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SOME FAULTS DETECTED BY LINEAMENTS OF CONSECUTIVE EPICENTERS

B. Muço*

ABSTRACT

This paper is concerned with the fault detection by mapping the lineaments of consecutive epicenters of earthquakes for relatively short intervals of time. The method is very suitable especially when fault traces are hidden by a recent sedimentary cover. Employing in analysis about 200 microearthquakes from 1982 to 1991, grouped in 17 time histories, 5 fault systems are well-detected which are the Drini Bay-Kukes, Librazhd-Nderfan, Drini Bay-Elbasan, Vlore-Debar and Bregu i Detit-Erseke faults.The study has given new evidence for some segments of above faults. The focal mechanism solutions for the earthquakes which belong to these fault systems, from 1964 to 1988, are also carried out.

INTRODUCTION

Today it is widely accepted the notion that shallow earthquakes are results of rupture processes occurring along the active tectonic faults due to tectonic deformation accumulated in due course.

Being the source of the earthquake foci, the faults, by the other hand, during the earthquake processes, can be renewed and their dimensions can be grown.

In spite of geological or geomorphic means, the seismic activity can also be used for inferring the active faults. Assessment of these faults can potentially provide basic information about seismic risk. Mapping of epicenters for Albanian earthquakes had thrown light on many fault systems (Sulstarova et al.,1980; Aliaj, 1988). But the complication of Albanian tectonic structure dissected by many faults as well as the uncertainties in epicentral location, may probably lead to ambiguities and misinterpretation of fault systems. A suitable method giving better results is the monitoring of dynamics of epicenters migration for relatively short intervals of time (Mizoue and Nakamura, 1976; Mizoue et al.,1978; Muço, 1992).

THE DYNAMICS OF EPICENTERS MIGRATION

The method consists in monitoring of seismic activity, separating and identifying the activity of each zone. Firstly, the arrival times of direct crustal phases Pg and Sg are observed in two nearest seismological stations for the earthquake which is considered as the first in the sequence. With these two stations, only by the fluctuations of differences between Pg and Sg time arrivals, one can judge for the displacement of epicenters. In attempting to separate the earthquakes into groups which belong to the same fault system, care must be taken to the record characteristics, coda form, first polarities etc.

Basing on the FASTHYPO algorithm (Herrman,1979), we constructed a new program for epicenter determination of the earthquakes which we identified as

* Seismological Center, Tirana, Albania.

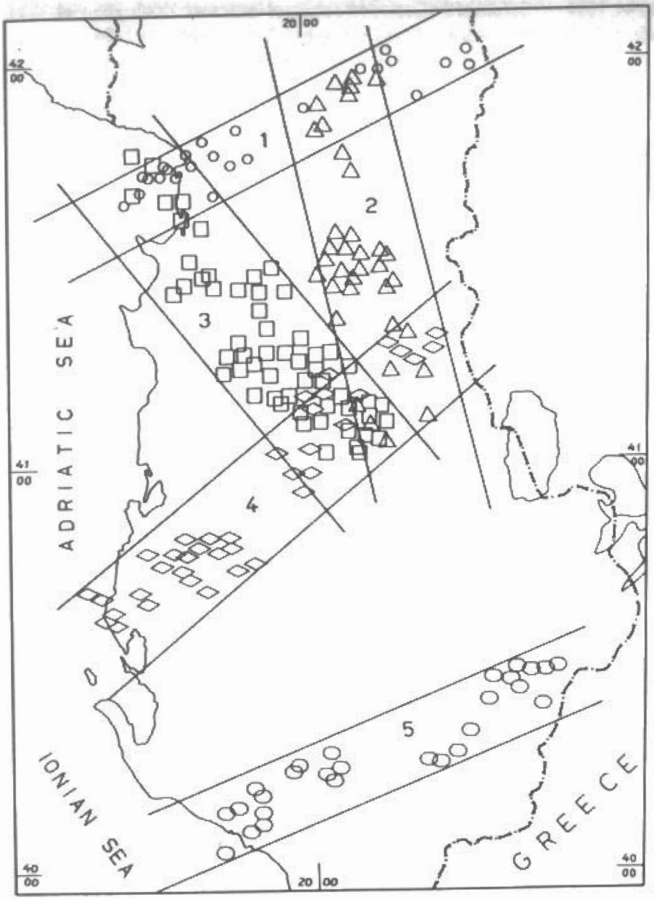

Fig. 1: The map of epicenters of earthquakes employed in fault detection by lineaments of consecutive epicenters. By stripes and numbers are noted 5 fault systems revealed. Different symbols are used for epicenters which belong to different faults (see Annex).

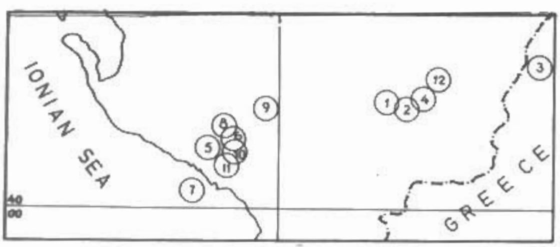

Fig 2: An example of dynamics of epicenter migration in the case of a time-history for the Bregu i Detit - Erseka fault.

connected with some fault systems. In this program, a special procedure is carried out for the depth determination, by minimising the residuals for each 5 km and inside this 5 km layer, for each 1 km. The velocity model used is of linear form : V = a + bH where the velocity is calculate according to a gradient depending from depth (Muço,1992).

The data processing consists mainly in making linkage systems of consecutive epicenters for each selected sequence of seismic activity. The accurate epicentral data plotted on a map and from the consecutive migration of epicenters, one can see the activation of different parts of a fault system during relatively short interval of time.

These traces don't represent exactly the faults. They are a kind of projection of the faults on earth surface. The planes of real tectonic faults could be displaced 10-20 km from these detected traces, depending from their dip. But nevertheless, one can judge about their existence and activity even when a vague evidence is given by the field geological observations.

OBSERVED CASES

Our study doesn't pretend searching of all fault systems of the country. Observed cases are selected from Monthly Seismological Bulletins of Albania from 1982 to 1991. The data from Monthly Seismological Bulletins of Montenegro, Preliminary Seismological Bulletins of Skopje and Monthly Seismological Bulletins of Athens, were also used. In our analysis, about 200 microearthquakes are employed, grouped in 17 sequences or time histories. The time interval for each time history was limited to 40-50 days. The magnitude range of earthquakes is 2.0 - 5.1. All the data are catalogued in Annex. Only the hypocenters with uncertainties less than 10 km for geographic coordinates and less than 5 km for depth, are taken into consideration.

From a careful analysis of the data, 5 fault systems are revealed. These are:

1) Drini Bay - Kukes (3 time histories)

2) Librazhd - Nderfan (3 time histories)

3) Drini Bay - Elbasan (6 time histories)

4) Vlore - Debar (3 time histories)

5) Bregu i Detit - Erseke (2 time histories)

The FIG. 1, shows the distribution of epicenters for above faults. In the Annex and FIG.2 , one can see the consecutive migration of epicenters (which are noted by numbers) for each time history. The epicentral depths show that all the considered seismic activity belongs to the crust. Some of the above faults are detected from previous studies (Sulstarova et al.,1980; Aliaj,1988). During the Dibra earthquake of November 30, 1967, a 10 km long rupture was appeared in the surface. The vertical displacement amplitude of this rupture reaches up to 50 cm (Sulstarova and Koçiaj, 1980). Our analysis gives some new evidences for particular segments of Drini Bay - Kukes fault, for Librazhd - Nderfan fault and Bregu i Detit - Erseke fault.

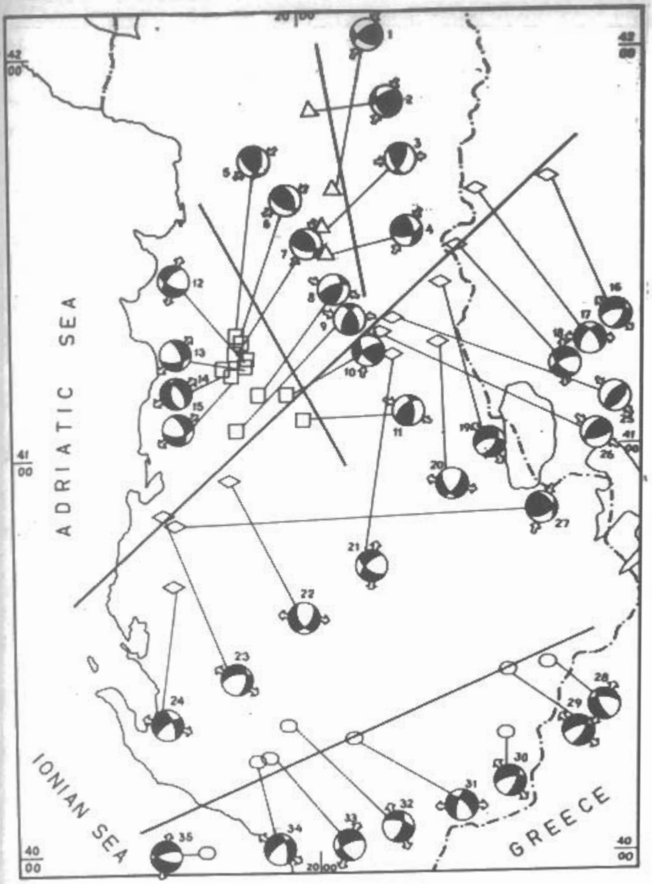

Fig. 3: The focal mechanism solutions for the earthquakes with Ms> 4.0, for the years 1964 - 1988, connected with detected faults.

FOCAL MECHANISM SOLUTIONS

From a study for focal mechanism solutions of Albanian earthquakes from 1964 to 1988, with magnitude more than 4.0 (Muço, 1992, Muço, 1994), are considered only these focal solutions whose earthquakes are thought as connected with some of above fault systems detected. For focal mechanism solutions we used a computer program compiled by Maki (1984) with some modifications for near epicenter-station distances (Muço,1992). The long period seismograms of WWSSN were read in for the earthquakes with magnitude more than 5.0.

From these focal mechanism solutions (FIG.3 and Table 1), one can see:

*) for Librazhd - Nderfan fault : The fault is of thrust type. Mean direction of compression vector has the azimuth of 240° and plunge 16°.

*) for Drini Bay - Elbasan fault : The focal mechanism solutions obtained

Table 1

No	Date	Coordinates			Magn.	Nod.pl.1,2 strike/dip	P Az/pl	T Az/pl
		FO	LO	HO				
1	18 08 86	41.61	20.12;	10	3.8	128/68; 32/3	132/8	53/44
2	28 11 78	41.83	20.04;	12	4.6	160/77; 260/54	214/14	13/35
3	26 02 79	41.52	20.06;	28	4.6	32/58; 149/53	92/3	358/53
4	23 09 77	41.49	20.08;	37	4.8	349/82; 93/31	55/30	288/45
5	13 01 86	41.30	19.77;	25	4.8	9/52; 125/61	245/5	341/51
6	07 06 86	41.27	19.64;	11	4.6	342/49; 135/45	59/2	322/75
7	26 06 86	41.26	19.61;	10	5.0	317/40; 99/56	205/8	317/69
8	08 07 81	41.12	19.85;	11	4.5	32/44;265/61	332/9	226/59
9	19 08 70	41.08	19.77;	21	4.9	193/55;345/38	271/9	150/74
10	21 10 79	41.14	19.94;	2	5.0	161/83; 255/58	212/17	114/27
11	30 03 84	41.09	20.00;	3	4.6	24/54; 224/38	123/8	251/77
12	07 06 86	41.26	19.63;	12	4.8	225/19; 121/86	50/46	195/38
13	09 01 88	41.19	19.68;	10	4.9	341/58; 83/71	306/37	210/8
14	29 06 84	41.20	19.72;	28	4.5	324/40; 157/51	108/82	241/6
15	09 01 88	41.25	19.66;	10	5.7	335/70; 85/46	290/47	35/14
16	19 08 84	41.63	20.80;	6	4.5	256/48; 55/44	234/79	336/2
17	20 03 87	41.67	20.57;	7	4.2	225/44; 343/65	206/54	100/12
18	26 08 69	41.50	20.50;	28	4.9	242/62; 143/65	99/31	194/8
19	30 11 67	41.41	20.44;	21	5.9	26/50; 265/58	231/56	327/4
20	28 02 82	41.28	20.44;	10	4.8	54/59; 172/52	19/53	114/4
21	18 04 68	41.25	20.22;	36	4.4	240/66; 139/67	99/35	189/0
22	03 12 78	40.92	19.65;	38	4.9	149/55; 44/69	2/40	100/9
23	17 11 82	40.84	19.54;	30	4.9	264/39; 3/82	238/40	123/27
24	02 03 76	40.66	19.59;	11	4.7	346/63; 244/68	204/36	296/3
25	02 12 67	41.32	20.29;	16	5.3	36/38; 221/2	309/7	146/82
26	10 05 69	41.30	20.21;	35	4.4	210/51; 74/47	321/3	57/66
27	16 11 82	40.82	19.58;	21	5.5	336/49; 79/75	202/16	306/41
28	23 12 86	40.45	20.66;	12	3.9	175/35; 282/32	165/61	26/5
29	07 01 87	40.44	20.61;	10	4.7	22/58; 257/46	239/59	137/7
30	17 09 74	40.29	20.63;	17	4.9	269/41; 19/73	249/48	136/20
31	21 11 79	40.28	20.16;	10	4.5	315/65; 220/70	175/25	270/11
32	25 05 66	40.32	19.82;	21	5.0	290/59; 32/71	254/37	158/8
33	09 08 66	40.22	19.86;	38	4.9	159/85; 253/50	108/31	213/23
34	13 02 87	40.22	19.87;	1	4.9	236/47; 356/62	215/54	113/1
35	24 04 70	39.91	19.61;	41	4.3	102/52; 253/42	69/73	178/5

are more complicated. There are presence of both thrust and normal type of fault. It is possible that some of the earthquakes whose focal mechanism are included here, are not generated by the mentioned fault.

*) for Vlora - Debar fault : The solutions reveal a normal fault with the azimuth of mean tensional stress direction 318^{o} and plunge 8^{o}. This general solution is in agreement with previous studies carried out for the strongest seismic event of this fault system: that of earthquake of November 30, 1967 (McKenzie, 1972 ; Anderson and Jackson, 1987).

*) for Bregu i Detit - Erseke fault : All the solution show a normal fault. The azimuth of mean tensional axis is 336^{o} and plunge 12^{o}.

From four cases with focal mechanism solution, the transversal faults result of normal type and longitudinal ones of thrust type.

CONCLUSIONS

Analysing about 200 microearthquakes for the period 1982-1991, the traces of some active faults of Albania are mapped.

The used method is the dynamics of epicenters migration, monitoring the consecutive epicenters within a relatively short interval of time. This method provided useful insight about some fault systems of the country as Drini Bay - Kukes fault, Librazhd - Nderfan fault, Drini Bay - Elbasan fault, Vlore - Debar fault and Bregu i Detit - Erseke fault.

For some of these faults, the results of focal mechanism solutions are also presented.

Although we are aware that our results are not conclusive, we are confident that a denser seismological network and the improvement of our computer facilities could lead to more better results.

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ANNEX

Fault	S	No	D	M	Y	Origin time			F	L	H	ML
1	○	1	9	01	1982	08	57	35.5	42.0	20.27	20	2.5
	''	2	9	01	1982	14	09	26.9	41.96	20.22	18	2.4
	''	3	11	01	1982	10	54	23.8	41.72	19.50	12	2.5
	''	4	14	01	1982	14	20	52.0	41.74	19.55	10	2.4
	''	5	20	01	1982	07	43	21.2	41.80	19.67	12	3.0
	''	6	20	01	1982	11	59	10.2	41.83	19.76	15	2.4
	''	1	21	11	1985	21	57	13.8	41.69	19.47	10	5.1
	''	2	21	11	1985	23	16	24.7	41.75	19.54	8	4.6
	''	3	21	11	1985	23	27	36.9	41.68	19.70	11	3.0
	''	4	22	11	1985	01	33	55.1	41.77	19.80	13	3.0
	''	5	22	11	1985	08	10	09.0	41.96	20.19	22	4.1
	''	6	22	11	1985	08	12	32.7	41.88	20.00	10	2.9
	''	7	22	11	1985	18	04	26.5	41.79	19.60	10	3.0
	''	8	23	11	1985	03	45	13.9	41.74	19.75	6	3.2
	''	9	24	11	1985	01	45	27.1	41.66	19.41	8	3.5
	''	1	8	01	1989	13	15	21.8	41.72	19.49	17	3.2
	''	2	8	01	1989	13	15	55.6	41.72	19.58	12	3.3
	''	3	8	01	1989	13	16	59.1	41.72	19.53	10	2.4
	''	4	8	01	1989	13	30	01.7	41.74	19.62	8	2.5
	''	5	8	01	1989	18	35	08.5	41.78	19.70	11	2.3
	''	6	16	01	1989	11	03	45.6	41.75	19.56	10	2.4
	''	7	21	01	1989	03	13	05.0	42.02	20.26	10	2.9
	''	8	21	01	1989	14	04	45.5	41.99	20.52	23	2.2
	''	9	22	01	1989	00	12	49.0	42.03	20.58	13	2.6
	''	10	22	01	1989	00	35	04.0	42.00	20.57	10	2.2
	''	11	22	01	1989	00	58	07.4	41.96	20.52	17	2.2
	''	12	22	01	1989	17	18	01.6	41.90	20.36	17	2.4
2	△	1	1	09	1984	16	05	48.3	41.77	20.14	23	2.2
	''	2	8	09	1984	02	47	51.7	41.84	20.09	22	2.3
	''	3	14	09	1984	15	57	45.6	41.23	20.37	10	2.5
	''	4	14	09	1984	15	58	07.7	41.31	20.31	18	2.2
	''	5	29	09	1984	06	15	34.0	41.88	20.06	20	2.3
	''	6	29	09	1984	11	14	03.1	41.51	20.24	26	3.7
	''	7	29	09	1984	11	19	36.2	41.51	20.23	33	3.1
	''	1	10	05	1987	17	26	03.3	41.94	20.10	12	3.5
	''	2	10	05	1987	17	54	47.1	41.92	20.13	20	2.6
	''	3	10	05	1987	20	46	43.6	41.72	20.13	8	2.4
	''	4	19	05	1987	22	42	23.2	41.83	20.05	18	2.5
	''	5	11	06	1987	02	11	19.3	41.51	20.16	12	2.5
	''	6	17	06	1987	11	00	56.7	41.48	20.14	11	3.7
	''	7	17	06	1987	11	16	01.9	41.45	20.26	24	2.2
	''	8	17	06	1987	11	26	25.2	41.46	20.25	20	2.4
	''	9	21	06	1987	10	37	05.7	41.12	20.36	18	2.3
	''	10	25	06	1987	00	01	59.7	41.57	20.12	16	2.3
	''	11	26	06	1987	17	20	29.1	41.22	20.23	12	3.0
	''	12	28	06	1987	11	19	14.7	41.51	20.23	25	2.2

Fault	S	No	D	M	Y	Origin time			F	L	H	ML
	''	1	24	01	1989	16	13	03.0	41.07	20.23	10	2.5
	''	2	24	01	1989	21	15	27.0	41.52	20.08	24	2.7
	''	3	24	01	1989	21	27	58.4	41.39	20.10	33	2.4
	''	4	24	01	1989	21	46	14.6	41.47	20.13	25	2.3
	''	5	24	01	1989	22	05	49.3	41.48	20.11	24	2.2
	''	6	24	01	1989	23	16	11.1	41.46	20.15	20	2.2
	''	7	25	01	1989	00	07	25.1	41.52	20.09	10	2.8
	''	8	25	01	1989	00	08	38.4	41.53	20.13	13	2.4
	''	9	26	01	1989	03	12	24.7	41.47	20.10	23	2.8
	''	10	27	01	1989	15	07	24.2	41.50	20.21	28	2.2
	''	11	27	01	1989	16	08	21.1	41.47	20.08	16	2.7
	''	12	28	01	1989	15	28	38.7	41.96	20.16	16	3.6
	''	13	28	01	1989	16	12	54.8	41.97	20.15	17	3.4
	''	14	28	01	1989	17	40	29.7	41.51	20.11	31	2.0
	''	15	29	01	1989	02	24	27.2	41.96	20.22	16	2.2
	''	16	29	01	1989	06	47	21.6	41.16	20.29	10	2.3
	''	17	30	01	1989	17	31	02.0	41.36	20.29	21	2.2
3	□	1	11	06	1984	12	46	51.3	41.11	20.13	11	2.9
	''	2	18	06	1984	19	16	26.1	41.29	19.96	19	3.2
	''	3	23	06	1984	20	04	58.8	41.00	20.18	12	2.5
	''	4	24	06	1984	07	32	15.4	41.58	19.71	2	2.2
	''	5	29	06	1984	23	18	34.1	41.17	19.83	34	3.7
	''	1	6	09	1984	03	15	22.3	41.19	19.92	12	3.0
	''	2	10	09	1984	13	41	26.7	41.04	20.15	22	2.4
	''	3	11	09	1984	19	47	06.6	41.16	20.06	9	2.5
	''	4	13	09	1984	10	26	03.8	41.21	20.05	3	2.3
	''	5	21	09	1984	15	54	06.8	41.16	20.07	10	2.5
	''	6	25	09	1984	02	27	59.7	41.11	20.02	17	3.2
	''	7	25	09	1984	06	04	16.8	41.13	19.97	6	2.3
	''	8	27	09	1984	18	40	10.0	41.48	19.68	18	3.0
	''	9	28	09	1984	02	05	12.9	41.44	19.88	29	3.0
	''	1	13	01	1986	13	48	05.3	41.30	19.77	25	4.0
	''	2	13	01	1986	13	51	31.3	41.21	19.89	22	2.8
	''	3	13	01	1986	19	59	24.0	41.01	20.03	14	3.2
	''	4	14	01	1986	06	13	27.6	41.32	19.87	22	2.4
	''	5	18	01	1986	07	30	59.7	41.77	19.45	10	3.2
	''	6	18	01	1986	07	52	45.9	41.75	19.52	7	2.3
	''	7	18	01	1986	09	35	29.4	41.64	19.56	16	2.4
	''	8	18	01	1986	13	49	55.5	41.61	19.60	10	2.3
	''	9	20	01	1986	04	21	53.2	41.68	19.45	21	2.7
	''	10	20	01	1986	14	35	06.9	41.36	19.82	15	2.4
	''	11	21	01	1986	14	08	48.4	41.65	19.60	13	2.5
	''	12	27	01	1986	09	40	21.3	41.28	19.86	18	3.1
	''	13	27	01	1986	16	05	47.8	41.10	19.98	11	2.4
	''	14	28	01	1986	05	56	35.5	41.09	20.13	10	2.4

Fault	S	No	D	M	Y	Origin time			F	L	H	ML
	''	1	3	06	1986	19	00	52.3	41.42	19.70	14	2.5
	''	2	7	06	1986	20	03	26.3	41.23	19.79	30	3.7
	''	3	7	06	1986	20	06	28.4	41.26	19.76	22	3.6
	''	4	7	06	1986	21	45	45.4	41.24	19.80	18	3.1
	''	5	8	06	1986	02	51	24.8	41.25	19.81	17	3.0
	''	6	9	06	1986	22	35	26.4	41.16	20.02	12	2.2
	''	7	12	06	1986	11	36	07.2	41.08	20.12	8	2.2
	''	8	12	06	1986	17	06	43.3	41.34	19.89	25	2.7
	''	9	14	06	1986	04	37	02.1	41.44	19.65	24	2.4
	''	10	21	06	1986	09	30	07.1	40.96	20.17	12	2.7
	''	11	26	06	1986	20	06	28.4	41.24	19.78	27	4.1
	''	12	26	06	1986	20	49	18.6	41.24	19.90	14	2.8
	''	1	2	03	1989	05	04	17.5	41.14	19.90	23	2.6
	''	2	2	03	1989	13	42	17.7	41.06	20.18	15	2.7
	''	3	2	03	1989	14	03	10.3	41.08	20.20	11	3.1
	''	4	6	03	1989	03	05	37.4	41.06	20.25	14	2.6
	''	5	6	03	1989	04	53	33.8	41.08	20.25	11	2.2
	''	6	10	03	1989	17	43	30.9	41.08	20.25	25	2.5
	''	7	17	03	1989	00	50	51.6	41.22	20.01	23	4.6
	''	8	17	03	1989	02	52	36.4	41.24	20.02	17	2.2
	''	9	17	03	1989	03	01	26.2	41.24	20.06	13	2.8
	''	10	17	03	1989	04	43	16.6	41.22	20.00	23	2.5
	''	11	17	03	1989	07	37	55.8	41.23	20.14	9	2.2
	''	12	17	03	1989	07	56	32.0	41.24	20.00	10	2.4
	''	13	17	03	1989	22	39	22.1	41.22	20.01	10	2.6
	''	14	18	03	1989	08	40	52.2	41.62	19.67	14	3.4
	''	15	19	03	1989	19	30	42.8	41.27	20.01	10	2.5
	''	1	5	03	1991	20	58	25.2	41.43	19.94	14	2.5
	''	2	16	03	1991	05	51	18.3	41.50	19.61	30	3.4
	''	3	16	03	1991	06	36	37.9	41.49	19.80	6	2.8
	''	4	16	03	1991	06	41	05.9	41.47	19.60	12	2.8
	''	5	16	03	1991	06	44	51.3	41.44	19.56	15	2.7
	''	6	16	03	1991	07	50	34.3	41.47	19.83	12	2.2
	''	7	18	03	1991	00	23	09.9	41.48	19.77	7	2.4
	''	8	20	03	1991	00	02	58.7	41.48	19.80	5	2.3
	''	9	20	03	1991	01	17	34.2	41.23	20.06	2	2.6
	''	10	22	03	1991	01	34	46.8	41.10	20.05	11	3.0
	''	11	22	03	1991	03	53	00.5	41.08	20.03	14	2.7
	''	12	23	03	1991	17	42	08.4	41.16	19.98	14	2.7
4	◇	1	11	07	1982	03	33	10.7	41.25	20.42	16	2.3
	''	2	11	07	1982	03	43	26.8	41.22	20.37	10	2.6
	''	3	16	07	1982	12	40	36.1	40.80	19.77	16	2.5
	''	4	18	07	1982	11	40	02.2	41.24	20.33	7	2.3
	''	5	27	07	1982	16	52	25.2	40.97	19.99	17	3.2
	''	6	30	07	1982	02	30	28.5	40.75	19.81	12	3.5
	''	7	30	07	1982	05	19	15.8	40.74	19.78	5	2.5

Fault	S	No	D	M	Y	Origin time			F	L	H	ML
	''	1	7	11	1982	16	16	45.3	41.29	20.43	12	2.7
	''	2	12	11	1982	23	01	56.9	41.12	20.16	10	3.2
	''	3	13	11	1982	09	15	00.8	41.03	19.89	28	2.5
	''	4	16	11	1982	23	41	19.7	40.79	19.70	21	5.1
	''	5	16	11	1982	23	47	00.0	40.76	19.65	18	3.4
	''	6	17	11	1982	00	18	39.3	40.76	19.50	12	3.2
	''	7	17	11	1982	00	21	01.7	40.77	19.54	23	3.0
	''	8	17	11	1982	00	38	00.9	40.77	19.68	12	4.2
	''	9	17	11	1982	00	54	37.6	40.78	19.59	12	3.4
	''	10	17	11	1982	03	36	16.4	40.72	19.60	13	4.0
	''	11	17	11	1982	17	50	36.9	40.78	19.48	13	3.0
	''	12	18	11	1982	00	31	00.4	40.79	19.70	14	3.2
	''	13	19	11	1982	04	39	13.1	40.80	19.63	19	3.3
	''	14	21	11	1982	00	58	00.7	40.74	19.60	12	3.1
	''	15	22	11	1982	13	55	05.7	41.29	20.29	10	2.8
	''	16	23	11	1982	20	46	15.7	41.15	20.05	12	2.5
	''	17	4	12	1982	04	12	20.1	41.13	20.03	22	2.7
	''	18	7	12	1982	22	25	26.8	40.65	19.48	12	3.0
	''	19	7	12	1982	23	00	17.2	40.61	19.36	11	3.0
	''	1	13	01	1985	20	35	59.2	41.02	20.00	12	2.5
	''	2	13	01	1985	23	44	58.4	40.98	20.00	11	2.3
	''	3	16	01	1985	23	35	58.2	40.61	19.37	37	4.8
	''	4	16	01	1985	23	49	36.6	40.65	19.32	16	3.5
	''	5	16	01	1985	23	51	49.7	40.58	19.35	13	3.2
	''	6	17	01	1985	00	22	53.7	40.69	19.29	18	3.1
	''	7	17	01	1985	10	50	08.0	40.79	19.71	12	2.5
	''	8	17	01	1985	12	06	37.2	40.92	20.00	8	2.2
	''	9	20	01	1985	08	17	06.5	40.68	19.67	20	2.3
5	○	1	4	01	1986	21	05	07.4	40.25	20.38	6	2.2
	''	2	4	01	1986	22	21	54.3	40.23	20.42	12	2.2
	''	3	6	01	1986	07	27	49.3	40.32	20.82	10	2.5
	''	4	9	01	1986	05	32	08.3	40.24	20.46	8	2.2
	''	5	15	01	1986	16	51	45.7	40.15	19.78	12	2.5
	''	6	15	01	1986	17	04	03.1	40.17	19.86	16	2.2
	''	7	15	01	1986	21	27	38.3	40.04	19.74	10	3.5
	''	8	15	01	1986	21	33	33.1	40.20	19.81	8	2.3
	''	9	15	01	1986	21	41	08.1	40.24	19.98	18	2.4
	''	10	16	01	1986	02	10	18.8	40.12	19.87	6	2.3
	''	11	16	01	1986	02	10	38.0	40.11	19.84	12	3.4
	''	12	18	01	1986	13	27	16.3	40.30	20.50	8	2.2
	''	1	18	12	1986	12	01	52.1	40.11	19.86	8	2.7
	''	2	18	12	1986	18	51	26.5	40.24	20.40	16	2.2
	''	3	23	12	1986	05	35	06.6	40.42	20.69	14	3.6
	''	4	23	12	1986	09	12	59.7	40.40	20.59	12	2.6
	''	5	23	12	1986	15	56	49.9	40.43	20.66	13	2.7
	''	6	23	12	1986	16	07	10.8	40.45	20.60	12	2.6
	''	7	27	12	1986	22	40	29.3	40.48	20.80	10	2.8

Fault	S	No	D	M	Y	Origin time			F	L	H	ML
	,,	8	7	01	1987	00	39	28.6	40.47	20.71	10	4.6
	,,	9	7	01	1987	00	44	52.5	40.48	20.69	10	3.6
	,,	10	8	01	1987	05	05	55.3	40.48	20.75	12	3.1
	,,	11	8	01	1987	09	02	43.3	40.39	20.75	8	2.7
	,,	12	21	01	1987	21	53	57.7	40.27	19.97	6	2.5
	,,	13	25	01	1987	03	02	10.6	40.10	19.85	10	3.0
	,,	14	26	01	1987	16	34	44.2	40.14	19.72	6	2.7
	,,	15	30	01	1987	07	20	06.7	40.22	20.06	10	2.2
	,,	16	2	02	1987	23	45	29.8	40.17	20.03	8	2.3
	,,	17	13	02	1987	13	58	06.2	40.21	20.04	9	4.6
	,,	18	13	02	1987	14	05	55.6	40.21	20.05	8	2.3
	,,	19	13	02	1987	14	20	07.5	40.24	20.05	10	2.4

Note: The time-histories of each fault are separated by space.
S - is the symbol used in FIG.1 .