.

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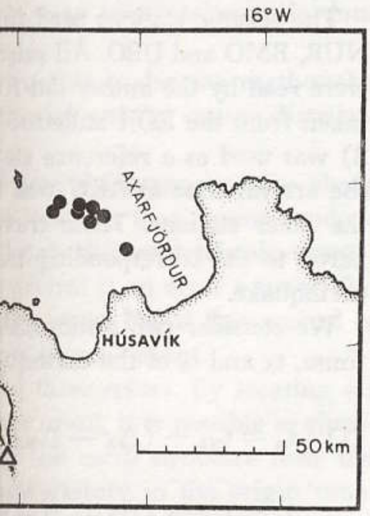

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The accuracy of the relative locations is estimated to be better than $\pm$ 5 km in the horizontal dimensions.

Given the relative location it was attempted to locate the pattern of epicenters in an absolute sense. For this purpose records from the WWNSS station AKU (Figure 2) were used. Azimuths of the P-wave and S-P times were determined where possible. These observations together with the best locations from Table 1 were used as constraints on the absolute location of the epicenter pattern. The

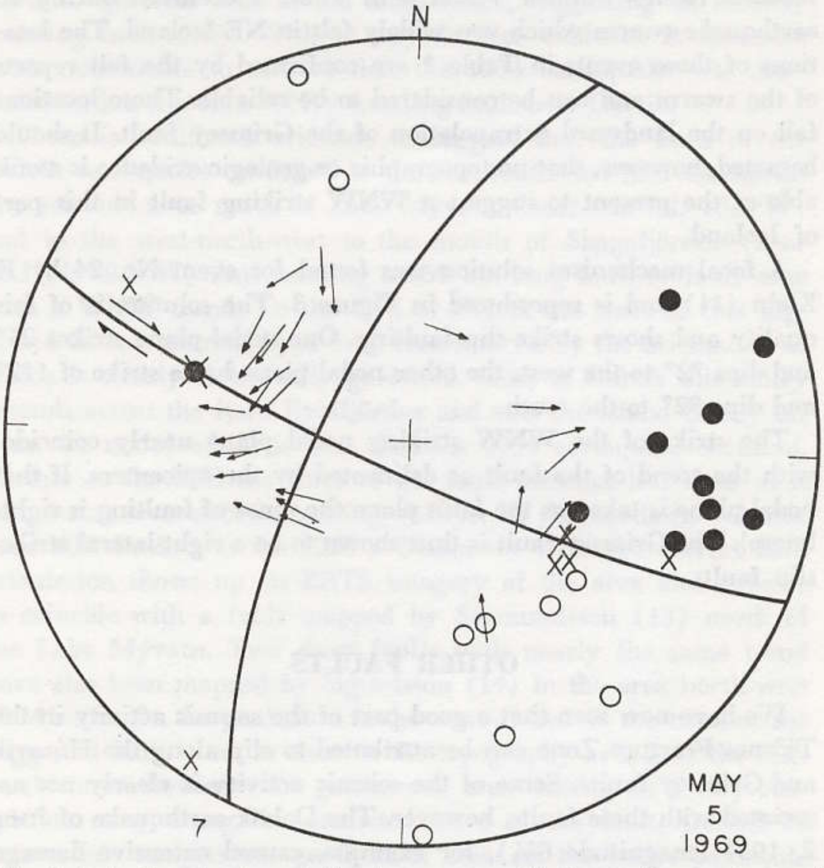

Fig. 3: A focal mechanism solution for event no. 24. P-wave first motions and polarisation of S-waves are plotted on the lower heimsphere. Open circles mark dilatational and filled circles compressional first motions. Crosses denote that the station is close to a nodal plane as indicated by the wave form. Reproduced from Conant [1972].

resulting locations are listed in Table 2 and shown in Figure 2. The last column in Table 2 gives the distance between the location in Table 1 and that in Table 2. None of these distances are less than 10 km, and discrepancies larger than 20 km are common.

The relocated epicenters delineate a WNW trending linear zone, probably a fault or a narrow fault zone. The location of this fault is somewhat uncertain, but it probably passes within a few kilometers of the island Grímsey. The fault possibly continues into Iceland. Events number 1 and 2 in Table 1 occurred during an earthquake swarm which was widely felt in NE Iceland. The locations of these events in Table 1 are confirmed by the felt reports of the swarm and can be considered to be reliable. These locations fall on the landward extrapolation of the Grímsey fault. It should be noted, however, that no topographic or geologic evidence is available at the present to suggest a WNW striking fault in this part of Iceland.

A focal mechanism solution was found for event No. 24 by F. Klein (11) and is reproduced in Figure 3. The solution is of fair quality and shows strike-slip faulting. One nodal plane strikes 25° and dips 72° to the west, the other nodal plane has a strike of 112° and dips 82° to the south.

The strike of the WNW striking nodal plane nearly coincides with the trend of the fault as delineated by the epicenters. If that nodal plane is taken as the fault plane the sense of faulting is right-lateral. The Grímsey fault is thus shown to be a right-lateral strike-slip fault.

OTHER FAULTS

We have now seen that a good part of the seismic activity in the Tjörnes Fracture Zone can be attributed to slip along the Húsavík and Grímsey faults. Some of the seismic activity is clearly not associated with these faults, however. The Dalvík earthquake of June 2, 1934 (magnitude 6¼), for example, caused extensive damage in the village of Dalvík and vicinity (Figure 1). The epicenter of that quake was estimated to be between Dalvík and the small island Hrísey to the east of Dalvík (12). This estimate was based on macroseismic observations.

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In a search for the causative fault we note that two strong tectonic trends are present in the area around Dalvík, a north-south trend as expressed in the direction of most fjords and valleys in North Iceland, and a west-north-west trend which is most obvious in the topography of the peninsula east of Dalvík. The latter trend coincides with the trend of the Húsavík and Grímsey faults which are known to be associated with earthquakes. Furthermore, the largest aftershock of the Dalvík earthquake of 1934 appeared to have its epicenter east of the main shock, suggesting an easterly trending fault (12). Without any further evidence it therefore seems reasonable to assume that the 1934 earthquake was associated with a slip on a WNW trending fault near Dalvík.

There is additional evidence to suggest that the fault of the Dalvík earthquake continues to the east-south-east into the northern volcanic zone north of Lake Mývatn (near 65.7°N, 16.9°W) and to the west-north-west to the mouth of Skagafjördur (near 66.1°N, 19.5°W) thus forming a 130 km long fault or fault zone with a WNW trend. To the ESE of Dalvík the trace of this suggested fault is marked by a deep erosional valley the orientation of which is clearly tectonically governed. Close to Dalvík this valley extends across the fjord Eyjafjördur and cuts the island Hrísey off from the mainland. It is here that the 1934 earthquake occurred. Farther to the ESE the trace of the fault becomes less clear as it cuts across several N-S trending valleys. In the northern volcanic zone still farther to the ESE a lineament with the correct ESE orientation shows up on ERTS imagery of the area and appears to coincide with a fault mapped by Saemundsson (13) north of the Lake Mývatn. Two short faults with nearly the same trend have also been mapped by Sigurdsson (14) in the area north-west of Mývatn. On the peninsula to the west of Dalvík the trace of the suggested fault is not as clear in the topography as it is to the east. In this area, however, the geothermal areas line up in a very conspicuous way along the predicted trace of the fault. Out of 30 known low temperature geothermal areas on the entire peninsula between Skagafjördur and Eyjafjördur 20 fall within 4 km of the predicted trace (information from the files of the National Energy Authority, 1974). It is well known that hydrothermal activity tends to occur above dykes or faults where water can percolate easily in the vertical direction. The alignment of the geothermal areas therefore suggests the existence of a throughgoing faulted zone.

The evidence cited here for a major WNW trending fault through Dalvík is rather fragmentary. The existence of the fault still remains to be proven through detailed geologic mapping of north Iceland.

The extension of the hypothetical Dalvík fault into the mouth of Skagafjördur raises an important possibility. The magnitude 7 earthquake of March 28, 1963 (event No. 12 in Table 1) was the largest earthquake to occur within the Tjörnes Fracture Zone since 1910 (9). The calculated epicenter of that earthquake (Table 1) is off the mouth of Skagafjördur and lies between the projected traces of the Dalvík and the Húsavík faults at the same distance from both faults. It would take a mislocation of only 15 km to move the epicenter to either of those faults. As was already shown in this study, a mislocation of 15 km is not unusual when teleseismic data are used. For reasons given later it appears more likely that the 1963 earthquake occurred on the Dalvík fault rather than on the extension of the Húsavík fault. Thus there is the possibility that the proposed Dalvík fault has had two large, destructive earthquakes in this century. Such a fault must be taken seriously into account when estimating the seismic risk of the region.

A focal mechanism solution for the large 1963 earthquake was found by Stefánsson (15) and independently by Sykes (3). The solution has two nearly vertical P-wave nodal planes, one with the strike of 17° and the other 106°. The tensional axis has an east-north-easterly trend. In the light of what has been said about the Grímsey, Húsavík and Dalvík faults the nodal plane striking 107° is the most likely fault plane, thus yielding right-lateral strike slip motion. It was this fault plane solution that originally led to the interpretation of the Tjörnes Fracture Zone as a transform fault (3).

The rate of motion along the proposed Dalvík fault is difficult to estimate. The fault crosses numerous valleys carved out by the glaciers of the last glacial period. These valleys are not noticeably displaced, which implies that the total horizontal motion along the fault hardly exceeds some hundred meters in post-glacial time, i.e. the last 10,000 years. Even if all the transform motion between

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the Kolbeinsey Ridge and the northern volcanic zone in Iceland were taken up by the Dalvík fault, the total horizontal motion in post-glacial time would be less than 200 meters calculated from the spreading rate. Since some of the transform motion is taken up by the parallel Húsavík and Grímsey faults, the total motion along the Dalvík fault is probably considerably less than 100 meters in post-glacial time and could conceivably be masked by erosion.

DISCUSSION

When the results of this study are added to the results of Saemundsson's study (5), a rather complex tectonic picture emerges. A series of N-S trending ridges and troughs are superimposed on the pattern of parallel WNW trending strike-slip faults described

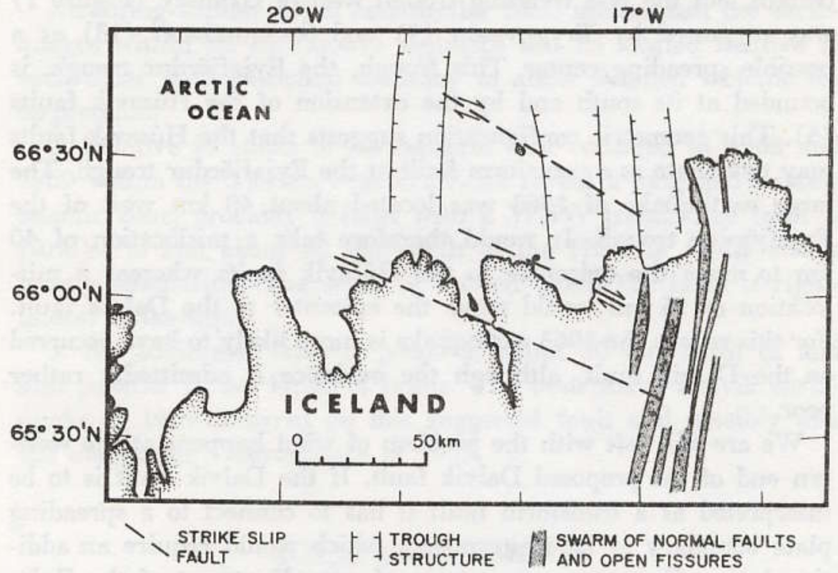

Fig. 4: A schematic diagram showing the spatial relationship between the proven and inferred strike-slip faults, the ridge-and-trough structures and the northern volcanic zone of Iceland as marked by the swarms of normal faults an open fissures. The westernmost trough is the Eyjafjördur trough, the easternmost one is the Axarfjördur trough. The fault swarms are drawn according to Saemundsson [1974].

in this paper (Figure 4). According to Saemundsson (5) the troughs have successively assumed the roles of spreading centers, the easternmost trough (the Axarfjördur trough) presently being the most significant one. Within such a framework the transform motion between the active spreading centers may shift with time between the different strike-slip faults. If the Axarfjördur trough is presently the most active spreading center, the Grímsey fault or some other fault farther to the north should be the most active transform fault. Significant seismic activity south of the Grímsey fault suggests that other spreading centers are presently active to the west of the Axarfjördur trough.

The linear magnetic anomaly pattern associated with the spreading Kolbeinsey Ridge extends as far south as 67°N (16). The central anomaly appears to bifurcate near the island Kolbeinsey. South of Kolbeinsey the position of the spreading plate boundary is uncertain, but the N-S trending trough west of Grímsey (Figure 1) was suggested by Tryggvason (9) and Saemundsson (13) as a possible spreading center. This trough, the Eyjafjördur trough, is bounded at its south end by the extension of the Húsavík faults (5). This geometric configuration suggests that the Húsavík faults may terminate as a transform fault at the Eyjafjördur trough. The large earthquake of 1963 was located about 40 km west of the Eyjafjördur trough. It would therefore take a mislocation of 40 km to move the epicenter to the Húsavík faults whereas a mislocation of 15 km would move the epicenter to the Dalvík fault. For this reason the 1963 earthquake is more likely to have occurred on the Dalvík fault, although the evidence is admittedly rather poor.

We are still left with the problem of what happens at the western end of the proposed Dalvík fault. If the Dalvík fault is to be interpreted as a transform fault it has to connect to a spreading plate boundary at its western end, which would require an additional spreading center or a zone of spreading west of the Eyjafjördur trough. The earthquake swarm of October 1973 (Table 1) may have occurred on such a spreading zone, but more data are needed to verify this suggestion.

Many questions on seismological aspects of the Tjörnes Fracture Zone remain unanswered. One interesting observation is, for ex-

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ample, that earthquakes occur both in mainshock-aftershock sequences and earthquake swarms, i.e. sequences without an outstanding mainshock. The sequence in August 1969 (Table 1) on the Grímsey fault was a typical earthquake swarm, whereas the large earthquakes 1934 and 1963 were mainshocks with extensive aftershock activity.

Some of the important tectonic and seismological questions will be answered when data become available from the seismograph network presently being installed in North Iceland.

CONCLUSIONS

1. Absolute locations of earthquake within a given region using teleseismic data often yield diffuse patterns which are difficult to put into a tectonic context.

Assuming similar depth and similar focal mechanism the earthquakes within an earthquake sequence can be located relative to each other with sufficient accuracy to allow detailed tectonic interpretation.

2. Relative locations of earthquakes that occurred in 1968 and 1969 within the Tjörnes Fracture Zone reveal a long and narrow seismic zone, probably a fault with a WNW trend. The fault is parallel to and about 40 km north of the Húsavík faults and is mostly submarine. The sense of motion along the fault is right-lateral strike-slip.

3. An additional fault is proposed about 30 km south of and also parallel to the Húsavík faults. The destructive Dalvík earthquake of 1934 occurred on this suggested fault and possibly also the magnitude 7 earthquake of 1963.

ACKNOWLEDGEMENTS

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Table 1

Epicenters north of Iceland between 66°N and 67.2°N during the period 1955–1973. Compiled from Sykes [1965] and the Preliminary Determination of Epicenters by the U.S.C.G.S., later NOAA and U.S.G.C. The magnitude (M) is a surface wave magnitude for events No. 1–18, but a body wave magnitude (m_b) for events no. 19–43. N is the number of P or PKP readings used in the location.

No.	*DATE*			*ORIGIN TIME*			*EPICENTER*		*M*	*N*
	Y	M	D	H	M	S	N LAT.	W LONG.		
1	1955	2	27	07	46	57.9	66.12	16.25	4.4	6
2	1955	2	27	08	28	30.9	66.08	16.51	4.2	6
3	1955	5	19	03	11	18.8	66.34	17.33	4.9	12
4	1956	10	29	16	20	59.6	66.46	17.73	4.6	9
5	1956	10	29	16	31	50.3	66.59	17.09	4.3	6
6	1956	10	30	00	11	03.6	66.48	17.73	4.9	27
7	1958	9	27	10	41	27.8	66.07	18.08	4.6	11
8	1958	12	06	09	43	23.8	66.42	18.75	3.9	4
9	1958	12	06	11	12	35.6	66.42	18.27	4.7	5
10	1958	12	06	15	33	14.3	66.40	18.12	4.6	5
11	1959	12	08	08	08	19.6	66.95	18.78	4.8	27
12	1963	3	28	00	15	47.5	66.3	19.6	6.8	43
13	1963	3	28	00	26	27.0	66.3	20.2	5.0	12
14	1963	3	28	00	59	38.9	66.4	19.6	4.7	18
15	1963	3	28	01	28	39.0	66.6	20.0	4.5	5
16	1963	4	27	03	42	33.9	66.7	19.2	4.6	13
17	1963	6	28	15	15	08.0	67.2	18.7	4.3	5
18	1963	10	15	09	59	30.1	67.2	18.4	5.6	39
19	1964	7	11	17	44	29.8	66.4	19.7	4.9	22
20	1967	7	26	21	59	50.2	66.5	17.1	4.1	6
21	1968	7	30	02	24	48.6	66.4	17.4	4.4	16
22	1969	4	01	04	10	45.8	66.4	17.7	4.5	26
23	1969	4	03	16	52	08.1	66.3	17.6	4.4	9
24	1969	5	05	21	47	31.7	66.8	18.2	5.2	52
25	1969	5	05	23	39	26.5	66.7	18.2	4.3	7
26	1969	5	06	23	56	33.6	66.3	17.3	4.5	6
27	1969	8	26	22	40	47.9	66.5	17.9	4.3	10
28	1969	8	26	22	47	25.9	66.3	17.7	4.8	23
29	1969	8	26	23	49	08.8	66.4	18.3	4.5	7
30	1969	8	27	03	24	28.4	66.5	17.7	4.1	5
31	1969	8	27	12	12	40.9	66.5	17.8	4.3	10

1

ween 66°N and 67.2°N during
om Sykes [1965] and the Pre-
nters by the U.S.C.G.S., later
e (M) is a surface wave magni-
ody wave magnitude (m_b) for
of P or PKP readings used in

ME	*EPICENTER*		*M*	*N*
	N LAT.	W LONG.		
9	66.12	16.25	4.4	6
9	66.08	16.51	4.2	6
8	66.34	17.33	4.9	12
6	66.46	17.73	4.6	9
3	66.59	17.09	4.3	6
6	66.48	17.73	4.9	27
8	66.07	18.08	4.6	11
8	66.42	18.75	3.9	4
6	66.42	18.27	4.7	5
3	66.40	18.12	4.6	5
6	66.95	18.78	4.8	27
5	66.3	19.6	6.8	43
0	66.3	20.2	5.0	12
9	66.4	19.6	4.7	18
0	66.6	20.0	4.5	5
9	66.7	19.2	4.6	13
0	67.2	18.7	4.3	5
1	67.2	18.4	5.6	39
8	66.4	19.7	4.9	22
2	66.5	17.1	4.1	6
6	66.4	17.4	4.4	16
8	66.4	17.7	4.5	26
1	66.3	17.6	4.4	9
7	66.8	18.2	5.2	52
5	66.7	18.2	4.3	7
6	66.3	17.3	4.5	6
9	66.5	17.9	4.3	10
9	66.3	17.7	4.8	23
8	66.4	18.3	4.5	7
4	66.5	17.7	4.1	5
9	66.5	17.8	4.3	10

Table 1 (Continued)

No.	*DATE*			*ORIGIN TIME*			*EPICENTER*		*M*	*N*
	Y	M	D	H	M	S	N LAT.	W LONG.		
32	1973	10	28	10	01	54.1	66.6	19.9	4.5	16
33	1973	10	28	10	42	50.6	66.7	19.7	4.4	16
34	1973	10	28	10	48	23.0	66.7	19.3	4.3	18
35	1973	10	28	10	53	21.3	66.8	19.7	4.3	13
36	1973	10	28	11	12	02.5	67.0	19.3	4.7	28
37	1973	10	28	11	25	40.6	66.8	19.5	4.4	14
38	1973	10	28	11	31	44.1	66.9	19.2	5.0	47
39	1973	10	28	11	47	37.6	66.8	19.3	4.7	16
40	1973	10	28	12	01	47.8	67.3	19.0	4.4	17
41	1973	10	28	14	25	54.2	66.9	19.5	4.5	25
42	1973	10	29	08	41	47.0	66.5	19.3	4.3	6
43	1973	11	29	14	02	30.2	66.5	19.6	4.3	7

Table 2

Relocated epicenters, and their distance from the location in Table 1. The numbers refer to Table 1.

No.	*N LAT.*	*W LONG.*	*DIST. (km)*
21	66.33	17.15	17
22	66.46	17.50	10
23	66.44	17.75	15
24	66.72	18.40	12
25	66.70	18.60	17
26	66.46	17.65	25
27	66.40	17.40	25
28	66.41	17.30	23
29	66.42	17.50	37
31	66.44	17.40	20

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