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2. Some Paleomagnetic measurements in Korean Peninsula

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Introduction

A paleomagnetic study in the Korean Peninsula was carried out as a program of the Japan-Korea cooperation work titled "Paleomagnetism, age dating and gravity study at central and southern part of Korean Peninsula, comparing with the moving of Southwest Japan".

The main purpose of this study from the sight of Japanese paleomagnetists is to accumulate paleomagnetic data in Korea so as to draw the reference apparent polar wondering path (APWP) for Japanese paleomagnetic work. Of course it needs scarcely be said that the APWP also gives the relative motion of the Korean Peninsula and the remainder of the Eurasian Continent. A problem which paleomagnetic studies in Japanese Islands often facing is the problem of reference. The position of the Japanese islands relative to the east end of the Eurasian Continent is important factor for the consideration of tectonic environment of the islands. Previous works used the APWP of Eurasian continent as the reference (e.g. Yaskawa 1975; Otofuji et al. 1985), or discuss only the deformation within the Japanese islands themselves (Kawai et al., 1971). The APWP of the Eurasian continent, however, does not owe to paleomagnetic data obtained from East Asia but to those from Europe or northern Asia (e.g. Irving, 1977). The paleomagnetists have had to make a notice that they supposed for the Eurasian Continent to have been experienced no deformation since the age of his paleomagnetic data. Therefore, the paleomagnetic results from Korean Peninsula have long been desired.

Main joint sampling journey of Japanese and Korean research members was carried out in July, 1983, and additional sampling was also made in Oct, 1984. A considerable number of the samples was collected by Korean research member only from Chugaryeong, Seoul, Kimpo and Bupyeong areas. The sampling sites were distributed widely in the southern part of the Korean Peninsula (Fig. 2-1) and the ages of these samples range from Cambrian to Quaternary. Samples with the ages of Cambrian to Triassic were collected in Jangseong and Mungyeong areas (e and f in Fig. 2-1, respectively), which are located in northeastern Ogcheon Zone. The sites of Jurassic samples were widely distributed, and located at Kimpo, Seoul, Mungyeong, Kumcheon, and Koryeong area (b, d, f, g, h in Fig. 2-1, respectively). Cretaceous samples were collected from Chugaryeong, Bupyeong and Koryeong areas (a, c and h in Fig. 2-1). Tertiary and Quaternary samples were collected from Chugaryeong and Pohang areas (a and i in Fig. 2-1, respectively). Informations on individual sampling site (number of samples, latitude, longitude, name of 1/50,000 map, age and rock type) are listed in Appendix 1.

Although many specimens are still remained waiting for measurement, a considerable number of specimens, especially from the Chugaryeong, Jangseong, Mungyeong and Pohang areas was finished to perform the paleomagnetic measurement and demagnetization. In this paper, We present the results already obtained, with brief description of experimental procedure employed.

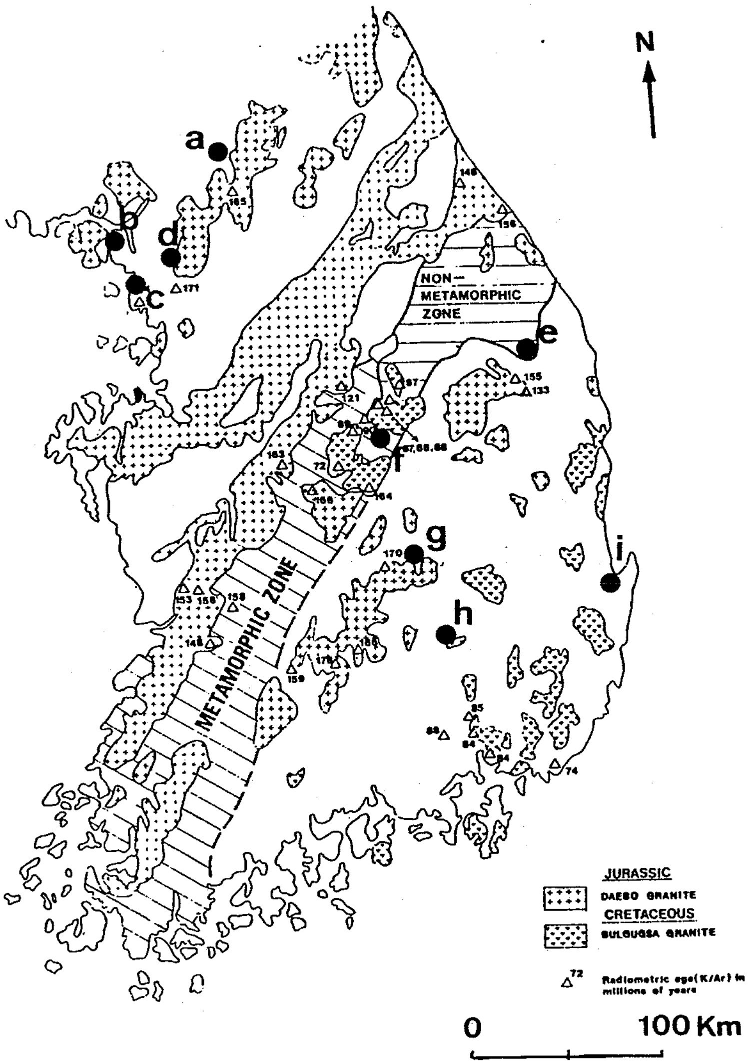


Fig. 2-1 Map showing the sampling localities.
a: Chugaryeong b: Kimpo c: Bupyeong d: Seoul e: Jangseong
f: Mungyeong g: Kumcheon h: Koryeong i: Pohang

Description of geology with no site of reference is mainly from Reedman and Um (1975), Kim (1982), and Um and Chun (1983).

Field and Laboratory Procedures

Oriented hand samples were collected using a magnetic compass in the manner described by Hirooka (1971). Cylindrical specimens with length and diameter of about 24mm were prepared from each hand sample. Coring was mainly made by a diamond core drill attached on a boring machine in Yonsei University, and cutting was mainly made by rock cutter in Kyoto University.

Measurement, demagnetization and data analysis were performed in Kyoto University. Measurements of remanence were carried out using an SCT cryogenic rock magnetometer for weakly magnetized specimens, or with a Schonstedt SSM-1A spinner magnetometer for relatively strongly magnetized specimens. These measuring instrument were connected with NEC PC-8001mkII and SHARP PC-7300 microcomputers, respectively, for stacking of data, and calculation of paleomagnetic direction.

Thermal demagnetization was accomplished in a non-inductively wound electric furnace contained within three layered mu-metal shield (Itoh and Torii, 1984). During the cooling cycle, the furnace was withdrawn from the region where specimens were placed so as to reduce the magnetic field. The mu-metal shields were frequently demagnetized by alternating field method such that the residual field in the sample space was maintained at less than 10 gammas during the cooling cycle. Progressive demagnetization was performed in 10 or more steps up to a step that the remanence had either become too weak for meaningful measurement or become masked by excessive build-up of VRM (viscous remanent magnetization).

Alternating field (a.f.) demagnetization was carried out by means of a two axis tumbler situated in a solenoid coil capable of giving a 1600 Oe field. The coil and the tumbler system were placed also in a magnetic field free space (less than 10 gammas) produced by a two layered mu-metal cylindrical shield.

Pre-Jurassic Sedimentary Rocks in Ogcheon Zone

Excepting for the Pre-Cambrian metamorphic rocks, pre-Jurassic rocks in the southern part of Korean Peninsula are distributed only in Ogcheon Zone. The paleomagnetic investigation of Ogcheon Zone is, therefore, indispensable to determine the paleoposition of Korean Peninsula in Paleo- and Mesozoic Eras. We performed the sampling in Jangseong and Mungyeong areas where the geological sequence is relatively continuous.

Until the present, progressive thermal demagnetization of pilot specimen from the most of the sites was finished. The results of the progressive thermal demagnetization show that the magnetization of the specimens in these areas is able to be classified into three groups (see orthogonal demagnetization diagrams for sites 11-27, 28-32 and 40-45 in Appendix B). Namely, (A) ones which are so unstable throughout the demagnetization procedure that we could not determine the reliable paleomagnetic direction (sites 11 b and 21 for Jangseong area, and sites 29-31, 41, 44 and 45 for Mungyeong area), (B) ones with single component at above 200°C (sites 11 a, 12 and 14-19 for Jangseong area, and sites 34, 35, 40 and 42 for Mungyeong area), (C) ones with double components at above 200°C (sites 13, 20, 22, 24, 25 and 27 for Jangseong area, and sites 32 and 43 for Mungyeong area).

The magnetic mineral mainly carrying the both components of remanence of (C) group specimens is thought to be mainly hematite, because the blocking temperature of them exceeded the Curie point of magnetite and no kink was found at that Curie point on the demagnetization curve. The two components are, however, fairly well distinguished from each other, since the upper limit of the blocking temperature of the lower component is about 640°C and the higher component has so high and narrow spectrum of blocking temperature that almost entire fraction of the component is removed within one demagnetization step of 670°C-700°C. Even if some of the lower component is remained above 670°C, it would not be large enough to make a significant directional change to the remanent magnetization after a treatment of 670°C. Therefore we referred the magnetic direction at 670°C to a single isolated component. The other hand, the magnetic mineral carrying the remanence of group (B) is thought to be magnetite or titanomagnetite, because the highest temperature of the blocking temperature spectrum is just below the Curie temperature of magnetite.

The magnetic directions before and after correction for tilting are illustrated in Fig. 2-2. Assuming that the Permian direction is reversed, as reversed epoch seems dominant in Permian age (Irving and Pullaiah, 1976), the paleolatitude of this result is coincide with another result from Sino-Korean block (McElhinny et al., 1981). The change in paleolatitude of Korean Peninsula seems to be as follows; (1) in southern hemisphere in the Cambrian, (2) in very low latitude in the Carboniferous, (3) slightly low latitude from the Permian to Triassic. We would not discuss about rotation of Korean Peninsula or Sino-Korean block here, since the tectonic structure of the Ogcheon Zone is so complex that the declination obtained through simple tilting correction does not seem represent rotation of whole the peninsula.

The magnetic directions before tilting correction of (B) group and

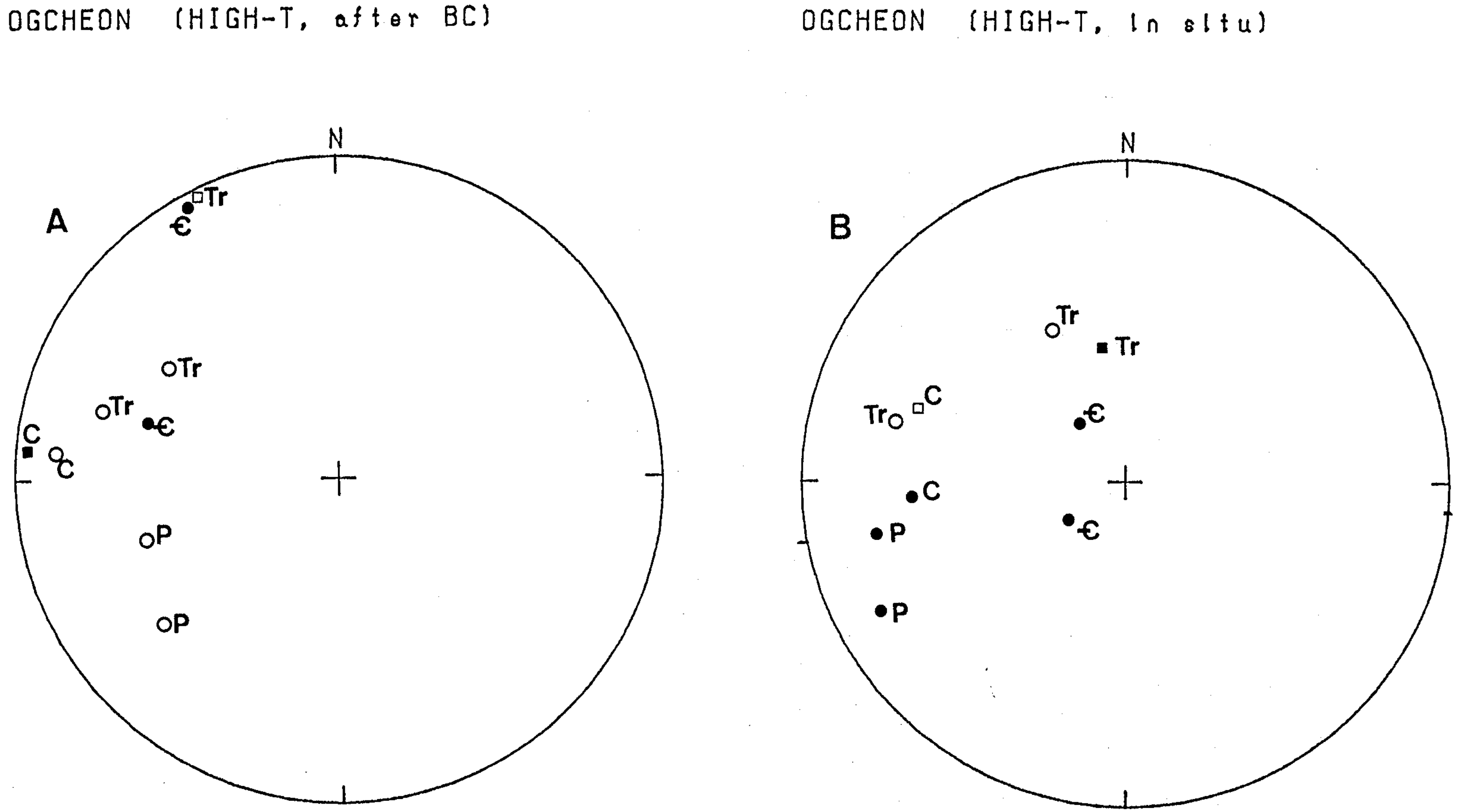


Fig. 2-2 Equal area projection of the high temperature component (magnetic directions at 660°C or 670°C) of pre-Jurassic rocks in Jangseong and Mungyeong area after (A) and before (B) bedding correction. Circles and squares show Jangseong and Mungyeong areas, and open and solid symbols represent upper and lower hemisphere, respectively.
Є: Cambrian C: Carboniferous P: Permian Tr: Triassic

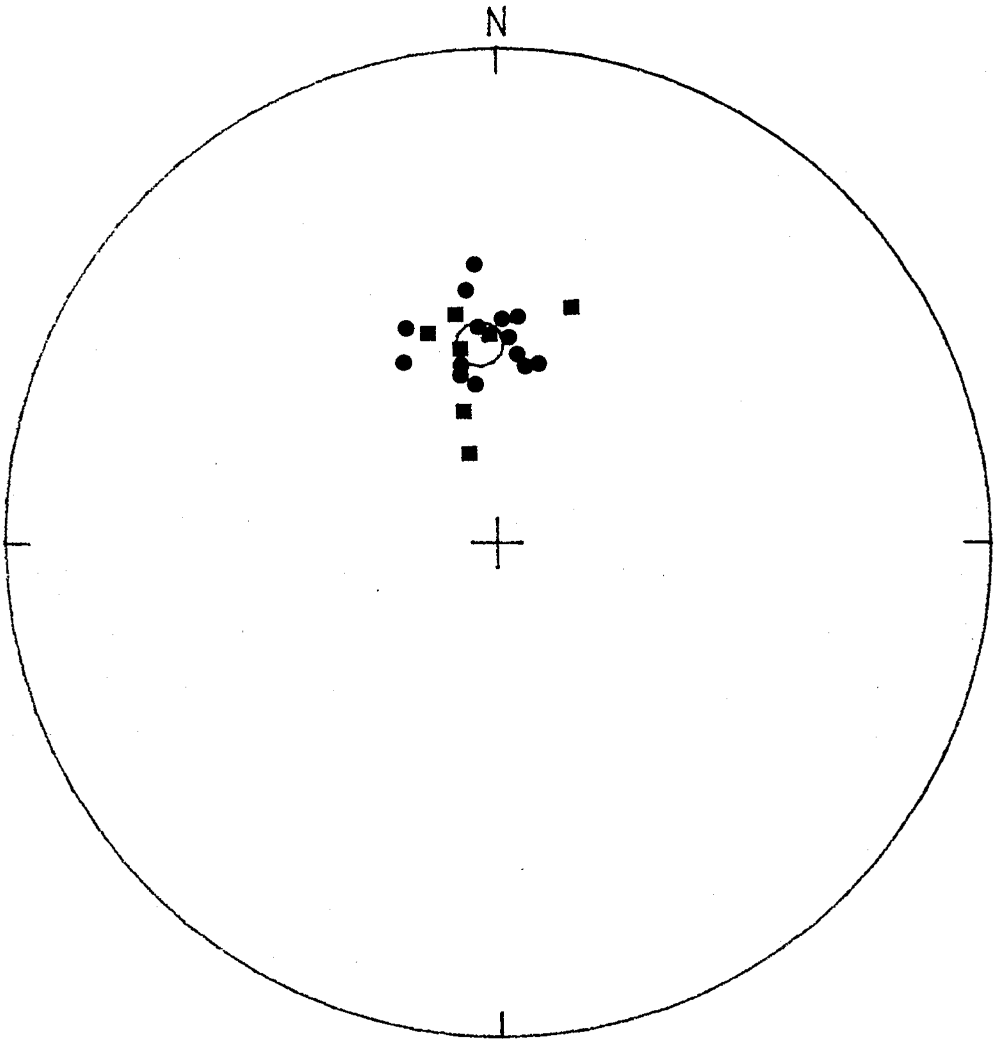
lower component of (C) group have a similar direction regardless of age and tilting of the bedding plane (Fig. 2-3). This fact indicates that these magnetizations were acquired after the structural movement which formed a complex structure of the Ogcheon Zone. The magnetic direction seems to be same as the present geomagnetic direction. However, some paleomagnetic works on Cretaceous rocks in Korean Peninsula (Kienzle and Scharon 1966; Ito and Tokieda 1980; Otofuji et al. 1983) show that the apparent paleomagnetic pole has not been situated so distant from the present North pole. Moreover, recent paleomagnetic work for Sino-Korean block shows that Jurassic apparent pole position was very close to the present north pole (Lin et al., 1985). Thus, we have to take a possibility of an older origin of the secondary component into consideration. A Cretaceous stable remagnetization is widely found in both northeastern and southwestern Japan by recent improvement of Japanese paleomagnetic studies (Shibuya and Sasajima, 1985; Fujiwara and Morinaga, 1983; Tosha, 1984). The stable secondary magnetization in the Ogcheon Zone might be the same case and have similar origin as Japanese one.

Jurassic and Cretaceous Rocks Distributed in Korea

Jurassic and Cretaceous rocks are the oldest non-metamorphic rocks which are distributed rather widely on both out sides of the Ogcheon Zone. Some investigators have a impression that the Ogcheon Zone is a suture zone. The purpose of the paleomagnetic study of these rocks is to get an information about the relative movement between massifs on both sides of the Ogcheon Zone.

Sampling was carried out in Kimpo, Bupyeong, Mungyeong, Kumcheon and Koryeong areas. Measurements and demagnetization of all the sites in

OGCHEON (LOW-T, In situ)



Dm = -4.8
Im = 56.8
A95= 3.8
k = 71.4
N = 21

Fig. 2-3 Equal area projection of the low temperature component (less than 660°C) of pre-Cretaceous rocks in Jangseong and Mungyeong area (not corrected for bedding).

Bupyeong area and thermal treatments of pilot specimens from Mungyeong area have been finished. However, all the specimen had unstable magnetization or only secondary magnetization (see orthogonal demagnetization diagrams for sites 30, 33-35, 44 and 45 in Appendix B). Further measurements will be performed.

Cretaceous (?) Volcanic Rocks in Chugaryeong Area

In Chugaryeong area, considerable amounts of Cretaceous (?) (maybe partly Tertiary) volcanic rocks are distributed. We sampled these volcanic rocks from 14 sites, whose rock types are ranged from rhyolite to basalt.

The results of progressive thermal and a.f. demagnetization experiments indicate that the remanent magnetizations of these rocks are very stable (see orthogonal demagnetization diagrams for sites 4-9 and 100-109). And the magnetic directions after a proper demagnetization treatment are mostly rather tightly clustered in each site. However, the direction of the site mean is scattered widely on the sphere as presented in Fig. 2-4 by schmidt equal area projection. Two interpretations are possible for this scattered magnetic direction: (A) These rock bodies have been suffered from a very large rotation individually after the magnetization was acquired. (B) The magnetic field was on the way of magnetic field reversals or excursion when the magnetization was acquired. Because the magnetic directions presented here are isolated single component (see the orthogonal demagnetization diagrams of pilot specimens in Appendix B), the scattered direction cannot be explained as resultant vector direction of multicomponent magnetization. In the interpretation of (B), we have to assume that all the volcanic rocks were erupted synchronously to the magnetic field reversal. This assumption seems not to be plausible. The

CHUGARYEONG

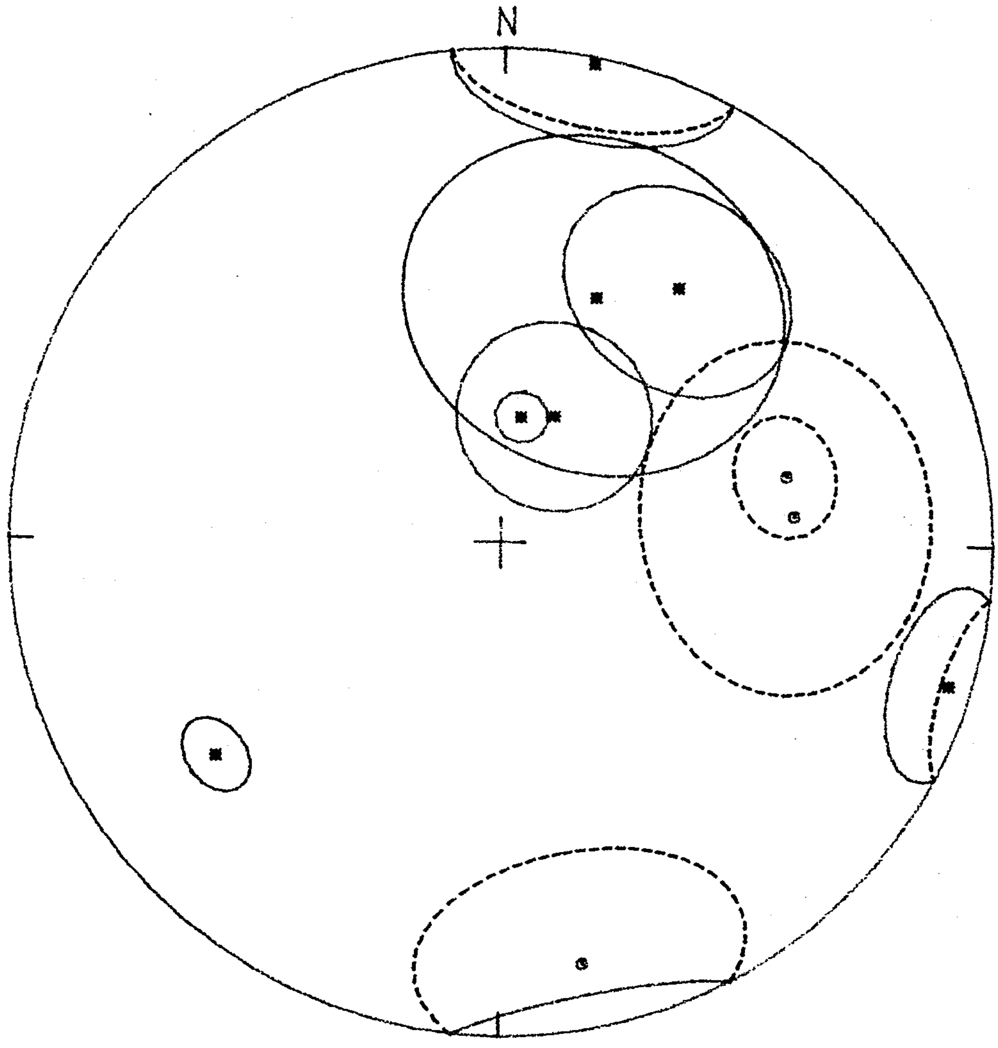


Fig. 2-4 Site mean magnetic directions for Cretaceous (?) volcanic rocks from Chugaryeong area.

result of scattered magnetic direction indicates that this area was suffered from a active tectonic movement in Cretaceous (?) age.

Lee (1983) claimed that the Chugaryeong area is a rift valley. Rift valley is, in fact, a tectonically active zone. However, the paleomagnetic results from volcanic rocks from Iceland, presently active rift zone, do not show such a chaotic direction (e.g. Wilson and McElhinny, 1974). We suggest, therefore, the Chugaryeong rift had some amounts of strike slip fault component.

In contrast to these tertiary rocks, the Quaternary basalt overlying them showed normal direction for normal polarity (Fig. 2-5).

Cenozoic rocks in Pohang and adjacent Area

Distribution of Tertiary strata is not wide but mostly restricted to a small area along the east coast of the Korean Peninsula. Among the areas where the Tertiary strata are distributed, the Pohang area has widest distribution and has the most complete succession.

In Pohang area, Yonil group, which is mostly composed of diatomaceous mudstone, is widely distributed in the center of the Pohang basin, and some Tertiary volcanic rocks are distributed on the collar of the basin.

(1) Diatomaceous mudstones in Yonil group

Yonil group is divided into five formations, namely Seoam conglomarate, Songhakdong formation, Daeguk formation, Idong formation and Pohang formation in ascending order. Biostratigraphic studies summarized by Kim (1982) showed that the age of this group is Middle Miocene to beginning of Late Miocene. Sampling was carried out on two sites from Songhakdong formation, two from Idong formation and one from Pohang

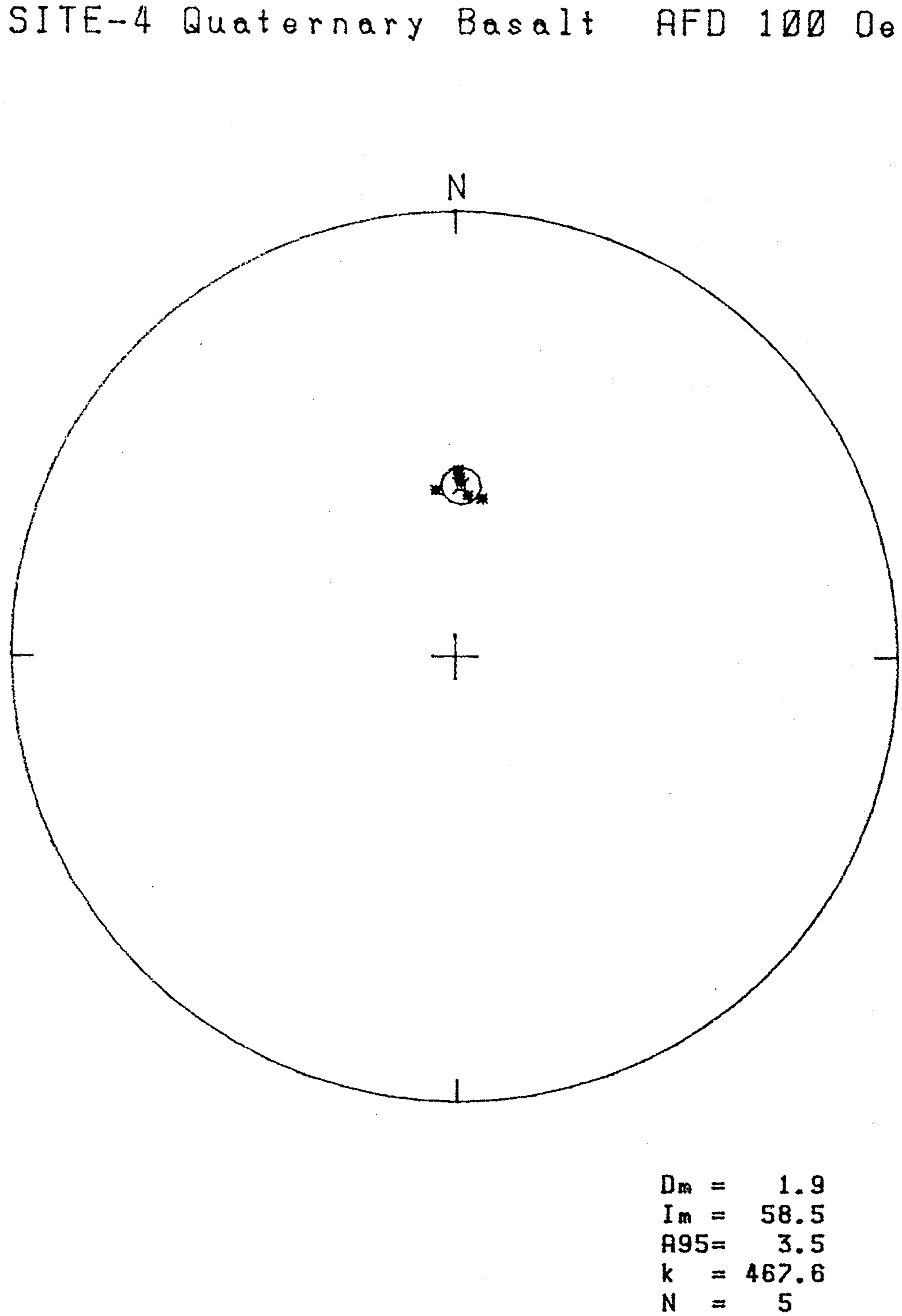


Fig. 2-5 Magnetic directions for Quaternary basalt in Chugaryeong area.

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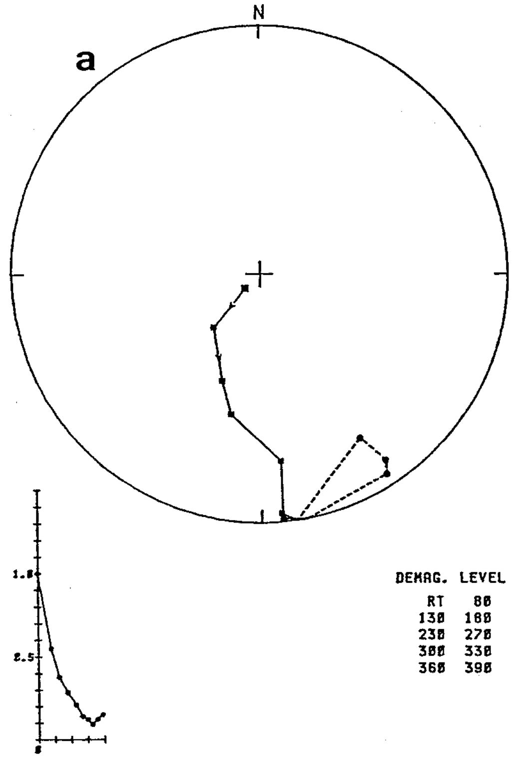

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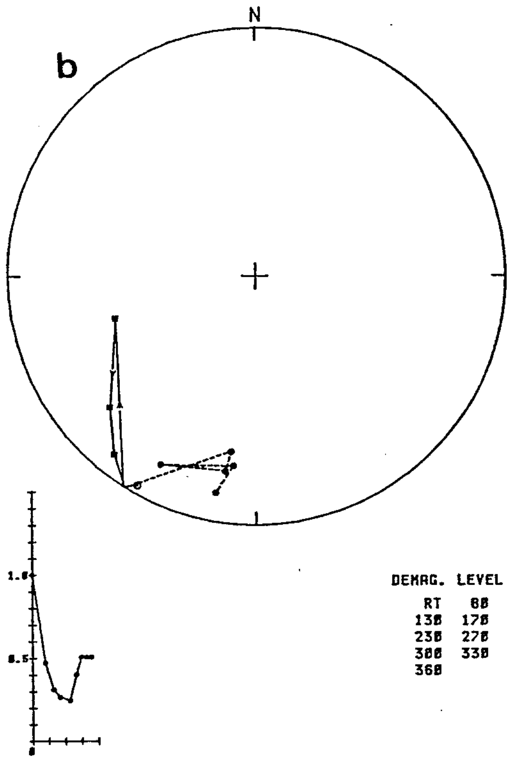

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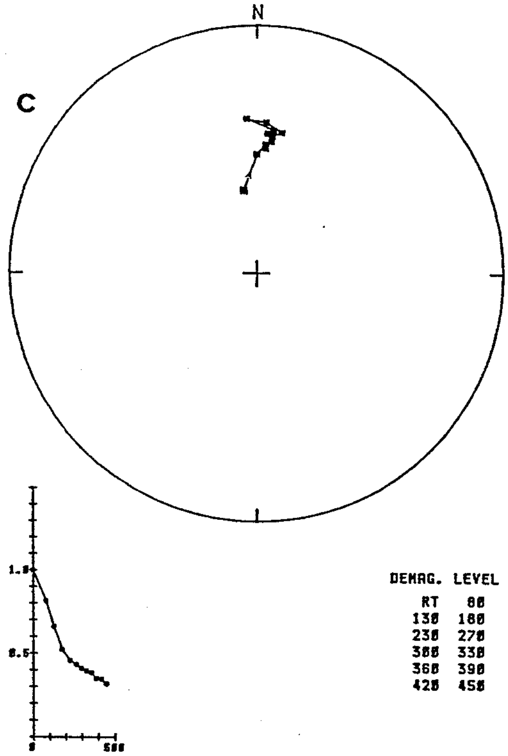

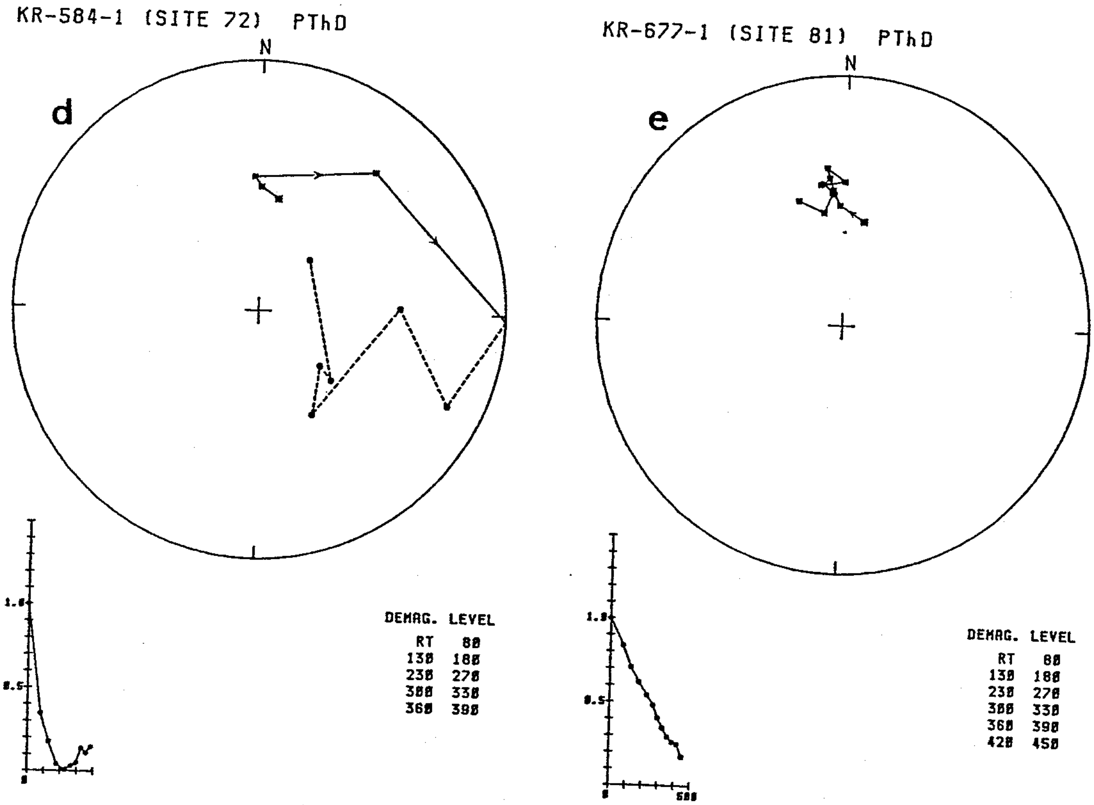

Fig. 2-6 Direction and intensity changes of the remanence of diatomaceous mudstones in Pohang area through the thermal demagnetization.

formation.

Magnetization of the diatomaceous mudstone is so weak that even the intensity of NRM (Natural remanent magnetization) before demagnetization is less than 10^{-6} emu. Thus the magnetic direction especially after the thermal treatment has marginal reliability. Figs. 2-6 a to e illustrates the directional and intensity changes on the way of thermal demagnetization. Samples from the two sites in the Idong formation have normal polarity and shows no migration of magnetic direction. On the other hand, those from Songhakdong and Pohang formations shows change of their magnetic direction with increasing temperature. They seem to move toward the reversed direction, though the weak intensity and relatively big noise make it difficult to determine the exact direction of the migration. These results are easily explained because the samples have two components which have overlapped blocking temperature spectrum; one has normal polarity in Idong formation and reversed polarity in Songhakdong and Pohang formations, and the other has normal polarity everywhere. Blocking temperature spectrum of the latter component has bulge in the lower temperature comparing to that of the former but is almost same in the higher temperature. If this explanation is true, we can determine the polarity of the diatomaceous mudstones. As the name of "diatomaceous mudstone" means, it contains many diatom fossils. A magnetostratigraphic work combined with the biostratigraphic works will be very valuable to determine the precise age of the Yonil group. We saw that the paleomagnetic investigation with diatomaceous mudstone is very difficult, but is able to determine the polarity.

(2) Tertiary Volcanic rocks around Pohang

Beneath the Yonil group there appear some volcanic rocks of Tertiary in age which belong to Janggi group. The result of progressive thermal demagnetization for pilot specimens shows that the remanence of these volcanic rocks are generally stable except for some trachyte tuffs (see orthogonal demagnetization diagrams for sites 77-78 in Appendix B). All the specimens being stable has normal polarity and shows similar declination to one in present magnetic field (Fig. 2-7).

This fact indicates that the rotation of the Japanese Islands in the age of Middle Miocene (Otofuji et al., 1985) affect no influence to the direction of the Korean Peninsula.

Concluding Remarks

We have not yet finished to construct an apparent polar wonder path (APWP) for the Korean Peninsula, but some interesting results are obtained in this stage of the research. Based on the reconnaissance work, we can draw some important objectives to be confirmed in the progressive studies. They are as follows;

(1) The paleolatitudinal changes for the Korean Peninsula looks similar to those reported for the North China Block (Lin et al., 1985), suggesting a close association between the two continental blocks in the Paleozoic through the Triassic.

(2) All pre-Cretaceous sedimentary rocks have very stable secondary magnetization with directions around present axial dipole field. Such a secondary component is widely seen in the Far East area.

(3) In order to examine the problem whether Chugaryeong area is a rift valley or not, we have applied paleomagnetic techniques to assess its

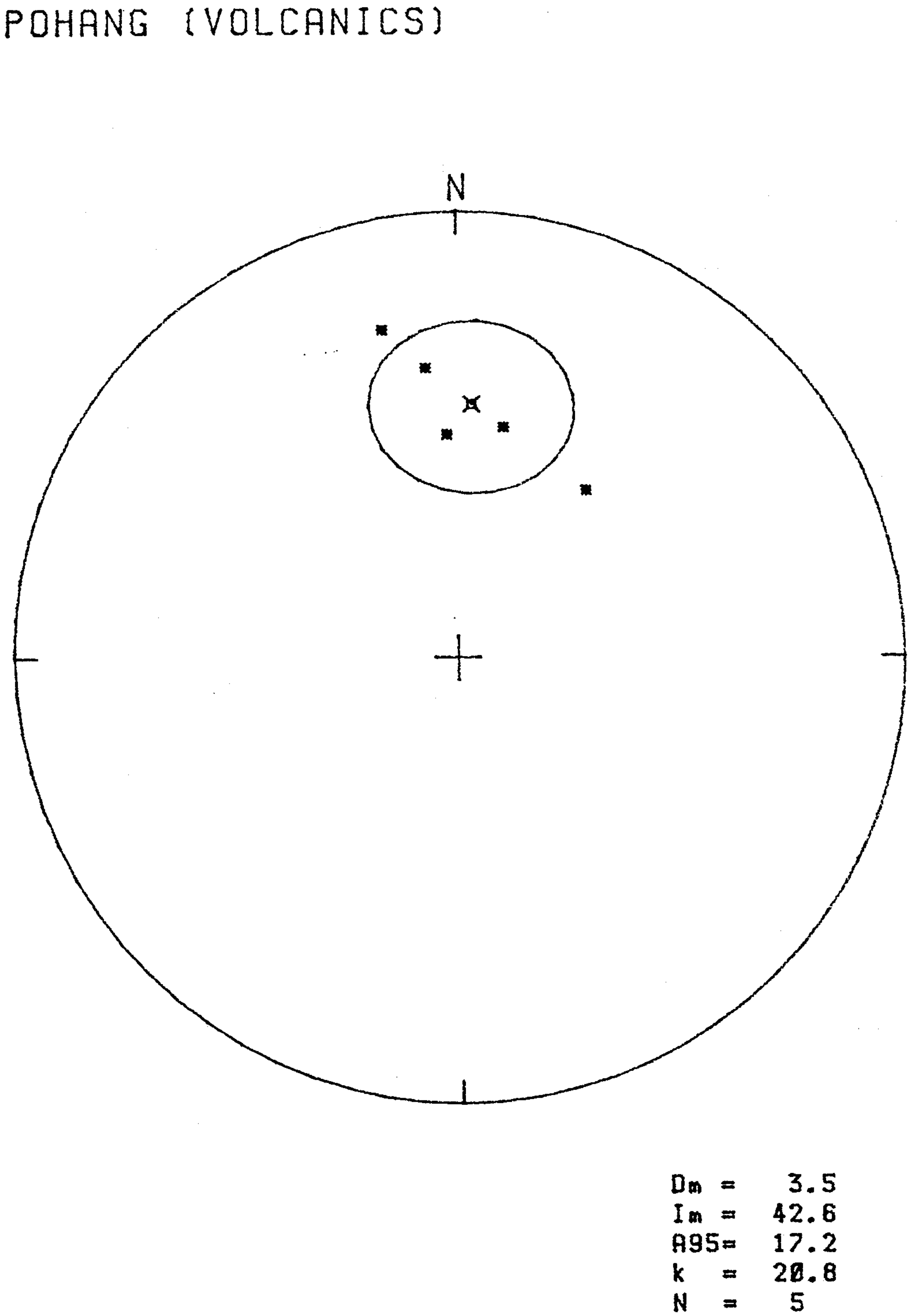

Fig. 2-7 Paleomagnetic directions for Tertiary volcanic rocks around Pohang.

geotectonic disturbances. On the basis of some characteristic paleomagnetic patterns obtained, it seems likely that after extrusion or explosion of various kinds of Cretaceous (?) volcanic rocks these rock bodies have been suffered from very complexed tectonic movements including rotational movements. This result is not be able to be explained by only a simple rifting movement.

(4) The paleomagnetic direction of Tertiary volcanic rock series distributed around Pohang shows a quite similar one to the present geomagnetic field within a range of errors. This fact suggests that the opening of the Japan Sea (East Sea) and the synchronous clockwise rotation of the Southwest Japan block (about 50°; Otofuji et al., 1985) occurred in the middle Miocene without giving significant rotational movement to the Korean Peninsula.

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Appenddix A

List of paleomagnetic sampling sites in this project.

site: site number
Ns: number of hand samples in the site
Lat: latitude of the site
Long: longitude of the site
Age: age of the samples

Chugaryeong area

site	Ns	Lat.	Long.	Map	Age	rock type
		(July 3, 1983)				
4	5	38°01'12"	127°08'25"	Cheolwon	Q	basalt
5	10	38°01'13"	127°07'38"	Cheolwon	T or K	andesitic basalt
6	13	38°02'28"	127°06'42"	Cheolwon	T or K	dacite tuff
7	10	38°02'24"	127°06'50"	Cheolwon	T or K	basaltic andesite
9	6	38°04'28"	127°06'35"	Cheolwon	T or K	basalt
		(August 1983)				
100	2	38°01'13"	127°07'38"	Cheolwon	T or K	andesitic basalt
102	2	38°02'24"	127°06'50"	Cheolwon	T or K	andesite dyke
103	5	38°02'26"	127°06'48"	Cheolwon	T or K	andesitic basalt
104	10	38°04'18"	127°08'21"	Cheolwon	T or K	welded tuff
105	5	38°08'54"	127°11'19"	Cheolwon	T or K	basic dyke
105'	5	38°08'54"	127°11'19"	Cheolwon	T or K	rhyolitic tuff
106	5	38°08'49"	127°11'20"	Cheolwon	T or K	rhyolitic tuff
107	3	38°09'08"	127°11'28"	Cheolwon	T or K	basic dyke
108	4	38°09'16"	127°11'30"	Cheolwon	T or K	rhyolitic tuff
109	6	38°08'40"	127°12'46"	Cheolwon	T or K	rhyolite

Kimpo area

site	Ns	Lat.	Long.	Map	Age	rock type
		(July 2, 1983)				
3	3	37°42'20"	126°32'00"	Kimpo	J	sandstone
		(November 16, 1983)				
155	3	37°43'58"	126°31'05"	Kimpo	J	sandstone
156	8	37°42'53"	126°31'55"	Kimpo	J	sandstone
		(January 25, 1984)				
157	6	37°42'50"	126°32'03"	Kimpo	J	sandstone
		(August 31, 1984)				
158	1	37°44'17"	126°32'30"	Kimpo	J	red shale
		(October 5, 1984)				
159	2	37°41'15"	126°33'26"	Kimpo	J	red shale
160	5	37°41'08"	126°33'30"	Kimpo	J	red shale

Bupyeon area

site	Ns	Lat.	Long.	Map	Age	rock type
		(September 1, 1983)				
110	5	37°28'01"	126°43'06"	Incheon	120Ma	rhyolite
111	5	37°27'05"	126°43'11"	Incheon	120Ma	rhyolite
112	5	37°28'21"	126°42'56"	Incheon	120Ma	rhyolite
113	4	37°28'29"	126°43'04"	Incheon	120Ma	rhyolite

Seoul area

site	Ns	Lat.	Long.	Map	Age	rock type
		(January 19, 1984)				
151	5	37°33'38"	126°53'41"	Seoul	160Ma	pink fd. gd.
152	5	37°33'51"	126°51'46"	Seoul	160Ma	pink fd. gd.
153	5	37°34'25"	126°49'37"	Seoul	160Ma	pink fd. gd.
154	6	37°34'37"	126°45'02"	Seoul	160Ma	pink fd. gd.
		(October 5, 1984)				
301	6	37°33'46"	126°57'06"	Seoul	K(?)	felsite
302	4	37°33'58"	126°57'11"	Seoul	K(?)	felsite
303	5	37°38'19"	126°55'08"	Seoul	J(?)	granodiorite

Jangseong area

site	Ns	Lat.	Long.	Map	Age(fm.)	rock type
		(July 5, 1983)				
11A	4	37°04'31"	129°03'08"	Jangseong	K(?)	granite
11B	4	37°04'31"	129°03'08"	Jangseong	contact metamorphic zone of granite	
12	3	37°04'40"	129°03'15"	Jangseong	Є(Jangsan)	quartzite
13	5	37°04'40"	129°03'02"	Jangseong	Є(Myobong)	slate
14	6	37°04'48"	129°02'54"	Jangseong	Є(Pungchon)	limestone
15	6	37°04'54"	129°02'53"	Jangseong	Є(Pungchon)	limestone
16	8	37°04'57"	129°02'53"	Jangseong	Є(Sesong)	slate
17	8	37°05'20"	129°05'39"	Jangseong	O(Dumugol)	limestone
18	8	37°05'34"	129°02'21"	Jangseong	O(Dumugol)	limestone
19	6	37°05'45"	129°01'22"	Jangseong	C(Hongjeom)	sandstone
		(July 6, 1983)				
20	8	37°06'05"	129°00'42"	Jangseong	C(Hongjeom)	sandstone
21	5	37°06'06"	129°00'14"	Jangseong	P(Sadong)	black shale
22	8	37°06'11"	129°00'11"	Jangseong	P(Sadong)	sandstone
23	8	37°06'28"	129°00'12"	Jangseong	P(Gobangsan)	red sandstone
24	9	37°06'31"	129°00'12"	Jangseong	P(Gobangsan)	red sandstone
25	9	37°07'06"	129°00'08"	Jangseong	Tr(Nogam)	red sandstone
26	5	37°07'06"	129°00'08"	Jangseong	Tr(Nogam)	red sandstone
27	11	37°07'58"	129°00'21"	Jangseong	Tr(Nogam)	red shale
27.5	2	37°06'21"	129°01'11"	In the tunnel of Jangseong Coal Mine		

Mungyeong area

site	Ns	Lat.	Long.	Map	Age(fm.)	rock type
		(July 8, 1983)				
28	10	36°39'12"	128°08'03"	Jeoncheon	P(Gobangsan)	sandstone
29	2	36°39'13"	128°08'07"	Jeoncheon	P(Gobangsan)	sandstone
30	8	36°39'17"	128°08'01"	Jeoncheon	J(Daedong)	shale
31	8	36°39'24"	128°07'56"	Jeoncheon	P(Gobangsan)	sandstone
32	11	36°39'35"	128°07'35"	Jeoncheon	Tr(Nogam)	red shale
33	10	36°39'43"	128°07'50"	Jeoncheon	J(Daedong)	sandstone
34	4	36°40'25"	128°08'34"	Jeoncheon	J(Daedong)	black shale
35	8	36°40'24"	128°08'37"	Jeoncheon	J(Daedong)	black shale
		(July 9, 1983)				
40	5	36°37'33"	128°08'59"	Jeoncheon	O(Dumugol)	limestone
41	5	36°37'33"	128°08'59"	Jeoncheon	O(Dumugol)	limestone
42	10	36°37'53"	128°09'06"	Jeoncheon	O(Dumugol)	limestone
43	8	36°37'33"	128°07'30"	Jeoncheon	C(Hongjeom)	silty sandstone
44	8	36°38'46"	128°08'50"	Jeoncheon	P(Sadong)	black shale
45	9	36°39'22"	128°08'31"	Jeoncheon	P(Gobangsan)	sandstone

Koryeong area

site	Ns	Lat.	Long.	Map	Age	rock type
		(July 11, 1983)				
60	10	35°46'51"	128°13'28"	Gaya	146Ma	bt-hb-granodiolite
62	9	35°47'54"	128°11'56"	Gaya	146Ma	bt-hb-granodiolite
63	6	35°47'28"	128°15'44"	Waegwan	146Ma	bt-hb-granodiolite
64	11	35°48'25"	128°13'33"	Gaya	146Ma	bt-hb-granodiolite
		(July 12, 1983)				
65	8	35°40'41"	128°14'19"	Habcheon	K(Nagdong)	sandstone
66	10	35°41'09"	128°15'10"	Cangnyeon	K(Nagdong)	acidic tuff
67	5	35°42'02"	128°13'33"	Habcheon	K(Nagdong)	fine sandstone

Kumcheon area

site	Ns	Lat.	Long.	Map	Age	rock type
		(July 18, 1983)				
84	5	36°08'40"	128°11'13"	Kumcheon	J	hb-bt-granite
85	6	36°03'47"	128°12'34"	Kumcheon	J	bt-granite
87	7	36°04'26"	128°05'22"	Kumcheon	J	hb-bt-granite

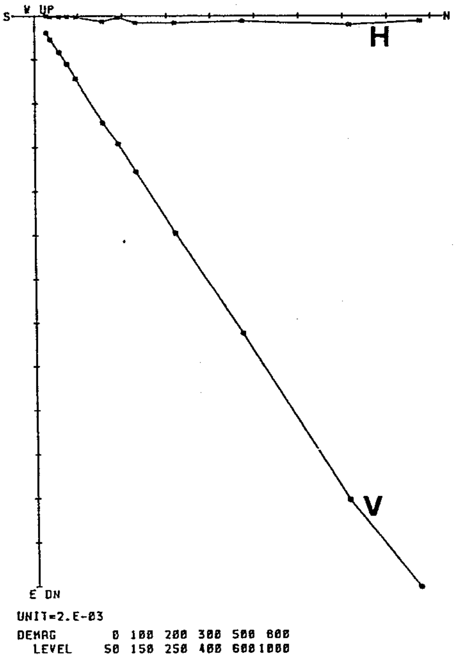
Pohang area

site	Ns	Lat.	Long.	Map	Age(gr.)	rock type
		(July 13, 1983)				
68	5	36°01'57"	129°17'21"	Pohang	Mio(Yonil)	mudstone
69	6	36°01'57"	129°17'21"	Pohang	Mio(Yonil)	mudstone
		(July 14, 1983)				
71	8	36°02'16"	129°18'45"	Pohang	Mio(Yonil)	mudstone
72	8	36°05'55"	129°26'02"	Pohang	Mio(Yonil)	mudstone
73	9	36°06'52"	129°23'58"	Pohang	44.5Ma	welded tuff
74	9	36°07'29"	129°17'07"	Pohang		greenish tuff
		(July 15, 1983)				
75	6	35°52'49"	129°31'33"	Gampo	Mio(Janggi)	acidic tuff
76	8	35°53'12"	129°31'34"	Gampo	Q	basalt
77	6	35°53'45"	129°30'30"	Gampo	Mio(Janggi)	trachyte tuff
78	8	35°53'54"	129°30'32"	Gampo	Mio(Jenggi)	trachyte tuff
79	9	35°54'02"	129°29'21"	Bulgugsa		welded tuff
80	5	36°01'37"	129°33'03"	Pohang	Q	basalt
		(July 16, 1983)				
81	8	36°03'58"	129°21'06"	Pohang	Mio(Yonil)	mudstone
82	7	36°15'09"	129°20'57"	Yeongdeong		welded tuff

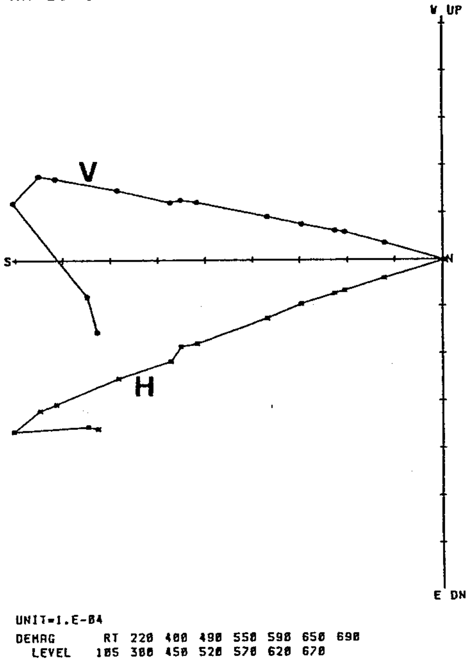
Appendix B

Orthogonal demagnetization diagram of a pilot specimen in each site. The abscissa represents north-south component, and the ordinate is east-west component for the horizontal projection and up-down component for the vertical projection. The unit of the axes is shown in the down left in emu. Demagnetization level is presented in the two lines below the figure in °C or Oe for thermal or a.f. for demagnetization, respectively. Horizontal projection is represented by "H".

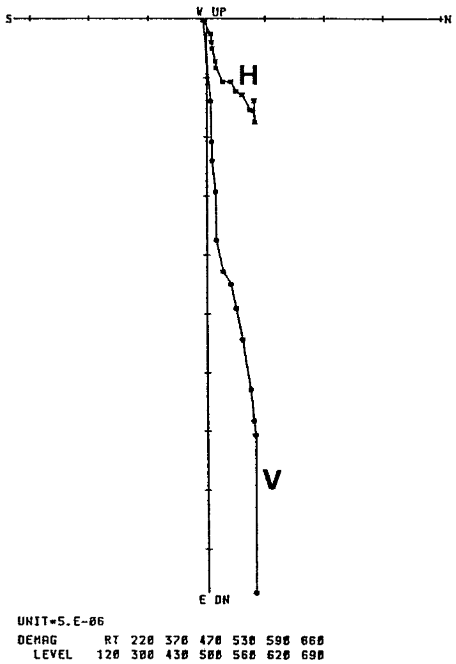
KR-6-2 (SITE 4) PAFD



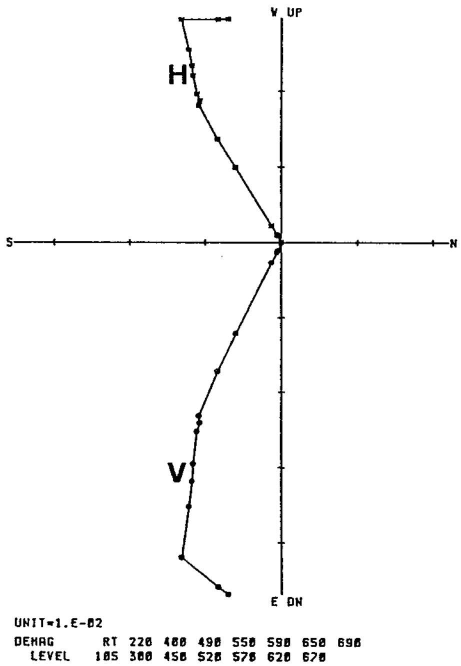
KR-21-2 (SITE 5) PThD



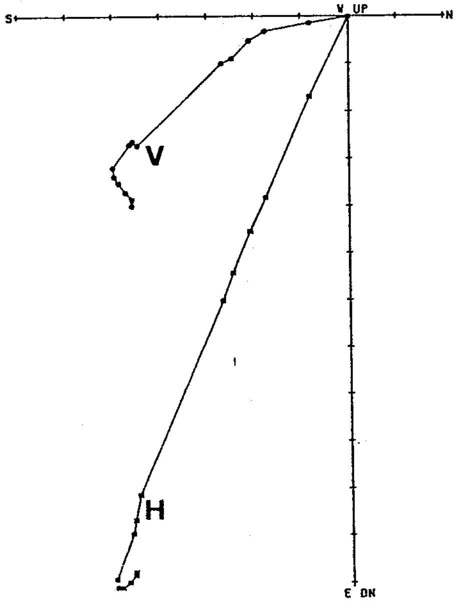
KR-37-1 (SITE 6) PThD



KR-51-2 (SITE 7) PThD

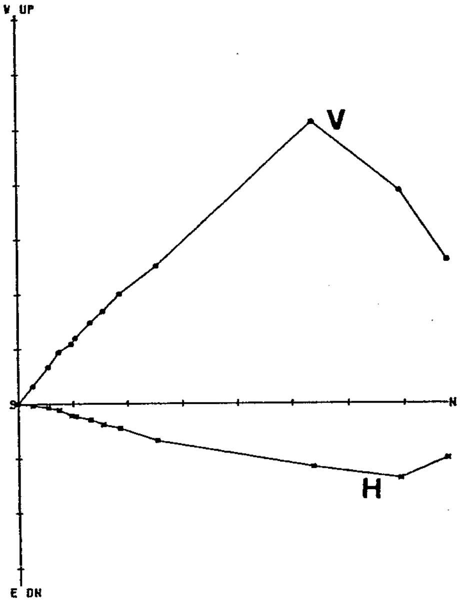


KR-65-1 (SITE 9) PThD



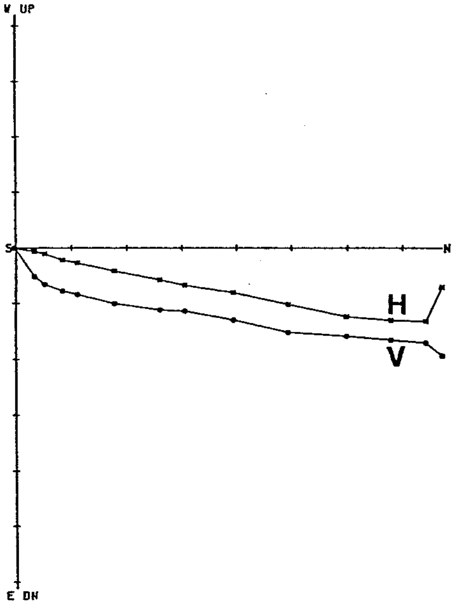
UNIT=1.E-03
DEMAG RT 220 400 490 550 590 650 690
LEVEL 105 300 450 520 570 620 670

KR-C34-1 (SITE 100) PThD



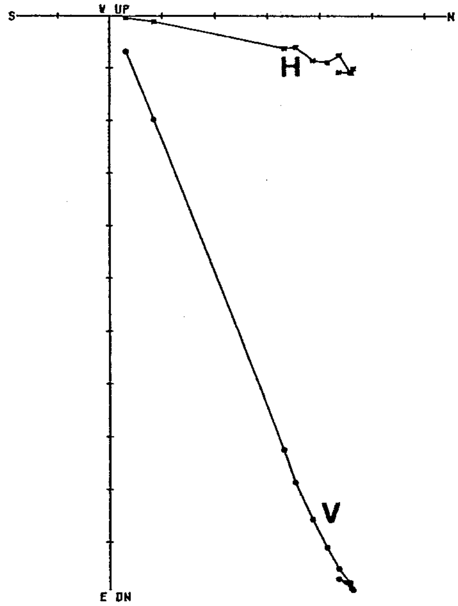
UNIT=5.E-04
DEMAG RT 220 370 470 530 620 690
LEVEL 110 300 430 500 560 650

KR-C26-1 (SITE 102) PThD



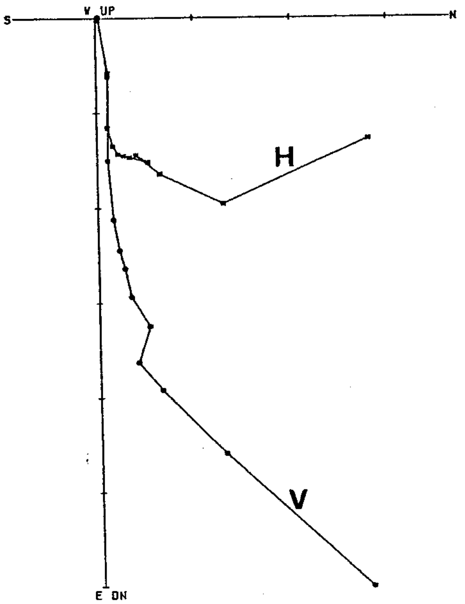
UNIT=5.E-05
DEMAG RT 220 370 470 530 590 650
LEVEL 110 300 430 500 560 620 690

KR-C28-2 (SITE 103) PThD



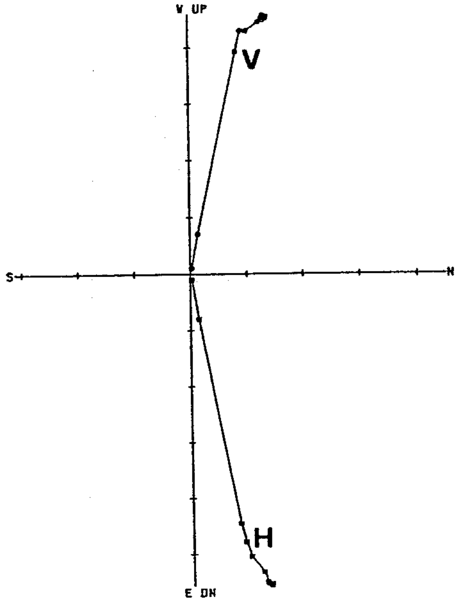
UNIT=2.E-02
DEMAG RT 220 370 490 550 610
LEVEL 120 300 440 520 580

KR-W3-1 (SITE 104) PThD



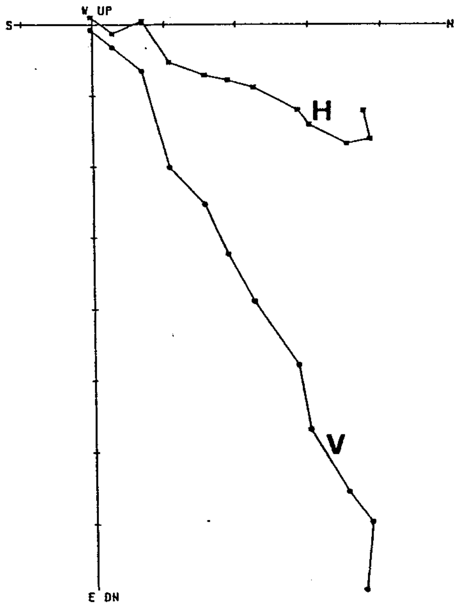
UNIT=5.E-05
DEMAG RT 220 370 470 530 590
LEVEL 120 300 430 500 560 620

KR-D5-2 (SITE 105) PThD



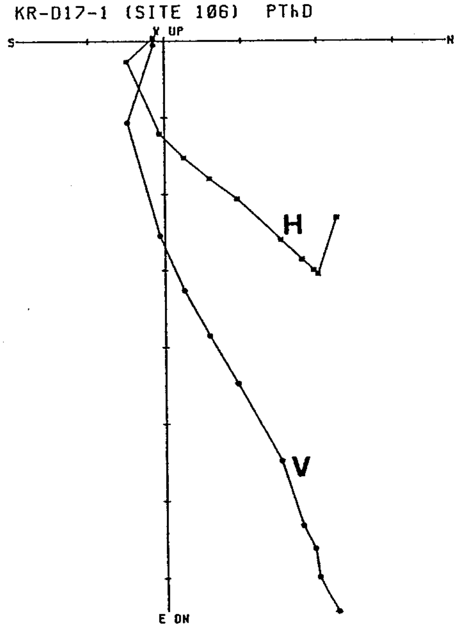
UNIT=2.E-02
DEMAG RT 220 370 490 550 610
LEVEL 120 300 440 520 580

KR-D10-2 (SITE 105') ThD

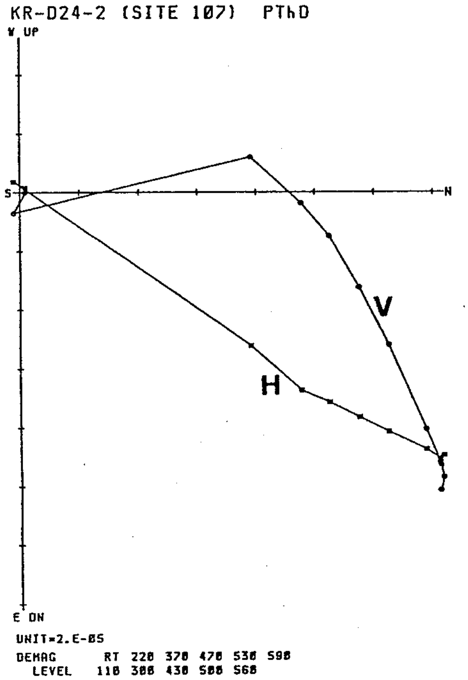


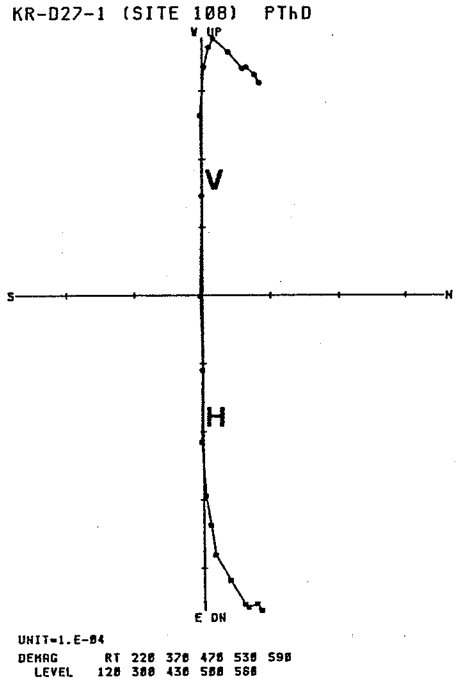
UNIT=5.E-06
DEMAG RT 220 370 470 530 590
LEVEL 110 300 430 500 560 620

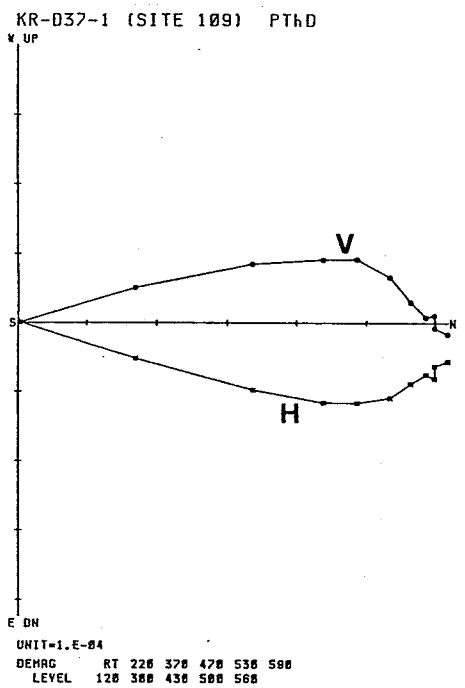
KR-D17-1 (SITE 106) PThD

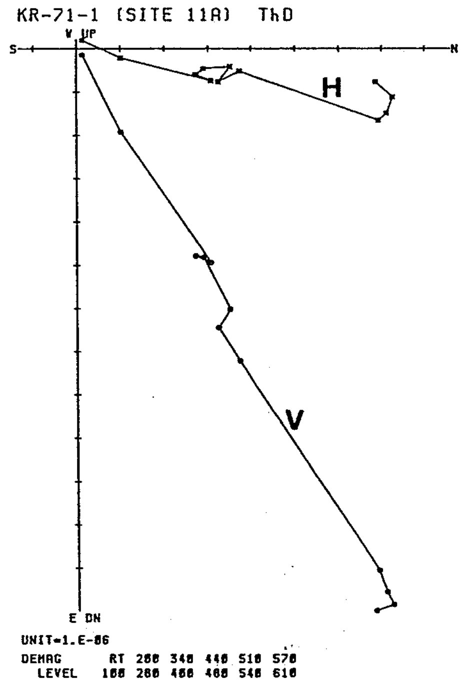


UNIT=1.E-05
DEMAG RT 220 370 470 530 500
LEVEL 110 300 430 500 560

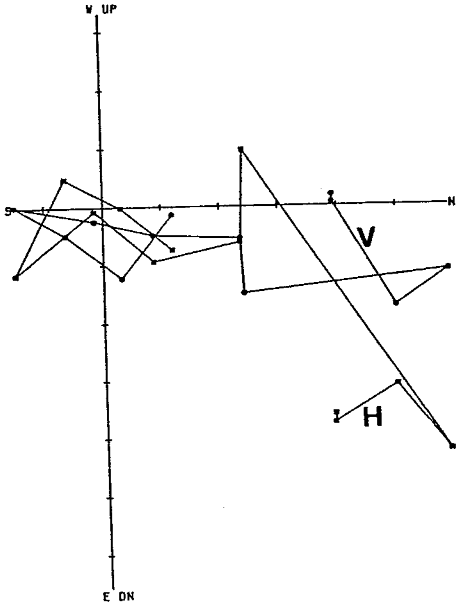

KR-D24-2 (SITE 107) PThD
W UP
S
N
E DN
V
H
UNIT=2.E-05
DEMAG RT 220 370 470 530 590
LEVEL 110 300 430 500 560


KR-D27-1 (SITE 108) PThD
W UP
S
N
E DN
V
H
UNIT=1.E-04
DEMAG RT 220 370 470 530 590
LEVEL 120 300 430 500 560


KR-D37-1 (SITE 109) PThD
W UP
S
N
E DN
V
H
UNIT=1.E-04
DEMAG RT 220 370 470 530 590
LEVEL 120 300 430 500 560

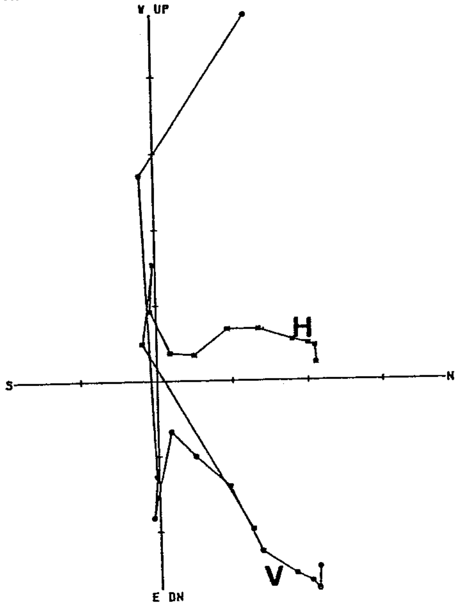

KR-71-1 (SITE 11A) ThD
W UP
S
N
E DN
H
V
UNIT=1.E-06
DEMAG RT 200 340 440 510 570
LEVEL 100 280 400 460 540 610

KR-77-1 (SITE 11B) ThD



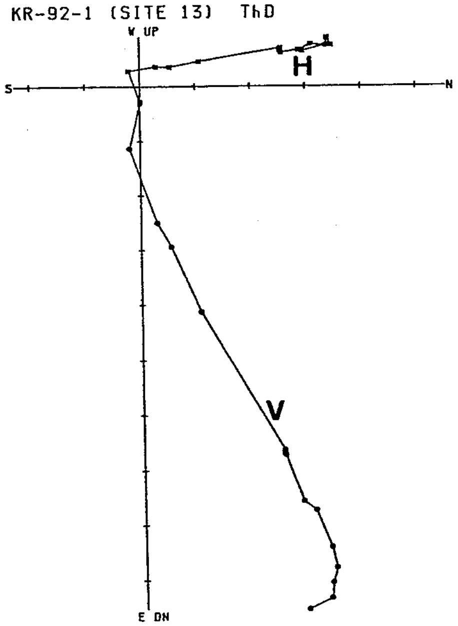
UNIT=1.E-06
DEMAG RT 200 340 440 510 570
LEVEL 100 200 400 480 540 610

KR-81-1 (SITE 12) ThD



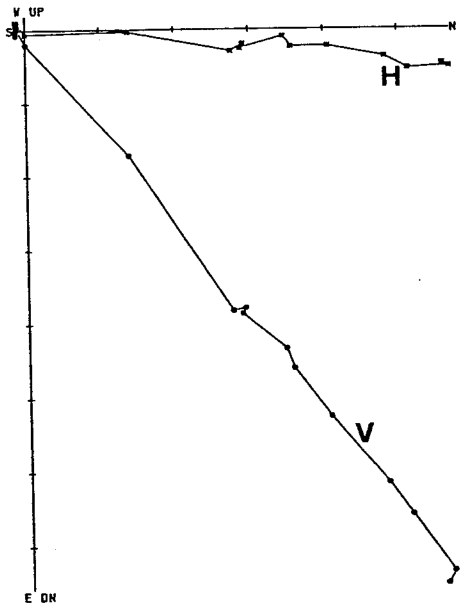
UNIT=2.E-06
DEMAG RT 200 340 440 510 570
LEVEL 100 200 400 480 540 610

KR-92-1 (SITE 13) ThD



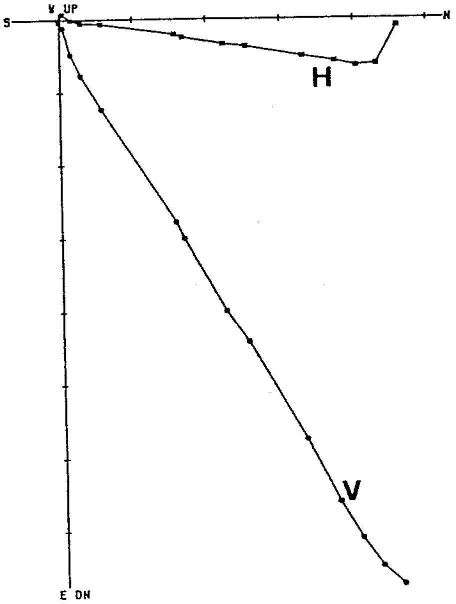
UNIT=5.E-05
DEMAG RT 200 340 440 510 570 640 700
LEVEL 100 200 400 480 540 610 670

KR-104-1 (SITE 14) ThD



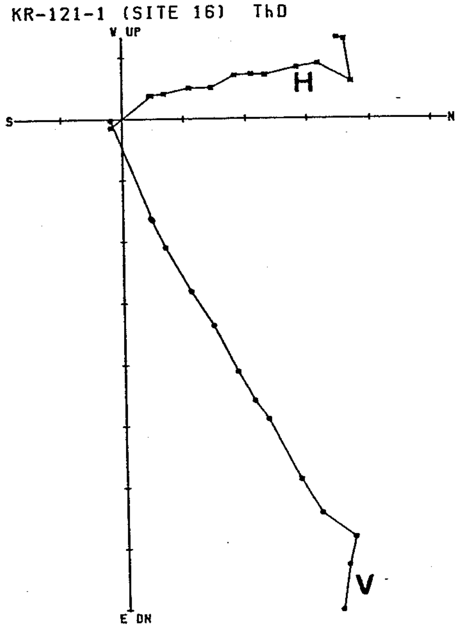
UNIT=5.E-06
DEMAG RT 200 340 440 510 570 640 700
LEVEL 100 200 400 480 540 610 670

KR-112-1 (SITE 15) ThD



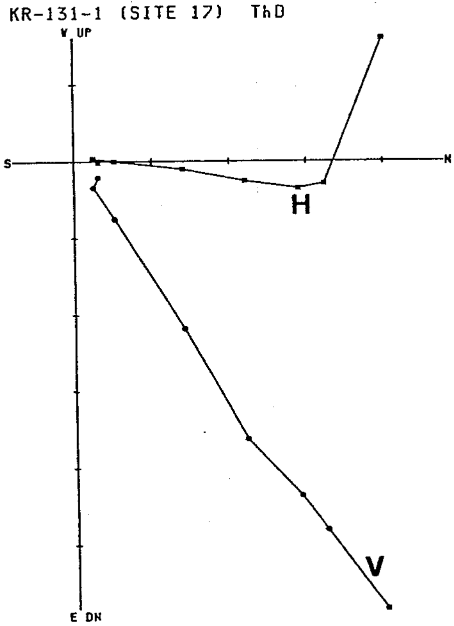
UNIT=1.E-04
DEMAG   RT 200 340 440 540 610 670
LEVEL   100 200 400 510 570 640 700

KR-121-1 (SITE 16) ThD



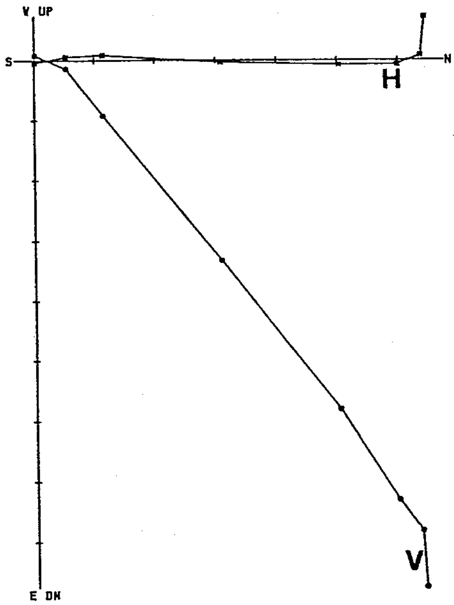
UNIT=5.E-05
DEMAG   RT 220 360 460 530 600 660
LEVEL   120 300 420 500 560 640 700

KR-131-1 (SITE 17) ThD



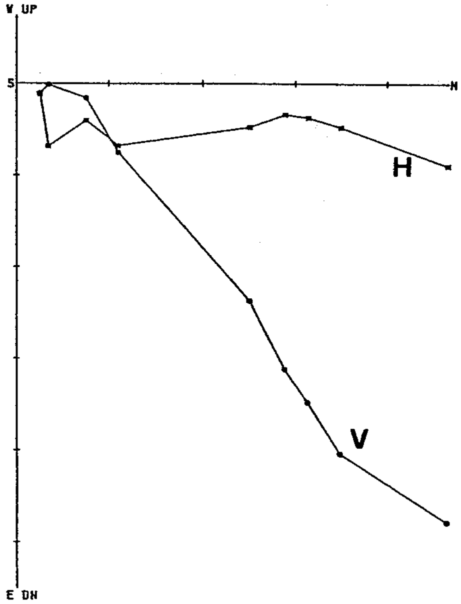
UNIT=2.E-06
DEMAG   RT 220 360 460
LEVEL   120 300 420 500

KR-141-1 (SITE 18) ThD



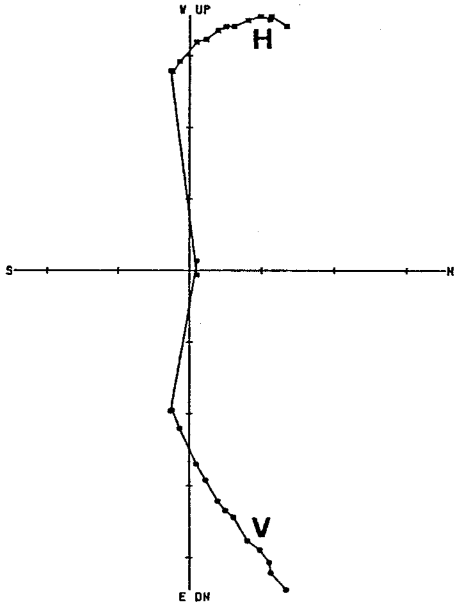
UNIT=1.E-06
DEMAG   RT 220 360 460
LEVEL   120 300 420 500

KR-153-1 (SITE 19) ThD



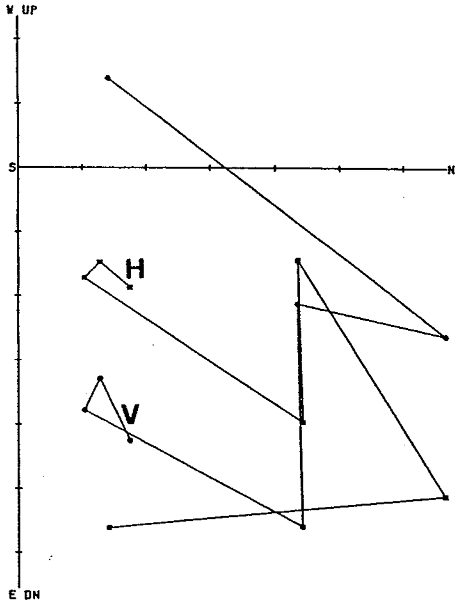
UNIT=5.E-06
DEMAG RT 220 360 460 530
LEVEL 120 300 420 500

KR-161-2 (SITE 20) ThD



UNIT=5.E-05
DEMAG RT 220 360 460 530 600 660
LEVEL 120 300 420 500 560 640 700

KR-181-4 (SITE 21) ThD



UNIT=2.E-07
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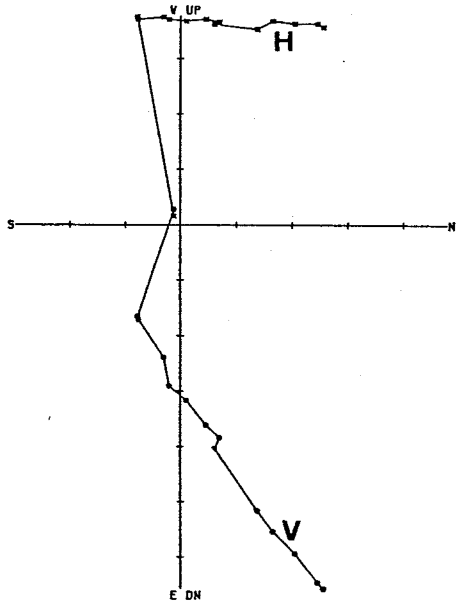
LEVEL 120 300 420

KR-193-3 (SITE 22) ThD



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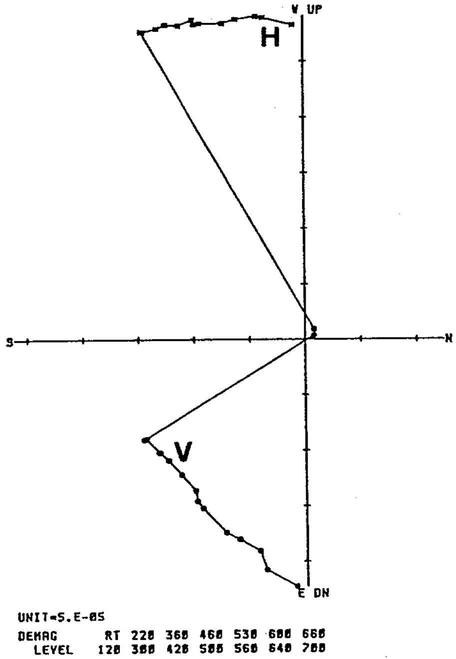
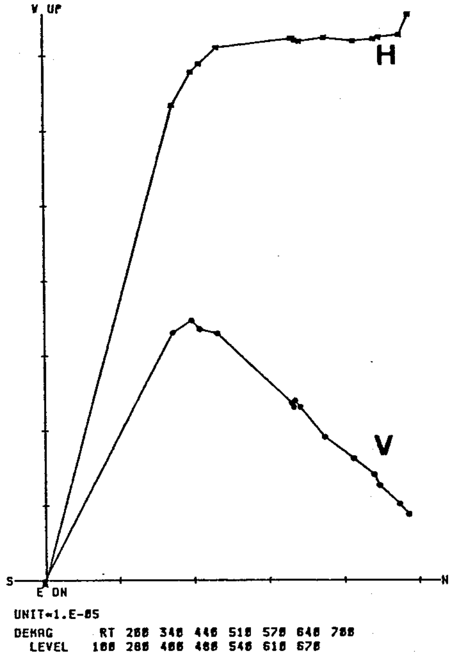
LEVEL 120 300 420 500 560 640 700

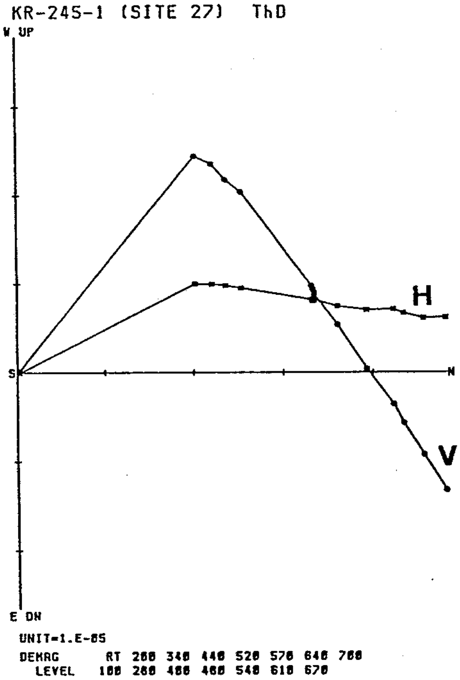
KR-216-3 (SITE 24)   ThD



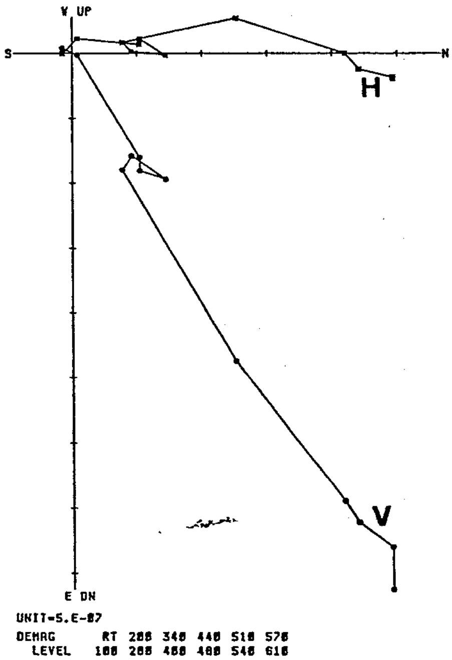
KR-225-1 (SITE 25)   ThD



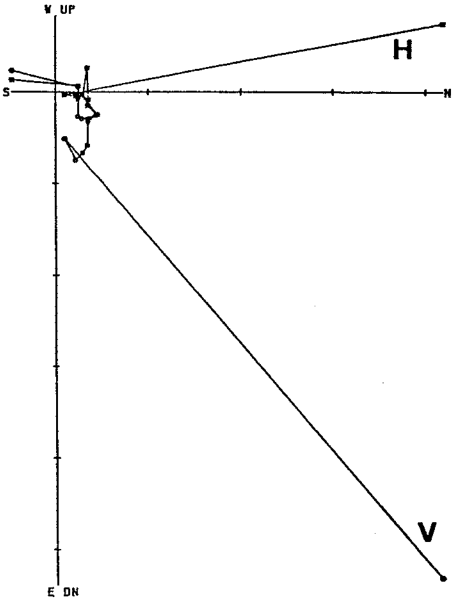
KR-245-1 (SITE 27)   ThD



KR-262-1 (SITE 28)   ThD



KR-271-1 (SITE 29) ThD



UNIT=1.E-06
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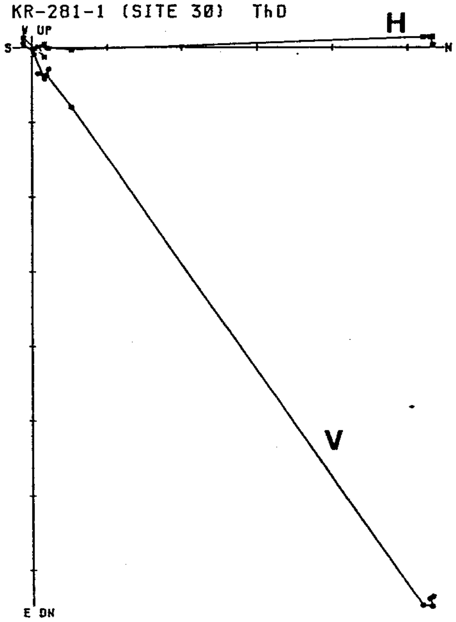
LEVEL 100 280 400 480 540 610

KR-281-1 (SITE 30) ThD



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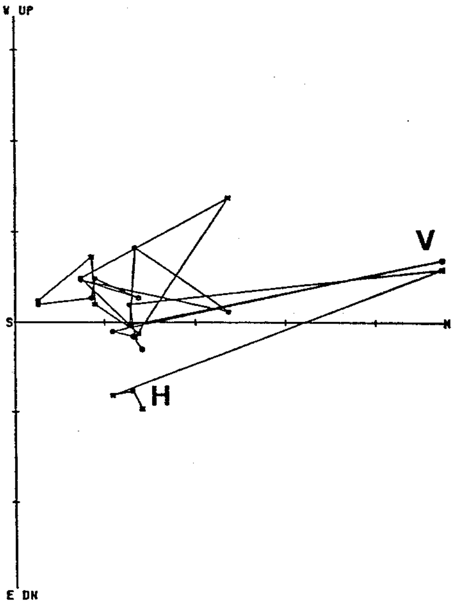
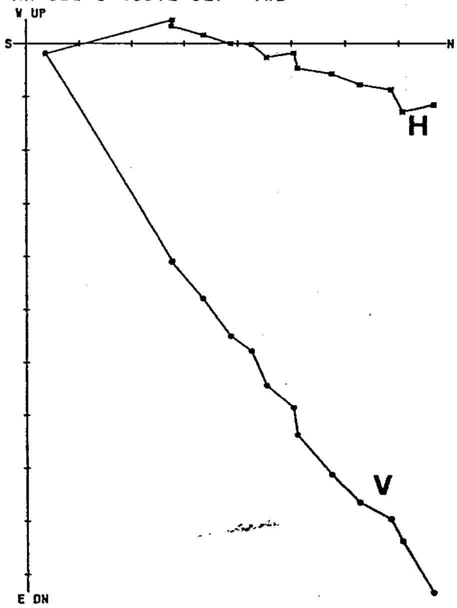
DEMAG RT 200 340 440 510 570
LEVEL 100 280 400 480 540 610

KR-293-1 (SITE 31) ThD



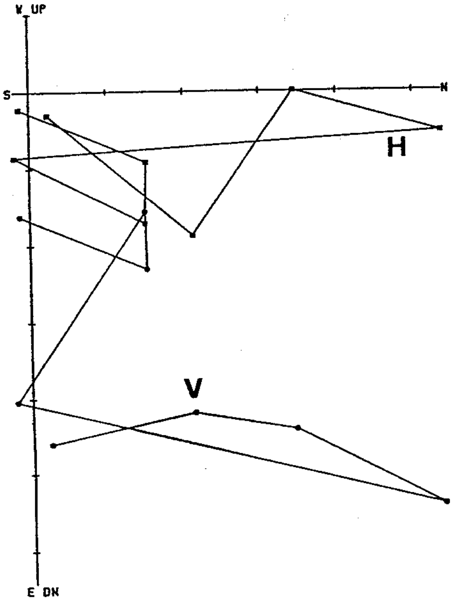
UNIT=5.E-07
DEMAG RT 200 340 440 510 570
LEVEL 100 280 400 480 540 610

KR-301-1 (SITE 32) ThD



UNIT=1.E-05
DEMAG RT 220 360 460 530 600 660
LEVEL 120 300 420 500 560 640 700

KR-322-1 (SITE 33) ThD



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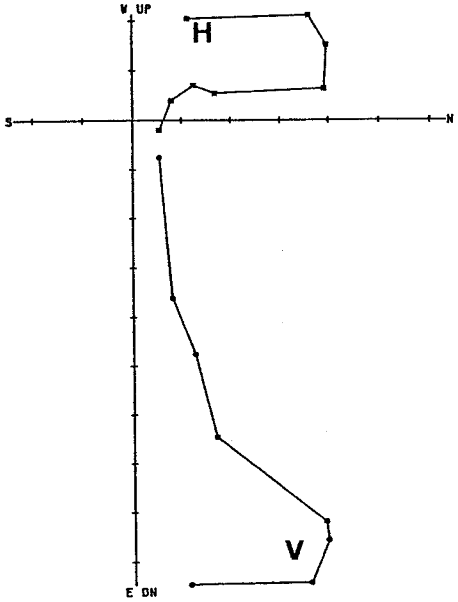
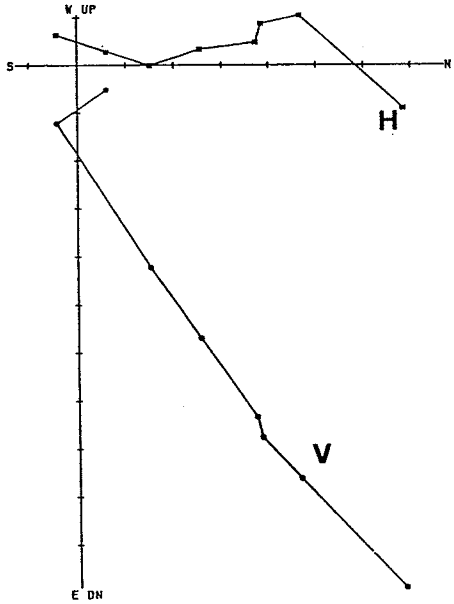
DEMAG RT 220 360 460
LEVEL 120 300 420 500

KR-333-1 (SITE 34) ThD



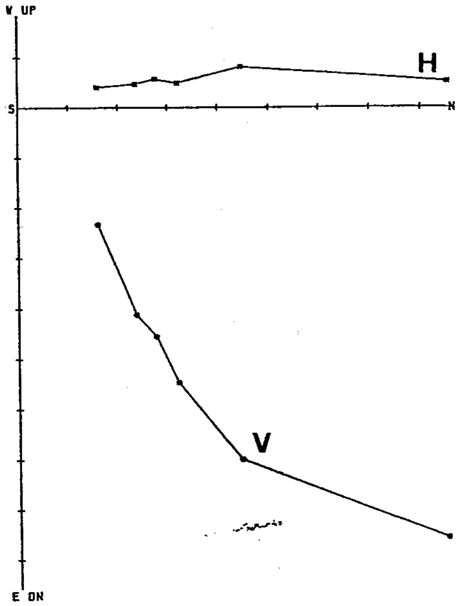
UNIT=2.E-07
DEMAG RT 220 360 460
LEVEL 120 300 420 500

KR-347-1 (SITE 35) ThD



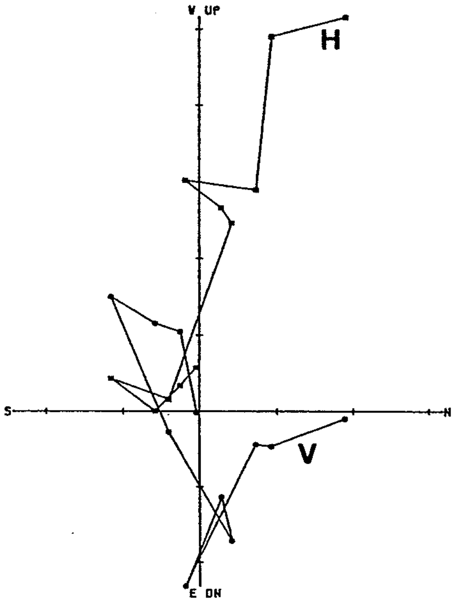
UNIT=2.E-07
DEMAG RT 220 360 460
LEVEL 120 300 420 500

KR-353-1 (SITE 40) ThD



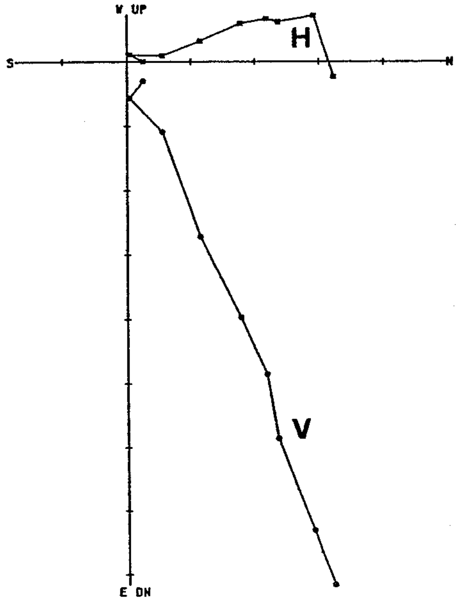
UNIT=1.E-07
DEMAG RT 220 360
LEVEL 120 300 420

KR-363-1 (SITE 41) ThD



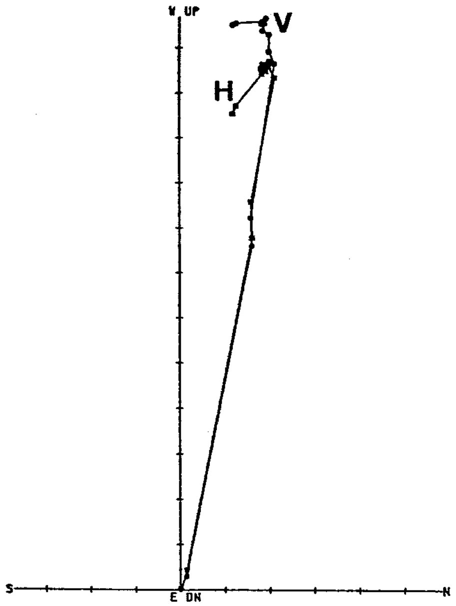
UNIT=1.E-07
DEMAG RT 220 360 470 540 610
LEVEL 120 300 420 510 570

KR-371-1 (SITE 42) ThD



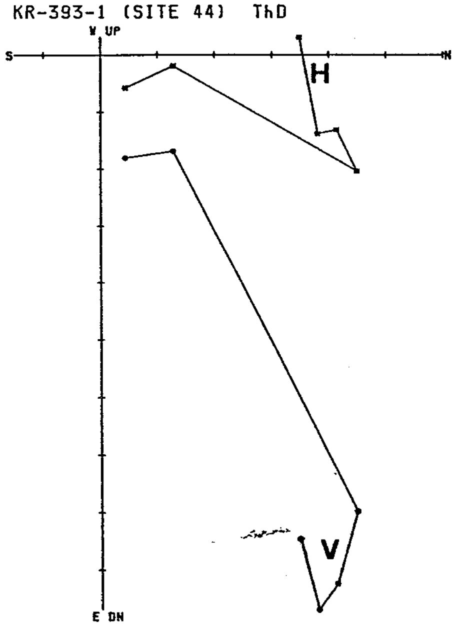
UNIT=1.E-06
DEMAG RT 220 360 470 540
LEVEL 120 300 420 510

KR-381-1 (SITE 43) ThD



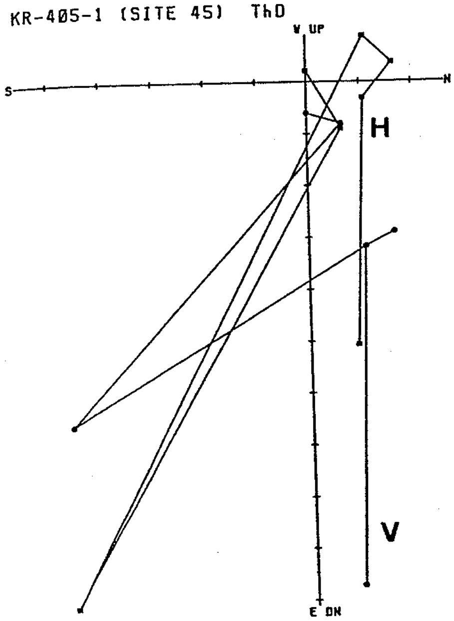
UNIT=2.E-04
DEMAG RT 220 360 470 540 610 670
LEVEL 120 300 420 510 570 640 700

KR-393-1 (SITE 44) ThD



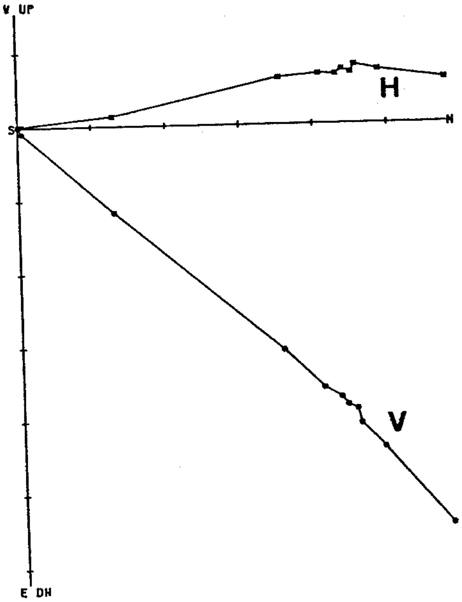
UNIT=1.E-07
DEMAG RT 220 360
LEVEL 120 300 420

KR-405-1 (SITE 45) ThD



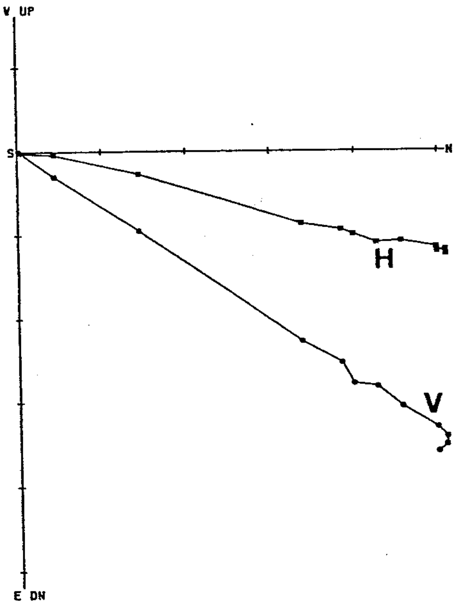
UNIT=1.E-07
DEMAG RT 220 360 510
LEVEL 120 300 420

KR-591-1 (SITE 73) PThD



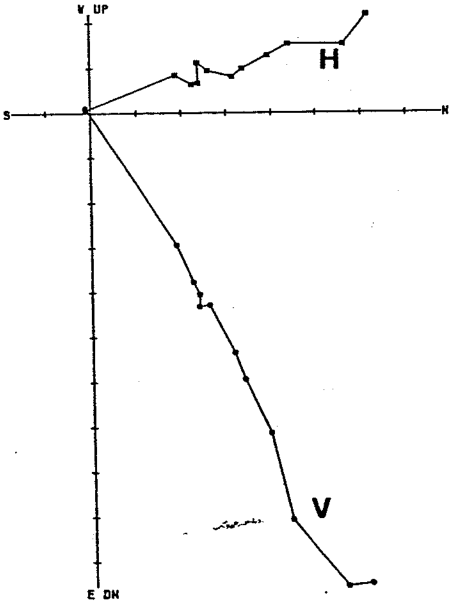
UNIT=5.E-06
DEMAG RT 220 370 460 530 580
LEVEL 120 300 430 500 560

KR-601-1 (SITE 74) PThD

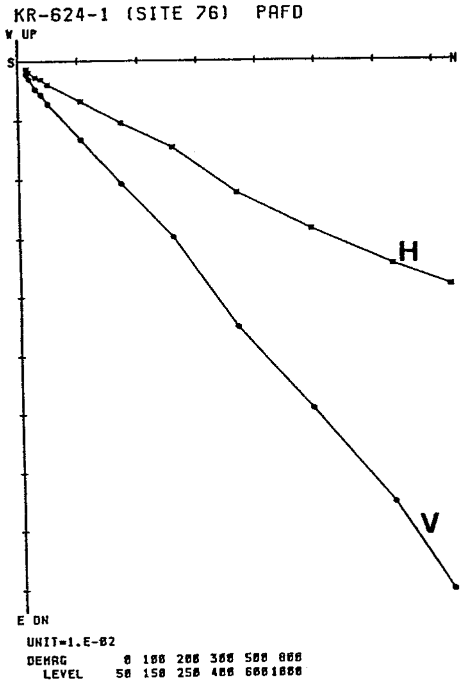


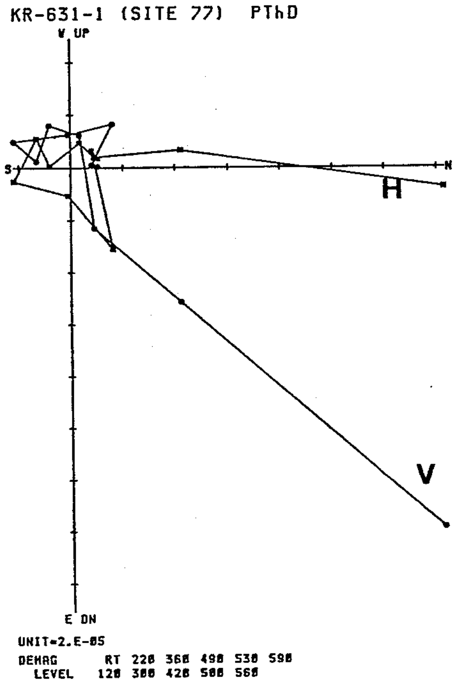
UNIT=1.E-05
DEMAG RT 220 370 460 530 590
LEVEL 120 300 430 500 560 620

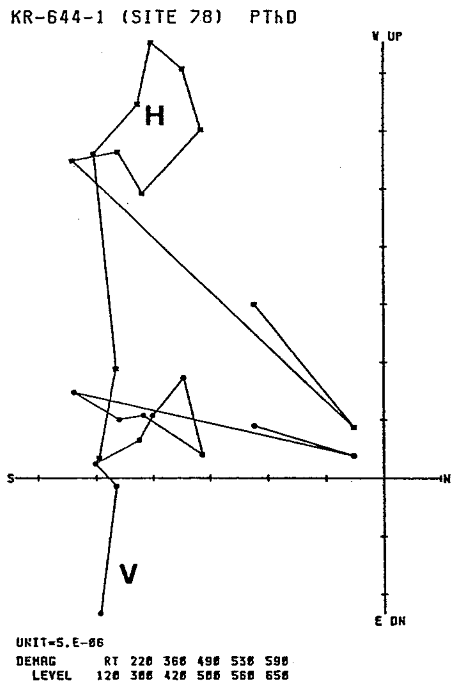
KR-611-1 (SITE 75) PThD

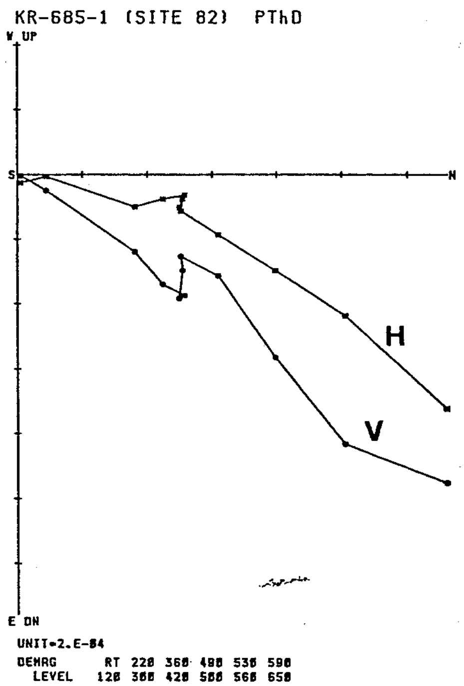


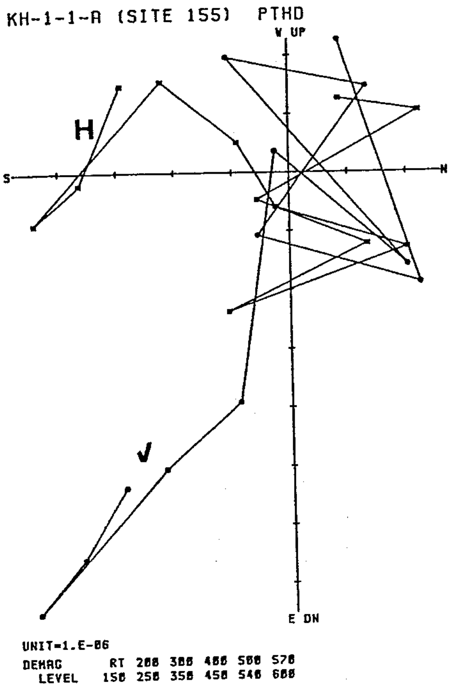
UNIT=2.E-04
DEMAG RT 220 360 490 530 590
LEVEL 120 300 420 500 560 650

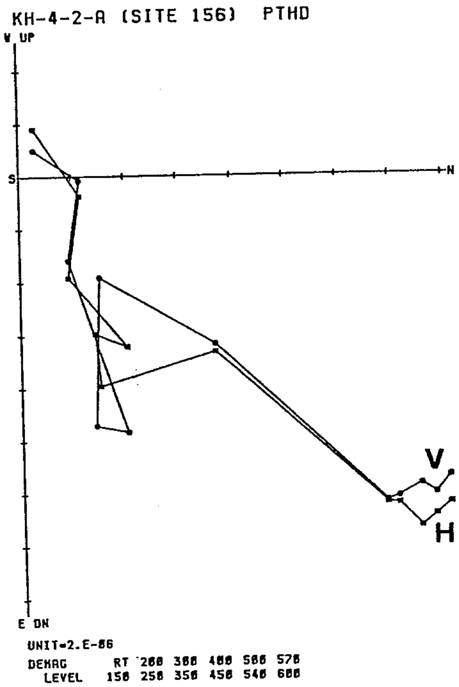

KR-624-1 (SITE 76) PAFD
W UP
S
N
H
V
E DN
UNIT=1.E-02
DEMAG 0 100 200 300 500 800
LEVEL 50 150 250 400 600 1000

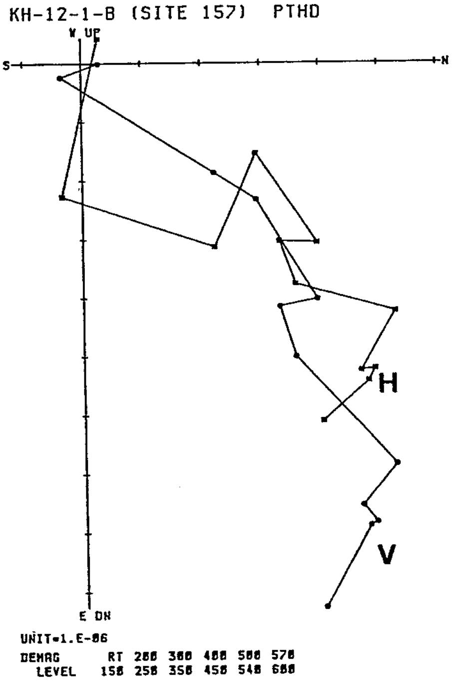

KR-631-1 (SITE 77) PThD
W UP
S
N
H
V
E DN
UNIT=2.E-05
DEMAG RT 220 360 490 530 590
LEVEL 120 300 420 500 560

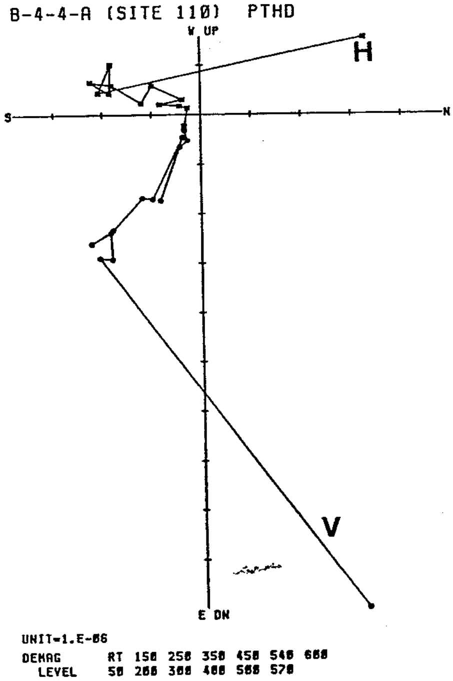

KR-644-1 (SITE 78) PThD
W UP
H
S
N
V
E DN
UNIT=5.E-06
DEMAG RT 220 360 490 530 590
LEVEL 120 300 420 500 560 650


KR-685-1 (SITE 82) PThD
W UP
S
N
H
V
E DN
UNIT=2.E-04
DEMAG RT 220 360 490 530 590
LEVEL 120 300 420 500 560 650

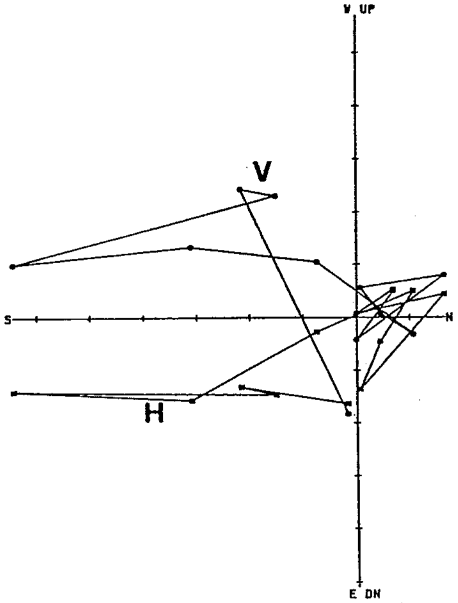

KH-1-1-A (SITE 155) PTHD
W UP
S
N
E DN
H
V
UNIT=1.E-06
DEMAG RT 200 300 400 500 570
LEVEL 150 250 350 450 540 600


KH-4-2-A (SITE 156) PTHD
W UP
S
N
E DN
V
H
UNIT=2.E-06
DEMAG RT 200 300 400 500 570
LEVEL 150 250 350 450 540 600


KH-12-1-B (SITE 157) PTHD
W UP
S
N
E DN
H
V
UNIT=1.E-06
DEMAG RT 200 300 400 500 570
LEVEL 150 250 350 450 540 600

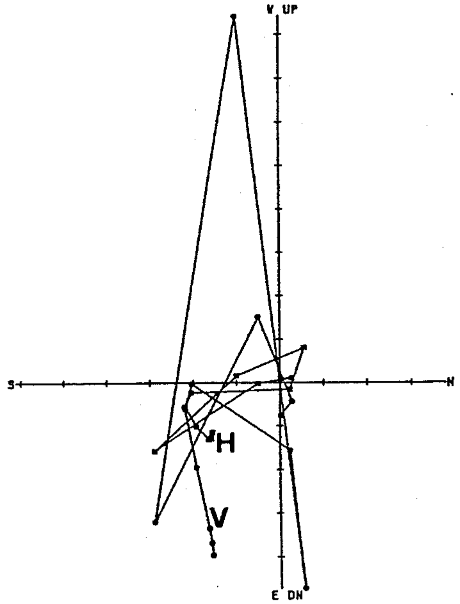

B-4-4-A (SITE 110) PTHD
W UP
S
N
E DN
H
V
UNIT=1.E-06
DEMAG RT 150 250 350 450 540 600
LEVEL 50 200 300 400 500 570

B-8-1-A (SITE 111) PTHD



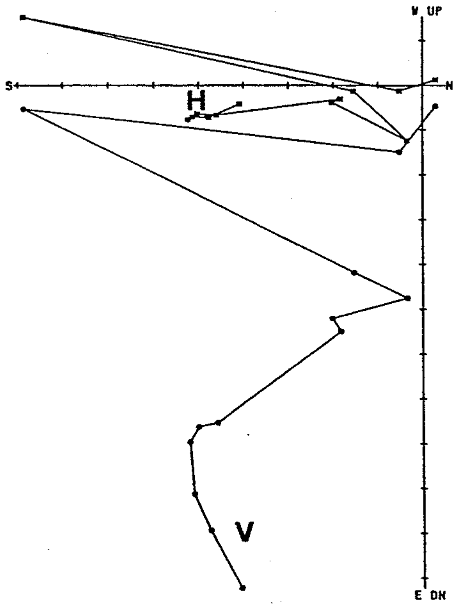
UNIT=1.E-07
DEMAG RT 200 300 400 500 570
LEVEL 150 250 350 450 540 600

B-12-2-A (SITE 112) PTHD



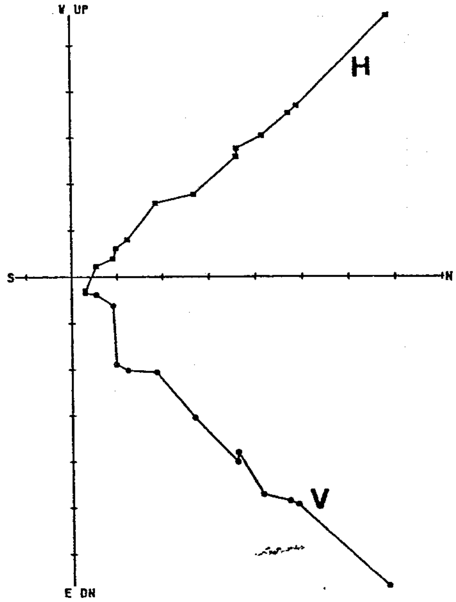
UNIT=1.E-05
DEMAG RT 150 250 350 450 540 600
LEVEL 50 200 300 400 500 570

B-20-2-A (SITE 113) PTHD



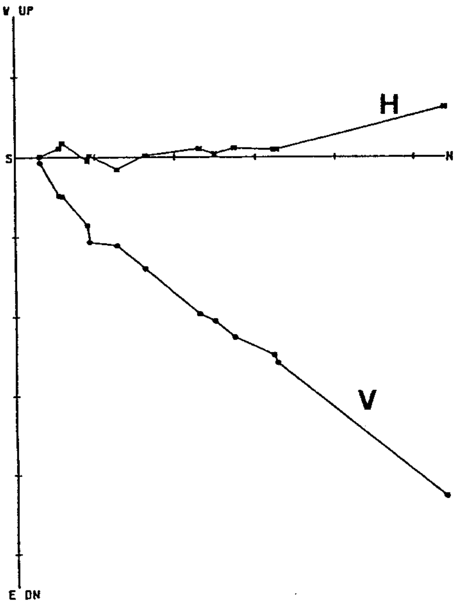
UNIT=2.E-06
DEMAG RT 150 250 350 450 540 600
LEVEL 50 200 300 400 500 570

SL-1-4-B (SITE 151) PTHD



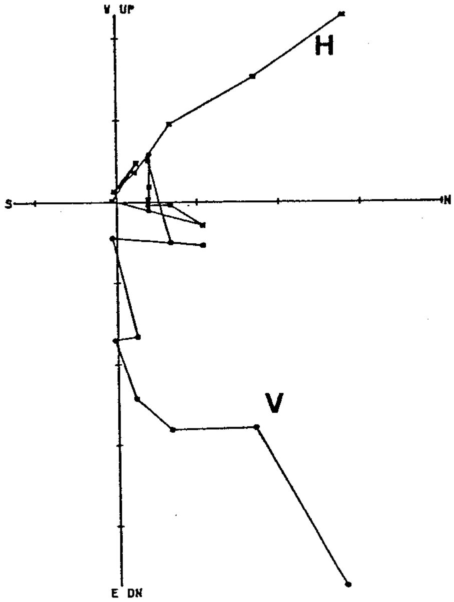
UNIT=1.E-04
DEMAG RT 150 250 350 450 540 600
LEVEL 50 200 300 400 500 570

SL-7-4-A (SITE 152) PTHD



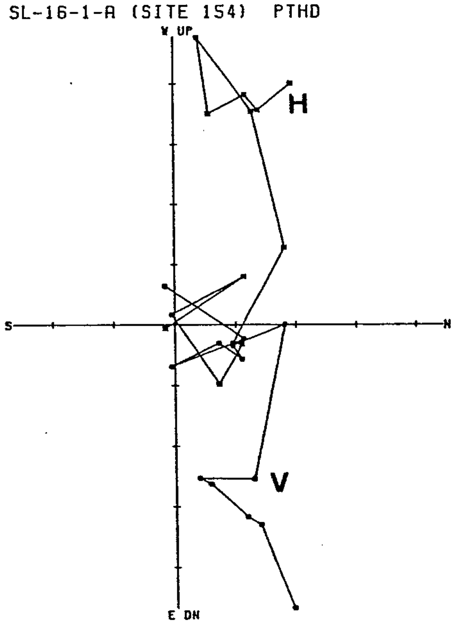
UNIT=1.E-04
DEMAG RT 150 250 350 450 540 600
LEVEL 50 200 300 400 500 570

SL-11-3-A (SITE 153) PTHD



UNIT=5.E-05
DEMAG RT 150 250 350 450 570
LEVEL 50 200 300 400 540 600

SL-16-1-A (SITE 154) PTHD



UNIT=2.E-07
DEMAG RT 150 250 350 450 540 600
LEVEL 50 200 300 400 500 570