

UNITED STATES DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

First-Motion Focal Mechanism Solutions  
for the IASPEI Earthquakes

by

Russell E. Needham  
U.S. Geological Survey  
Denver, Colorado

Open-File Report 85-458  
1985

This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

## CONTENTS

---

	Page
Introduction.....	1
Data.....	1
Computations.....	1
References.....	2

---

## ILLUSTRATIONS

---

Figure	1.	Lower hemisphere focal sphere projections for events 1-4.....	7
	2.	Lower hemisphere focal sphere projections for events 5-8.....	8
	3.	Lower hemisphere focal sphere projections for events 9-12.....	9
	4.	Lower hemisphere focal sphere projections for events 13-16.....	10
	5.	Lower hemisphere focal sphere projections for events 17-20.....	11
	6.	Lower hemisphere focal sphere projections for events 21-24.....	12
	7.	Lower hemisphere focal sphere projections for events 25-28.....	13
	8.	Lower hemisphere focal sphere projections for events 29-32.....	14
	9.	Lower hemisphere focal sphere projections for events 33-36.....	15
	10.	Lower hemisphere focal sphere projections for events 37-40.....	16
	11.	Lower hemisphere focal sphere projections for events 41-44.....	17
	12.	Lower hemisphere focal sphere projections for events 45-48.....	18
	13.	Lower hemisphere focal sphere projections for events 49-51.....	19

---

## TABLES

---

Table	1.	Chronological listing of IASPEI events with event numbers.....	3
	2.	Focal mechanism parameters for the IASPEI events.....	5

## INTRODUCTION

A special session on the Analysis of Selected Earthquakes is to be convened by the Commission on Practice at the 1985 International Association on Seismology and the Physics of the Earths" Interior (IASPEI) General Assembly in Tokyo, Japan. This report provides first-motion focal mechanisms for the 51 earthquakes that were chosen for analysis at this session. Table 1 lists the hypocenter parameters for these earthquakes chronologically and by event number.

## DATA

The focal mechanisms were computed interactively using the first-motion data obtained from the following three sources: (1) the first-motion data reported by station analysts to the National Earthquake Information Center (NEIS); (2) first motions determined by U.S. Geological Survey personnel from seismograms of the World Wide Standardized Seismograph Network (WWSSN); and (3) first motions obtained from the waveform data of the Global Digital Seismograph Network (GDSN).

## FOCAL MECHANISMS

Table 2 shows the focal mechanism parameters for each of the events of the IASPEI list ordered by event number (table 1). No parameters are given for events 3, 6, and 44 because of insufficient data to control either nodal plane orientation.

The focal angles which are listed on table 2 and plotted on the lower hemisphere focal sphere projections on figures 1-13, were derived from the Earth model of Jeffreys and Bullen (1958). These figures, ordered by event number, show the nodal plane configuration, the P, T, and B axes of the focal mechanism, and the station data used. The size of the symbols on these focal sphere solutions depends on the source of the first motions. The large symbols denote long-period P-phase first motions, and the small symbols denote the short-period P-phase first motions. The + symbol on the figures denotes the first-motion data from phase pP.

Station data for events occurring between 1981 to 1983 can be found in Needham (1985) except for events 12, 14, and 20. The station data for these 3 events, as well as for the events occurring in 1980 and 1984, are available from the author upon request.

#### REFERENCES

- Needham, R. E., 1985, Catalog of first-motion focal mechanisms, 1981-1983:  
U.S. Geological Survey Bulletin Series 85-\_\_\_\_\_, in press.
- Jeffreys, H., and Bullen, K. E., 1958, Seismological tables: British  
Association for Advancement of Science, Gray Milne Trust, London.

IASPEI EVENTS  
HYPOCENTER PARAMETERS

EVT. NO.	DATE UTC.	ORIGIN TIME UTC. HR MN SEC	GEOGRAPHIC COORDINATES		DEPTH km.	MAG. MB MS		CONTRIBUTED VALUES	REGION
			LAT.	LONG.					
01	01/01/80	16 42 40.0	38.815 N	27.780 W	10G	6.0	6.7	7.2 BRK	AZORES ISLANDS
02	05/25/80	16 33 44.7	37.600 N	118.840 W	5	6.1	6.1	6.5MLPAS	CALIFORNIA-NEVADA BORDER REGION
03	06/29/80	07 20 05.5	34.808 N	139.181 E	15	5.8	6.2	6.3 PAS	NEAR S. COAST OF HONSHU, JAPAN
04	07/29/80	14 58 40.8	29.598 N	81.092 E	18D	6.1	6.5	6.6 BRK	NEPAL
05	10/10/80	12 25 23.5	36.195 N	1.354 E	10G	6.5	7.3	7.7 BRK	ALGERIA
06	10/24/80	14 53 35.1	18.211 N	98.240 W	72	6.4		7.0 PAS	CENTRAL MEXICO
								7.0 BRK	
07	11/08/80	10 27 34.0	41.117 N	124.253 W	19D	6.2	7.2	7.0 BRK	NEAR COAST OF NORTHERN CALIFORNIA
08	11/23/80	18 34 53.8	40.914 N	15.366 E	10G	6.0	6.9	7.2 BRK	SOUTHERN ITALY
								6.5MLTRI	
09	01/18/81	18 17 24.4	38.640 N	142.750 E	33N	6.1	6.9	6.6 BRK	NEAR EAST COAST OF HONSHU, JAPAN
10	01/23/81	21 13 51.7	30.927 N	101.098 E	33N	5.7	6.8	6.6 PAS	SICHUAN PROVINCE, CHINA
11	07/06/81	03 08 24.2	22.293 S	171.742 E	33N	6.9	7.0	7.0MSBRK	LOYALTY ISLANDS REGION
								7.5MWHRV	
12	10/28/81	04 34 17.8	31.272 S	110.649 W	10G	6.2	6.2	6.6MSBRK	EASTER ISLAND REGION
								6.4MWHVD	
								6.4MSPAS	
13	11/22/81	15 05 20.6	18.752 N	120.839 E	24D	6.2	6.5	6.7MSBRK	LUZON, PHILIPPINE ISLANDS
								6.5MWHVD	
14	11/27/81	17 21 45.8	42.913 N	131.076 E	543D	5.8		6.2MWHVD	E.USSR-N.E.CHINA BORDER REGION
15	01/03/82	14 09 50.5	0.972 S	21.870 W	10G	5.8	6.5	6.3MSPAS	CENTRAL MID-ATLANTIC RIDGE
								7.1MWHVD	
16	01/09/82	12 53 51.9	46.984 N	66.656 W	10G	5.7	5.2	5.8LGBLA	NEW BRUNSWICK
								5.5MWHRV	
17	08/05/82	20 32 53.0	12.597 S	165.931 E	31	6.2	7.1	7.5MSBRK	SANTA CRUZ ISLANDS
								7.0MWHRV	
								7.3MSPAS	
18	09/06/82	01 47 02.7	29.325 N	140.360 E	176	6.5		6.7MBPAS	SOUTH OF HONSHU, JAPAN
								6.8MWHRV	
19	12/13/82	09 12 48.1	14.701 N	44.379 E	5G	6.0	6.0	6.0MSPAS	WESTERN ARABIAN PENINSULA
								6.2MWHRV	
20	02/13/83	01 40 11.0	39.945 N	75.135 E	16	5.6	6.2	6.2MWHRV	SOUTHERN XINJIANG, CHINA
21	04/03/83	02 50 01.2	8.717 N	83.123 W	37D	6.5	7.3	7.2MSBRK	COSTA RICA
								7.5MWHRV	
22	04/04/83	02 51 34.4	5.723 N	94.722 E	79	6.6		6.8MBPAS	NORTHERN SUMATERA
								7.0MWHRV	
23	04/11/83	08 18 10.1	10.419 N	62.764 W	40	6.0	5.9	6.1MSBRK	NEAR COAST OF VENEZUELA
								6.1MWHRV	
24	04/18/83	10 58 51.3	27.793 N	62.054 E	64	6.5		6.5MSBRK	SOUTHERN IRAN
								6.7MWHRV	
								6.1MSPAS	
25	05/02/83	23 42 37.8	36.219 N	120.317 W	10G	6.2	6.5	6.3MLPAS	CENTRAL CALIFORNIA
								6.5MWHRV	
								6.7MLBRK	
26	05/26/83	02 59 59.6	40.462 N	139.102 E	24	6.8	7.7	7.8MSPAL	NEAR WEST COAST OF HONSHU, JAPAN
								7.7MWHRV	
								7.7MSBRK	
27	06/01/83	01 59 54.7	17.038 S	174.605 W	179D	6.2		6.6MBPAS	TONGA ISLANDS
								6.5MWHRV	
								6.3MBBRK	
28	06/02/83	20 12 50.7	9.512 S	71.249 W	598	5.9		6.2MBPAS	PERU-BRAZIL BORDER REGION
								6.2MWHRV	
29	06/09/83	18 46 00.9	51.414 N	174.111 W	21	6.2	5.8	5.8MSBRK	ANDREANOF ISLANDS, ALEUTIAN IS.
								6.1MWHRV	
30	06/21/83	06 25 27.4	41.346 N	139.099 E	10	6.7	6.9	6.9MSPAS	HOKKAIDO, JAPAN REGION
								6.8MWHRV	
								6.5MSBRK	
31	06/24/83	09 06 45.8	24.176 N	122.402 E	44	6.1	6.7	6.4MSBRK	TAIWAN REGION
								6.6MWHRV	
								6.4MSPAS	
32	07/12/83	15 10 03.4	61.031 N	147.286 W	37	6.1	6.4	6.3MSBRK	SOUTHERN ALASKA
								6.5MWHRV	
								6.4MLPMR	
33	08/06/83	15 43 51.2	40.142 N	24.766 E	02	6.2	7.0	7.3MSBRK	AEGEAN SEA
								6.7MWHRV	
								7.2MSPAS	
34	08/17/83	10 55 54.1	55.867 N	161.287 E	63	6.6		7.0MBPAS	NEAR EAST COAST OF KAMCHATKA
								7.0MWHRV	
								6.5MSPAS	

Table 1.--Chronological listing of IASPEI events with event numbers.

35	09/07/83	19 22 05.2	60.976 N	147.500 W	45	6.2 6.2	6.2MSBRK	SOUTHERN ALASKA
							6.4MWHRV	
36	09/12/83	15 42 08.6	36.502 N	71.082 E	209D	6.1	6.1MWHRV	
37	10/04/83	18 52 13.3	26.535 S	70.563 W	15	6.4 7.3	7.4MSBRK	NEAR COAST OF NORTHERN CHILE
							7.7MWHRV	
							7.4MSPAL	
38	10/09/83	11 25 40.6	26.135 S	70.518 W	16	5.9 6.2	6.2MSBRK	NEAR COAST OF NORTHERN CHILE
							6.5MWHRV	
39	10/17/83	19 36 21.5	37.588 N	17.520 W	10G	6.0 6.3	6.6MSBRK	NORTH ATLANTIC OCEAN
							6.4MWHRV	
40	10/22/83	04 21 35.0	60.665 S	25.451 W	24D	6.5 6.8	6.7MSBRK	SOUTH SANDWICH ISLANDS REGION
							6.6MWHRV	
							6.7MSPAL	
41	10/30/83	04 12 27.1	40.330 N	42.187 E	12	6.1 6.9	6.9MSBRK	TURKEY
							6.6MWHRV	
							6.7MSPAL	
42	11/16/83	16 13 00.1	19.430 N	155.454 W	12G	6.4 6.7	6.7MWHRV	HAWAII
43	11/24/83	05 30 34.2	7.481 S	128.168 E	179	6.4	7.1MSBRK	BANDA SEA
							7.4MWHRV	
44	11/30/83	17 46 00.7	6.852 S	72.110 E	10G	6.6 7.6	7.7MSBRK	CHAGOS ARCHIPELAGO REGION
							7.7MWHRV	
45	12/22/83	04 11 29.2	11.866 N	13.529 W	11	6.4 6.2	6.2MSBRK	NORTHWEST AFRICA
							6.3MWHRV	
							6.1MSPAS	
46	12/30/83	23 52 39.9	36.372 N	70.738 E	214D	6.6	7.2MSBRK	HINDU KUSH REGION
							7.4MWHRV	
47	01/01/84	09 03 37.6	33.404 N	137.322 E	374D	6.5	6.8MSBRK	NEAR S.COAST OF HONSHU,JAPAN
							6.6MBPAL	
48	02/07/84	21 33 20.5	9.924 S	160.455 E	14	6.5 7.5	7.7MSPAL	SOLOMON ISLANDS
							7.5MSBRK	
49	03/05/84	03 33 51.2	8.136 N	123.765 E	651D	6.7		MINDANAO,PHILIPPINE ISLANDS
50	03/19/84	20 28 39.8	40.288 N	63.333 E	26D	6.5 7.0	7.1MSBRK	UZBEK SSR
51	03/24/84	09 44 02.6	44.162 N	148.289 E	43D	6.1 7.1	7.0MSBRK	KURIL ISLANDS

Table 1.--Chronological listing of IASPEI events with event numbers.--Continued

**IASPEI EVENTS  
FOCAL MECHANISM PARAMETERS**

EVENT#	NODAL PLANE 1 (DEG.)			NODAL PLANE 2 (DEG.)			P AXIS (DEG.)		T AXIS (DEG.)		B AXIS (DEG.)	
	$\vartheta$	$\delta$	$\lambda$	$\vartheta$	$\delta$	$\lambda$	PLG	AZM	PLG	AZM	PLG	AZM
1	240	85	165	331	75	5	7	287	14	195	74	42
2	5	82	-7	96	83	-172	11	321	1	230	79	136
3												
4	250	48	60	111	50	119	1	181	68	88	22	271
5	240	60	90	60	30	90	15	330	75	150	0	60
6												
7	50	90	-3	140	87	180	2	5	2	95	87	230
8	320	70	90	140	20	90	25	50	65	230	0	140
9	10	82	90	190	8	90	37	100	53	280	0	10
10	42	88	180	212	90	-2	1	267	1	357	88	132
11	258	18	90	78	72	90	27	168	63	348	0	78
12	322	79	180	232	90	-11	8	186	8	278	79	52
13	140	45	-90	320	45	-90	90	0	0	50	0	140
14	163	85	90	343	5	90	40	253	50	73	0	163
15	180	80	6	89	84	170	3	135	11	44	78	239
16	72	68	130	186	45	32	14	134	50	27	37	235
17	161	60	90	341	30	90	15	251	75	71	0	161
18	58	70	-145	315	57	-24	39	280	8	184	50	84
19	340	75	-90	160	15	-90	60	250	30	70	0	160
20	65	73	90	245	17	90	28	155	62	335	0	65
21	125	73	90	305	17	90	28	215	62	35	0	125
22	0	55	40	244	58	138	2	303	51	211	39	34
23	239	50	-50	6	54	-127	60	216	2	122	29	31
24	20	80	158	114	68	11	8	69	23	335	66	177
25	307	70	90	127	20	90	25	37	65	217	0	127
26	168	58	90	348	32	90	13	258	77	78	0	168
27	48	68	-90	228	22	-90	67	318	23	138	0	48
28	150	45	-100	344	46	-80	83	334	0	67	7	157
29	58	78	90	238	12	90	33	146	57	328	0	58
30	16	30	90	196	60	90	15	286	75	106	0	16
31	80	67	122	202	39	39	16	147	56	32	29	246
32	233	65	-70	12	32	-126	64	177	18	308	18	44
33	315	90	-10	45	80	180	7	270	7	360	80	135
34	235	63	40	124	55	146	5	358	47	93	43	263
35	15	45	-120	234	52	-63	69	206	4	306	21	37
36	208	48	90	28	42	90	3	298	87	118	0	28
37	160	74	90	340	16	90	29	250	61	70	0	160
38	172	74	90	352	16	90	29	262	61	82	0	172
39	189	88	5	99	85	178	2	324	5	54	85	211
40	350	85	-176	260	86	-5	6	215	1	305	84	41
41	220	77	13	127	77	167	0	174	18	83	72	264
42	35	90	155	125	65	0	17	83	17	347	65	215
43	105	43	90	285	47	90	2	15	88	195	0	105
44												
45	265	68	-152	164	64	-25	35	125	2	34	55	300

Table 2.--Focal mechanism parameters for the IASPEI events.

IASPEI EVENTS FOCAL MECHANISM PARAMETERS												
EVENT#	NODAL PLANE 1 (DEG.)			NODAL PLANE 2 (DEG.)			P AXIS (DEG.)		T AXIS (DEG.)		B AXIS (DEG.)	
	$\vartheta$	$\delta$	$\lambda$	$\vartheta$	$\delta$	$\lambda$	PLG	AZM	PLG	AZM	PLG	AZM
46	117	62	90	297	28	90	17	207	73	27	0	117
47	165	70	80	12	22	116	24	263	64	59	9	168
48	178	77	90	358	13	90	32	268	58	88	0	178
49	45	55	-66	187	42	-120	69	9	7	118	19	211
50	40	55	90	220	35	90	10	130	80	310	0	40
51	45	65	90	225	25	90	20	135	70	315	0	45

Table 2.--Focal mechanism parameters for the IASPEI events.--Continued



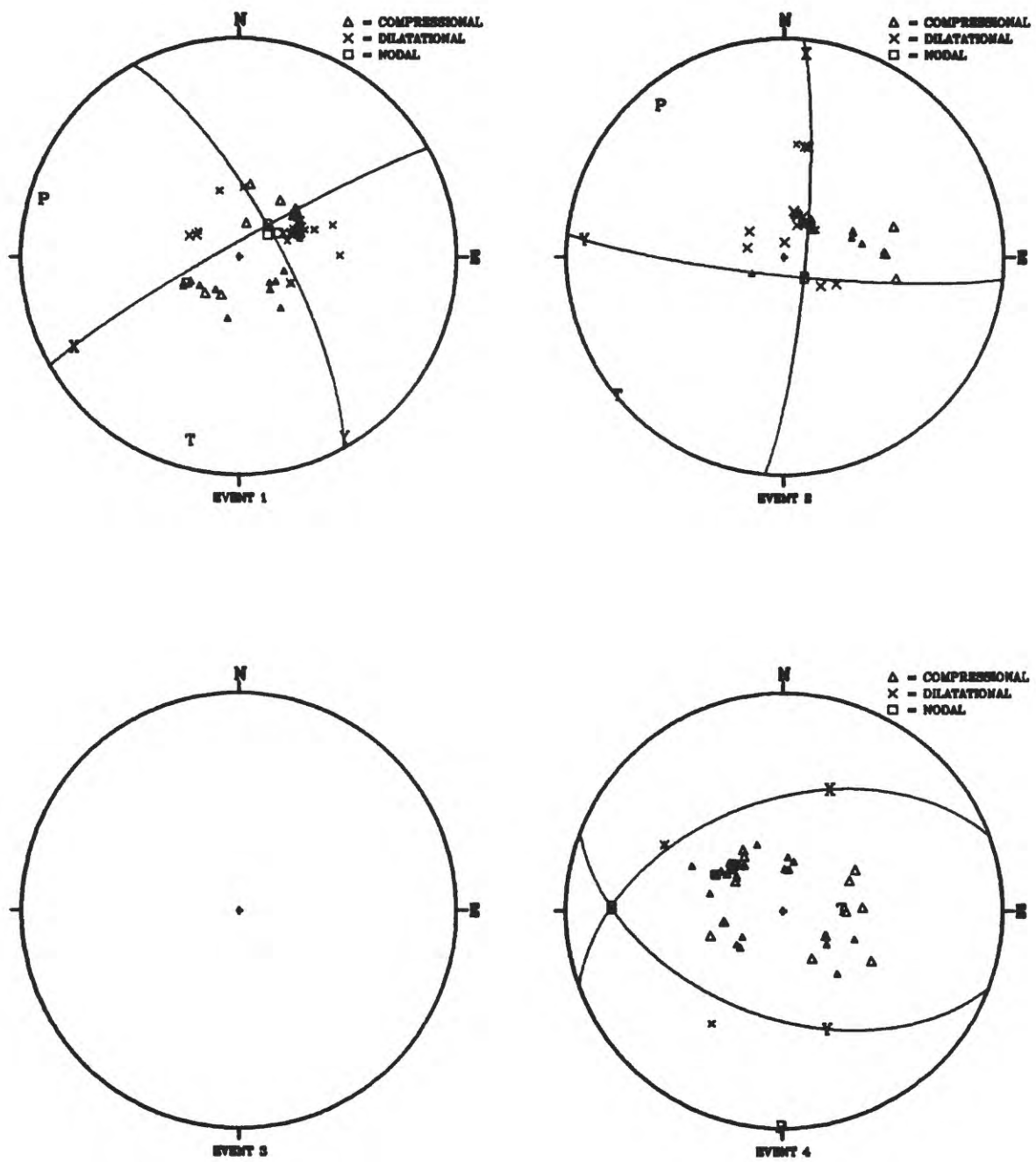


Figure 1.--Lower hemisphere focal sphere projections for events 1-4.

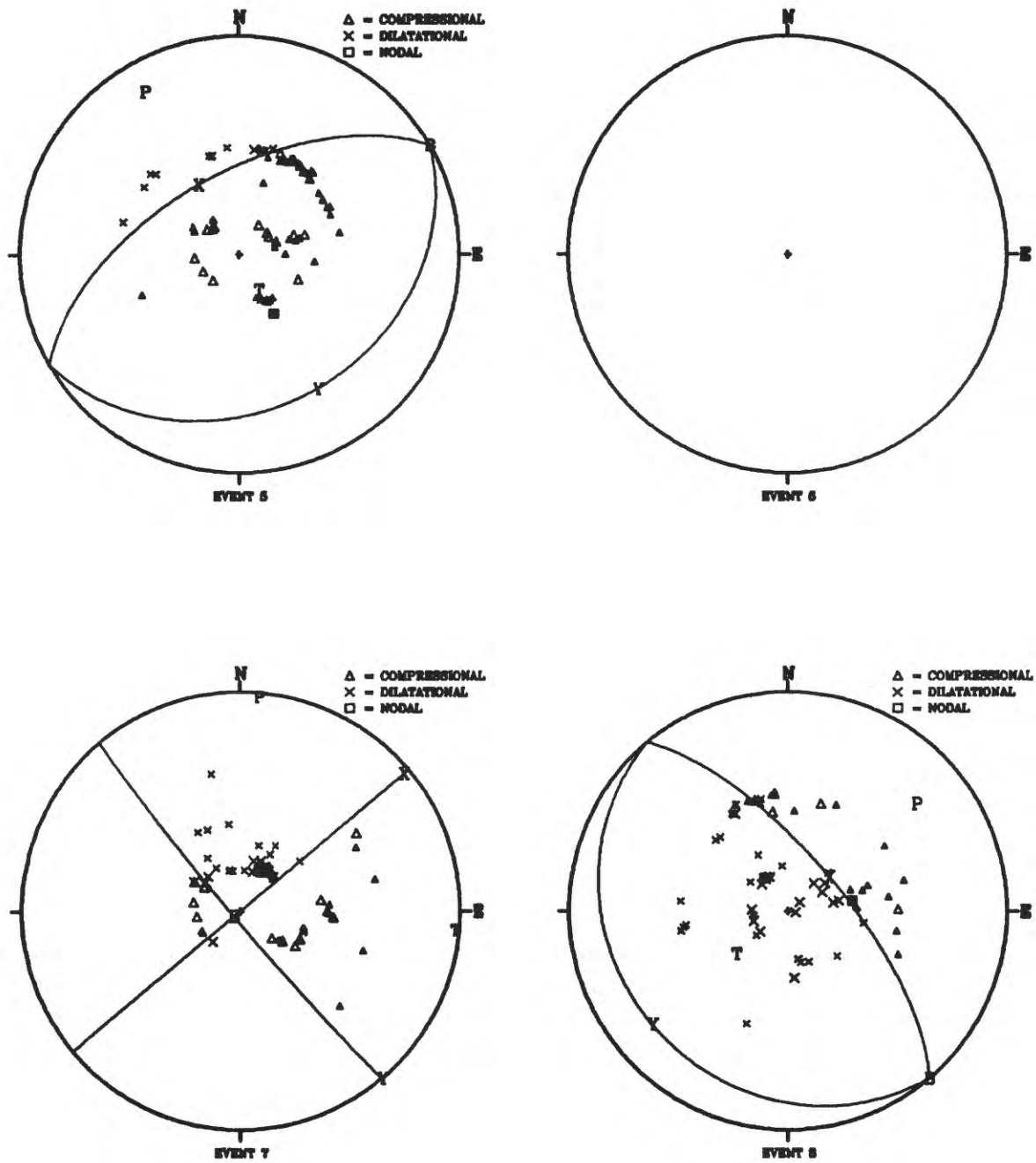


Figure 2.--Lower hemisphere focal sphere projections for events 5-8.

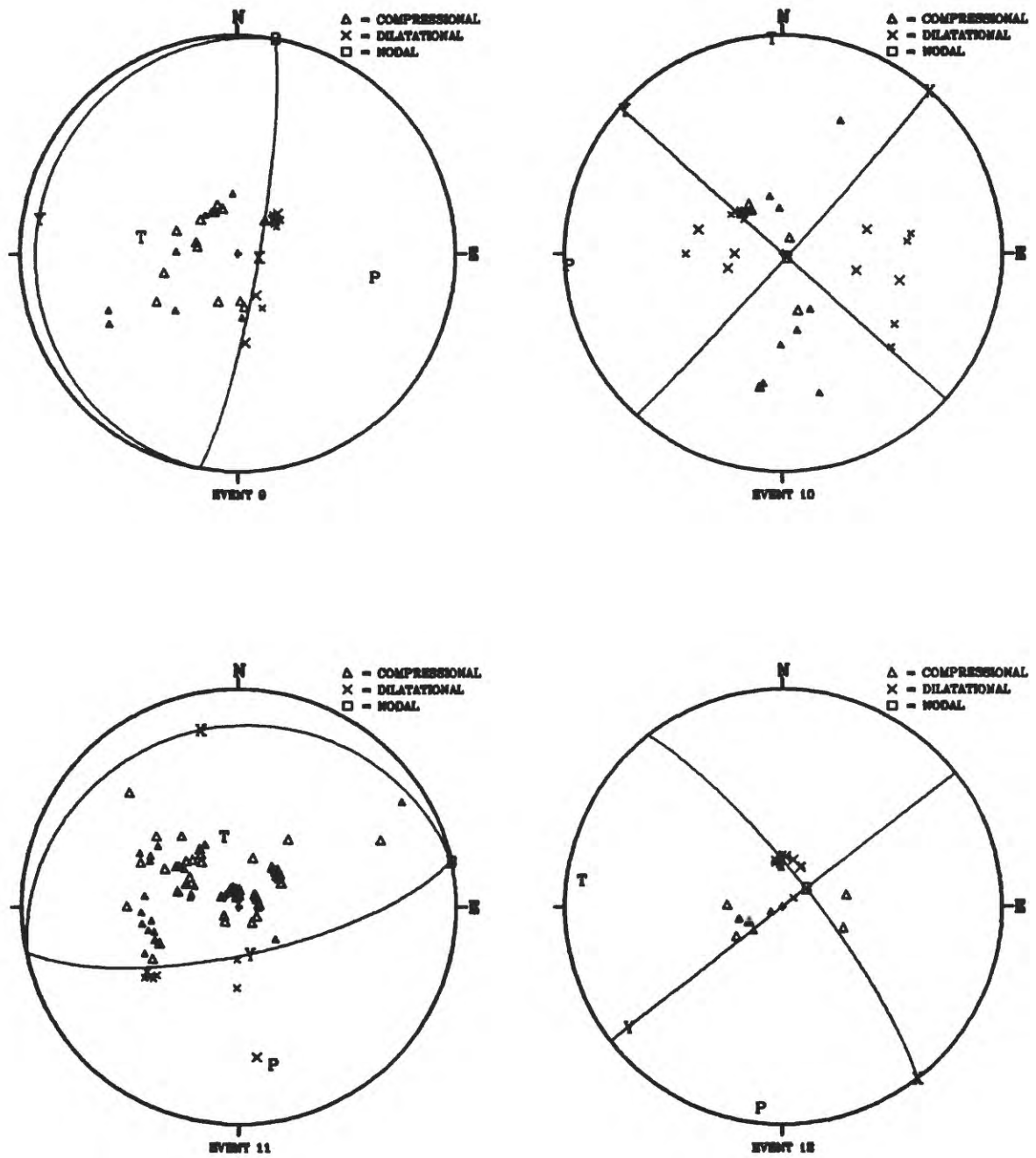


Figure 3.--Lower hemisphere focal sphere projections for events 9-12.

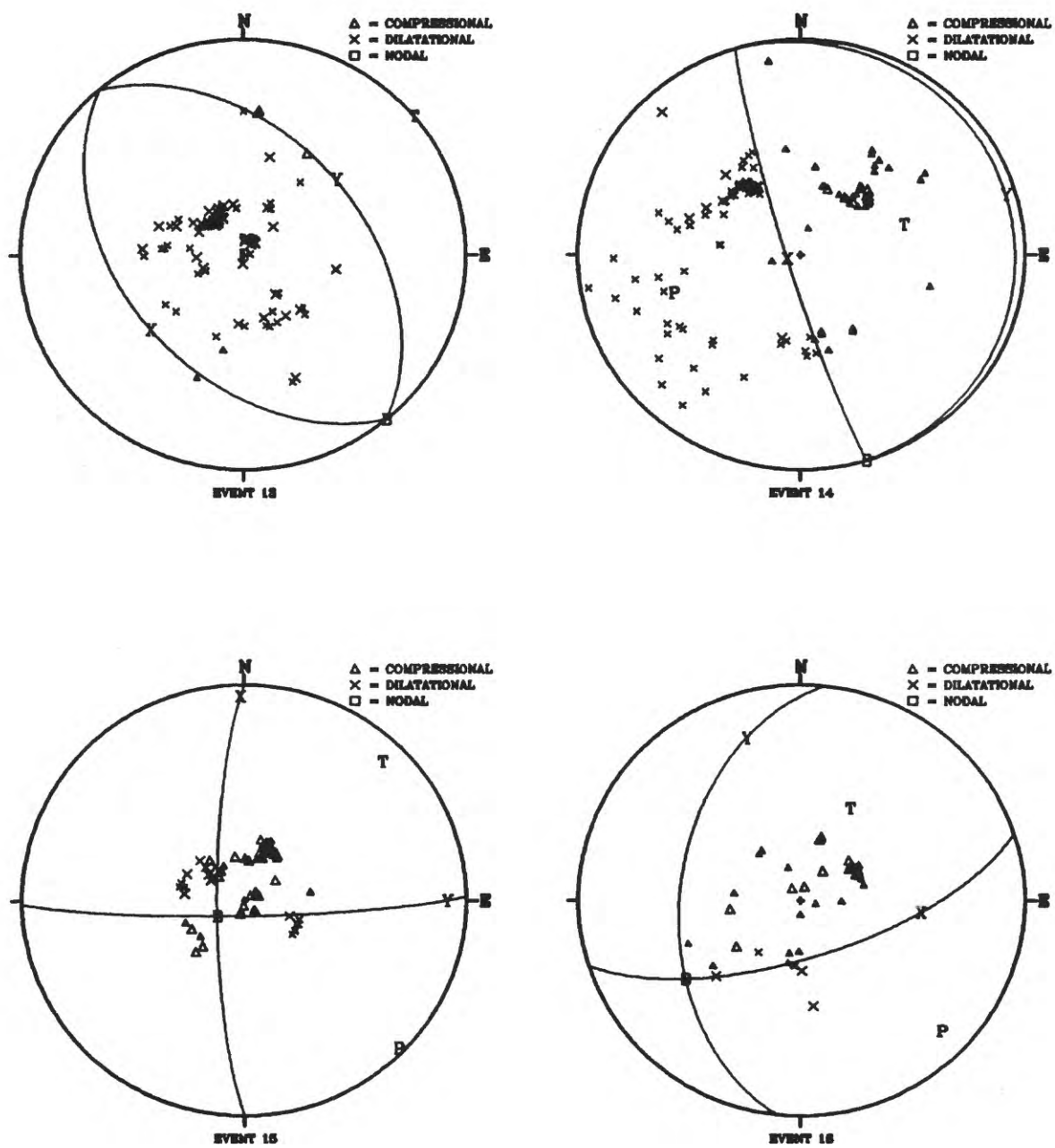


Figure 4.--Lower hemisphere focal sphere projections for events 13-16.

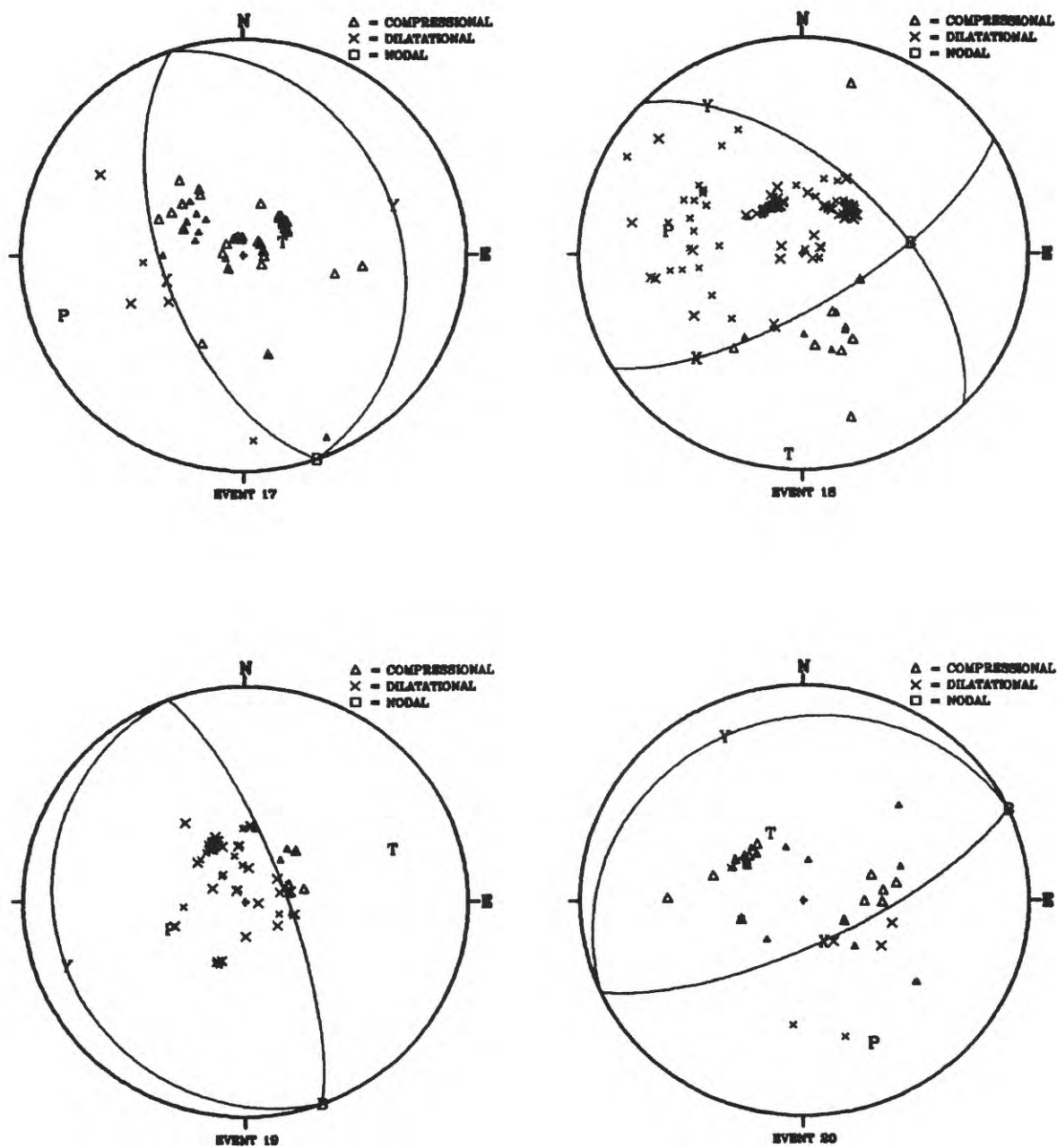


Figure 5.--Lower hemisphere focal sphere projections for events 17-20.

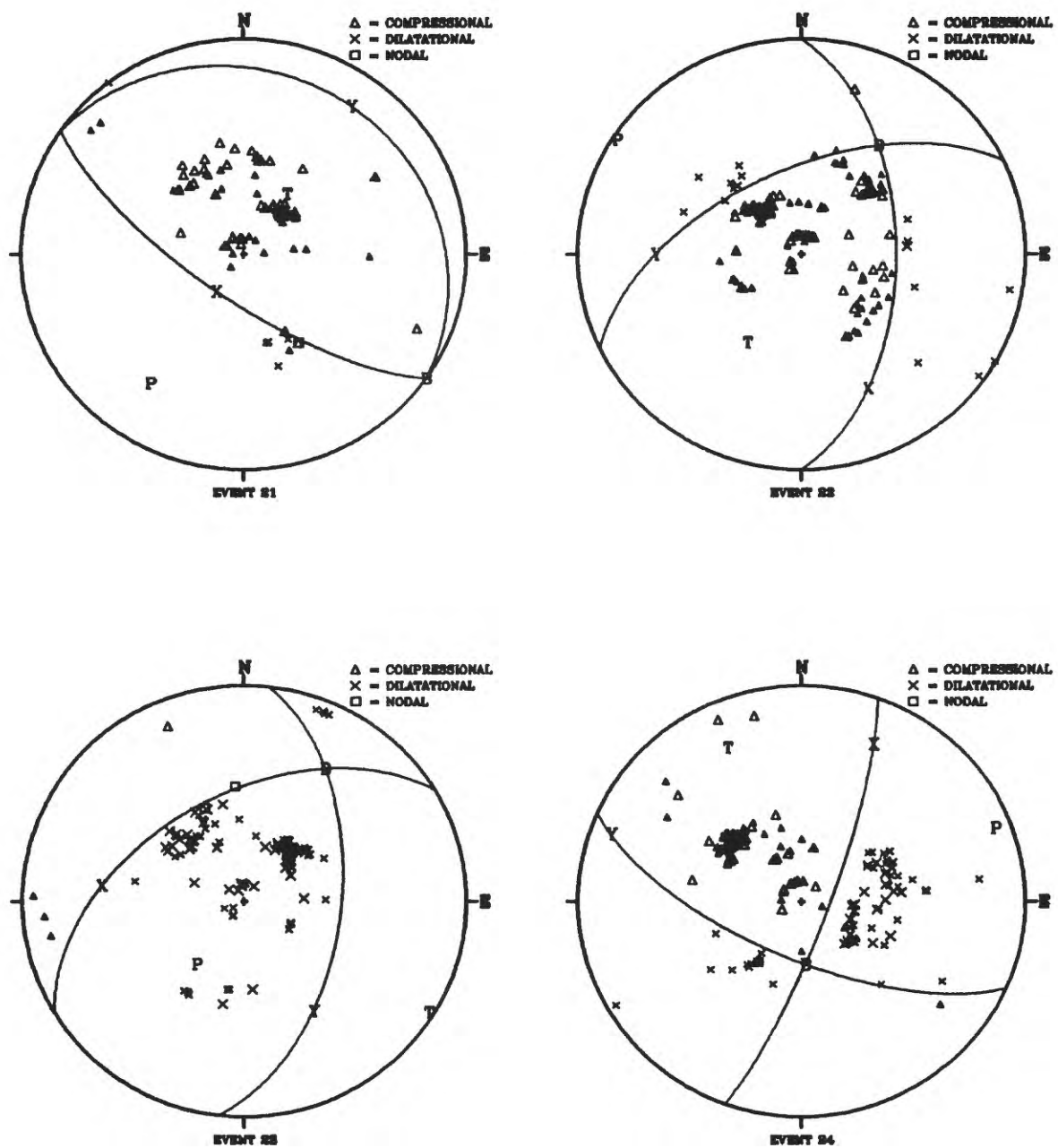


Figure 6.--Lower hemisphere focal sphere projections for events 21-24.

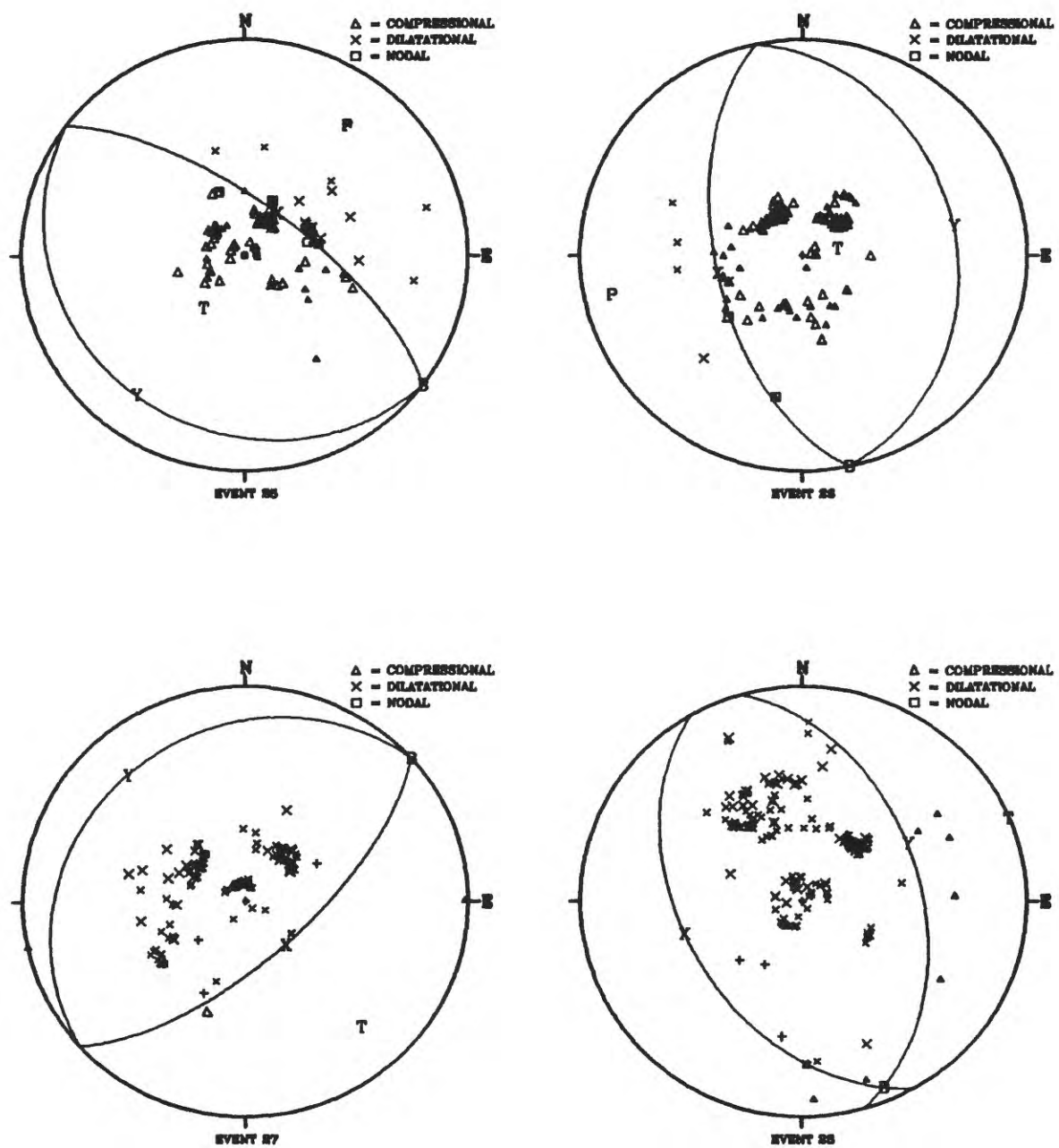


Figure 7.--Lower hemisphere focal sphere projections for events 25-28.

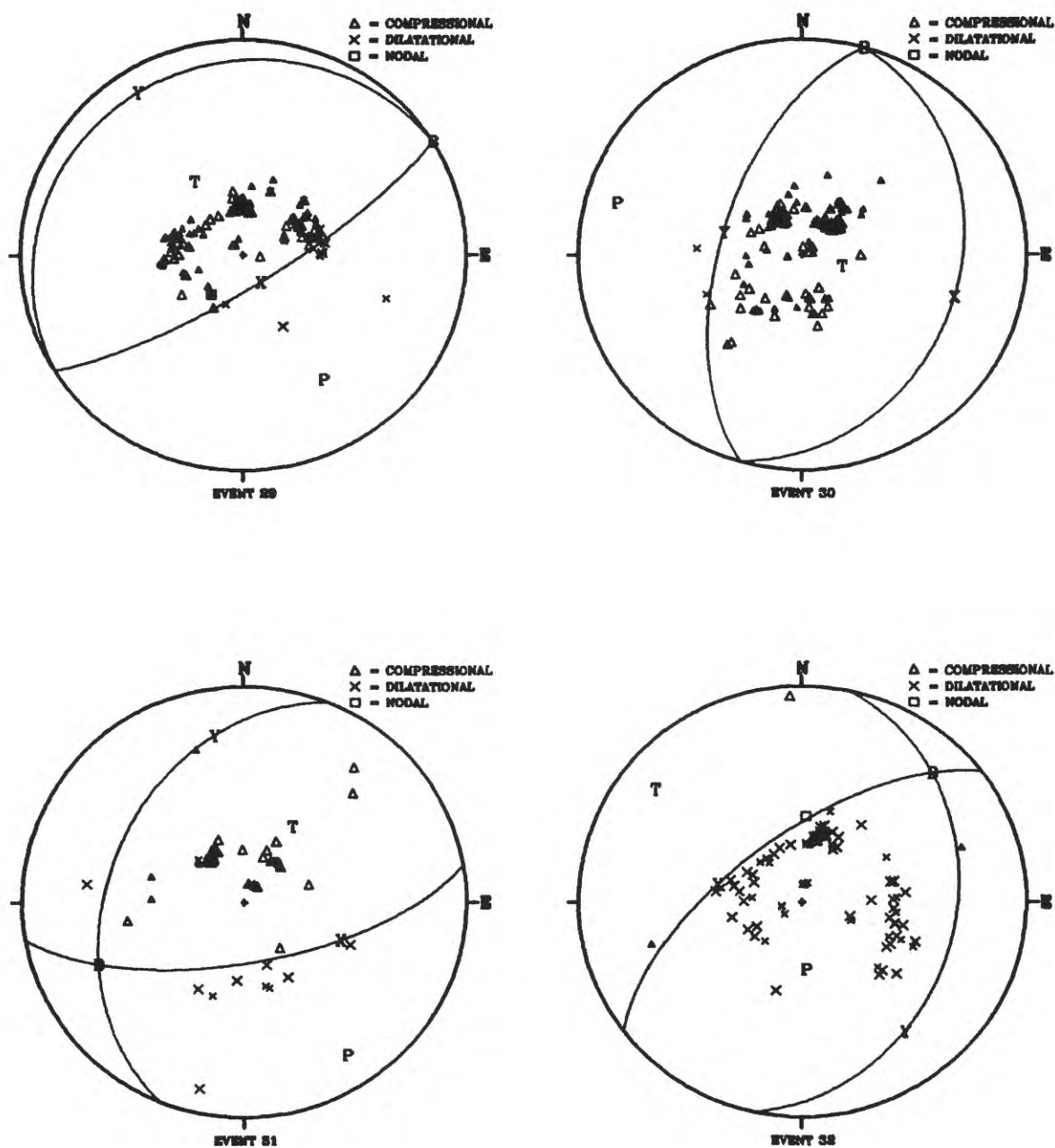


Figure 8.--Lower hemisphere focal sphere projections for events 29-32.



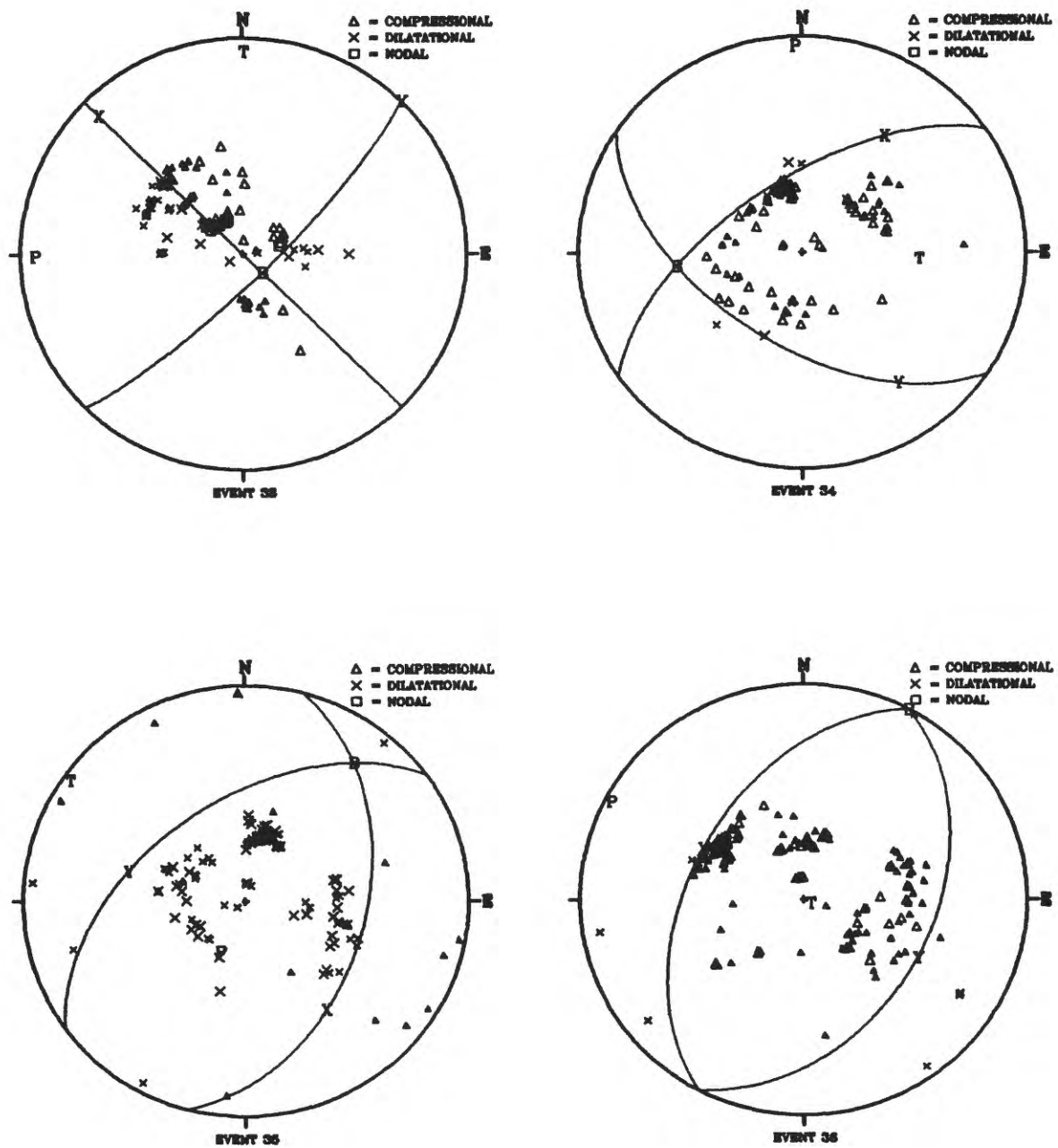


Figure 9.--Lower hemisphere focal sphere projections for events 33-36.

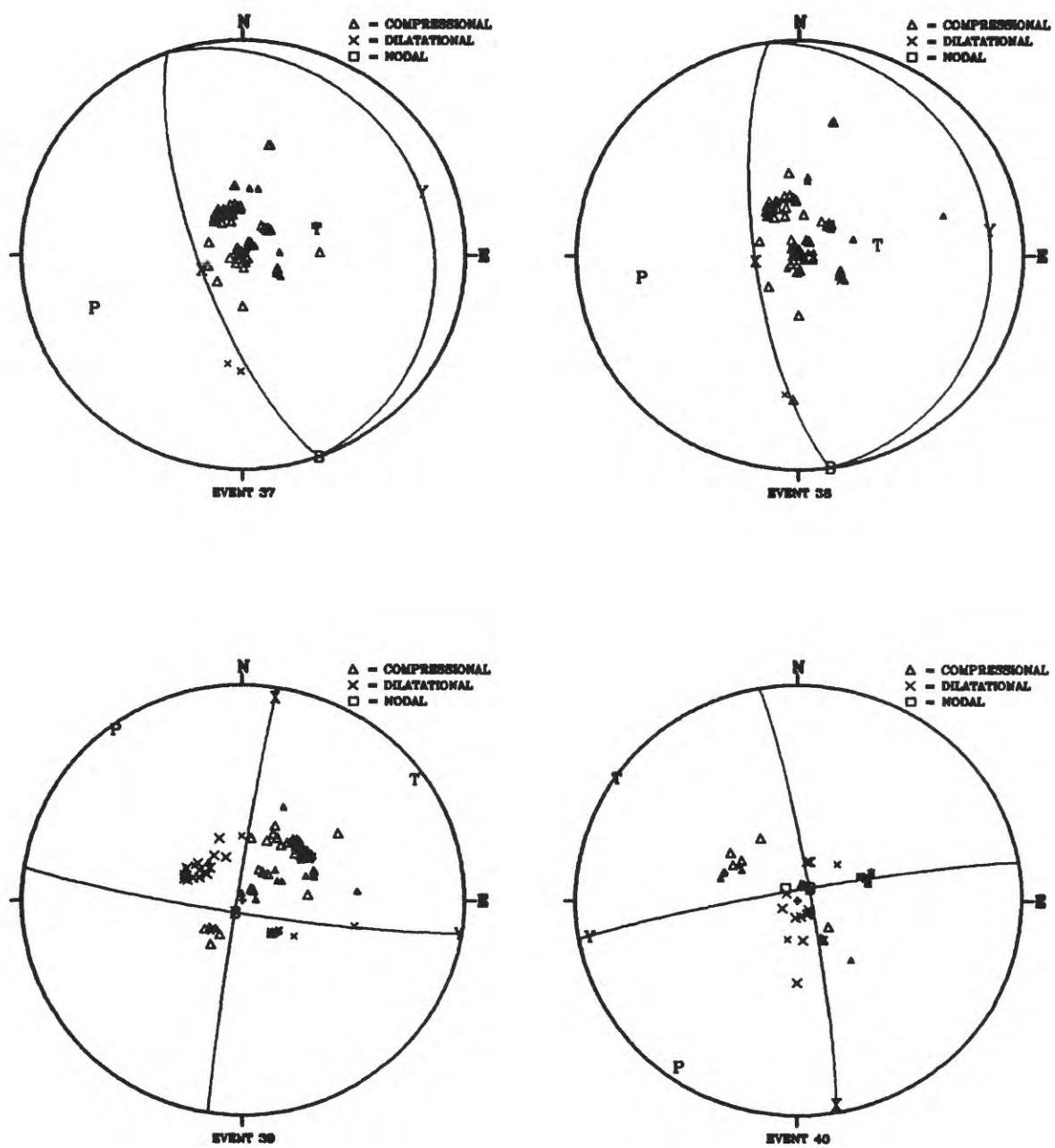


Figure 10.--Lower hemisphere focal sphere projections for events 37-40.

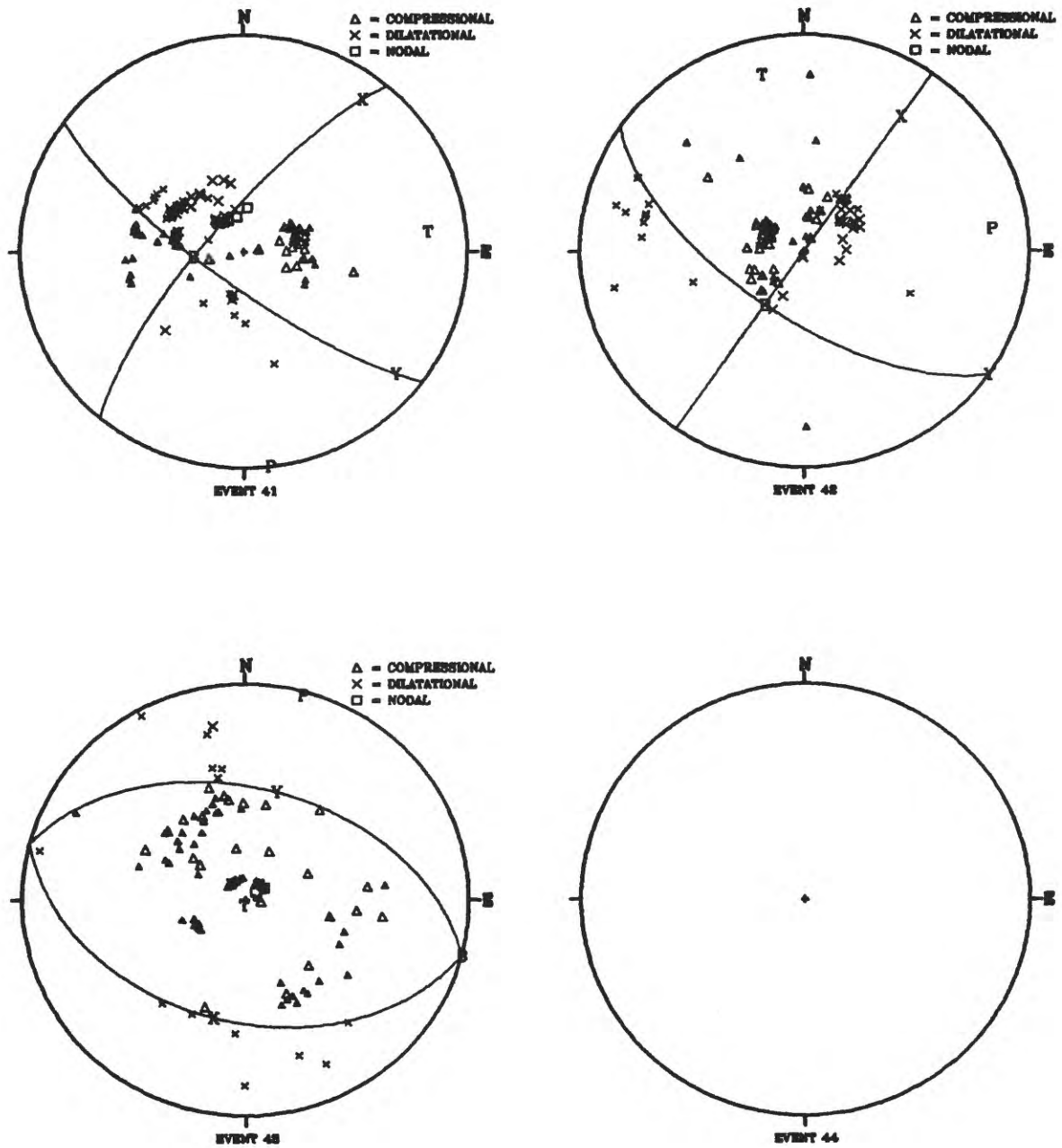


Figure 11.--Lower hemisphere focal sphere projections for events 41-44.

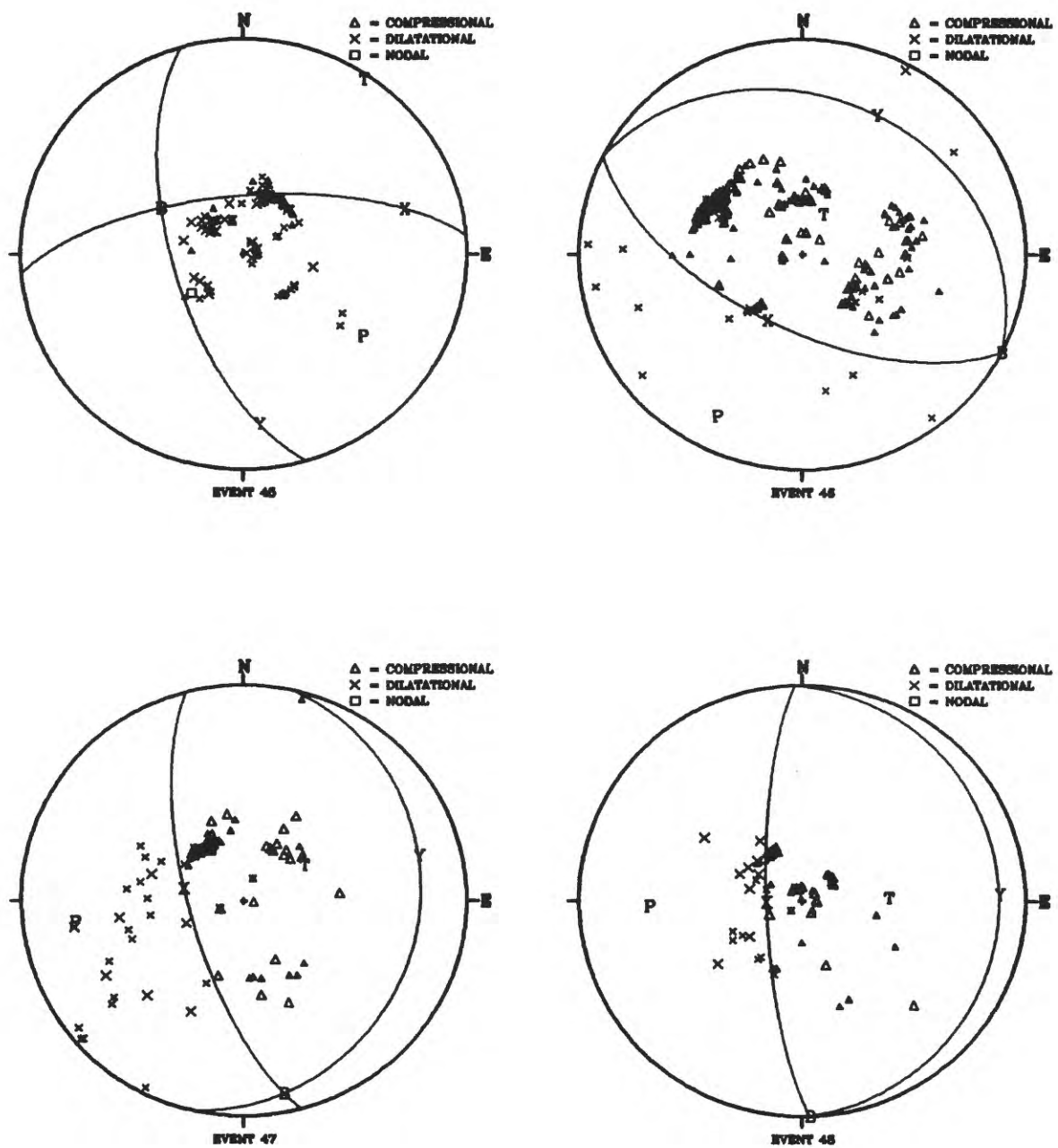


Figure 12.--Lower hemisphere focal sphere projections for events 45-48.

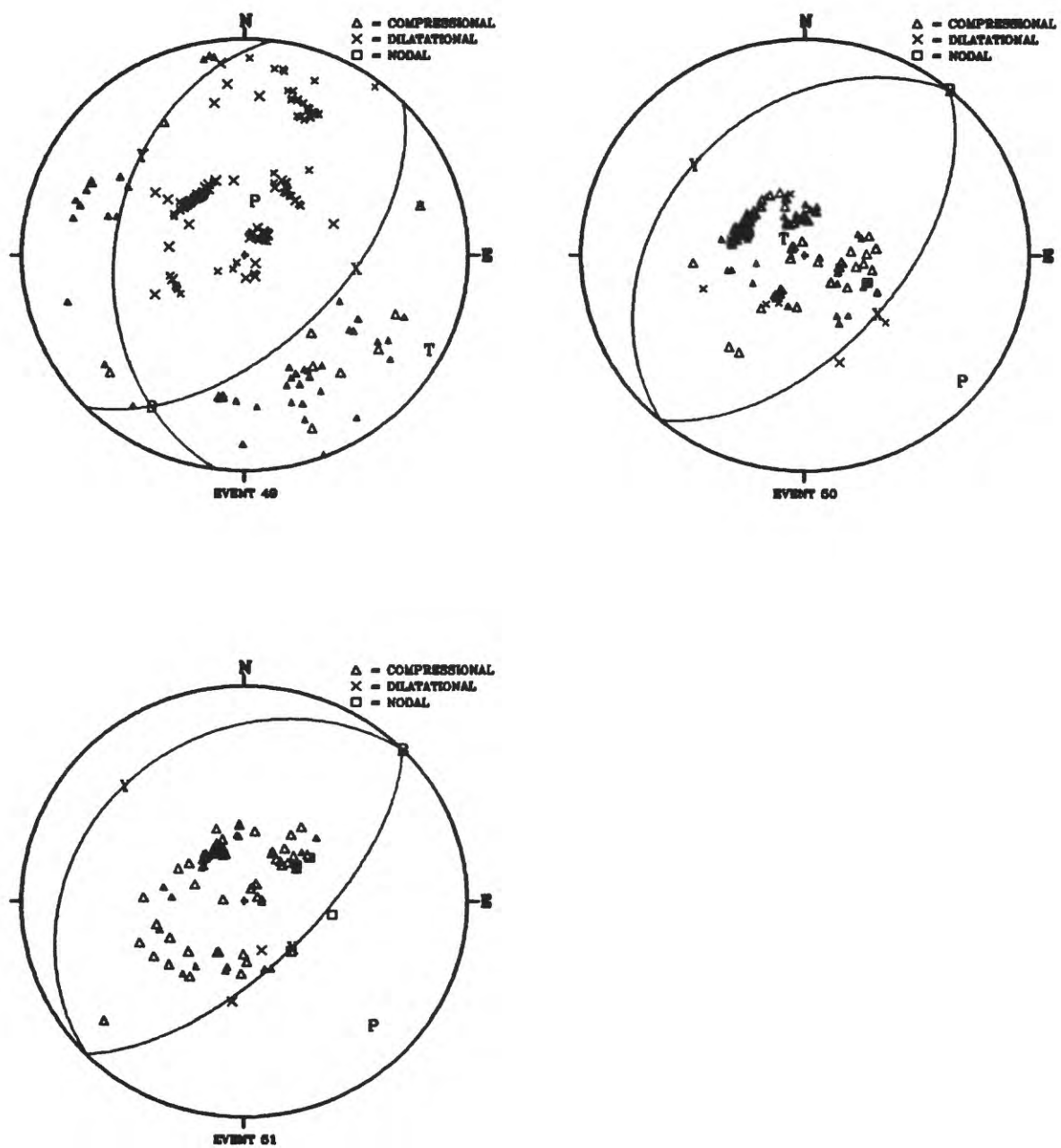


Figure 13.--Lower hemisphere focal sphere projections for events 49-51.