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Abstract. The daily variation of the geomagnetic field is analyzed for the eight quiet days of the International Geophysical Year (1957-58) when the daily planetary character-figure Cp = 0.0. The amplitudes and phases of the first four harmonics of the average variation on these days in the components X, Y and Z are given for each of the 108 stations analyzed. The average daily variation at each station is also illustrated with daygraphs of X, Y, Z, and with vectograms of X, Y. The results are discussed in the light of those obtained by Vestine *et al.* in their analysis of three very quiet days of the Second International Polar Year (1932-33). The positions of the northern and southern foci in five different longitudinal sectors are also estimated. The study of the daily variation curves presents evidence that the northern current system penetrates the southern hemisphere before local noon, and the southern system penetrates the northern hemisphere after local noon.

Résumé. L'auteur analyse les variations quotidiennes du champ géomagnétique des huit jours calmes de l'Année internationale de géophysique (1957-1958) lorsque la donnée planétaire quotidienne était $C_p = 0.0$. Il donne les amplitudes et les phases des quatre premières harmoniques de la variation moyenne de ces jours des composantes X, Y et Z pour chacune des 108 stations analysées. La variation quotidienne moyenne à chaque station est illustrée à l'aide des graphiques quotidiens X, Y et Z, et des vectogrammes de X, Y. L'auteur expose les résultats à la lumière de ceux obtenus par Vestine et coll. dans leur analyse des trois jours très calmes de la Deuxième année polaire internationale (1932-1933). Il estime également les positions des foyers nord et sud dans cinq différents secteurs longitudinaux. L'étude des courbes de variations quotidiennes montre que le système de courant nord pénètre dans l'hémisphère sud avant midi (heure locale) et que le système sud pénètre dans l'hémisphère nord après midi (heure locale).

Introduction

The daily geomagnetic variations on normal days so apparent on magnetograms from low and mid latitude stations are considered to be due to ionospheric currents produced by dynamo-action in the E-layer. It has been shown in the past that these currents and the currents induced by them in the solid earth contribute about 67 per cent and 33 per cent respectively to the daily variations. When quiet day data are used in the analysis the computed daily variation is called Sq variation and the current system which gives rise to such variations is known as the Sq (or vortex current) system. Many studies done in the past on Sq variation have been summarized by Chapman and Bartels (Geomagnetism 1, 2, 1940), Vestine *et al.* (1947), Price and Stone (1964), Matsushita and Campbell (1967) and others. In an earlier study, most of the available geomagnetic data of the IPY period (International Polar Year, January 1932–December 1933; mean yearly sunspot number $\overline{R} = 8.4$) were analyzed by Vestine *et al.* for days grouped in various ways. In one part of their study they analyzed data from the three days January 3, 4 and February 17, 1933, when the Planetary Character Figure Cp = 0.0, even though there occurred 58 such days during the IPY period. This was done probably because only on these days were the desired data available from all the 33 stations included in the analysis, of which only seven were in the southern hemisphere. During the International Geophysical Year (July 1957–December 1958; $\overline{R} = 194.4$) data from many more observatories became available. Accordingly, in the present work data from 108 observatories, widely spread over the globe, are analyzed for the eight most quiet days (Cp = 0.0) which are listed in Table I. The use of data for the same days from all the stations ensures its homogeneity, and also the effect of the worldwide day-to-day variability remains nearly the same everywhere. A comparative study of the Sq variation on very quiet days, where the same data are used to the fullest extent possible for different elements and different stations, sheds light on the magnitude of the ionospheric currents during magnetic calm conditions in the IGY and the IPY periods.

Not all the stations included in the present work functioned for the entire IGY period and unfortunately some quiet day data are missing at some stations. In such cases appropriate substitutions of the data are made from other days (in some cases repeating data from one of the days being used). For the station Quetta, data for February 8, 9, March 8, 9, August 19, September 17, October 14 and 15, 1956, when Cp = 0.0, are used as the IGY data are not available to the author. Although the harmonic coefficients and the ranges given in Table II for Quetta are for these days, the ranges were appropriately corrected for the increased activity during the IGY for the purpose of calculations whenever it was felt necessary.

During the unprecedented maximum sunspot-number period of the IGY, the magnetic disturbances at high latitude stations were relatively large even on the international quiet days. However, in the present work no attempt was made to consider the local quiet days.

The data presented in this report will be used to derive the external and the internal part of the dynamo current system responsible for the observed diurnal variations. The interest is to see

Table I

August 23, 1957 August 24, 1957 May 24, 1958	j – season
October 6, 1957 October 8, 1957	e – season
November 5, 1958 November 30, 1958 December 1, 1958	d – season

Table II

Component		X	X	X	Y	Y	Y	Z	Z	Z
STATION	N=	AMP.(γ)	PH(°)	RANGE(γ)	AMP.(γ)	PH(°)	RANGE(γ)	AMP.(γ)	PH(°)	RANGE(γ
1. THULE VILLAGE	1	14.7	77.0	34	17.0	346.3	43	13.0	286.2	37
GM = 88.9N, 357.8	2	2.0	310.9		3.1	306.4		7.2	141.7	
GG = 77.5N, 69.2W	3	3.6	196.4		4.4	142.3		2.7	341.7	
DIP LAT. = 81.7	4	3.6	37.8		.2	146.2		2.9	128.7	
2. RESOLUTE BAY	1	32.1	78.4	77	22.2	21.9	73	12.3	232.7	39
GM = 83.0N, 289.6	2	11.5	313.2		15.5	247.0		9.7	347.3	
GG = 74.7N, 94.8W	3	8.5	177.8		8.2	70.7		5.4	132.3	
DIP LAT. = 88.2	4	4.4	29.7		2.2	244.3		1.4	325.1	
3. GODHAVN	1	1.8	122.5	18	26.2	21.8	70	31.7	61.9	85
GM = 79.9N, 32.5	2	6.9	37.8		11.9	245.2		15.8	268.9	
GG = 69.2N, 53.6W	3	1.3	182.4		7.9	118.7		7.0	158.8	
DIP LAT. = 73.51	4	3.2	248.3		3.4	30.2		.5	190.5	
4. MURCHISON BAY	1	10.1	212.2	47	27.5	26.4	58	26.0	55.6	62
GM = 75.3N, 137.3	2	13.8	56.7		5.8	266.8		1.3	230.9	
GG = 80.0N, 18.3E	3	3.4	239.6		2.5	72.7		5.3	3.0	
DIP LAT. = 57.0	4	3.9	39.5		1.1	124.2		2.6	154.3	
5. BAKER LAKE	1	19.4	136.9	61	14.8	347.4	42	13.5	22.3	43
GM = 73.8N, 315.2	2	16.4	341.5		9.0	230.6		7.0	290.1	
GG = 60.3N, 96.0W	3	6.1	188.8		4.4	86.4		6.5	157.2	
DIP LAT. = 82.7	4	.8	103.5		2.5	269.8		3.3	53.9	
6. CHURCHILL	1	18.6	148.7	39	14.9	15.8	51	3.4	76.7	24
GM = 68.6N, 322.6	2	3.2	3.2		13.2	232.9		7.1	322.2	
GG = 58.7N, 94.3W	3	1.4	20.6		3.1	80.3		3.7	252.2	
DIP LAT. = 77.2	4	3.7	307.3		2.4	320.1		1.0	112.3	
7. TROMSO	1	14.5	116.7	39	16.3	32.1	36	7.9	185.5	45
GM = 67.0N, 117.5	2	6.4	300.8		5.4	274.7		10.8	72.1	
GG = 69.7N, 18.9E	3	2.3	198.9		3.2	68.5		7.7	66.6	
DIP LAT. = 66.31	4	2.3	357.5		.9	293.5		4.8	7.1	
8. CHELYUSKIN	1	15.4	143.7	44	4.5	124.2	15	1.4	117.0	17
GM = 65.9N, 177.5	2	8.1	263.1		3.8	261.8		6.9	33.9	
GG = 77.7N, 104.3E	3	3.9	329.7		1.5	328.7		2.1	58.3	
DIP LAT. = 83.4	4	2.4	29.0		.9	28.0		1.9	177.5	
9. COLLEGE	1	20.3	130.9	46	16.4	22.3	44	2.1	133.9	11
GM = 64.5N, 255.4	2	1.9	247.8		8.5	223.9		3.0	199.1	
GG = 64.9N, 147.9W	3	3.3	160.0		2.8	122.6		2.1	162.4	
DIP LAT. = 65.41	4	.8	178.9		.7	123.1		.4	141.3	
10. BIG DELTA	1	19.2	127.5	43	16.0	24.9	44	3.9	225.3	13
GM = 64.4N, 259.0	2	1.9	266.7		8.7	229.4		2.7	156.8	
GG = 64.1N, 145.9W	3	2.6	171.3		2.9	126.3		2.3	167.3	
DIP LAT. = 64.81	4	.8	204.1		.5	99.7		.6	179.0	
11. SODANKYLA	1	16.9	130.5	43	17.2	53.8	40	2.3	241.8	10
GM = 63.8N, 120.0	2	6.9	331.2		6.2	303.2		2.5	19.1	
GG = 67.4N, 26.7E	3	3.0	237.5		3.4	124.8		.3	256.3	
DIP LAT. = 64.81	4	1.4	54.2		1.3	351.6		1.4	338.2	
12. DIXON IS.	1	7.8	100.0	25	4.9	74.8	16	5.1	204.0	13
GM = 63.0N, 161.4	2	7.7	281.5		4.6	279.1		3.0	308.9	
GG = 73.5N, 80.6E	3	.9	32.8		.6	31.1		.8	17.9	
DIP LAT. = 77.5	4	1.9	128.5		1.0	133.9		.1	314.7	

Table II (Cont'd)

Component STATION	N=	X AMP.(γ)	X PH(°)	X RANGE(γ)	Y AMP.(γ)	Y PH(°)	Y RANGE(γ)	Z AMP.(γ)	Z PH(°)	Z RANGE(γ)
13. LERWICK	1	19.0	102.4	47	14.0	21.2	40	4.3	69.7	13
GM = 62.5N, 88.6	2	10.2	285.5		7.1	221.9		2.5	293.4	
GG = 60.1N, 1.2W	3	2.1	131.8		4.2	64.2		1.5	92.3	
DIP LAT. = 58.51	4	1.1	22.7		1.6	234.5		.6	345.4	
14. HEALY	1	19.2	135.4	43	14.5	7.2	41	.8	86.6	9
GM = 62.4N, 255.5	2	3.0	237.3		9.3	215.6		2.2	157.6	
GG = 63.9N, 149.0W	3	2.2	159.0		2.6	95.8		1.9	157.9	
DIP LAT. = 63.81	4	1.8	241.4		.7	249.3		.8	126.4	
15. DOMBAS	1	18.6	98.0	46	15.8	17.6	40	2.8	79.2	11
GM = 62.3N, 100.1	2	8.1	266.6		6.4	227.8		2.5	303.5	
GG = 62.1N, 9.1E	3	2.9	134.3		4.0	39.0		1.2	81.9	
DIP LAT. = 59.71	4	1.7	330.3		1.2	221.1		1.1	285.7	
16. MEANOOK	1	17.0	124.1	42	15.4	28.9	46	3.1	140.4	10
GM = 61.8N, 301.0	2	7.6	340.1		9.7	246.7		1.0	210.8	
GG = 54.6N, 113.3W	3	4.0	194.2		4.2	120.4		2.5	117.6	
DIP LAT. = 66.21	4	1.5	66.3		1.7	358.6		1.6	56.7	
17. CAPE WELLEN	1	15.3	93.6	34	4.0	67.5	9	2.1	186.3	6
GM = 61.8N, 237.0	2	4.5	264.8		1.7	242.4		.8	12.4	
GG = 66.2N, 169.8W	3	1.8	107.3		.5	86.9		1.1	126.3	
DIP LAT. = 62.5	4	.8	71.0		.2	97.1		.8	115.1	
18. ANCHORAGE	1	21.6	114.2	48	19.7	18.1	56	1.6	152.0	9
GM = 60.9N, 258.1	2	7.4	274.3		9.1	233.3		1.3	154.6	
GG = 61.2N, 150.0W	3	2.4	168.9		1.2	70.7		2.1	176.0	
DIP LAT. = 60.6	4	3.1	98.4		4.3	74.5		1.7	71.5	
19. TIXIE BAY	1	15.1	108.6	37	13.5	10.7	34	8.9	273.9	24
GM = 60.5N, 191.0	2	5.7	267.1		6.3	209.8		5.7	113.4	
GG = 71.6N, 129.0E	3	1.8	157.6		1.7	33.1		1.3	227.3	
DIP LAT. = 76.11	4	1.3	227.7		1.3	241.8		1.2	165.4	
20. SITKA	1	19.8	112.0	43	18.7	15.6	52	4.4	172.8	12
GM = 60.0N, 275.4	2	7.1	305.5		10.1	230.5		1.5	9.6	
GG = 57.0N, 135.3W	3	1.7	174.9		4.5	83.5		1.8	172.0	
DIP LAT. = 60.41	4	.7	48.4		1.3	317.1		.7	51.4	
21. ESKDALEMUIR	1	18.0	99.8	42	14.3	23.3	46	6.1	91.3	17
GM = 58.5N, 82.9	2	8.6	282.9		9.0	218.1		3.9	271.4	
GG = 55.3N, 3.2W	3	2.1	151.4		5.5	56.8		2.4	93.5	
DIP LAT. = 53.61	4	.7	5.6		2.0	237.7		.6	296.3	
22. LOVO	1	17.2	91.8	43	21.8	14.9	60	4.1	80.2	14
GM = 58.1N, 105.8	2	7.2	261.2		10.5	207.4		3.6	261.1	
GG = 59.3N, 17.8E	3	3.7	123.9		6.4	15.7		1.8	63.3	
DIP LAT. = 57.21	4	1.5	316.6		1.9	199.4		1.4	247.9	
23. NURMIJARVI	1	17.3	97.0	43	15.5	19.5	40	3.0	84.0	12
GM = 57.9N, 112.6	2	7.3	279.7		6.7	226.0		3.0	284.7	
GG = 60.5N, 24.7E	3	4.0	139.7		4.3	27.3		1.1	95.4	
DIP LAT. = 58.21	4	1.7	335.2		1.0	232.7		1.5	255.8	
24. VALENTIA	1	16.6	89.7	39	14.7	14.8	48	10.0	96.9	31
GM = 56.1N, 73.1	2	8.2	261.8		9.5	208.4		7.8	278.2	
GG = 51.9N, 10.3W	3	2.1	106.0		5.6	36.7		4.2	89.7	
DIP LAT. = 50.51	4	.5	326.2		1.9	218.0		1.2	270.0	

Table II (Cont'd)

Component		X		X	Y		Y	Z		Z
STATION	N=	AMP.(γ)	PH(°)	RANGE(γ)	AMP.(γ)	PH(°)	RANGE(γ)	AMP.(γ)	PH(°)	RANGE(γ)
25. RUDE SKOV	1	16.0	101.4	39	17.5	27.6	51	7.0	93.1	22
GM = 55.8N, 98.5	2	6.7	278.5		9.5	225.5		5.7	286.6	
GG = 55.8N, 12.5E	3	3.1	157.0		5.7	47.9		3.1	110.5	
DIP LAT. = 53.81	4	.8	358.3		1.7	240.6		1.8	317.1	
26. AGINCOURT	1	17.0	121.4	48	17.4	24.4	57	1.6	144.2	7
GM = 55.0N, 347.0	2	12.1	321.7		11.3	231.1		1.4	306.4	
GG = 43.8N, 79.3W	3	5.5	162.4		6.5	79.5		1.0	141.0	
DIP LAT. = 60.81	4	1.8	22.7		2.1	293.6		.7	324.8	
27. HARTLAND	1	15.2	93.6	36	15.0	25.1	50	9.8	87.0	28
GM = 54.6N, 79.0	2	7.4	266.3		10.4	217.5		6.8	280.0	
GG = 51.0N, 4.5W	3	1.8	133.3		5.9	52.8		3.5	94.8	
DIP LAT. = 49.21	4	.7	354.1		1.9	239.2		1.1	285.5	
28. WINGST	1	15.9	99.8	39	17.2	24.5	51	7.9	83.3	24
GM = 54.5N, 94.0	2	6.9	273.2		9.5	217.8		5.8	271.4	
GG = 53.7N, 9.7E	3	3.4	151.2		6.0	40.0		3.0	92.9	
DIP LAT. = 51.61	4	.6	15.0		1.6	229.4		1.5	295.4	
29. VICTORIA	1	15.9	113.2	40	17.7	13.4	53	4.9	78.5	17
GM = 54.2N, 293.0	2	8.8	328.4		11.2	221.9		3.6	268.5	
GG = 48.5N, 123.4W	3	3.6	179.0		4.7	71.2		2.7	108.8	
DIP LAT. = 54.91	4	1.0	22.0		2.2	304.2		1.2	343.5	
30. NIEMEGK	1	13.1	104.3	32	18.2	29.6	56	7.3	73.7	23
GM = 52.2N, 96.6	2	5.0	284.4		10.9	224.8		5.0	265.9	
GG = 52.0N, 12.7E	3	3.3	176.5		6.7	49.6		3.0	93.5	
DIP LAT. = 50.0	4	.8	45.6		1.9	244.9		1.7	304.4	
31. DOURBES	1	12.6	92.4	27	16.5	36.1	52	7.8	82.5	21
GM = 51.7N, 88.7	2	4.9	298.7		10.7	232.7		4.8	277.2	
GG = 50.1N, 4.6E	3	1.3	209.5		5.8	75.8		2.3	106.8	
DIP LAT. = 47.9	4	1.2	58.9		1.5	258.3		.8	317.6	
32. YAKUTSK	1	17.2	89.1	42	14.8	.5	44	1.6	178.9	6
GM = 51.0N, 193.8	2	8.7	265.9		8.8	182.8		1.1	84.8	
GG = 62.0N, 129.7E	3	3.7	83.4		4.0	354.1		.8	288.1	
DIP LAT. = 63.2	4	.4	243.0		.8	188.6		.7	98.0	
33. MOSCOW	1	12.9	114.7	35	18.0	37.7	51	4.3	76.4	16
GM = 50.8N, 120.5	2	5.3	322.4		9.7	245.2		3.8	285.6	
GG = 55.5N, 37.3E	3	4.4	182.4		4.8	75.2		2.4	122.4	
DIP LAT. = 54.61	4	1.2	53.0		2.0	271.7		1.4	295.9	
34. SWIDER	1	11.3	113.8	30	18.6	37.6	55	8.1	98.1	25
GM = 50.6N, 104.6	2	4.4	314.4		10.2	238.3		5.7	291.9	
GG = 52.1N, 21.3E	3	3.9	195.9		6.2	75.4		3.1	113.1	
DIP LAT. = 50.91	4	1.1	72.5		2.4	289.7		2.3	337.9	
35. FREDERICKSBURG	1	16.7	117.6	46	18.5	23.1	62	4.7	112.2	17
GM = 49.6N, 349.8	2	10.3	324.0		12.6	230.8		4.2	305.7	
GG = 38.2N, 77.4W	3	5.5	185.7		7.2	79.5		2.6	138.0	
DIP LAT. = 54.41	4	2.3	40.6		2.6	303.1		.8	340.0	
36. KAZAN	1	12.0	115.0	32	17.0	32.7	49	3.4	96.6	12
GM = 49.3N, 130.4	2	5.4	327.0		9.4	236.9		3.1	273.7	
GG = 55.8N, 48.9E	3	4.0	166.1		4.6	68.5		1.8	101.2	
DIP LAT. = 56.4	4	1.3	7.8		1.9	233.1		1.2	264.6	

Table II (Cont'd)

Component STATION	N=	X AMP.(γ)	X PH(°)	X RANGE(γ)	Y AMP.(γ)	Y PH(°)	Y RANGE(γ)	Z AMP.(γ)	Z PH(°)	Z RANGE(γ)
37. BELOIT	1	15.7	132.0	43	18.5	40.8	62	6.6	83.7	26
GM =49.2N, 324.8	2	9.5	354.9		13.5	252.9		5.2	302.3	
GG =39.5N, 98.1W	3	5.3	227.2		6.4	106.3		4.5	152.1	
DIP LAT. =52.21	4	2.4	106.4		1.8	358.2		1.7	39.1	
38. FURSTENFELDBRUCK	1	8.0	110.6	23	18.0	26.8	58	8.6	74.5	26
GM =48.9N, 92.4	2	2.1	311.5		11.5	215.4		5.8	263.7	
GG =48.2N, 11.3E	3	3.6	200.9		7.5	41.9		3.2	90.3	
DIP LAT. =45.81	4	1.3	69.5		2.5	225.3		1.3	285.7	
39. LVOV	1	8.6	83.6	25	17.6	8.7	53	8.1	59.6	25
GM =48.0N, 102.0	2	4.3	273.0		10.3	180.2		5.7	229.7	
GG =49.9N, 23.7E	3	4.3	119.5		5.9	352.8		3.1	39.0	
DIP LAT. =47.9	4	1.5	314.5		1.8	185.1		1.5	205.3	
40. WIEN-KOBENZL	1	8.2	123.3	25	18.6	33.9	59	7.9	75.6	23
GM =47.9N, 97.8	2	2.6	339.6		11.3	227.7		5.1	277.1	
GG =48.3N, 16.3E	3	4.3	206.6		6.8	58.9		2.7	100.9	
DIP LAT. =46.01	4	1.8	81.4		2.4	266.6		1.6	316.9	
41. HURBANOVO	1	7.3	136.5	24	17.8	36.7	56	8.0	82.1	25
GM =47.2N, 99.8	2	2.9	6.0		11.1	229.3		5.7	279.5	
GG =47.9N, 18.2E	3	4.5	217.0		6.6	69.7		3.3	117.3	
DIP LAT. =45.61	4	1.9	88.2		1.9	274.5		1.9	318.5	
42. PRUHONICE	1	9.8	108.4	27	18.9	31.3	59	9.0	89.5	25
GM =47.2N, 98.9	2	3.8	303.1		11.2	225.6		5.8	252.8	
GG =50.0N, 14.6E	3	3.8	197.9		7.0	54.3		1.2	121.9	
DIP LAT. =47.8	4	1.5	65.1		2.2	257.6		1.4	328.8	
43. TIHANY	1	6.8	131.3	22	17.7	35.5	58	7.7	74.8	24
GM =46.3N, 99.1	2	2.2	12.8		11.4	231.7		5.3	277.3	
GG =46.9N, 17.9E	3	4.2	220.0		7.0	70.0		2.9	112.0	
DIP LAT. =44.51	4	1.9	91.7		2.5	283.1		1.4	314.7	
44. CASTELLACCIO	1	9.2	168.4	37	21.3	16.7	67	0.0	0.0	0
GM =45.7N, 89.5	2	5.5	2.9		12.3	183.3		0.0	0.0	
GG =44.4N, 8.9E	3	6.8	176.8		8.4	4.4		0.0	0.0	
DIP LAT. =41.41	4	2.6	351.9		3.4	185.9		0.0	0.0	
45. LOGRONO	1	5.4	94.9	14	16.6	39.6	58	11.5	72.3	33
GM =45.4N, 80.7	2	2.1	272.4		12.0	230.1		6.8	256.0	
GG =42.5N, 0.9E	3	1.9	212.8		7.3	63.9		4.4	86.7	
DIP LAT. =39.71	4	1.3	54.3		2.3	263.3		1.6	277.8	
46. TORTOSA	1	1.0	173.6	11	17.4	41.5	62	9.8	82.1	27
GM =43.9N, 79.7	2	1.6	73.0		12.8	233.6		6.5	265.1	
GG =40.8N, 0.0N	3	3.0	249.8		8.2	75.4		2.8	104.2	
DIP LAT. =37.51	4	1.7	67.1		2.6	280.4		1.0	319.7	
47. ODESSA	1	6.8	134.7	23	17.9	31.3	59	6.8	69.7	21
GM =43.8N, 111.1	2	4.1	11.4		11.3	228.9		4.9	264.9	
GG =46.8N, 30.9E	3	4.5	199.5		6.9	68.2		2.0	100.1	
DIP LAT. =45.31	4	2.0	58.3		2.8	271.8		.8	276.6	
48. TOLEDO	1	.5	113.5	10	17.5	35.4	62	11.2	75.7	34
GM =43.6N, 75.7	2	1.5	89.0		12.7	221.3		7.5	258.3	
GG =39.9N, 4.1W	3	2.9	245.2		8.0	56.9		4.4	86.9	
DIP LAT. =36.71	4	1.4	63.8		2.9	246.5		1.6	287.9	

Table II (Cont'd)

Component STATION	N=	X AMP.(γ)	X PH(°)	X RANGE(γ)	Y AMP.(γ)	Y PH(°)	Y RANGE(γ)	Z AMP.(γ)	Z PH(°)	Z RANGE(γ)
49. SURLARI	1	5.9	149.3	25	17.0	27.7	56	7.9	66.7	27
GM =42.5N, 106.1	2	4.1	17.4		10.7	221.7		6.0	260.3	
GG =44.7N, 26.3E	3	5.0	197.3		6.7	56.7		3.4	90.3	
DIP LAT. =42.31	4	2.2	51.2		2.5	258.2		1.4	280.6	
50. SAN FERNANDO	1	4.5	275.1	22	16.6	35.4	61	0.0	0.0	0
GM =41.0N, 71.3	2	4.8	103.8		12.4	223.5		0.0	0.0	
GG =36.5N, 6.2W	3	4.1	266.9		7.9	57.2		0.0	0.0	
DIP LAT. =33.21	4	2.0	86.7		2.6	247.7		0.0	0.0	
51. IRKUTSK	1	15.1	115.8	42	16.1	14.7	53	3.0	87.5	12
GM =41.0N, 174.4	2	10.6	328.9		11.5	222.1		2.8	267.9	
GG =52.5N, 104.0E	3	5.3	173.8		5.7	52.3		1.9	101.7	
DIP LAT. =56.9	4	.8	28.9		.7	234.7		.6	288.0	
52. ALMERIA	1	4.3	265.9	20	17.1	38.3	63	9.6	66.7	24
GM =40.6N, 75.3	2	4.5	97.6		13.0	225.3		5.0	244.0	
GG = 36.9N, 2.5W	3	4.2	260.7		8.1	67.5		2.4	64.8	
DIP LAT. =33.01	4	1.9	79.3		3.1	263.4		.6	288.4	
53. TUCSON	1	8.9	135.8	30	18.1	18.1	69	10.9	82.4	33
GM =40.4N, 312.2	2	6.9	5.5		14.7	226.9		7.1	281.4	
GG =32.2N, 110.8W	3	5.4	231.2		8.5	78.4		4.0	128.1	
DIP LAT. =40.31	4	2.6	90.0		3.5	305.3		1.6	.6	
54. Y.-SAKHALINSK	1	12.9	107.8	39	15.6	15.3	55	4.1	79.4	11
GM =36.9N, 206.7	2	10.0	306.5		12.0	213.8		2.4	269.3	
GG =47.0N, 142.7E	3	5.6	142.6		6.7	38.6		1.4	101.0	
DIP LAT. =41.51	4	1.4	337.5		1.6	229.9		.5	285.1	
55. TBILISI	1	7.2	170.5	37	17.4	24.5	59	8.3	60.7	30
GM =36.7N, 122.1	2	8.1	28.0		11.9	229.7		6.7	258.9	
GG =42.1N, 44.7E	3	6.0	208.4		6.9	72.6		3.5	105.7	
DIP LAT. =40.91	4	2.9	56.5		2.6	259.7		1.3	300.7	
56. MEMAMBETSU	1	11.3	120.4	38	15.9	16.8	59	4.6	85.0	11
GM =34.0N, 208.4	2	9.6	321.5		12.7	217.7		2.2	287.4	
GG =43.9N 144.2E	3	5.6	161.1		7.6	46.5		1.1	126.6	
DIP LAT. =38.21	4	1.5	4.9		2.0	247.3		.4	255.7	
57. TASHKENT	1	7.9	151.1	37	16.3	17.4	60	6.9	68.6	25
GM =32.4N, 143.7	2	9.0	2.1		12.2	223.1		5.5	259.8	
GG =41.4N, 69.2E	3	5.2	181.5		7.9	59.9		3.6	111.9	
DIP LAT. =41.51	4	2.3	1.4		1.9	253.8		1.2	309.3	
58. VLADIVOSTOK	1	12.3	115.5	41	17.5	16.2	62	9.1	78.3	23
GM =32.3N, 197.9	2	11.1	323.0		13.4	223.0		4.6	272.7	
GG =43.1N, 131.9E	3	6.1	166.3		7.6	55.5		2.5	110.5	
DIP LAT. =40.01	4	1.7	16.0		1.6	256.1		.8	309.6	
59. ASHKHABAD	1	5.7	171.0	30	15.0	11.9	64	7.4	73.6	27
GM =30.3N, 133.1	2	6.1	6.9		12.8	210.2		5.9	267.7	
GG =37.9N, 58.1E	3	3.9	166.8		9.9	55.1		3.7	115.2	
DIP LAT. =41.51	4	3.5	8.1		4.3	256.1		1.7	297.1	
60. SAN JUAN	1	3.0	353.6	15	16.4	6.7	47	6.0	94.2	15
GM =29.9N, 3.2	2	4.5	198.1		9.4	199.6		2.8	305.1	
GG =18.4N, 66.1W	3	1.6	345.7		4.1	54.2		1.2	158.7	
DIP LAT. =32.11	4	.2	355.2		.9	266.4		.1	338.9	

Table II (Cont'd)

Component STATION	N=	X AMP.(γ)	X PH(°)	X RANGE(γ)	Y AMP.(γ)	Y PH(°)	Y RANGE(γ)	Z AMP.(γ)	Z PH(°)	Z RANGE(γ)
61. HELWAN	1	16.2	253.2	51	16.7	24.4	57	11.1	92.8	38
GM = 27.2N, 106.4	2	12.5	76.3		11.2	228.8		8.8	305.3	
GG = 29.9N, 31.3E	3	6.8	240.0		7.4	83.5		5.5	150.0	
DIP LAT. = 24.91	4	3.8	91.1		2.6	313.8		2.1	359.5	
62. KAKIOKA	1	5.5	177.2	29	15.1	30.3	60	6.8	99.6	21
GM = 26.0N, 206.0	2	7.2	8.8		13.5	246.6		4.1	357.8	
GG = 36.2N, 140.2E	3	4.4	219.1		8.5	89.1		3.0	222.7	
DIP LAT. = 30.11	4	1.2	103.3		2.0	308.9		.3	71.5	
63. SIMOSATO	1	5.9	210.7	30	14.8	27.8	64	8.4	94.6	26
GM = 23.0N, 202.4	2	7.3	17.4		14.3	243.3		3.9	359.8	
GG = 33.6N, 135.9E	3	4.7	216.8		9.6	84.3		4.2	237.5	
DIP LAT. = 27.91	4	1.5	96.1		2.9	300.1		1.1	108.7	
64. ASO	1	5.6	208.7	27	14.3	15.4	62	11.2	68.1	32
GM = 22.1N, 198.1	2	6.8	349.9		13.7	217.8		6.3	271.5	
GG = 32.9N, 131.0E	3	4.3	176.6		9.1	49.1		3.9	106.0	
DIP LAT. = 28.41	4	1.5	53.1		2.4	250.6		.9	278.5	
65. QUETTA	1	7.1	252.1	22	11.9	22.7	53	7.9	78.9	24
GM = 21.6N, 139.7	2	6.0	73.9		10.6	233.6		4.8	281.8	
GG = 30.2N, 67.0E	3	1.5	280.2		8.8	90.2		2.9	153.2	
DIP LAT. = 27.11	4	.5	13.8		3.0	304.8		1.1	18.3	
66. M BOUR	1	25.6	270.0	67	19.3	68.5	52	12.1	96.0	41
GM = 21.3N, 55.0	2	12.6	146.5		10.9	253.7		8.8	288.3	
GG = 14.4N, 17.0W	3	6.2	344.7		5.3	99.1		5.8	148.8	
DIP LAT. = 9.11	4	3.0	214.8		1.1	323.8		2.9	13.8	
67. HONOLULU	1	15.9	258.2	40	14.8	14.1	56	13.3	67.1	41
GM = 21.1N, 266.5	2	7.3	95.2		12.0	251.4		7.3	288.3	
GG = 21.3N, 158.2W	3	4.5	292.6		7.0	123.4		4.8	158.8	
DIP LAT. = 22.01	4	1.2	131.4		4.0	356.7		2.8	36.3	
68. KANOYA	1	8.2	260.0	22	13.8	22.4	62	11.6	71.0	33
GM = 20.5N, 198.1	2	4.8	23.1		13.8	224.9		6.5	282.6	
GG = 31.4N, 130.9E	3	2.9	188.1		9.0	66.5		3.9	123.4	
DIP LAT. = 26.0	4	.7	137.7		2.2	273.5		1.6	270.3	
69. PARAMARIBO	1	25.2	288.4	60	13.9	39.8	45	15.1	108.4	38
GM = 17.0N, 14.5	2	9.1	143.8		10.3	225.7		8.1	320.5	
GG = 5.8N, 55.2W	3	4.9	336.2		4.4	79.8		3.8	178.2	
DIP LAT. = 17.61	4	1.8	102.3		1.5	303.1		.2	305.8	
70. CHA-PA	1	23.3	276.6	60	9.2	358.7	43	9.7	79.6	27
GM = 11.0N, 173.4	2	11.8	91.2		8.3	214.4		5.3	297.4	
GG = 22.4N, 103.8E	3	6.2	287.4		7.3	69.4		2.8	140.8	
DIP LAT. = 15.81	4	2.4	114.9		3.6	288.2		1.4	3.9	
71. IBADAN	1	56.2	259.1	141	13.8	80.4	34	26.6	262.2	74
GM = 10.6N, 74.6	2	28.6	93.8		6.6	283.8		18.5	82.3	
GG = 7.4N, 3.9E	3	12.1	315.1		2.8	149.2		6.6	281.8	
DIP LAT. = -03.11	4	4.6	137.4		1.9	330.1		2.7	151.2	
72. TATUOCA	1	30.3	271.9	73	18.4	55.1	42	14.7	83.3	39
GM = 9.6N, 20.8	2	13.9	114.2		8.6	229.5		8.7	275.8	
GG = 1.2S, 48.5W	3	6.5	313.1		1.2	96.1		3.2	141.6	
DIP LAT. = 8.91	4	1.2	144.4		1.9	351.8		1.6	42.3	

Table II (Cont'd)

Component		X	X	X	Y	Y	Y	Z	Z	Z
STATION	N=	AMP.(γ)	PH(°)	RANGE(γ)	AMP.(γ)	PH(°)	RANGE(γ)	AMP.(γ)	PH(°)	RANGE(γ)
73. ALIBAG	1	27.9	259.9	74	8.5	30.1	48	13.1	76.6	45
GM = 9.5N, 143.6	2	15.8	86.4		10.4	246.2		8.8	311.2	
GG = 18.6N, 72.9E	3	7.5	291.4		8.5	79.8		7.0	144.5	
DIP LAT. = 12.91	4	1.6	132.4		3.0	283.6		4.0	338.4	
74. TALARA	1	39.5	271.0	91	12.5	325.3	39	14.3	74.3	34
GM = 6.6N, 347.7	2	15.0	116.0		6.4	122.4		3.1	285.9	
GG = 4.6S, 81.3E	3	6.5	324.3		5.0	189.9		6.2	227.3	
DIP LAT. = 6.31	4	1.6	152.4		3.8	316.0		4.3	16.0	
75. ADDIS ABABA	1	56.7	258.5	147	3.4	172.8	24	5.1	250.7	13
GM = 5.3N, 109.2	2	32.2	97.5		6.4	1.0		2.7	95.4	
GG = 9.0N, 38.7E	3	11.3	316.7		3.7	151.7		.3	236.3	
DIP LAT. = -0.51	4	3.7	200.4		1.7	348.3		.5	328.8	
76. BANGUI	1	34.3	275.5	90	9.3	117.5	31	8.6	248.1	21
GM = 4.8N, 88.5	2	19.6	130.1		8.0	348.1		4.4	88.1	
GG = 4.4N, 18.5E	3	6.3	349.3		4.4	204.7		.8	3.0	
DIP LAT. = -7.11	4	2.3	186.2		2.2	51.6		.8	224.7	
77. CHICLAYO	1	45.2	270.7	102	14.6	312.9	40	17.2	68.6	36
GM = 4.5N, 349.0	2	16.4	116.8		6.1	112.2		5.5	240.5	
GG = 6.8S, 79.8W	3	6.3	334.6		5.5	196.4		3.4	251.6	
DIP LAT. = 4.91	4	1.9	171.0		3.4	324.9		2.3	25.4	
78. GUAM	1	34.9	269.4	80	9.0	64.3	41	9.3	73.3	23
GM = 3.9N, 212.8	2	14.0	111.1		10.2	266.2		3.5	290.8	
GG = 13.5N, 144.7E	3	5.6	324.1		5.9	91.7		2.4	159.1	
DIP LAT. = 6.51	4	1.8	170.4		1.9	301.0		1.4	332.0	
79. FANNING IS.	1	37.9	259.8	79	3.6	32.9	31	19.5	102.6	53
GM = 3.8N, 268.9	2	12.9	99.9		7.1	258.9		11.7	300.0	
GG = 3.9N, 159.4W	3	3.0	348.7		5.2	116.9		6.3	167.5	
DIP LAT. = 5.31	4	2.2	227.8		3.0	312.8		3.4	17.9	
80. MUNTINLUPA	1	35.0	273.2	84	5.7	52.1	34	16.6	94.8	44
GM = 3.0N, 189.7	2	15.8	124.0		8.3	276.0		9.3	300.6	
GG = 14.4N, 121.0	3	6.5	340.0		5.8	110.1		4.6	167.7	
DIP LAT. = 7.21	4	3.2	208.1		2.2	339.1		1.7	25.8	
81. ANNAMALAINAGAR	1	38.8	272.8	97	4.0	83.5	26	14.0	57.3	34
GM = 1.5N, 149.4	2	20.5	109.0		6.4	279.3		6.3	228.5	
GG = 11.4N, 79.7E	3	7.6	339.7		4.6	111.4		1.1	15.3	
DIP LAT. = 2.71	4	2.6	221.6		2.2	332.4		.8	118.4	
82. CHIMBOTE	1	49.8	275.4	115	15.9	277.7	63	19.2	65.2	42
GM = 1.0N, 351.0	2	21.3	119.8		16.3	92.6		8.6	236.1	
GG = 9.1S, 78.6W	3	7.0	338.5		6.8	231.5		2.6	214.5	
DIP LAT. = 3.21	4	1.9	178.1		5.2	306.0		4.1	16.1	
83. KODAIKANAL	1	54.9	273.4	141	13.4	62.7	66	14.3	68.8	31
GM = 0.6N, 147.1	2	28.2	117.1		16.6	261.7		4.3	268.1	
GG = 10.2N, 77.5E	3	14.8	338.8		9.8	100.0		2.8	151.9	
DIP LAT. = 1.71	4	4.9	200.5		2.1	343.3		1.4	28.8	
84. JARVIS IS.	1	68.9	265.4	155	4.2	257.2	15	2.8	93.7	13
GM = 0.5S, 269.0	2	29.4	101.2		3.0	280.6		3.1	275.2	
GG = 0.4S, 160.0W	3	9.1	334.1		3.0	108.5		2.0	125.0	
DIP LAT. = 1.11	4	5.3	212.3		1.9	274.2		1.0	325.5	

Table II (Cont'd)

Component		X	X	X	Y	Y	Y	Z	Z	Z
STATION	N=	AMP.(γ)	PH(°)	RANGE(γ)	AMP.(γ)	PH(°)	RANGE(γ)	AMP.(γ)	PH(°)	RANGE(γ)
85. HUANCAYO	1	87.2	275.0	194	16.2	280.1	45	12.2	56.5	29
GM = 0.6S, 353.8	2	39.7	108.4		9.7	91.9		4.0	227.7	
GG = 12.0S, 75.3W	3	11.2	329.9		4.2	228.8		2.7	249.1	
DIP LAT. = 1.01	4	3.8	217.5		2.3	324.3		2.0	42.3	
86. TRIVANDRUM	1	60.1	270.3	152	1.5	13.0	17	16.9	327.3	50
GM = 0.9S, 146.3	2	32.8	104.7		4.3	255.6		11.8	136.7	
GG = 8.5N, 77.0E	3	12.7	327.6		3.4	78.4		3.7	5.0	
DIP LAT. = -0.31	4	4.4	211.0		1.2	303.7		.9	203.8	
87. KOROR	1	67.9	276.3	165	5.7	118.2	27	11.4	2.2	40
GM = 3.3S, 203.5	2	33.8	122.2		8.2	313.2		9.2	183.3	
GG = 7.3N, 134.5E	3	14.2	348.3		3.5	137.4		4.4	34.6	
DIP LAT. = -0.041	4	5.7	222.5		.3	349.2		1.8	270.6	
88. YAUCA	1	70.3	274.1	155	18.1	256.9	64	30.2	277.1	81
GM = 5.5S, 354.0	2	29.0	113.0		14.7	52.4		19.2	93.9	
GG = 15.5S, 74.6W	3	8.4	337.7		11.6	219.4		8.0	264.3	
DIP LAT. = -2.21	4	3.4	228.2		2.8	340.2		1.6	346.4	
89. LUANDA	1	26.2	259.2	68	12.2	126.8	45	1.6	317.7	7
GM = 7.1S, 80.5	2	14.8	81.0		11.1	331.6		1.2	269.9	
GG = 8.8S, 13.2E	3	5.7	260.2		6.7	178.0		.8	134.5	
DIP LAT. = -23.91	4	3.1	62.1		2.6	2.2		1.6	281.2	
90. VASSOURAS	1	37.5	279.8	88	10.8	111.5	44	4.7	192.8	21
GM = 11.9S, 23.9	2	16.3	112.6		8.3	353.9		3.7	137.3	
GG = 22.4S, 43.7W	3	6.8	306.1		8.7	224.1		5.0	346.9	
DIP LAT. = -11.71	4	.6	99.4		3.7	73.2		1.8	180.4	
91. HOLLANDIA	1	39.8	289.1	92	11.0	149.9	47	14.0	176.6	38
GM = 12.5S, 210.3	2	16.7	122.9		12.8	352.0		7.0	7.1	
GG = 2.6S, 140.5E	3	6.2	316.0		6.3	207.8		2.0	209.7	
DIP LAT. = -10.91	4	1.1	53.4		2.6	87.4		1.3	197.1	
92. APIA	1	31.8	276.4	74	12.6	185.3	53	7.0	207.8	14
GM = 16.0S, 260.2	2	16.0	107.6		13.0	358.3		.4	138.1	
GG = 13.8S, 171.8W	3	5.8	303.0		6.6	192.9		.3	22.8	
DIP LAT. = -16.31	4	.9	144.5		.7	334.8		.3	227.5	
93. KUYPER	1	32.1	308.0	79	12.7	164.3	53	16.1	252.7	45
GM = 17.5S, 175.6	2	16.1	141.0		13.6	355.8		9.6	85.7	
GG = 6.0S, 106.8E	3	7.4	335.2		6.2	203.5		4.2	293.6	
DIP LAT. = -17.61	4	1.0	128.9		3.0	69.6		1.1	143.7	
94. TANANARIVE	1	11.0	284.6	31	16.4	181.3	83	10.2	251.0	30
GM = 23.1S, 112.1	2	7.7	120.6		19.2	17.5		6.5	97.8	
GG = 18.9S, 47.6E	3	2.3	312.8		12.4	216.4		2.9	298.8	
DIP LAT. = -34.81	4	2.2	62.0		4.0	43.0		1.2	116.3	
95. TRELEW	1	3.8	314.0	13	13.6	199.9	60	14.2	261.5	37
GM = 31.7S, 3.2	2	2.4	323.6		13.8	27.7		8.0	85.7	
GG = 43.2S, 65.3W	3	2.1	162.7		8.8	214.3		4.4	276.4	
DIP LAT. = -22.41	4	1.3	75.2		1.7	38.6		.9	105.8	
96. HERMANUS	1	8.6	55.7	35	20.2	157.9	79	8.5	241.0	36
GM = 33.3S, 80.5	2	8.1	244.3		18.0	1.1		8.1	50.5	
GG = 34.4S, 19.2E	3	5.4	103.0		10.6	201.3		5.9	229.7	
DIP LAT. = -46.81	4	1.0	260.0		4.2	13.0		2.7	49.0	

Table II (Cont'd)

Component		X	X	X	Y	Y	Y	Z	Z	Z
STATION	N=	AMP.(γ)	PH(°)	RANGE(γ)	AMP.(γ)	PH(°)	RANGE(γ)	AMP.(γ)	PH(°)	RANGE(
97. WATHEROO	1	7.1	25.2	24	18.9	164.2	73	14.0	236.9	63
GM = 41.8S, 185.6	2	5.9	247.7		17.8	349.9		16.5	39.0	
GG = 30.3S, 115.9E	3	1.6	89.1		8.9	183.7		9.0	225.2	
DIP LAT. = -46.41	4	.9	73.9		2.3	17.9		2.9	43.1	
98. TOOLANGI	1	11.5	68.5	45	19.5	174.8	80	1.7	254.9	6
GM = 46.7S, 220.8	2	10.9	260.1		19.5	358.1		1.0	17.6	
GG = 37.5S, 145.5E	3	5.1	105.3		9.5	185.6		1.4	201.2	
DIP LAT. = -51.21	4	2.3	308.6		2.0	2.2		.8	.8	
99. AMBERLEY	1	14.8	72.2	48	20.2	166.9	75	1.9	263.5	8
GM = 47.7S, 252.5	2	12.7	250.1		19.0	345.1		2.3	18.5	
GG = 43.2S, 172.7E	3	5.3	82.5		7.5	168.7		1.1	165.1	
DIP LAT. = -51.31	4	1.3	235.1		.7	35.4		.2	240.0	
100. ARGENTINE IS.	1	25.7	90.7	63	18.4	186.3	56	12.7	305.2	31
GM = 53.6S, 3.6	2	12.9	291.1		11.9	28.7		4.6	122.4	
GG = 65.3S, 64.3W	3	6.0	117.5		4.8	203.5		2.8	322.2	
DIP LAT. = -38.11	4	.7	352.9		2.0	35.9		1.0	99.2	
101. MACQUARIE IS.	1	14.0	87.0	40	21.6	184.5	65	10.4	26.2	23
GM = 61.0S, 243.0	2	9.5	245.3		13.6	358.4		2.8	179.7	
GG = 54.5S, 159.0E	3	4.2	97.9		5.6	188.8		2.3	54.0	
DIP LAT. = -67.61	4	1.5	268.5		1.6	350.6		1.0	46.3	
102. BYRD STATION	1	16.0	134.3	49	24.4	199.1	54	6.2	37.9	18
GM = 70.5S, 336.0	2	12.0	323.6		7.3	316.2		.3	24.2	
GG = 80.0S, 120.0W	3	5.4	38.7		3.5	10.8		2.4	331.6	
DIP LAT. = -61.51	4	2.0	110.6		2.5	61.3		2.1	81.2	
103. LITTLE AMERICA	1	6.1	128.6	18	38.4	223.4	75	13.1	282.8	39
GM = 74.1S, 312.1	2	3.7	100.2		5.3	33.8		8.0	350.1	
GG = 78.3S, 162.5W	3	2.4	255.5		3.5	263.0		5.1	163.4	
DIP LAT. = -70.61	4	1.6	69.6		3.2	124.9		3.6	264.7	
104. WILKES	1	45.7	333.3	150	42.5	163.3	126	24.3	285.9	75
GM = 75.2S, 179.2	2	25.7	164.3		26.9	10.5		18.6	150.5	
GG = 66.4S, 110.6E	3	17.1	307.9		11.6	220.7		11.1	348.1	
DIP LAT. = -74.01	4	16.4	126.8		6.2	40.1		4.0	123.4	
105. MIRNY	1	20.1	20.3	64	32.2	158.6	82	20.2	343.2	72
GM = 77.0S, 146.8	2	14.3	264.0		18.0	27.2		14.9	159.2	
GG = 66.6S, 93.0E	3	1.1	62.9		3.2	205.5		8.5	343.9	
DIP LAT. = -65.51	4	4.3	131.7		2.1	289.1		6.2	203.0	
106. OASIS	1	35.8	338.8	91	54.2	138.8	126	15.9	120.0	43
GM = 77.6S, 160.3	2	16.2	175.4		22.6	345.0		5.8	275.9	
GG = 66.3S, 100.7E	3	7.6	340.6		8.1	200.3		3.7	31.1	
DIP LAT. = -69.0	4	4.3	130.6		2.5	23.7		6.5	202.8	
107. SCOTT BASE	1	18.8	20.9	51	23.2	138.4	83	12.2	228.5	41
GM = 79.0S, 294.4	2	8.2	103.1		14.1	265.1		6.8	314.5	
GG = 77.8S, 166.7E	3	6.9	221.1		7.4	188.3		6.9	125.1	
DIP LAT. = -74.3	4	2.7	53.2		9.2	1.6		5.7	310.2	
108. VOSTOK	1	42.9	77.1	91	38.5	156.4	95	17.4	242.1	42
GM = 89.2S, 92.6	2	11.6	261.5		14.0	3.5		3.1	324.7	
GG = 78.5S, 106.9E	3	2.7	34.7		.7	142.2		6.2	8.1	
DIP LAT. = -68.31	4	2.8	54.8		4.4	123.6		4.7	131.7	

how well the results agree with those in the literature based on considerably larger volumes of data.

The geomagnetic (gm) and the geographic (gg) coordinates and also the dip latitude of the observatories are given in Table II. Figure 1 gives the location of all the stations included in the present investigation and shows the dip equator, the geomagnetic equator and the geographic equator. In Figure 2 the daily variations on individual days in the H-component are shown for stations Huancayo and Kodaikanal. Clearly the variations are not similar on all these days even though for each one of these days Cp = 0.0. This clearly demonstrates the variability of Sq on quiet days (Mayaud, 1965).

Method

The computations have been made in the following steps:

(1) Columnwise average of the 25 mean hourly values of the eight international quiet days, given in Table I, have been taken–the 25th value on each day is the first of the next day and has been used to remove non-cyclic variation.

(2) The 25 average values obtained above are rearranged if necessary, to the time of the nearest meridian, to which the time is being reckoned at a particular station. This may or may not be the exact local time of the station. A conversion of the data to the exact local time of the station can however be done by a method suggested by Price and Stone (1964).

(3) The difference between the 25th and the 1st value of the above 25 values is the average non-cyclic part for all the eight days under consideration. This is removed linearly from all the 25 values α_i, where $i = 1, 2, 3, \ldots, 25$ i.e.; $\Delta = \alpha_{25} - \alpha_1$, $\beta_i = \alpha_i - \frac{(i-1)\Delta}{24}$.

(4) The deviations are computed from the midnight point by subtracting β_1 from β_i values i.e. $\delta_i = \beta_i - \beta_1$.

(5) The deviations ΔH and ΔD (i.e. δ_i data points for H and D respectively) are later used to compute the deviations ΔX and ΔY of the northerly (X) and easterly (Y) components as follows:

$$\Delta X_i = \Delta H_i \times \cos D - 29.1 \times 10^{-5} \times H \times \sin D \times \Delta D_i$$

$$\Delta Y_i = \Delta H_i \times \sin D + 29.1 \times 10^{-5}\, H \times \cos D \times \Delta D_i$$

where ΔD_i is in minutes of arc, and D and H are the averages of the daily mean values (including baseline value) of the eight most quiet days under consideration. The deviations ΔX_i, ΔY_i, and ΔZ_i have been plotted in Figure 3 and these give the average daily variation from a zero level at midnight in local time at individual stations. The stations are rearranged in order of their decreasing latitude from the geomagnetic pole.

(6) Using ΔX_i, ΔY_i and δ_i data for Z the amplitudes and the phases of the first four harmonics are computed by Fourier analysis. The amplitudes are next adjusted to compensate for averaging the data for eight days. These are given in Table II for all stations.

(7) The ranges for X, Y and Z components given in Table II are the sums of the absolute values of the maximum (A_{max}) and the minimum (A_{min}) during the 24 hour period, $r = |A_{max}| + |A_{min}|$.

(8) Vectograms (vector diagrams) given in Figure 4 are traced using ΔX_i and ΔY_i data as computed above. The stations are arranged in order of their decreasing geomagnetic latitude. In these vectograms the day part is shown by a continuous line and the night part by a broken line. In the equatorial electrojet belt the north-south variation dominates over the east-west variation, and for higher latitudes on either side of this belt the latter type variation becomes larger until the vectograms degenerate into figures of eight under the focus of the vortex system in either hemisphere. The vectograms are in the clockwise sense to the north, and counter-clockwise to the south of the northern focus, and the reverse is the case with respect to the southern hemisphere. In the auroral and the polar zones the vectograms in general are oval shaped and show equal variations during the day and the night part; also they are clockwise in the northern hemisphere and counter-clockwise in the southern hemisphere (except Wilkes which shows a clockwise rotation). Their large size indicates the concentration of large overhead currents caused by the enhanced particle precipitation and/or electric field in the ionosphere.

Results and discussions

At any station, the local daily variations of the geomagnetic components with the seasonal effects superimposed on them, are influenced by the location of the station with respect to the geographic equator. On the other hand the intensity of the variations depends to a large extent upon the location of the station with respect to the geomagnetic equator and also the dip equator. Thus a study of the daily geomagnetic variations on a global scale has to take into account the locations of the stations with respect to these equators. As seen in Figure 1 the dip equator is considerably to the north of the geographic equator in Africa and South Asia but is significantly to the south of it in South America. This also is the case for the geomagnetic equator. This brings into the picture a longitudinal asymmetry in Sq variations which was considered of secondary importance in the past because of the lack of sufficient data for analysis (Vestine *et al.,* 1947). The availability of a large volume of geomagnetic data during IGY clearly showed this longitudinal asymmetry, making it necessary to divide the globe into different longitudinal sectors. The choice of these sectors has not been standardized so far, and three (Price and Wilkins, 1963; Matsushita and Maeda, 1965) as well as five (Price and Stone, 1964) sectors have been considered in the past. In the present work, the longitudinal sectors of Price and Stone are adopted.

A preliminary study of Table II and of Figures 3 and 4 may be summarized as follows:

(1) Analysis of only a few very quiet days, eight in this case, during a time of very high sunspot number seems to give meaningful daily variation at the majority

of the stations. This is clear from the fact that systematic changes are noted in Figure 3 for each of the components, X, Y and Z, from high latitude stations to the low latitude stations in both hemispheres, and the harmonic coefficients are comparable with those obtained from considerably larger amounts of data (Gupta and Chapman, 1970). Besides the broad features of the daily variation some finer points, which will be discussed here, are also seen clearly.

(2) As expected, larger amplitudes (or ranges) of the daily variation are found during the IGY than during the IPY period. However the form of the variations remains virtually unchanged. For comparison of results, the following latitudinal zones are considered on the basis of the known ionospheric current systems which exercise the major influence within the specified approximate boundaries (the northern and the southern hemisphere latitudes are designated by positive and negative signs respectively):

(i) Equatorial electrojet systems ± 4° dip latitude.
(ii) Vortex (Dynamo or Sq) system ± (4°-60°) gm latitude.
(iii) Auroral electrojet system ± (60° - 70°) gm latitude.
(iv) Polar current system ± (70°-90°) gm latitude.

The ratio of the ranges for the IGY period to those for the IPY is found to be nearly the same whether all or only the common stations in the two periods are included in the analysis. Thus these ratios are given for the former case only in Table III, for the three components individually and also combined. It also lists these ratios for the station Huancayo alone. Also given in this Table are the average ranges of IGY for the southern auroral and polar zones as no stations were in operation during IPY south of 60° geomagnetic latitude.

An overall increase in the daily ranges by a factor of 2.3 is seen for the IGY period over that of the IPY and the largest increases are noted in the auroral zone. This observed excess in the auroral zone may be accounted for by the enhanced particle precipitation and/o electric fields in the ionosphere at thos latitudes during IGY giving rise to ver strong electrojet currents. The effect of the increased ultraviolet flux caused by the excessive activity on the solar dis may also increase ionospheric conduc ivity but nearly proportionately every where. The overall ratio of the ranges fo mid and low latitude stations under the northern vortex system is found to be about 1.5 times larger than the corre ponding ratio in the southern hemispher This excess is most probably caused by the fact that the IPY data used in the present analysis are for January and February when it is summer in the southern hemisphere and the daily range are relatively larger there than in the northern hemisphere. The effect of this would be to give a smaller ratio in the southern hemisphere. The overall result given in Table III would be closer to those of Price and Stone (1964) if this factor of 1.5 is taken into consideratio

Table III

In different zones the ratio of the average range for the IGY to the average range for the IPY period (for the IGY period ranges at individual stations are given in Table II and for IPY period these are measured from Figure 87A, B of Vestine *et al.*). Also given are the ratios for the station Huancayo separately.

	X	Y	Z	X+Y+Z
Polar zone (N) (70° to 90°)	1.5	3.1	2.6	2.4
Auroral zone (N) (60° to 70°)	3.5	3.6	2.0	3.1
Mid and low latitudes (N) (4° to 60°)	2.3	2.9	2.8	2.7
Equatorial zone -4° to +4° dip latitude	1.8	0.8	1.9	1.5
(for Huancayo only)	(2.3)	(0.9)	(1.5)	(1.6)
Mid and low latitude (S) -4° to -60°	2.3	1.5	1.7	1.8
For all latitudes	2.3	2.4	2.2	2.3
*Auroral zone (S) (-60° to -70°)	45.7γ	75.2γ	45.0γ	55.3γ
*Polar zone (S) (-70° to -90°)	116.6	124.0	65.0	101.8

*The Figure 87A, B of Vestine *et al.* does not include any station south of 60° geomagnetic latitude. This is why the average values of the ranges for IGY instead of the Ratio of the ranges are given.

It also deserves mention that the Y-component in the equatorial electroje zone does not show any significan change except a small decrease in the range from IPY to the IGY period.

(3) With the availability of the data from several stations, some recen estimates of the latitudes of the norther and the southern vortex foci in mid and low latitudes are made by Price and Wilkins (1963), Price and Stone (1964) Matsushita and Maeda (1965), Fatkulli and Feldstein (1965), and calculate theoretically by Stening (1971). A large number of stations are used in the presen work, and the estimated geographi latitudes of the two foci, and the possibl variations in these latitudes because of interpolations, are given in Table IV fo five longitudinal sectors of the earth These latitudes are estimated on the following basis:

At the latitude of the overhead focus Sq(Y) would show a large range and Sq(X) not only would show a small rang but also a variation changing from the equatorial to the polar type as the focus moves towards the poles or towards the equator relative to the station. This means that a vectogram in the X-Y plane will elongate in the Y-direction tracing approximately a figure of *eight* or several loops depending upon the number of crossings towards the north and the south of the station during a 24-hour period.

The geographic latitudes of the foci of the vortex systems are found to be northernmost in the Europe-African sector and southernmost in the American sector as are also the geographic latitudes of the dip equator. In the northern hemisphere there seems to be a systematic decrease by approximately 5 degrees in the successive eastern sectors relative to the Europe-African sector. No such systematic change is noted in the southern hemisphere, which may partly be because of the fact that the estimated positions of the focus cannot be taken very seriously until more data are available from a closer network of observatories near these latitudes.

Table IV

Average geographic latitudes of the northern and the southern foci in different longitudinal sectors.

	Europe and Africa (E–A) 30°W-30°E	West Asia (WA) 30°E-90°E	East Asia (EA) 90°-150°E	Pacific (PA) 150°E-120°W	America (AM) 120°W-30°W
N	40°±1°	35°±2°	31°±2°	24°±3°	19°±2°
S	25°±2°	25°±2° ?	25°±2°	28°±3°	41°±2°

(4) At mid and low latitude stations the daily variation of Sq(Y) shows a crest in the morning and a trough in the evening in the northern hemisphere, whereas it shows a trough in the morning and a crest in the evening in the southern hemisphere. A knowledge of the hours of these extrema of variation in Sq(Y) provides a measure of the relative movement of the vortex systems in the two hemispheres. Accordingly an examination has been made of the smoothed daily Sq(Y) variations which reveals the following information:

Numbers of hours by which the northern vortex system leads the southern vortex system (a negative sign means a lead of the southern system over the northern system)

	AM	E-A	WA	EA	PA
Morning	0	1	1	2	1.5
Evening	−1	1	1	2	2.5

Clearly this analysis shows that the relative positions of the two vortex systems are not symmetrical in the two hemispheres and in the different sectors, except in the morning hours in the American sector. A similar conclusion was reached earlier by Price and Stone (1964).

The general characteristics of the Sq(Y) daily variation in the two hemispheres (viz. for the northern hemisphere a maximum in the morning and a minimum in the evening) have just been pointed out. If the daily variations at some stations are contrary to these general features one may suspect the penetration of one vortex system into the other. It may be noticed from Figure 3 that at stations Muntinlupa, Guam, Annamalainagar, Kodaikanal, Trivendrum, Koror, Fanning Is., Addis Ababa, Bangui and Jarvis Is., all of which lie within geographic latitudes 0-14°N (and geomagnetic 0-6°N) except Jarvis Is. (.5°S) there are peaks both in the morning and in the evening hours indicating that the southern vortex system penetrates the northern region in the evening and influences the daily variations in the northern hemisphere; similarly the penetration (near the equator) of the northern system into the southern hemisphere may be understood by the presence of a peak at Jarvis Is. The penetration of the southern vortex system can be seen as far north as Alibag and M'Bour and that of the northern system into the southern hemisphere as far south as Hollandia, Vassouras and Apia. These observations may show that the boundary between the two vortex systems at any point in the equatorial plane varies all the time and does not necessarily coincide with the dip equator. Also they do not support the hypothesis (Matsushita, 1960) that the equatorial electrojet constitutes an effective boundary between the two vortex systems, as was also noted by Gettemy (1962). The extent to which the northern vortex system penetrates the southern hemisphere in the morning hours and the southern vortex system penetrates the northern hemisphere in the evening hours may also depend on the magnetic activity of the day. Such a study in different longitudinal sectors would require the analysis of data collected for a long period from several stations within about 20° latitude from the dip equator in both hemispheres.

A study of the penetration of the two vortex systems into the opposite hemispheres has been done on a seasonal basis by Price and Stone (1964) as against the annual basis presented in this work. The phenomenon deserves further attention.

(5) Equatorial Electrojet

The Sq(X) ranges are found to be abnormally large in a narrow region around the dip equator which was termed 'equatorial electrojet region' by Chapman (1951). These ranges as obtained in the present analysis are given in column 2 of Table V for 6 equatorial electrojet stations all of which lie between ± 2° of dip equator. Also given for comparison are the ranges obtained by (a) Price and Stone (1964; from 1958 International Quiet Days), (b) Chapman and Rao (1965; 1958 International Quiet Days) and (c) Gupta and Chapman (1970; July 1957–December 1959 i.e. IGY/C all available days). It is immediately noticed from the ranges obtained in various ways by these authors that the electrojet intensity is largest in South America followed successively by that in East Asia (Koror), the Pacific, India and Africa. Analysis of the IQSY data from these

Table V

Ranges at equatorial stations of the X(H) component computed variously by several authors during specific intervals of the IGY/C period data; column 3–of the eight most quiet days (Cp = 0.0) of the IGY; column 4 and 5–of International Quiet Days of the year 1958, column 6–of available all days during the IGY/C period.

Station	Dip Latitude	Gupta	Price-Stone	Chapman-Rao	Gupta and Chapman 1970
Huancayo	1.0°	194γ	185γ	191γ	178γ
Addis Ababa	−0.5	147	147	136	135
Kodaikanal	1.7	141		128	135
Trivendrum	−0.3	152	151	142	141
Koror	−0.04	165	173	166	170
Jarvis	1.1	155	150	154	160

stations may further elaborate on this. A further comparison of the Sq(X) ranges in the different longitudes at stations close to those given in Table V indicates that the ranges tend to decrease rather rapidly as the distance of the station from the dip equator increases in either hemisphere.

As far as Sq(Y) ranges are concerned it is found that these are large at the equatorial electrojet stations of Chimbote (61), Kodaikanal (67) and Yauca (64) which are respectively at 3.2°, 1.7° and −2.2° dip latitudes.

In earlier investigations Onwumechilli and Alexander (1959) had found a large range of Sq(Z) at Ibadan and later Forbush and Casaverde (1962) and Chapman and Raja Rao (1965) found even larger ranges of Sq(Z) at the South American station Yauca. The results of the present investigations of data for the most quiet days confirm these findings. The Sq(Z) range at Ibadan and Yauca are found to be respectively 74γ and 81γ. The range at Yauca is larger than that found anywhere in the electrojet zone so far. In this connection Chapman and Raja Rao (1965) observed, "This great Z-perturbation occurs quite close to the centre line of the electrojet at a distance not much, if any, more than about twice the height of the electrojet." From the centre line of the jet on the ground the distance where Z-perturbation becomes maximum may be found as follows:

Assume an infinite line current of intensity i flowing eastward at a height of h km from the surface. The magnetic intensity F at a point P at a distance of x km from the base of h may be given by Ampères Law by the relation

$$\oint F\,ds = 4\pi i$$

$$\text{or } F = \frac{2i}{r} \text{ where } r^2 = x^2 + h^2$$

(See Chapman and Bartels 1940, p. 27.)

$$H = \frac{2i}{r} \cdot \frac{h}{r} = 2i \cdot \frac{h}{x^2 + h^2}$$

Y = 0 as the current is assumed to be of infinite length in the Y-direction.

$$Z = \frac{2i}{r} \cdot \frac{x}{r} = 2i \cdot \frac{x}{x^2 + h^2}$$

the extrema of Z fall at $\frac{dZ}{dx} = 0$ i.e. $x = \pm h$. This shows that the Z-perturbation due to the electrojet would have its maximum value at distances equal to the height of the electrojet on either side of jet centre line. More realistic models of the electrojet assumed in the past taking into consideration the induction inside the earth have been worked out and the reader is referred to Chapman (1951) and Onwumechilli (1967).

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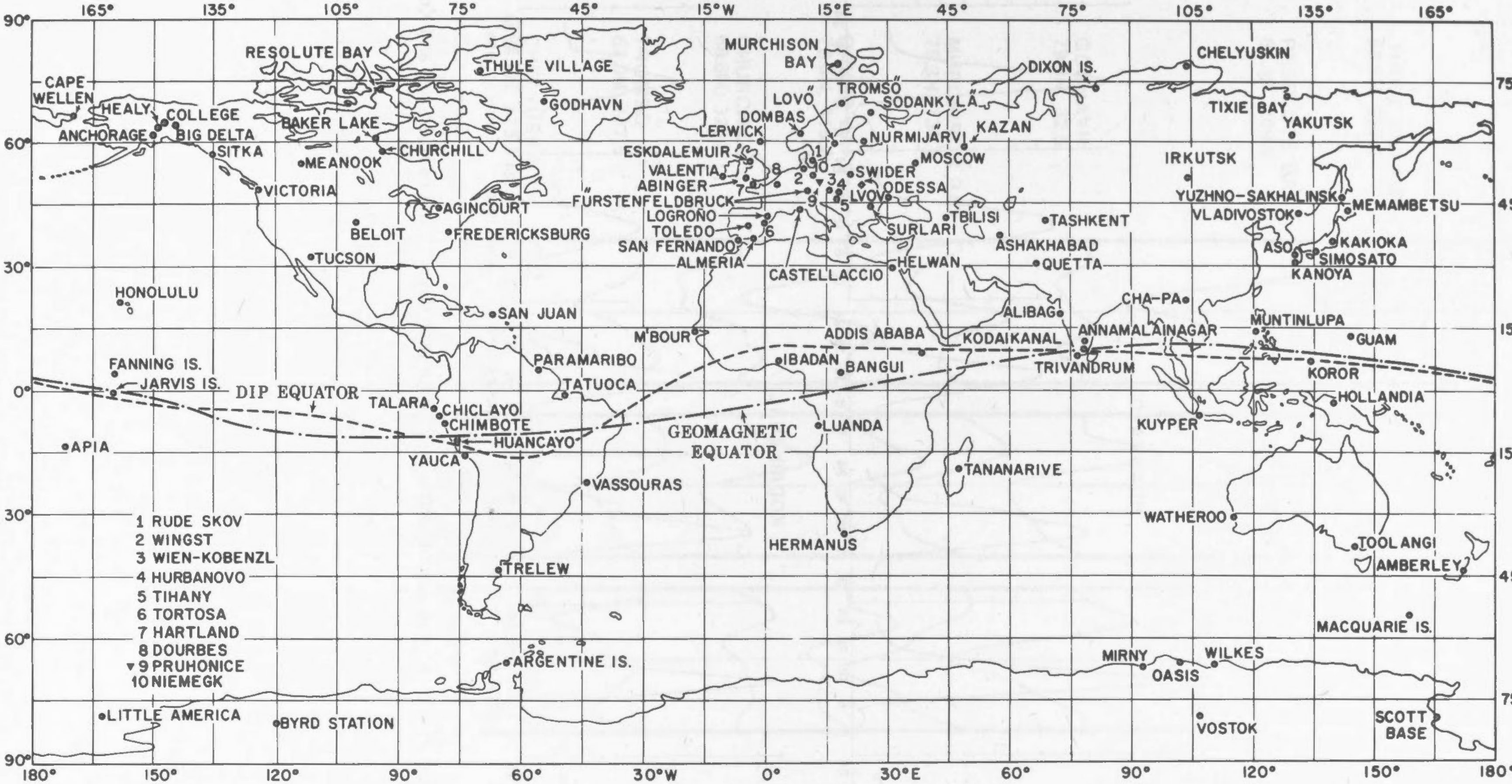


Figure 1. The world map shows the locations of the stations included in the analysis. Where space permits, the names are indicated alongside the station; in Europe the map is crowded and ten stations are numbered and their names are given on a separate list on the map. The geomagnetic equator is shown by the chain line and the dip equator by a broken line.

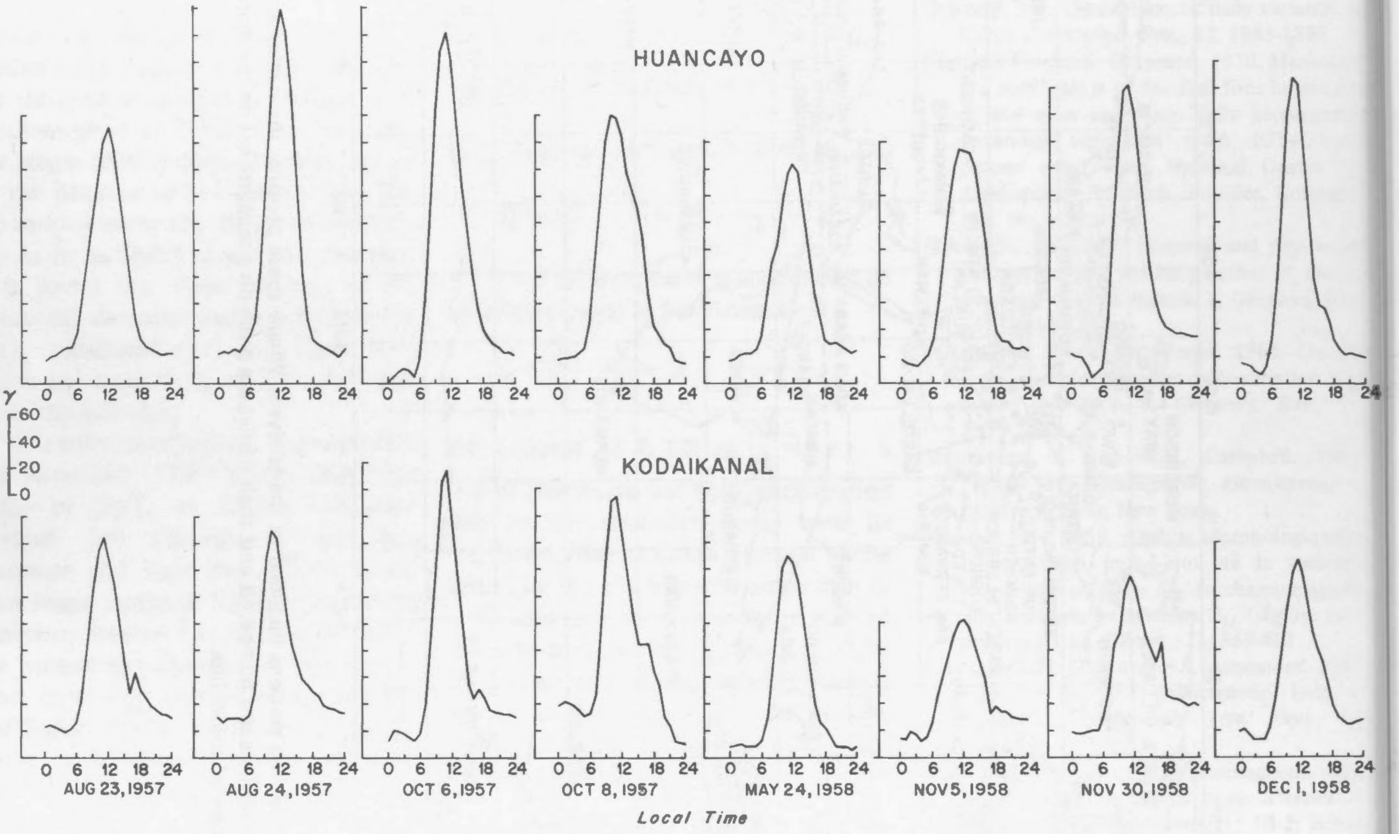


Figure 2. Daily variations of H on the individual eight days (Cp = 0.0 for each day) at stations Huancayo and Kodaikanal.

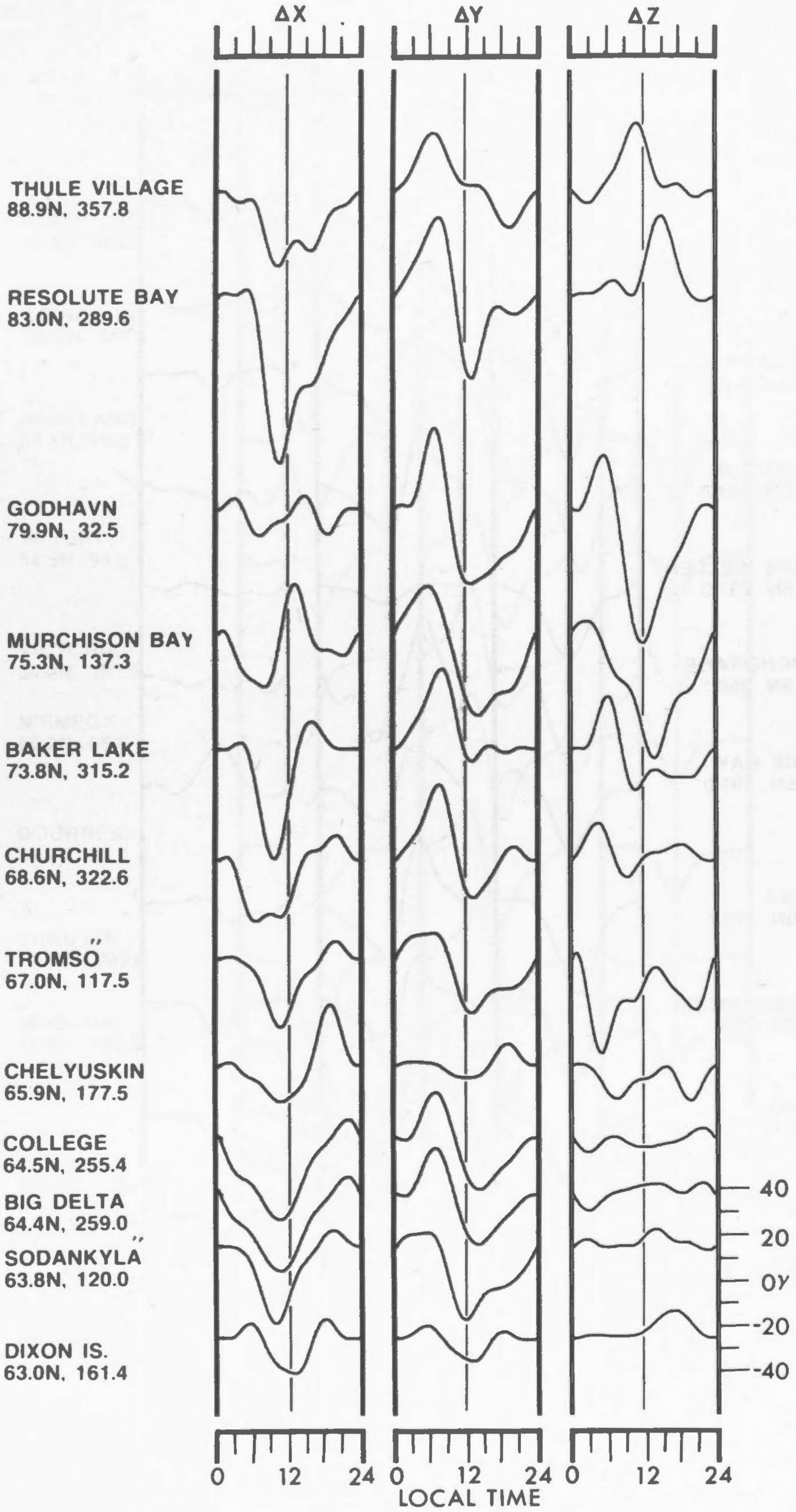


Figure 3a

Figure 3. Solar daily variation of Sq for the components X, Y and Z for the eight most quiet days (Cp = 0.0) of the IGY period; geomagnetic coordinates (in degrees) are indicated underneath the station.

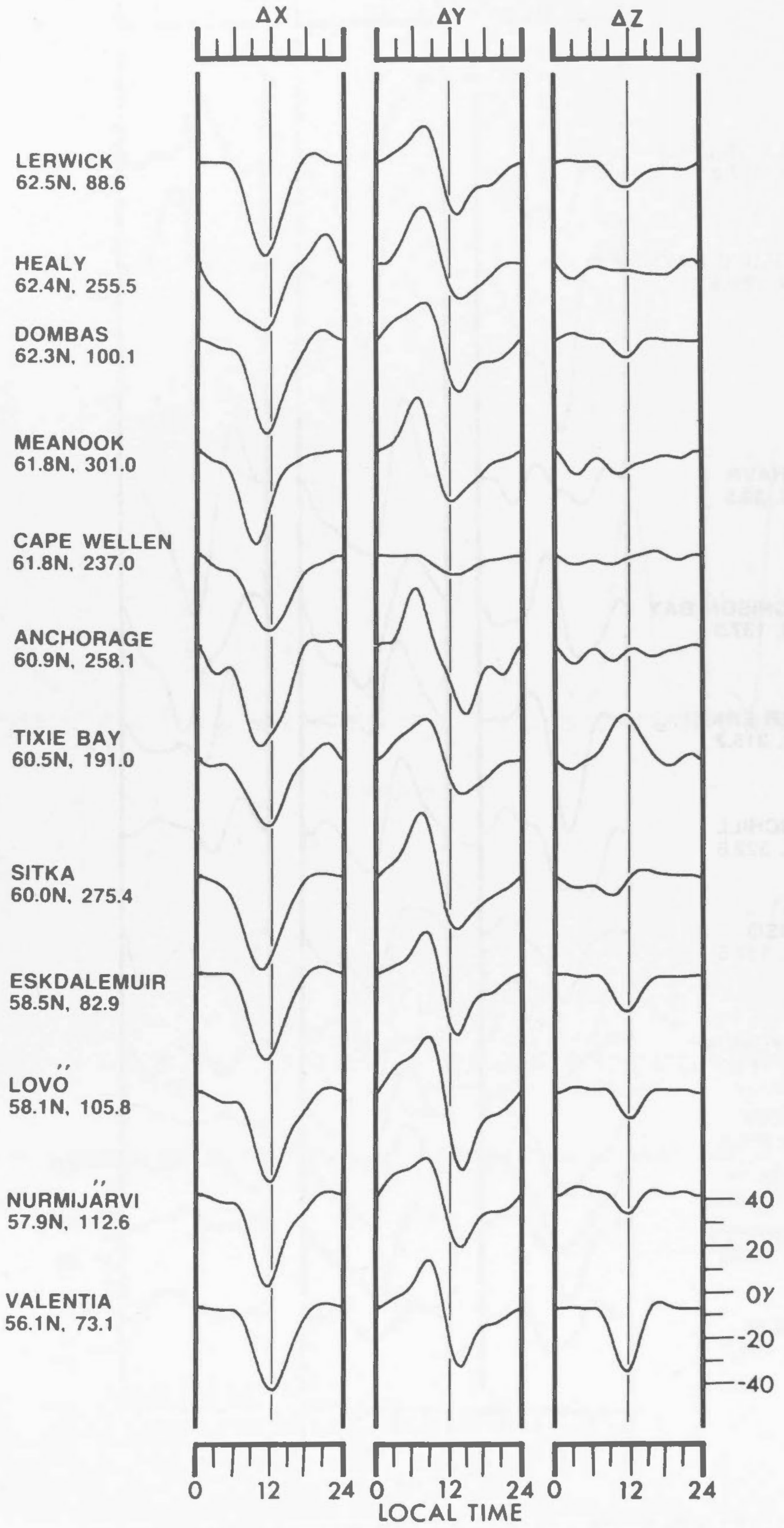

ΔX
ΔY
ΔZ
LERWICK
62.5N, 88.6
HEALY
62.4N, 255.5
DOMBAS
62.3N, 100.1
MEANOOK
61.8N, 301.0
CAPE WELLEN
61.8N, 237.0
ANCHORAGE
60.9N, 258.1
TIXIE BAY
60.5N, 191.0
SITKA
60.0N, 275.4
ESKDALEMUIR
58.5N, 82.9
LOVÖ
58.1N, 105.8
NURMIJÄRVI
57.9N, 112.6
VALENTIA
56.1N, 73.1
40
20
0γ
-20
-40
0
12
24
0
12
24
0
12
24
LOCAL TIME

Figure 3b

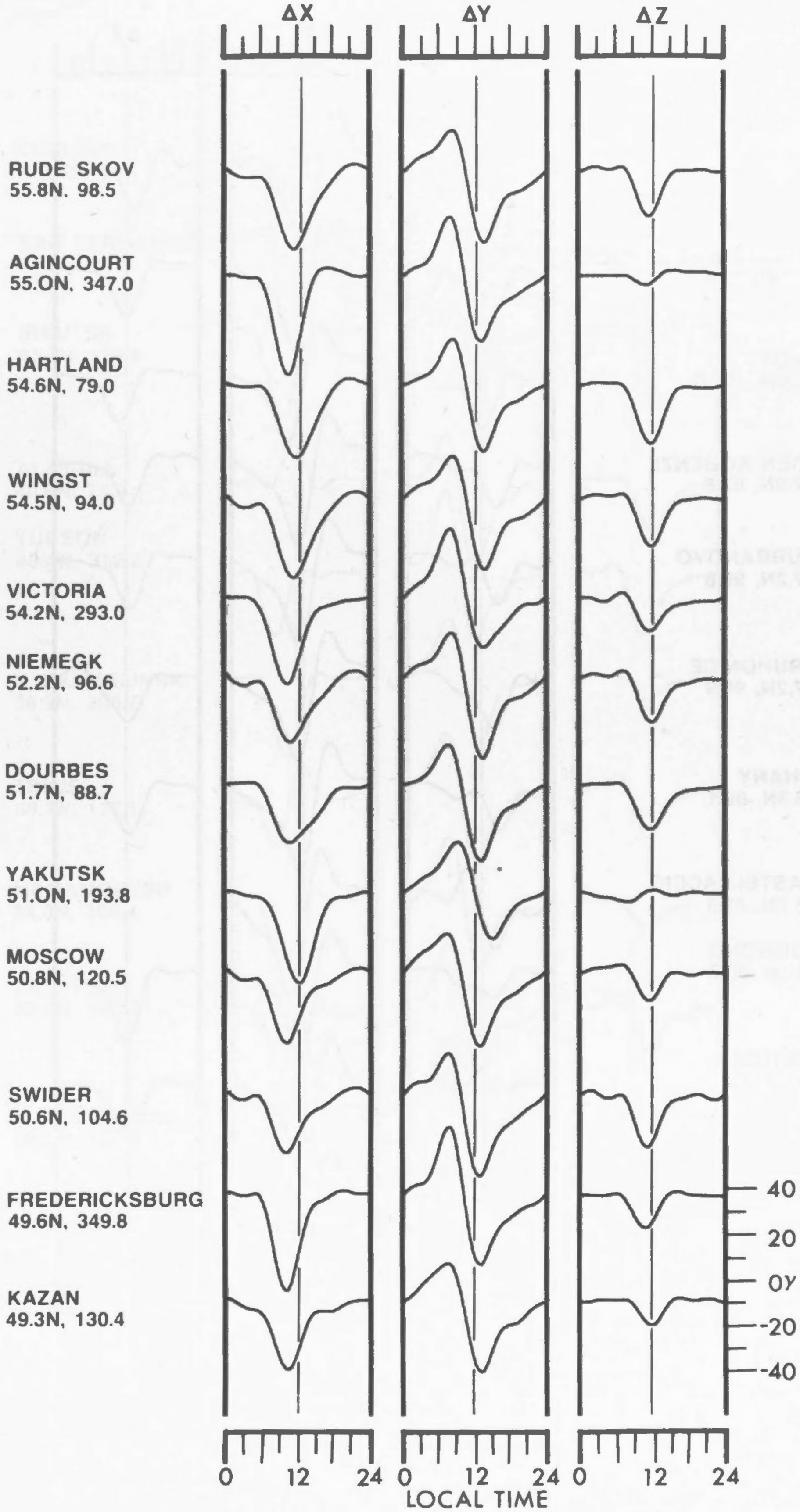

ΔX
ΔY
ΔZ
RUDE SKOV
55.8N, 98.5
AGINCOURT
55.0N, 347.0
HARTLAND
54.6N, 79.0
WINGST
54.5N, 94.0
VICTORIA
54.2N, 293.0
NIEMEGK
52.2N, 96.6
DOURBES
51.7N, 88.7
YAKUTSK
51.0N, 193.8
MOSCOW
50.8N, 120.5
SWIDER
50.6N, 104.6
FREDERICKSBURG
49.6N, 349.8
KAZAN
49.3N, 130.4
40
20
0γ
-20
-40
0
12
24
0
12
24
0
12
24
LOCAL TIME

Figure 3c

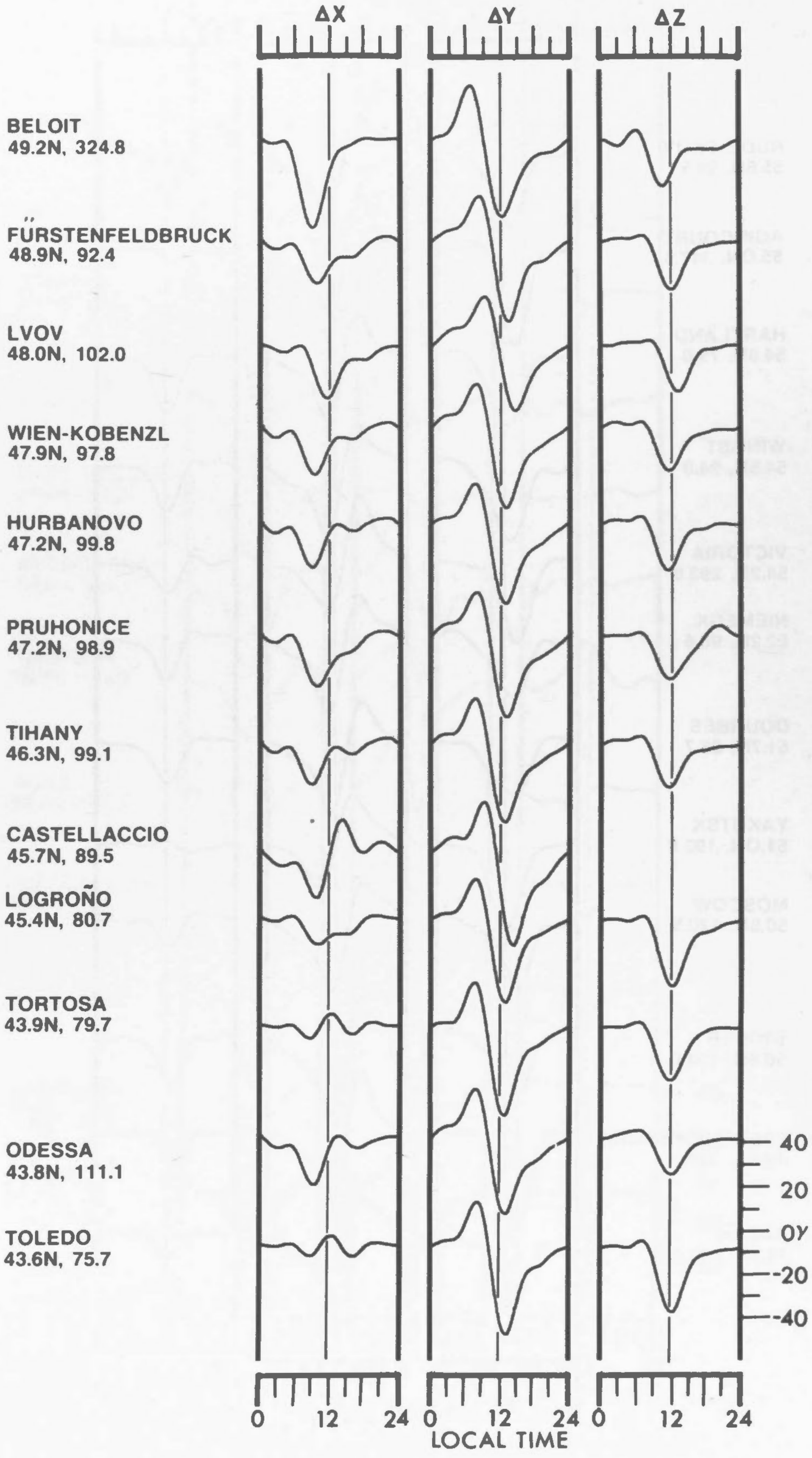

ΔX
ΔY
ΔZ
BELOIT
49.2N, 324.8
FÜRSTENFELDBRUCK
48.9N, 92.4
LVOV
48.0N, 102.0
WIEN-KOBENZL
47.9N, 97.8
HURBANOVO
47.2N, 99.8
PRUHONICE
47.2N, 98.9
TIHANY
46.3N, 99.1
CASTELLACCIO
45.7N, 89.5
LOGROÑO
45.4N, 80.7
TORTOSA
43.9N, 79.7
ODESSA
43.8N, 111.1
TOLEDO
43.6N, 75.7
40
20
0γ
-20
-40
0
12
24
0
12
24
0
12
24
LOCAL TIME

Figure 3d

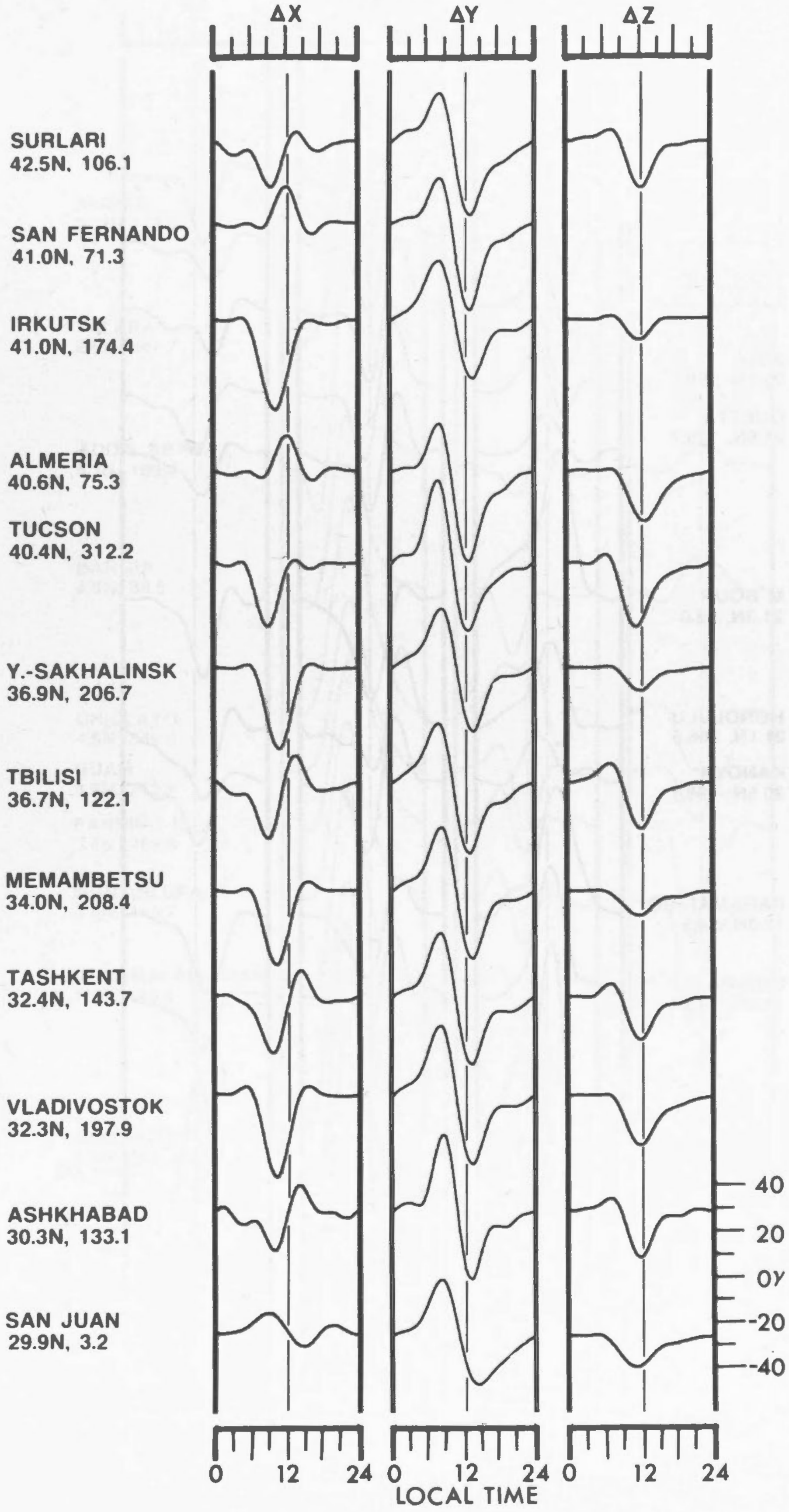
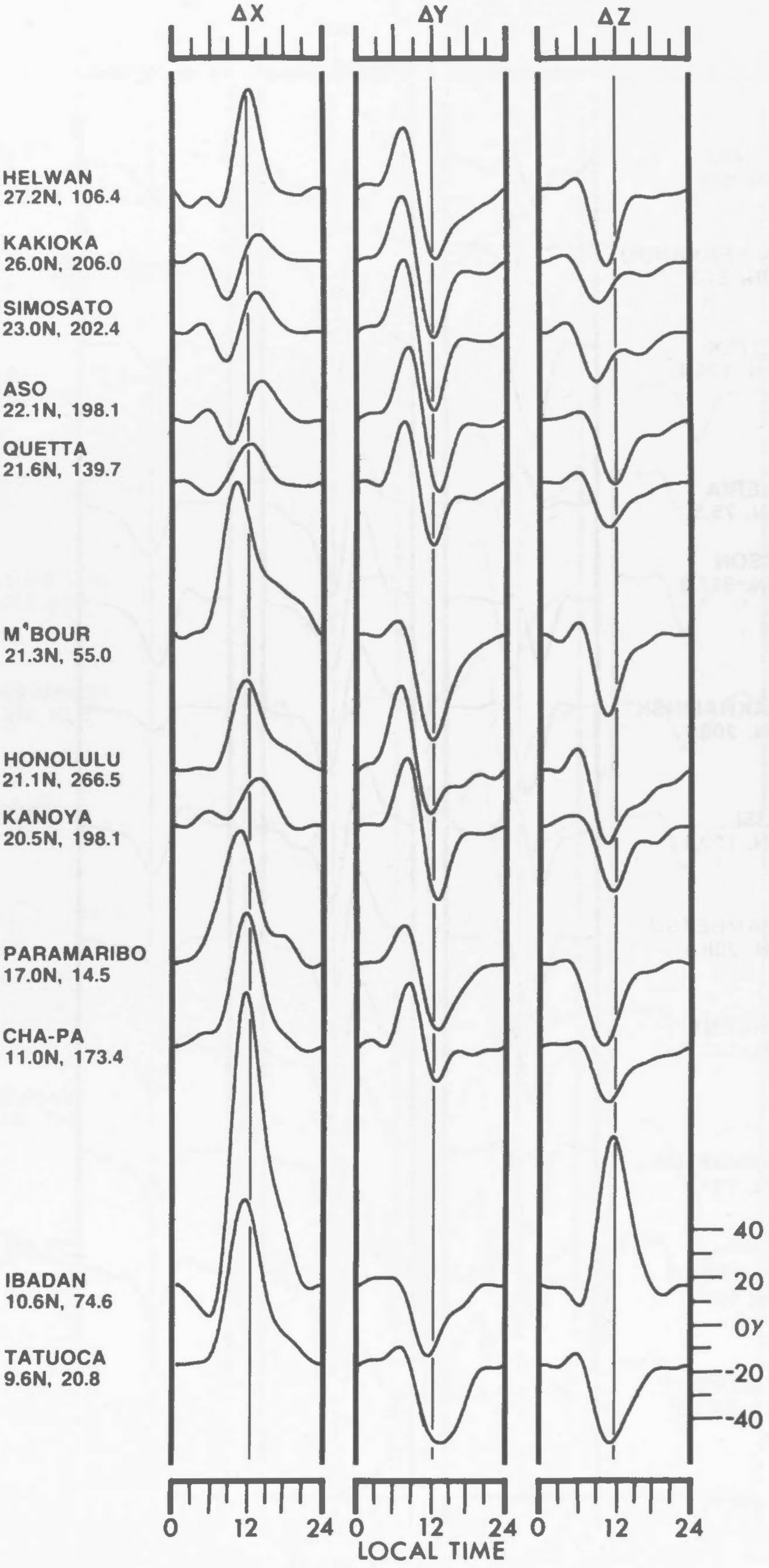

ΔX
ΔY
ΔZ
SURLARI
42.5N, 106.1
SAN FERNANDO
41.0N, 71.3
IRKUTSK
41.0N, 174.4
ALMERIA
40.6N, 75.3
TUCSON
40.4N, 312.2
Y.-SAKHALINSK
36.9N, 206.7
TBILISI
36.7N, 122.1
MEMAMBETSU
34.0N, 208.4
TASHKENT
32.4N, 143.7
VLADIVOSTOK
32.3N, 197.9
ASHKHABAD
30.3N, 133.1
SAN JUAN
29.9N, 3.2
40
20
0γ
-20
-40
0
12
24
0
12
24
0
12
24
LOCAL TIME

Figure 3e

Figure 3f


ΔX
ΔY
ΔZ
HELWAN
27.2N, 106.4
KAKIOKA
26.0N, 206.0
SIMOSATO
23.0N, 202.4
ASO
22.1N, 198.1
QUETTA
21.6N, 139.7
M'BOUR
21.3N, 55.0
HONOLULU
21.1N, 266.5
KANOYA
20.5N, 198.1
PARAMARIBO
17.0N, 14.5
CHA-PA
11.0N, 173.4
IBADAN
10.6N, 74.6
TATUOCA
9.6N, 20.8
40
20
0γ
-20
-40
0
12
24
0
12
24
0
12
24
LOCAL TIME

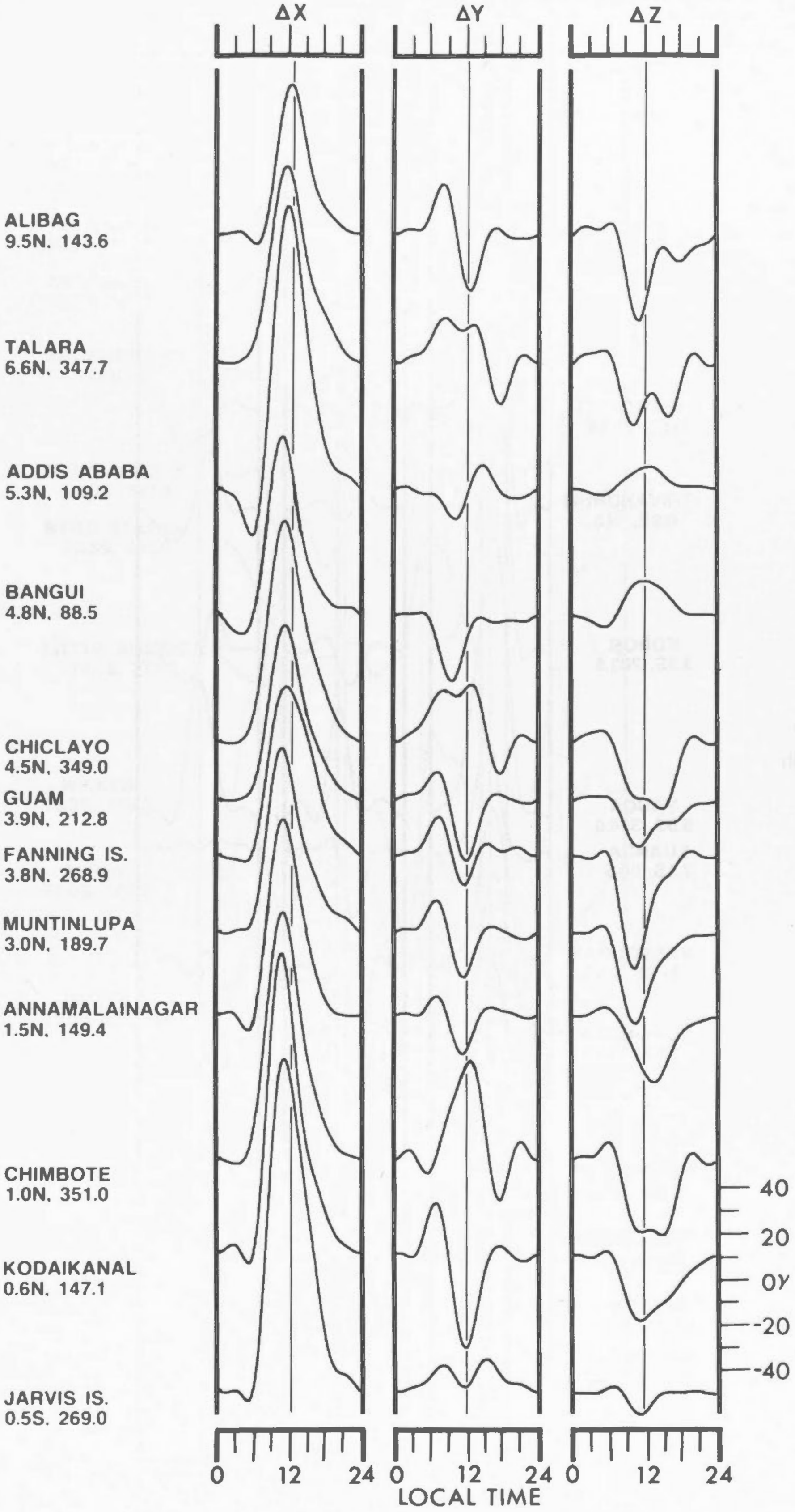
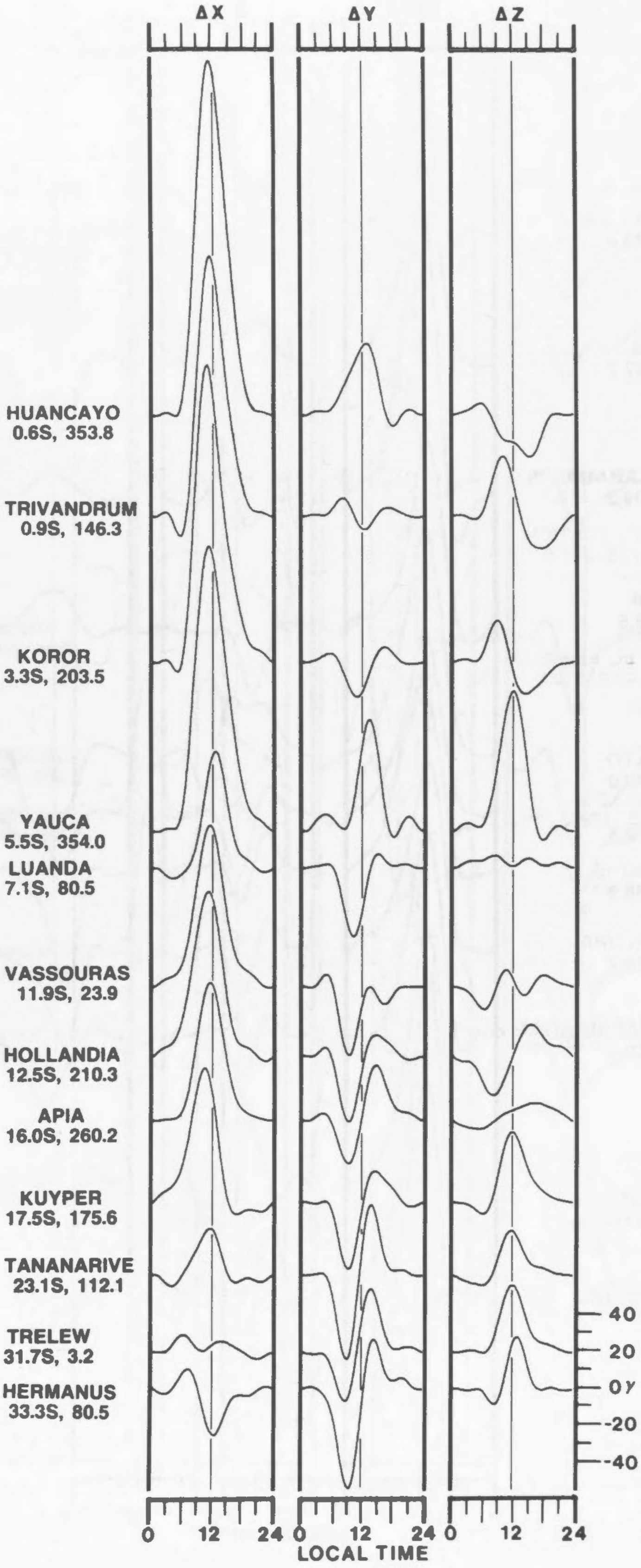

ΔX
ΔY
ΔZ
ALIBAG
9.5N. 143.6
TALARA
6.6N. 347.7
ADDIS ABABA
5.3N. 109.2
BANGUI
4.8N. 88.5
CHICLAYO
4.5N. 349.0
GUAM
3.9N. 212.8
FANNING IS.
3.8N. 268.9
MUNTINLUPA
3.0N. 189.7
ANNAMALAINAGAR
1.5N. 149.4
CHIMBOTE
1.0N. 351.0
KODAIKANAL
0.6N. 147.1
JARVIS IS.
0.5S. 269.0
40
20
0γ
-20
-40
0
12
24
0
12
24
0
12
24
LOCAL TIME

Figure 3g

Figure 3h


ΔX
ΔY
ΔZ
HUANCAYO
0.6S, 353.8
TRIVANDRUM
0.9S, 146.3
KOROR
3.3S, 203.5
YAUCA
5.5S, 354.0
LUANDA
7.1S, 80.5
VASSOURAS
11.9S, 23.9
HOLLANDIA
12.5S, 210.3
APIA
16.0S, 260.2
KUYPER
17.5S, 175.6
TANANARIVE
23.1S, 112.1
TRELEW
31.7S, 3.2
HERMANUS
33.3S, 80.5
40
20
0γ
-20
-40
0
12
24
0
12
24
0
12
24
LOCAL TIME

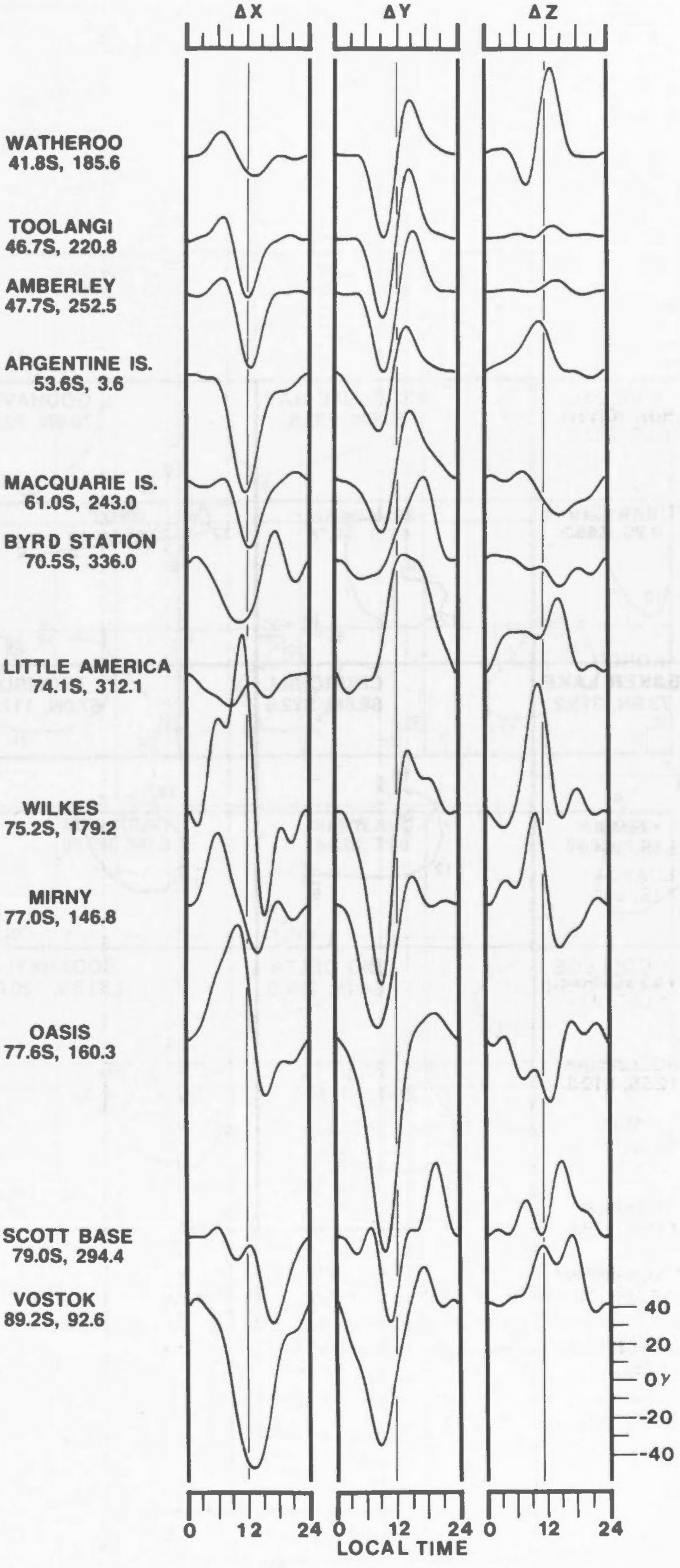

ΔX
ΔY
ΔZ
WATHEROO
41.8S, 185.6
TOOLANGI
46.7S, 220.8
AMBERLEY
47.7S, 252.5
ARGENTINE IS.
53.6S, 3.6
MACQUARIE IS.
61.0S, 243.0
BYRD STATION
70.5S, 336.0
LITTLE AMERICA
74.1S, 312.1
WILKES
75.2S, 179.2
MIRNY
77.0S, 146.8
OASIS
77.6S, 160.3
SCOTT BASE
79.0S, 294.4
VOSTOK
89.2S, 92.6
40
20
0γ
-20
-40
0
12
24
0
12
24
0
12
24
LOCAL TIME

Figure 3i

Figure 4a

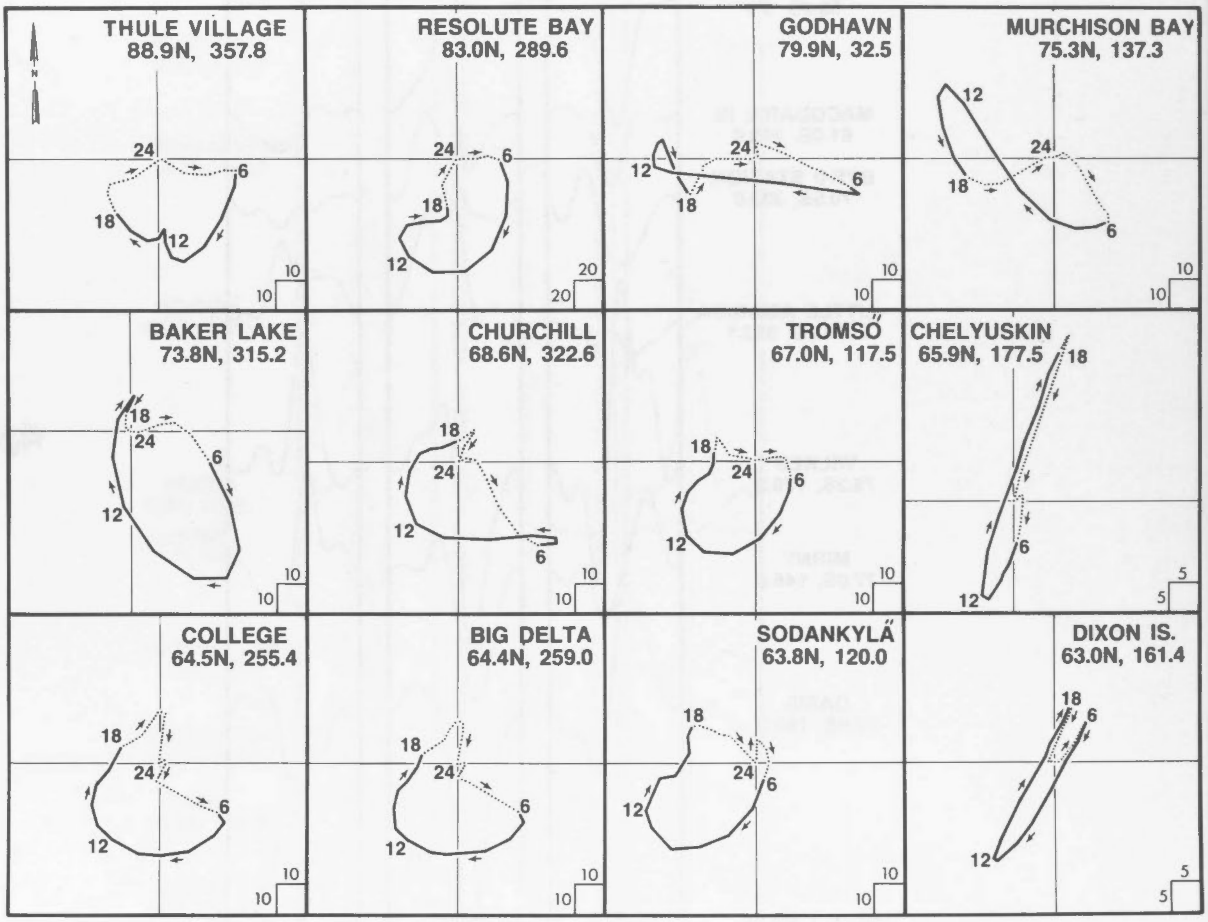


Figure 4. Vectograms obtained from the X and Y deviations of the eight most quiet days (Cp = 0.0) of the IGY period; the geomagnetic coordinates (in degrees) are indicated underneath the station. The day part is shown by a continuous line and the night part by a broken line. The scales for the X and Y axes are given on the lower right-hand corner.

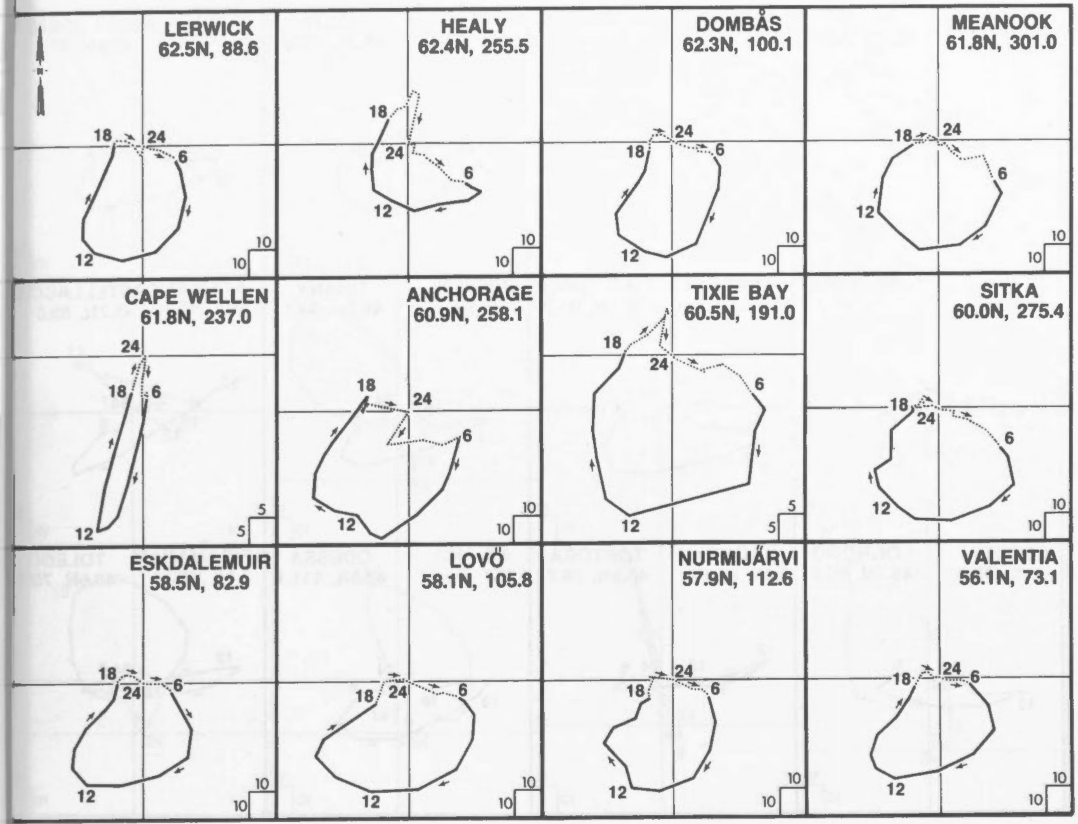


Figure 4b

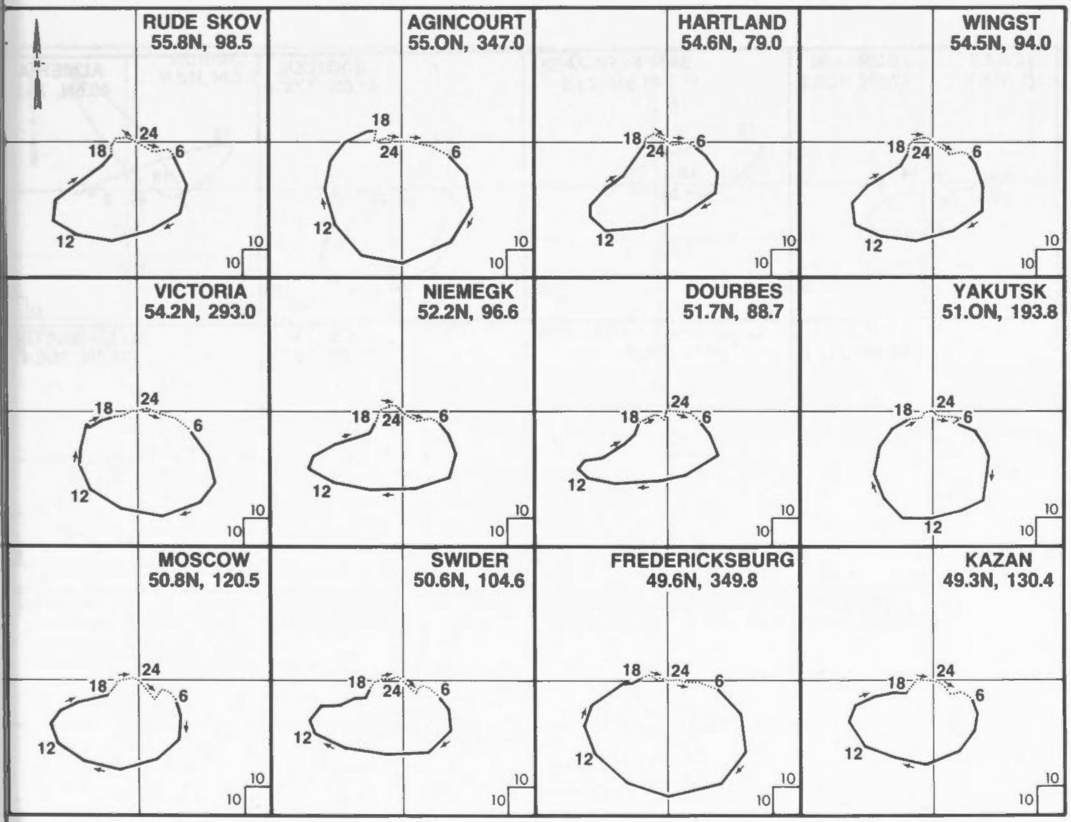


Figure 4c

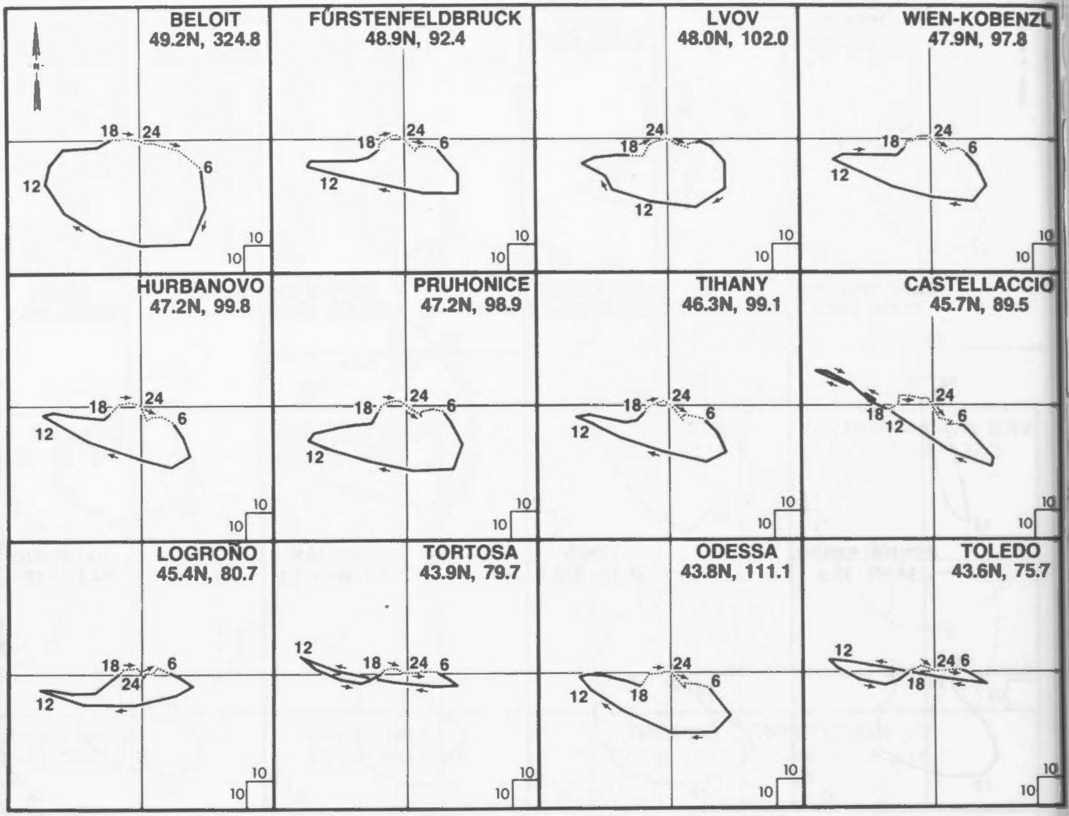


Figure 4d

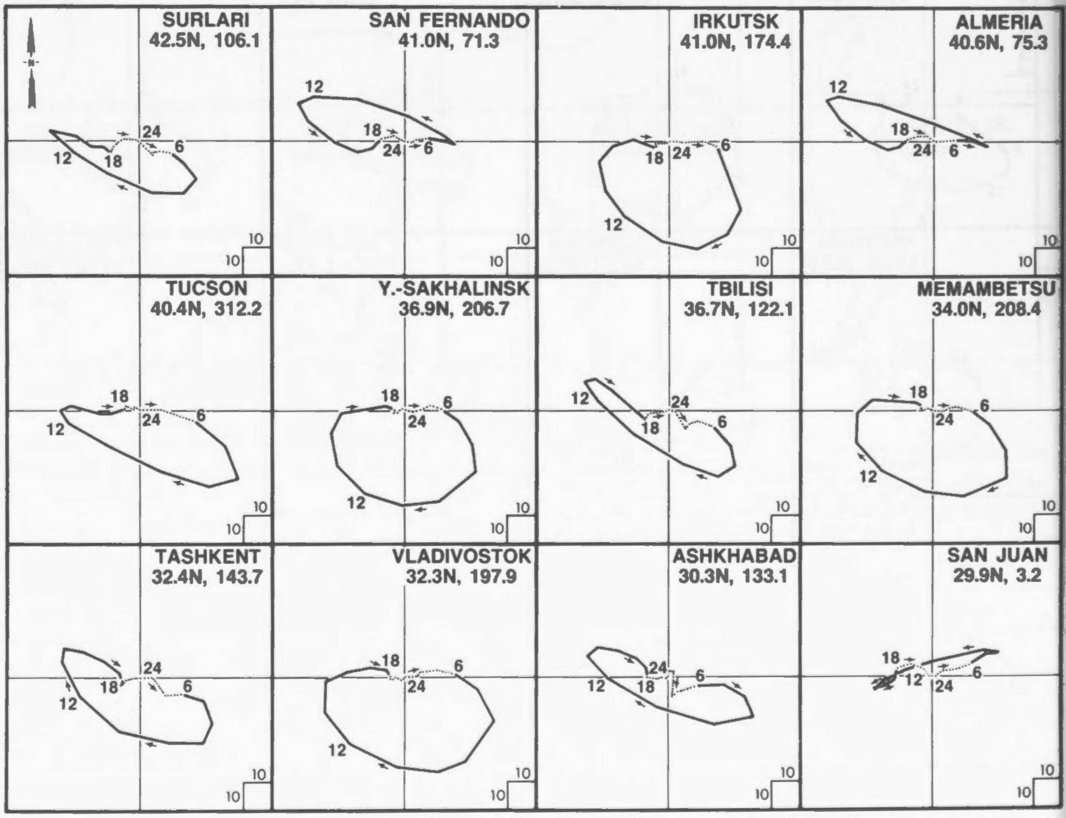


Figure 4e

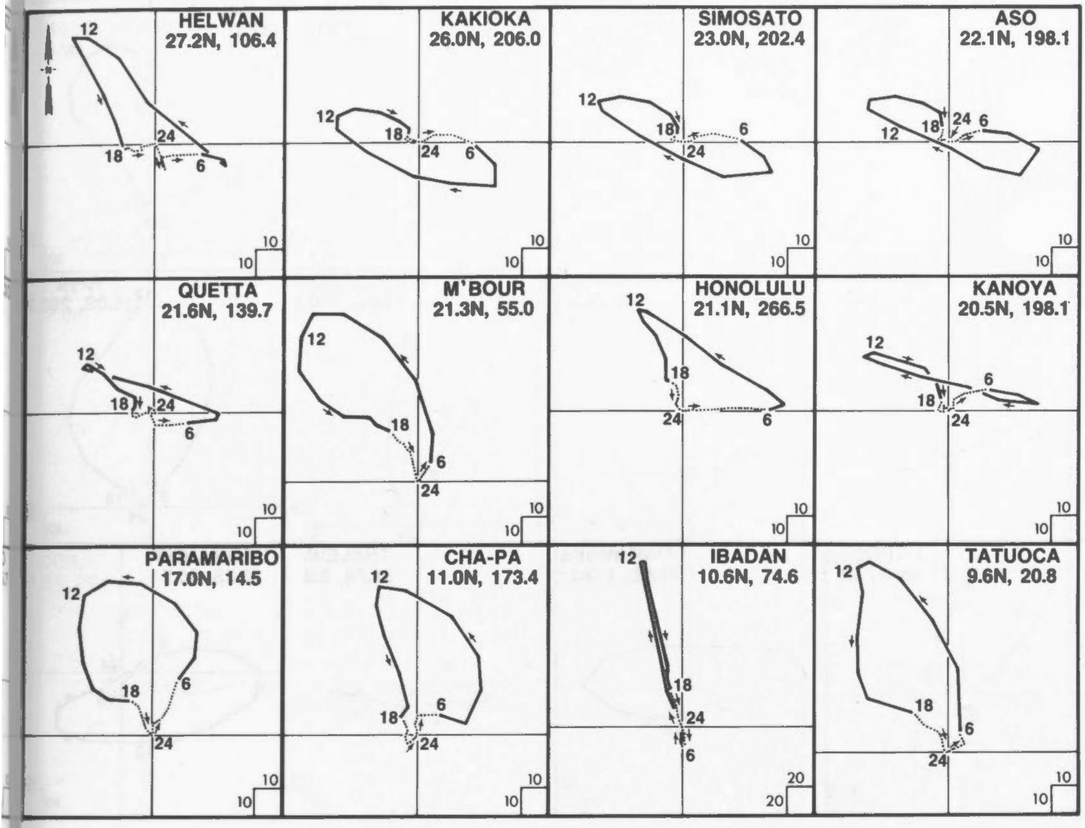


Figure 4f

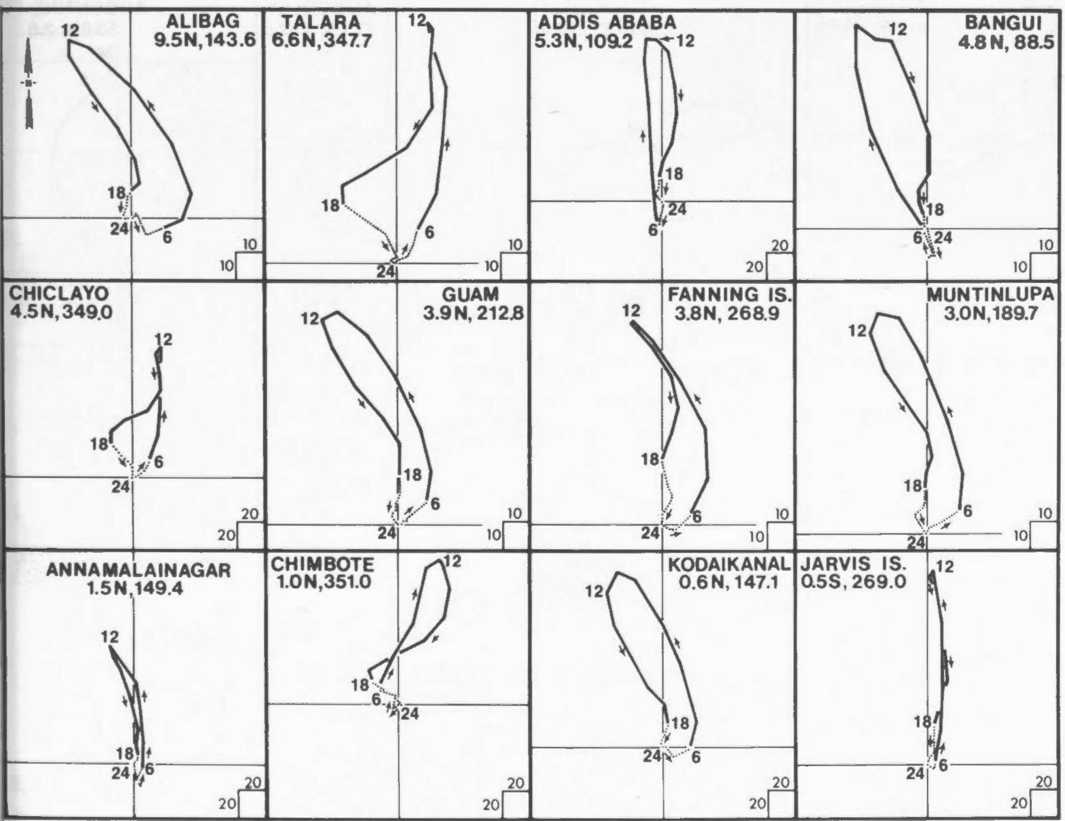


Figure 4g

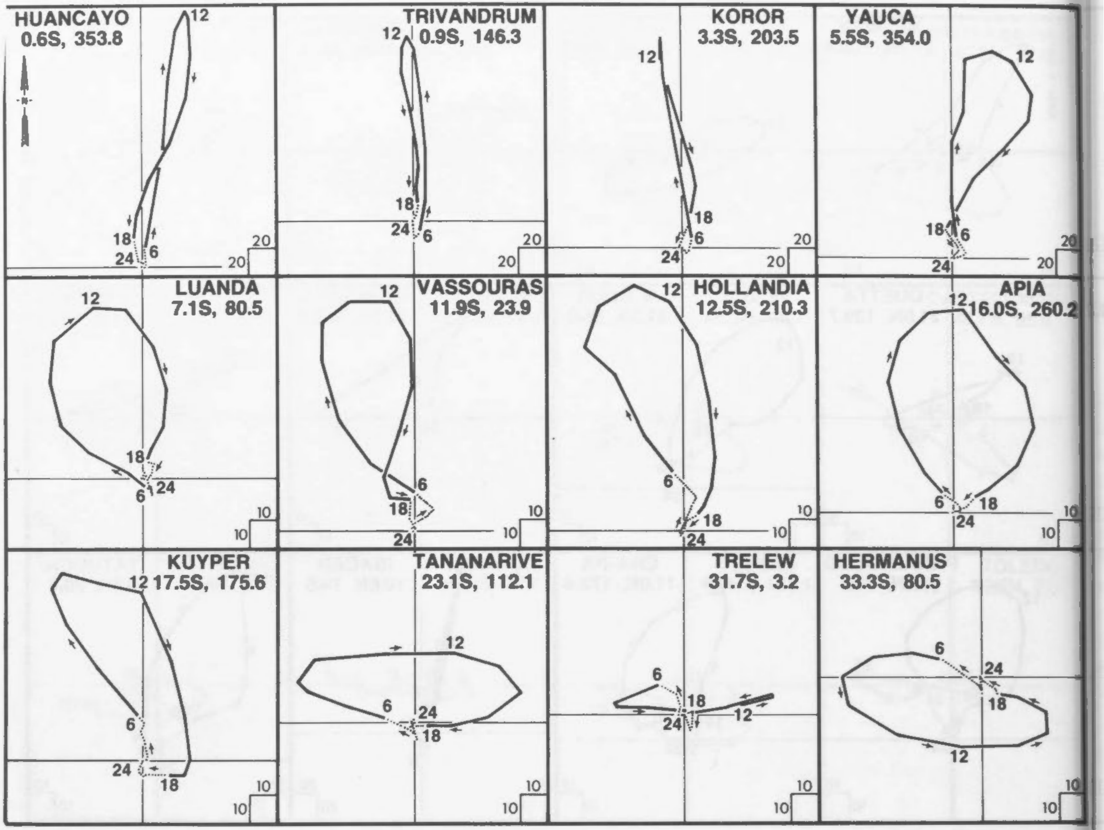


Figure 4h

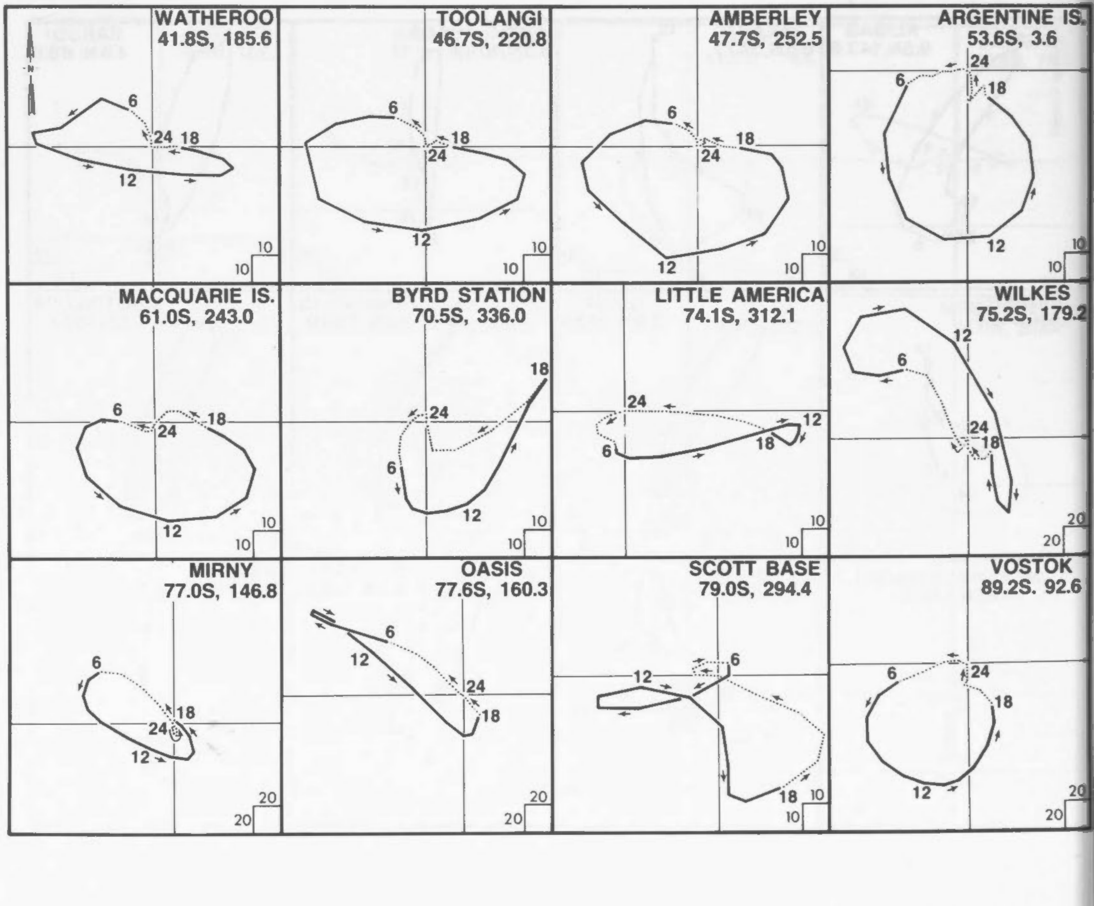


Figure 4i