SECULAR VARIATION OF THE GEOMAGNETIC FIELD FROM PUGWASH MUD - A PRELIMINARY INVESTIGATION

by

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Secular Variation of the Geomagnetic Field from Pugwash Mud - A preliminary Investigation

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Introduction

The purpose of this project was to determine the course of post glacial secular variation in the geomagnetic field, as recorded in Pugwash Mud. To this end, the project was a success, and linear trends for both declination and inclination were observed. Anticipating the conclusions, the inclination decreases from 65° N at the sea water-sediment interface to 46°N at a depth of 50 cm, a change of approximately -0.5°/cm. Declination increases from 2°E at the surface to 40°E at a depth of 41 cm, a change of approximately 1.50°/cm. These linear trends probably represent a portion of a longer secular variation cycle, the whole of which should be investigated. Many technical problems were encountered during sample preparation and analysis. The problems, and how we dealt with them, are discussed in Section II.

Secular variation has been the source of other investigations (Ellwood, 1971; Ozima and Aoik, 1972; Barbett; and McElhinny, 1972; R. Thompson, 1973; Gaskawa *et al.*, 1973; Gaskawa, 1974; Creer, 1974; Smith and Ade-Hall, 1975). A concise description of secular variation appears in Nelson, Hurwitz, Knapp (1962), Smith (1967) and Strangway (1970).

II Sampling procedures and analysis

Sampling - Two oriented cores, 4 m apart were obtained by scuba divers at a depth of 22 m in St. Georges Bay, Northumberland Straight, just off Linwood Harbor, Lat. 45°40.6', Long. 61°37.1' (see Fig. 1). The sediment in this area has

been described by Kranck (1971) as "Type A - mixed bottom consisting of glacial sediments or Buctouche sand and gravel overlain by small irregular patches or a thin discontinuous layer of Pugwash Mud". X-ray photographs of the two cores showed the two cores fit the Type A description (see plate 1). The cores were brought to Dalhousie, and core 1 was frozen immediately, at -16°C. The other core was refrigerated at 4°C, to "stiffen up" before splitting and sampling in the laboratory.

Each core was marked and split along a magnetic North line. The most serious problem during splitting occurred when we tried to separate the two halves once they were split. In both cores (1 and 2) the Pugwash mud section (upper 20 cm) pulled apart unevenly, leaving irregular surfaces, as witnessed by their varying x-ray absorbance (plates 1, 2, 7). However, the internal structure of the Pugwash Mud was undisturbed and gave consistent data for both cores. The many ice rafted pebbles caused some minor disturbances of the sediment during sampling. The split halves were then sampled with oriented mini-cores. Sampling density was maximized, and local sediment disturbance minimized, by sampling at 2.9 cm intervals. X-ray photographs allowed us to avoid large pebbles and other sample defects. The mini-cores were placed in a bell jar with an open beaker of water. The samples were analysed magnetically on a digital spinner magnetometer, Schonstedt D.S.M. # 1, as described by Smith and Ade-Hall (1975).

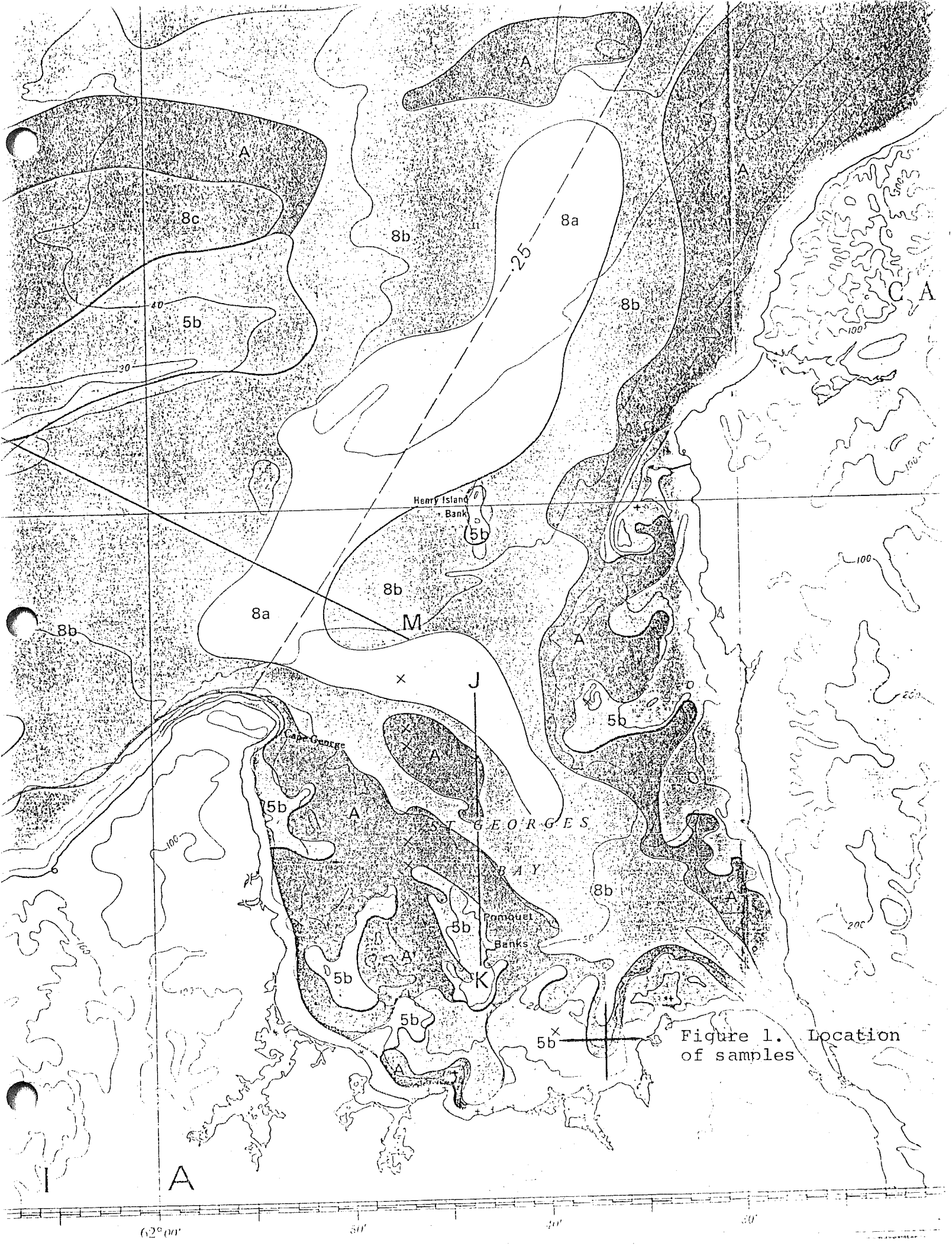


Figure 1. Location of samples

Fig. 1 Sample location in St. Georges Bay, Lat 45°40.6', Long 61°37.1'. Sediment types as described by Kranck (1971).

A mixed bottom consisting of glacial sediments or Buctouche sand and gravel overlain by small irregular patches or a thin discontinuous layer of Pugwash Mud.

8a, 8b, 8c Pugwash mud: 82, silty mud with less than 5% sand; 8b, sandy mud with 5-50% sand; 8c, muddy sand with 50-95% sand.

5b Buctouche sand and gravel: 5b, mainly sandy gravel with more than 5% gravel.

A. Accuracy and precision of data

Three sources contributing to errors in the NRM determinations are listed below. Where possible, estimates are made of the accuracy or precision lost at each step.

1. Core orientation

FIELD
- scuba divers' initial orientation - notching core tube towards magnetic north. Dec. 5°
- scuba divers' emplacement of core vertically Inc. 5°

LABORATORY
- constructing a straight magnetic north line on curved, spiralling, core tube. Dec. 3°
- splitting core along reference line. Dec. 3°
- orienting mini-cores perpendicular to split core surface. Dec. 2°
- orienting mini-cores towards top of core. Inc. 2°
- orienting mini-cores in sample holder. Inc. 1/2°

Table 1 Precision and accuracy of sample orientation

	Dec.	Inc.
cumulative	±13°	±7.5°
anticipated*	± 7°	±5.5°

anticipated Error = $(\sigma_1^2 + \ldots\ldots \sigma_N^2)^{1/2}$

Note that the field orientations are crucial to overall accuracy, where as the lab orientations determine the precision obtained within each core.

2. Sample defects

Sample defects include: sediment disturbance caused by sampling, sediment reorientation during analysis, presence of ice rafted pebbles, bioturbation (gas bubbles), discontinuities in the sediment structure, shrinkage due to drying. Sample defects tended to obscure the NRM determinations, and affected both the accuracy and precision of the data. X-ray photographs of whole and split cores, and mini-cores in two different orientations, were a great asset in this regard, and aided us in suppressing some of the noise in our secular variation plots. Each of the sample defects is discussed below.

(1) Sediment disturbance caused by sampling should affect only the accuracy of the inclination. The split core x-ray photographs showed that the bedding was generally skewed downward, towards the outside edge of the large core, during the field sampling. The degree of skewness varies with depth but ranges from a minimum of $^{1}/2$ cm to 2 or more cm. The degree of skewness is not easy to establish because bedding is not always discernible, and the outside edge of the large core is not visible in x-ray photographs. The effect of skewness is shown in Fig. 2. Precision of the data should be retained because each mini-core is taken in the same orientation. However, since at least 30% of each mini-core (by volume) is systematically skewed in the same direction, and the remanence measured is an average total moment, then it is probable that the measured inclination

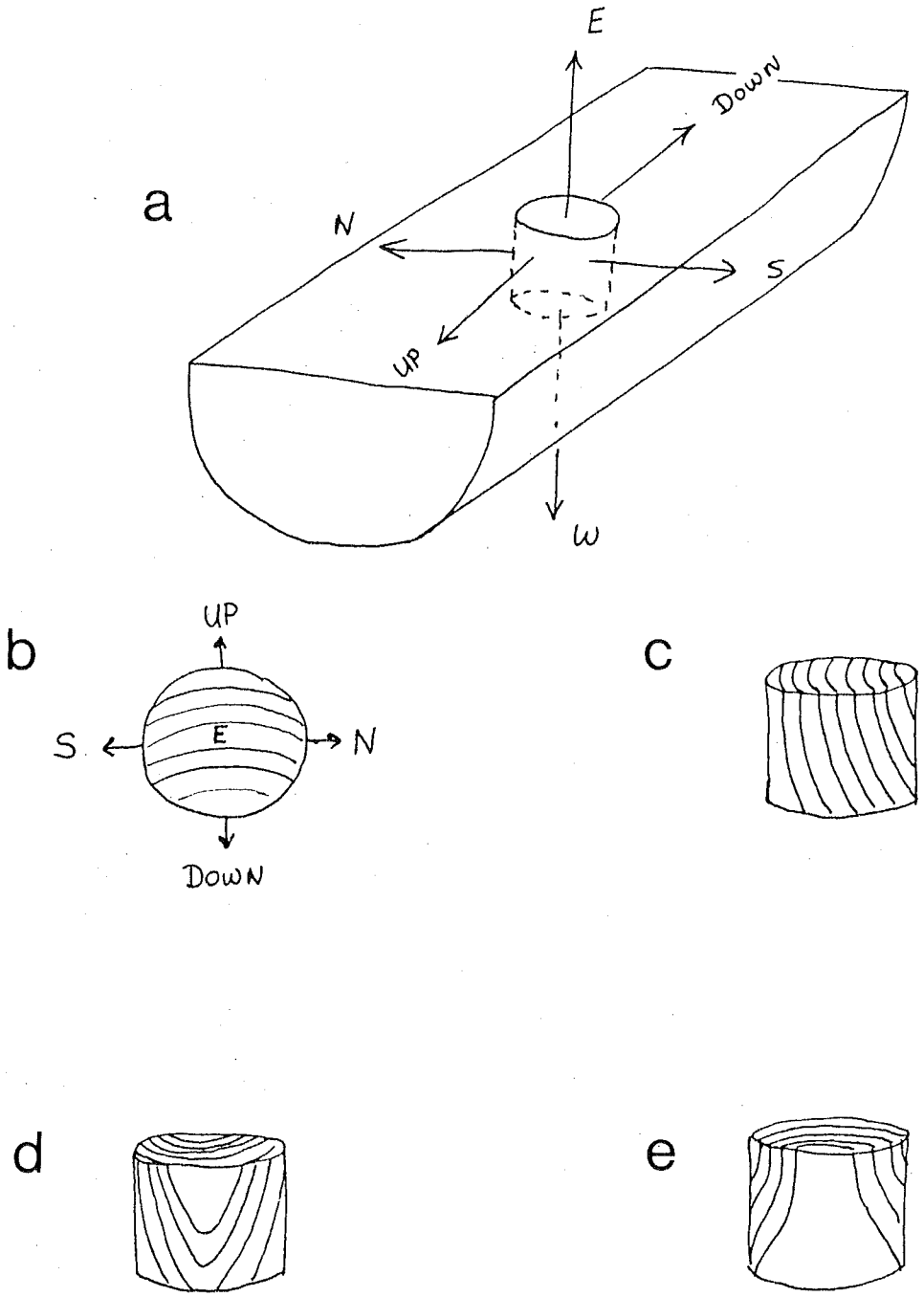


Figure 2. Sample skewness caused by sediment drag along the inner surface of the core liner.

values are actually 2-4° steeper than the correct values. Laboratory sampling disturbance should not affect the accuracy or precision of the data. Essentially non-magnetic mini-core plastic sleeves were carefully sharpened before plunging into the sediment, and disturbed less than 5% of the sample .

Sediment reorientation within the plastic sleeves may take place while spinning the sample (5 rotations/sec) in the magnetometer, or when tumbling during demagnetization. For example 1-8, 1-16, 2-12, 2-14 (see raw data section) have stable inclination values during demagnetization between 100-200 oe. and steadily increasing or decreasing values of declination. These anomalous declination values suggest that the sample is rotating within the sleeve during the analysis. One sample "rattled" during analysis, and another sample actually fell apart. Shrinking due to evaporation might allow some samples to become reoriented and give anomalous declination values.

The presence of ice rafted pebbles turned out to be less of a problem than was anticipated. Fifteen pebbles were analyzed for their remanence as a function of volume (Fig. 3), and their remanence is generally one order of magnetude less than remanence of even the weaker samples. Only one pebble was encountered which had a remanence (4×10^{-5}) comparable to the sediment. However, if a sample contains pebbles and shows anomalous magnetic properties, then the magnetic properties of the pebble should be examined as well.

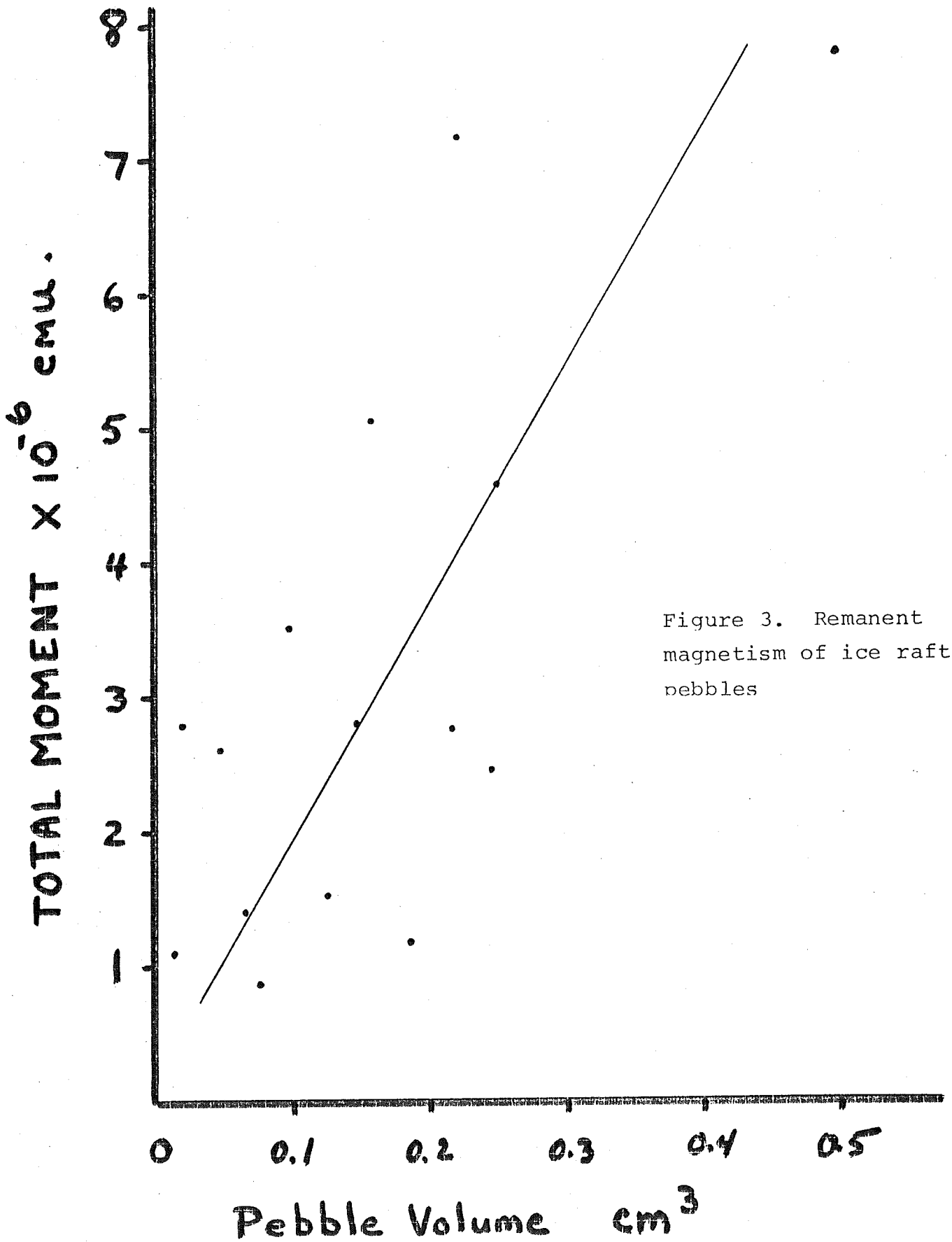


Figure 3. Remanent magnetism of ice rafted pebbles

The other sample defects, bioturbation, gas bubbles and discontinuities, and are not significant factors in this study. Bioturbation seems minimal in the cores, and gas bubbles are easily avoided using x-ray photographs.

A clear plastic tubing was used for the mini-cores. These plastic sleeves were machined at Dalhousie, and proved to be very satisfactory. The remanent magnetization of the empty sample holders are presented in Fig. 4, and are always 1 or 2 orders of magnetude weaker than the weakest samples.

Therefore, in addition to the sample orientation problems, sediment disturbance before and during the analysis can also play a significant role in decreasing accuracy and precision of the magnetic data. Approximately 3° should be subtracted from all inclination values to correct for bedding disturbances. In addition to the systematic error, sediment disturbances introduce random errors, which are impossible to estimate. To circumvent this problem, a reliability scheme was devised. The samples were rated according to their behaviour during demagnetization (see raw data): (1) indicates a steady demagnetization, with stable inclination and declination values after cleaning; (2) indicates acute abnormalities in the magnetic behavior during demagnetization; (3) indicates unreliable data. Plotting data of reliability (1) and (2) removed a considerable amount of noise in declination plots.

3. Finally, the reproducibility of any stable inclination or declination is 3°. Taking into account sample orientation

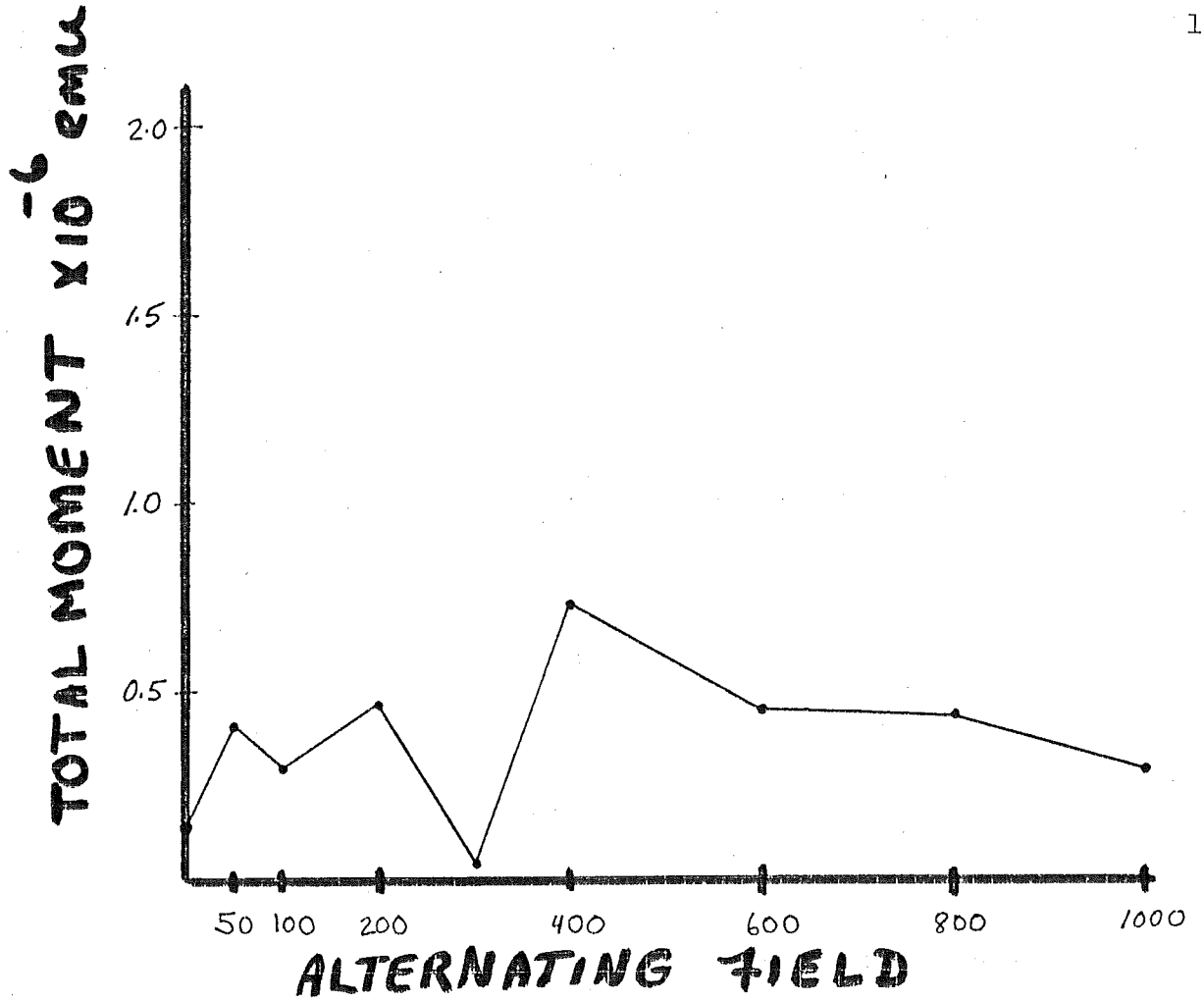


Figure 4. Magnetic behavior of empty sample holders during a.f. demagnetization

and reprodicibility, stable declination directions have a 68% chance of being with 7° of the correct value. Stable inclination directions have a 68% chance of being within 5.5° of the correct value. Sample defects play an indefinite role in obscuring the data, but seem to have consistently increased all inclination values by 3°. In some cases, a sample reliability index has eliminated bad data from the secular variation plots.

III Results of the Magnetic Analysis

The results of the magnetic analyses are summarized in Tables 3, 4 and 5, and Figures 5-11. Keeping in mind the problems with sample orientation and sample defects, the data for the two cores is remarkably consistent.

Figure 5 shows the NRM intensity values before cleaning. In both cores, the total moment first increases then continually decreases to a depth of about 20 cm. Below 20 cm, the remanence varies, but especially low values ($\sim 10^{-5}$) were obtained for Buctouche sand and gravel.

Three explanations of the decrease in NRM with increasing depth of Pugwash mud are offered. The first possibility is that the magnetic carriers are being altered chemically, in which case NRM does not serve as a valuable magnetic parameter to date the core. The second possibility is that the amount of magnetic material in Pugwash mud decreases with depth, in which case the NRM values alone would correlate Pugwash Mud obtained anywhere in Southwest Harbour, or perhaps even in the Northumberland Strait.

One must also consider the strength of the ancient geomagnetic field. During the past 2000 years, the geomagnetic dipole moment has apparently decreased by about one third of its peak value to the present value of 8.0×10^{-25} gauss. cm^3 (Fig. 12). On this basis, I am tempted to date the 5-7 cm interval of cores 1 and 2 at around 100 A.D.

Table 5 summarizes the magnetic behavior during demagnetization of all the mini cores. One would expect samples of this nature to acquire weak magnetic components parallel to the present day field. Upon demagnetization, the remanent vector should swing away from the present field revealing a stable direction of magnetization which is taken to be the geomagnetic field direction at the time of sediment deposition. However, the weak components had a random orientation. Upon cleaning 42% of the vectors swung towards the present field, 37% swung away, 17% did not change, and 4% were too erratic for determinations. The reason for this random orientation of weak components is unclear. Sample defects may contribute to randomizing the weak components.

Figures 6-11 show the changes in declination and inclination as a function of depth. The general conclusion is that the inclination decreases by 20° and the declination increases by 60°, from top to bottom of the long cores. The inclination decreases linearly to a first approximation from 65°N at the surface, to 46°N at a depth of 50 cm, a change of approximately (-0.5°/cm). The declination increases approximately linearly from 0° at the surface to 40° at a depth of 41 cm, a change of + 1.5°/cm.

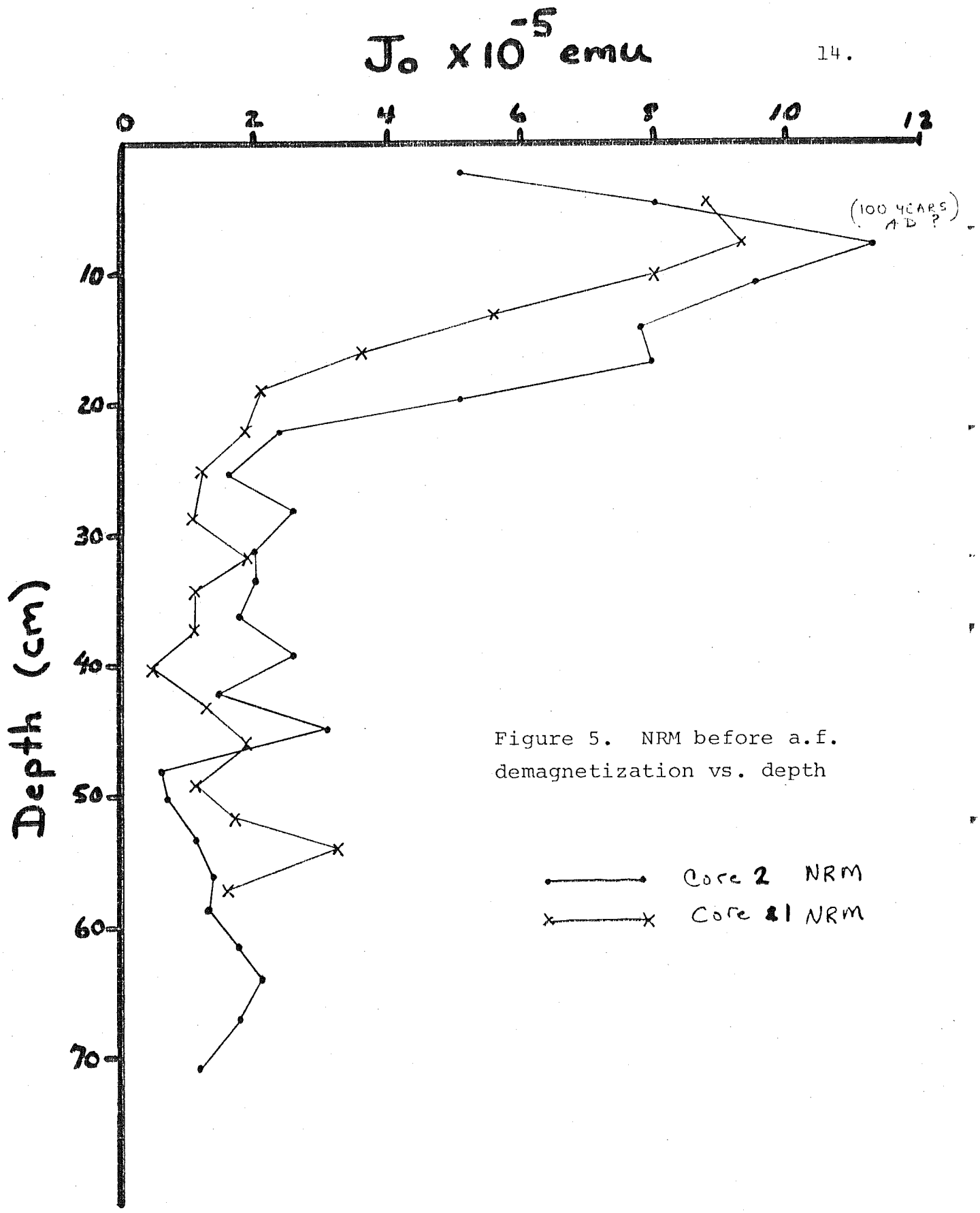


Figure 5. NRM before a.f. demagnetization vs. depth

Sample #	Z(cm)	$J_o \times 10^{-5}$	D°	D_4°	C_D	I°	I_4	C_I	Reliability D	Reliability I
25	2.2	5.08	38.3		-	68.2		-	2	2
1	4.7	8.02	20.8	17.1	-	68.3	66.5	-	2	2
2	7.8	11.30	10.7	6.1	+	62.3	65.7	NC	2	1
3	10.8	9.49	8.5	9.3	+	67.1	65.4	NC	1	1
4	14.0	7.84	-5.8	2.0	+	65.0	66.8	-	2	1
5	16.8	7.96	23.6	10.9	-	67.0	63.4	NC	2	1
6	19.3	5.13	-18.2	21.4	+	67.8	57.9	NC	2	1
7	22.2	2.36	44.0	26.3	-	53.7	55.5	+	2	2
8	25.2	1.57	36.2	35.9	-	43.1	55.7	-	2	2
9	28.0	2.57	43.2	29.4	-	57.1	54.8	NC	2	1
10	30.9	2.01	20.1	40.9	+	68.8	54.6	NC	2	1
11	33.3	2.08	18.0	35.6	-	50.0	54.4	+	2	1
12	36.2	1.80	82.3	30.5	-	42.3	57.2	NC	3	1
13	39.0	2.57	22.0	37.9	-	56.5	57.2	-	2	1
14	42.0	1.24	-0.2	23.2	+	80.0	63.6	-	3	2
15	44.8	3.12	47.4	34.5	+	50.0	56.9	-	2	1
16	47.7	0.59	135.4	56.8	ND	68.0	53.0	-	3	2
17	50.0	0.73	23.4	-	+	29.4	52.8	-	2	2
18	53.1	1.07	231.7	61.7	ND	64.3	48.7	-	3	2
19	55.8	1.36	67.2	-	+	49.4	53.5	-	3	1
20	58.5	1.33	89.2	74.4	-	51.7	53.5	+	2	2
21	61.2	1.77	66.9	66.6	-	48.6	53.5	-	2	2
22	63.8	2.14	74.1	58.1	-	64.1	49.8	NC	2	2
23	67.0	1.80	36.2	-	-	49.5		-	2	2
24	70.5	1.20	55.3		-	36.9		+	2	2

Table 3. Core 2 - Summary of Magnetic Parameters

Z = depth from the sea water interface in cm
D = stable declination in degrees - convention
D_4 = 4 pt. running averages of stable declinations
C_D & C_I = change in declination upon a.f. demagnetization; (+) = towards present field, (-) away from present field
NC = no change
I = stable inclination in degrees
I_4 = 4 pt. running averages of stable inclinations

Reliability - based on determination of sediment structure and pebble content with x-ray photographs, and careful examination of magnetic parameters (1) = good, (2) = questionable (3) = unreliable

Table 4. CORE 1A - Summary of Magnetic Parameters

Sample #	Z(cm)	$Jox10^{-5}$	D^{o}	D_4^{o}	C_D	I^{o}	I_4^{o}	C_I	Reliability D	Reliability I
1	4.4	8.76	-1.6		+	61.7		NC	1	1
2	7.3	9.32	-4.5		+	65.6		+	1	1
				-2.2			63.5			
3	10.0	8.01	-10.2		+	64.8		+	1	1
				-2.2			62.6			
4	13.1	5.55	7.5		+	62.4		+	1	1
				2.7			59.7			
5	16.2	3.62	5.0		+	58.2		+	2	1
				16.8			60.2			
6	19.1	2.07	8.6		+	53.8		+	1	1
				8.9			59.4			
7	22.2	1.88	45.9		-	67.0		+	2	2
				14.6			61.6			
8	25.0	1.23	-23.6		+	58.9		-	3	1
				15.7			62.7			
9	28.5	1.07	27.6		-	66.8		+	3	2
				20.9			52.6			
10	31.6	1.95	13.2		+	58.4		NC	1	1
				30.6			56.6			
11	34.4	1.13	19.0		+	26.8		+	1	2
				40.4			44.2			
12	37.1	1.12	211.5		ND	74.8		-	3	3
				50.0			35.1			
13	40.0	0.49	62.4		+	17.1		NC	2	2
				-			42.7			
14	43.0	1.31	67.0		-	22.3		NC	2	2
				34.9			38.3			
15	45.6	1.90	51.6		+	57.2		NC	2	2
				12.2			42.4			
16	49.0	1.12	-41.3		+	57.1		-	3	2
				0.6			42.2			
17	51.8	1.70	-37.2		NC	33.4		-	3	2
				-			43.2			
18	54.3	3.11	29.2		+	21.4		-	2	2
19	56.9	1.62	147.1		ND	61.3		+	3	2

	Core 1		Core 2		$\frac{D_1 + D_2}{2}$	$\frac{I_1 + I_2}{2}$	TOTAL %
	D	I	D	I			
(+)	68	47	36	16	51	32	42
(-)	16	26.5	56	52	35	39	37
N.C.	5	26.5	-	32	5	29	17
N.D.	11	-	8	-	9	-	4

Table 5. Sample behaviour during alternating field demagnetization (by percent). (+) = upon demagnetization, remanence swings towards the present day field; (-) = remanence swings away from or through present day field; N.C. = no significant change; N.D. = NO DATA

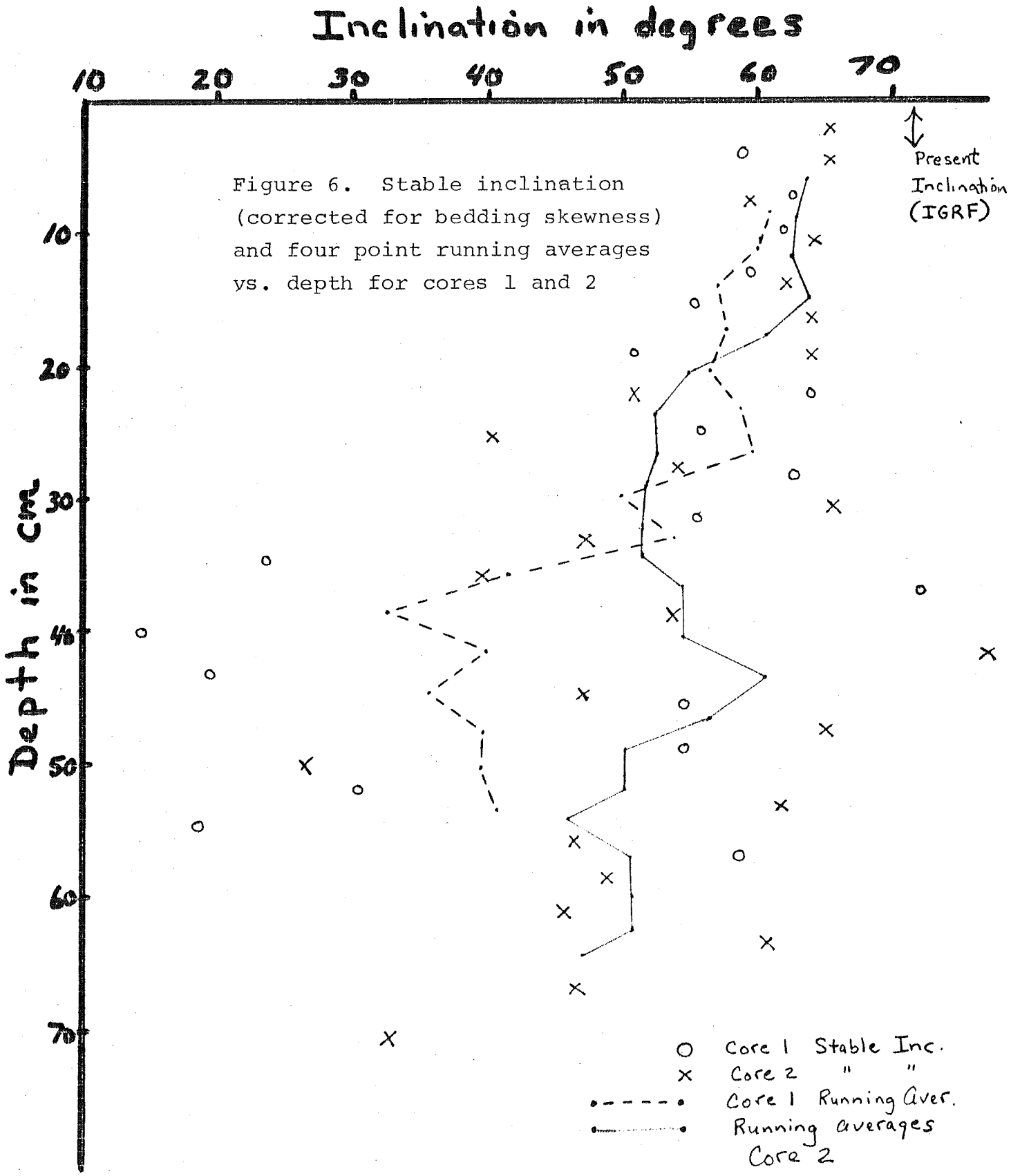


Figure 6. Stable inclination (corrected for bedding skewness) and four point running averages vs. depth for cores 1 and 2

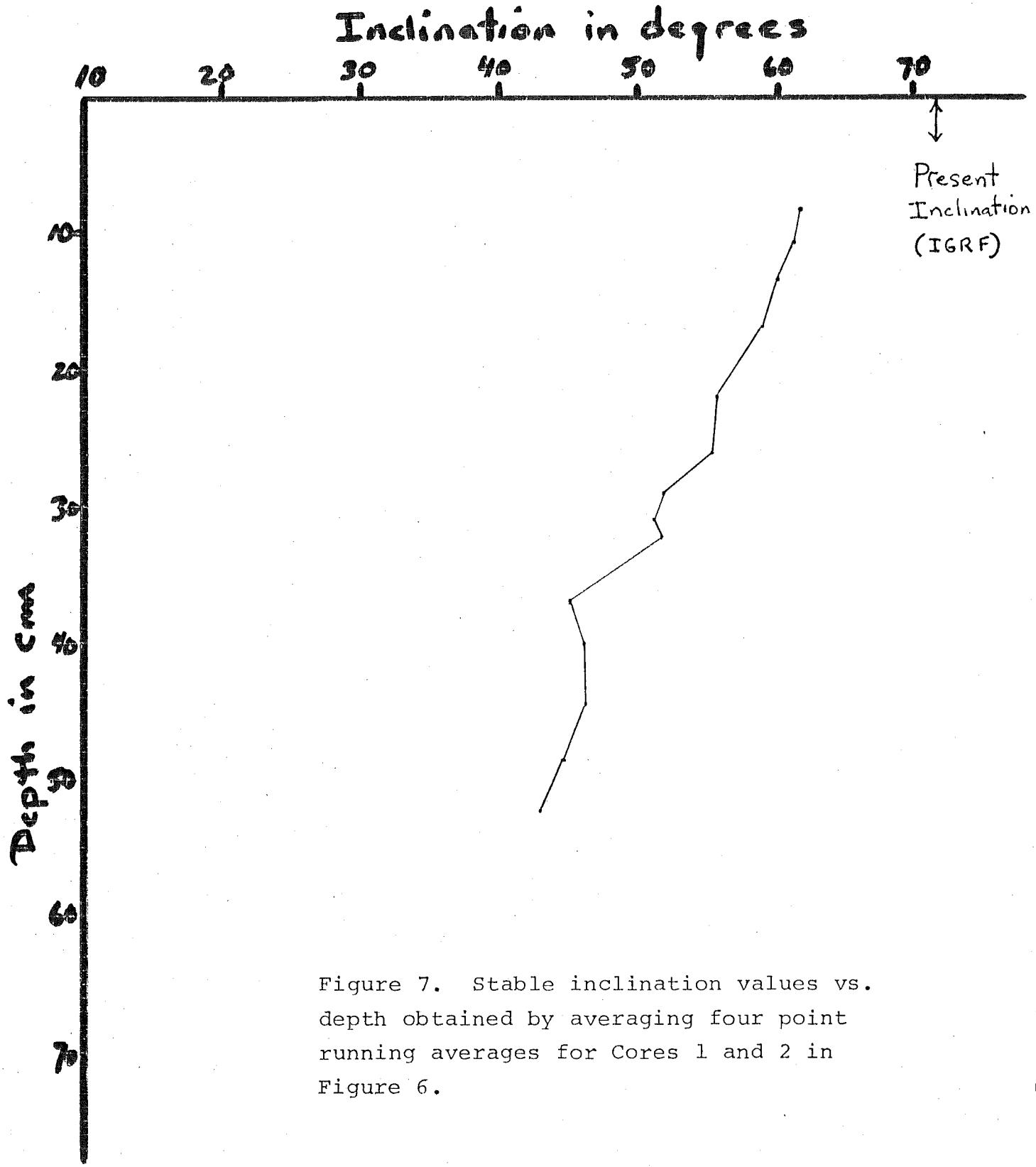


Figure 7. Stable inclination values vs. depth obtained by averaging four point running averages for Cores 1 and 2 in Figure 6.

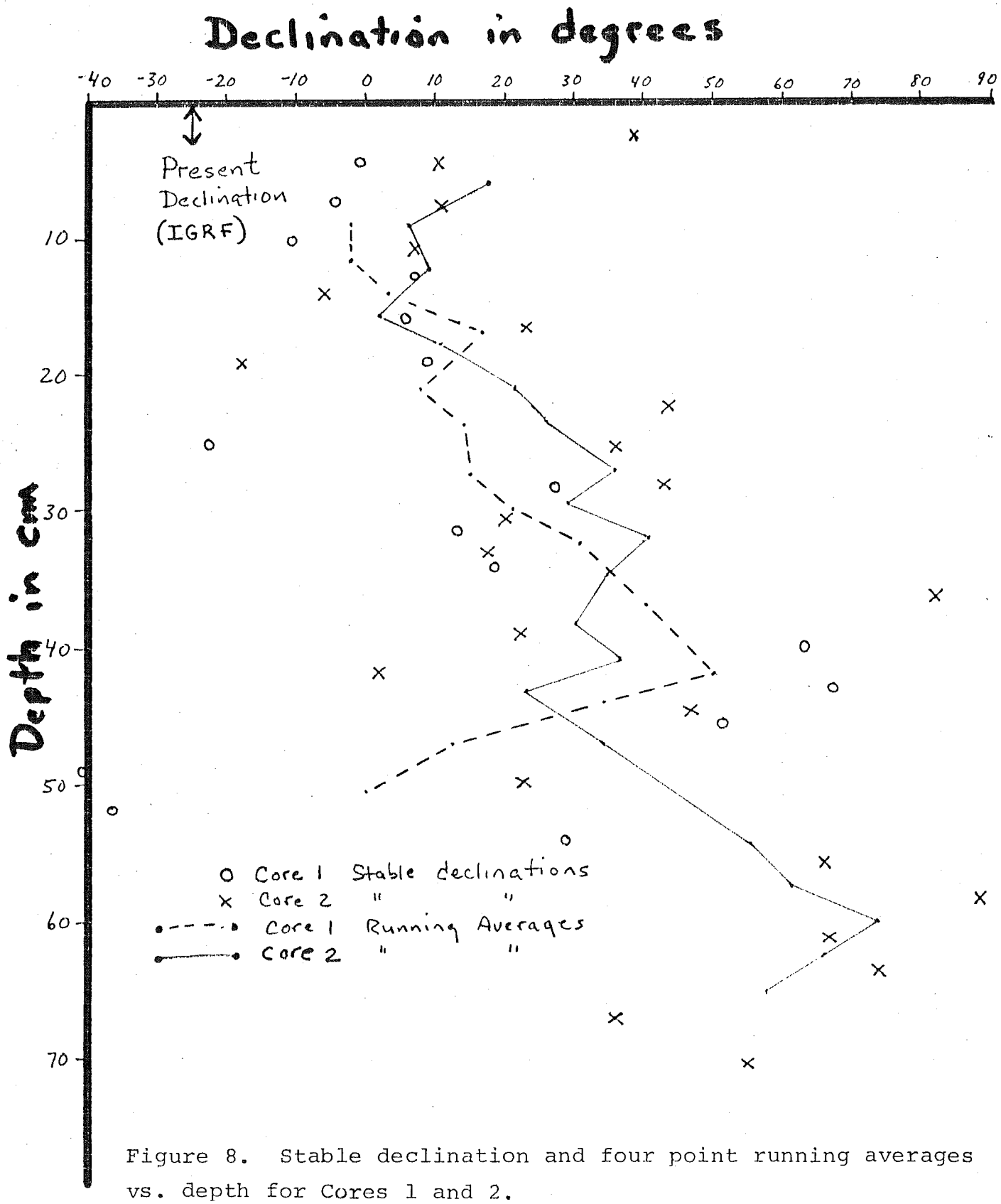


Figure 8. Stable declination and four point running averages vs. depth for Cores 1 and 2.

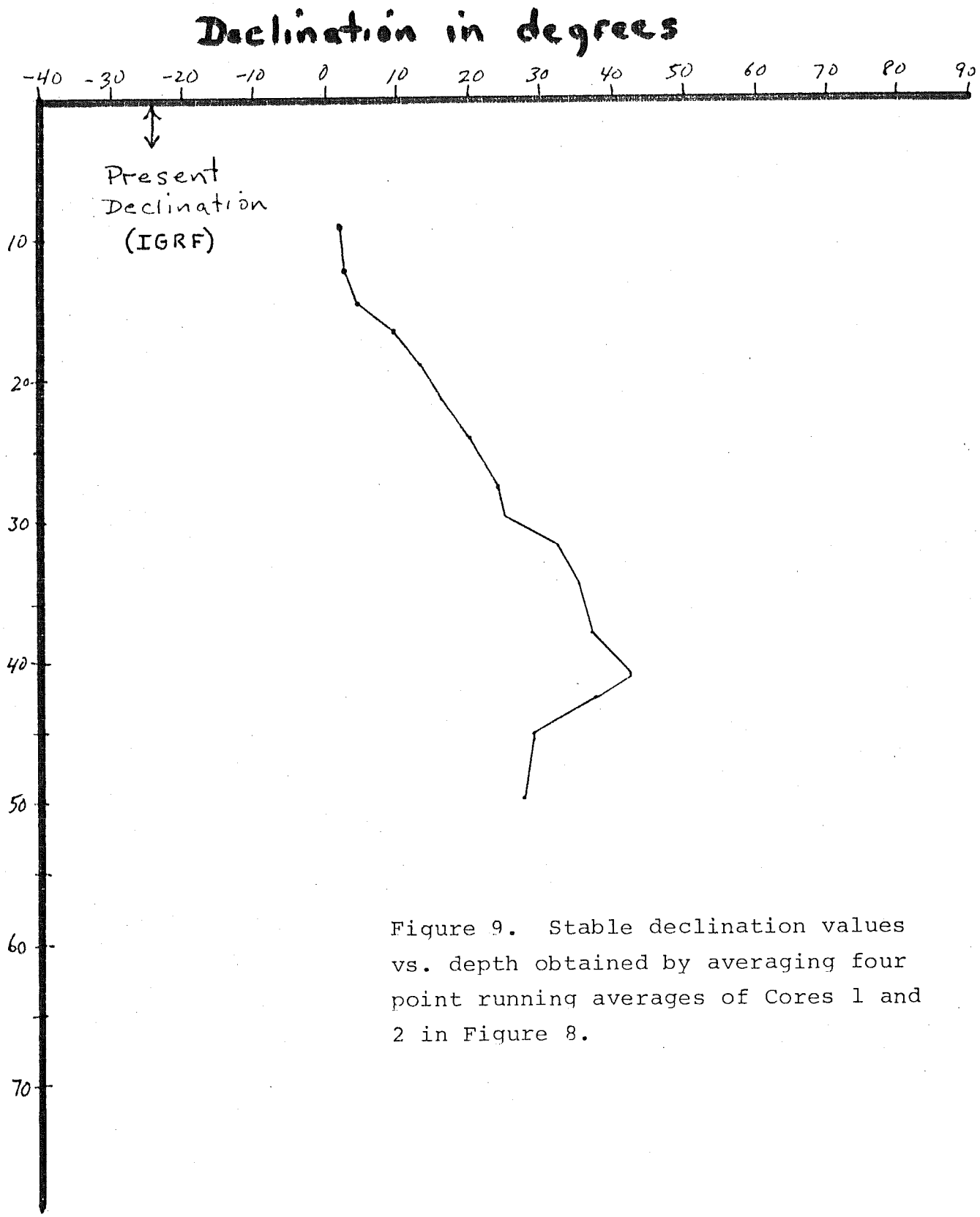


Figure 9. Stable declination values vs. depth obtained by averaging four point running averages of Cores 1 and 2 in Figure 8.

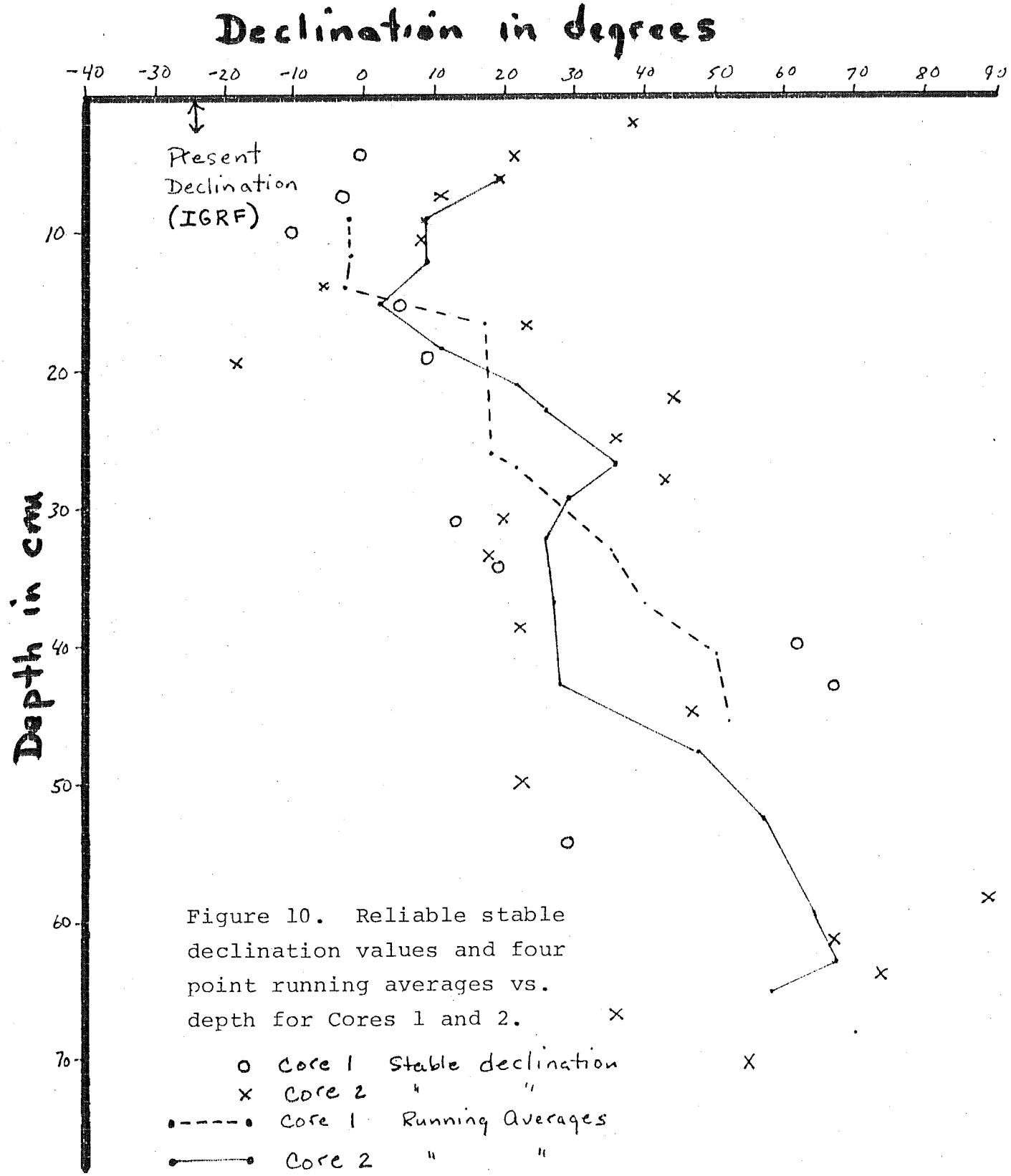


Figure 10. Reliable stable declination values and four point running averages vs. depth for Cores 1 and 2.

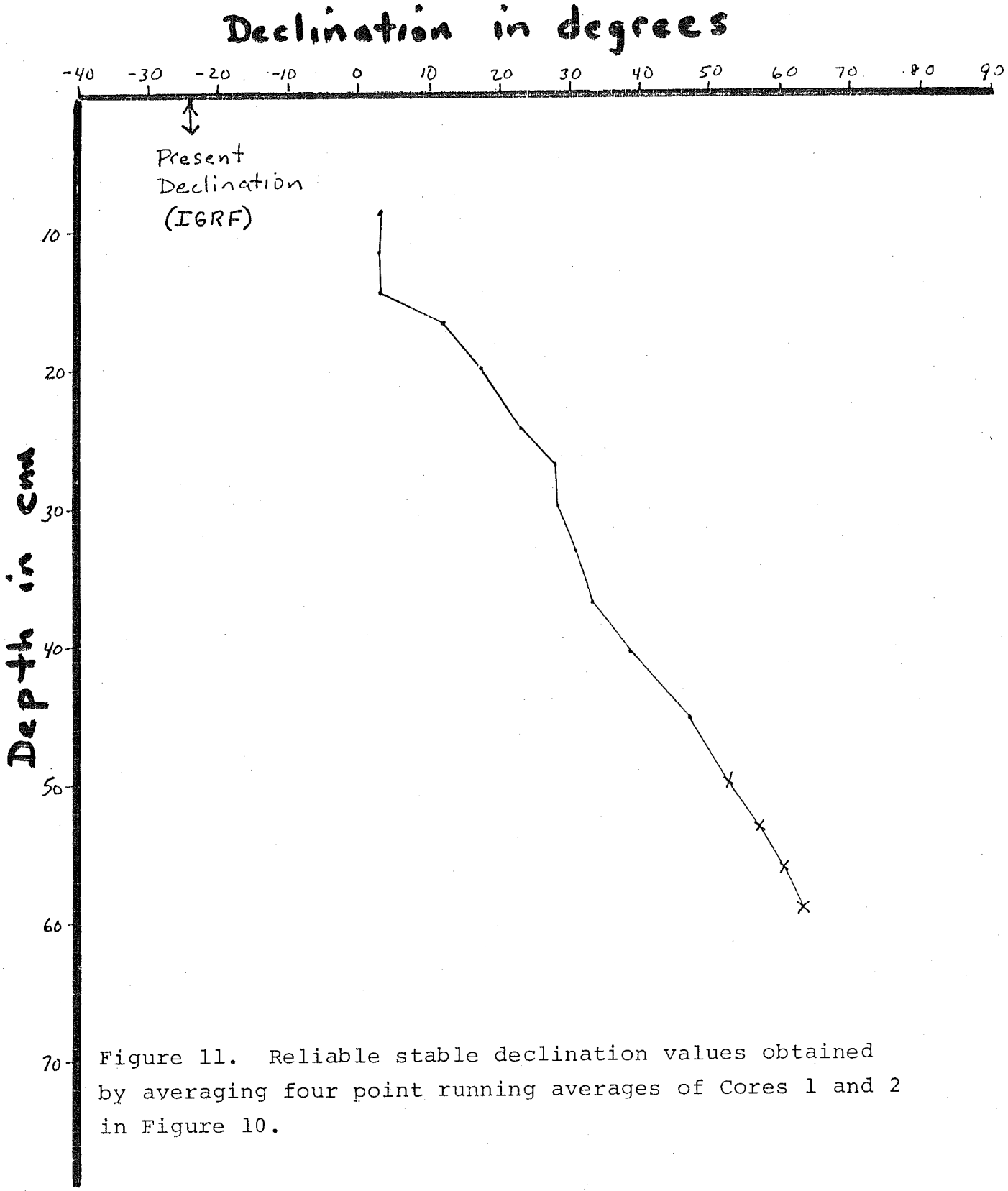
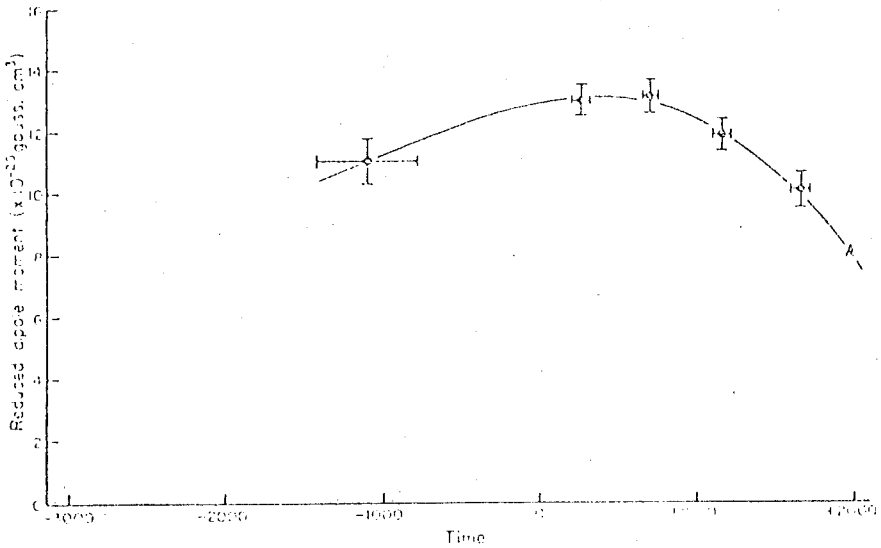


Figure 11. Reliable stable declination values obtained by averaging four point running averages of Cores 1 and 2 in Figure 10.



Historic and archaeological reduced dipole moments (meaned in groups of ten commencing with the youngest) plotted against time. Error bars represent standard errors of the means. Times A.D. are expressed as positive numbers; times B.C. are expressed as negative numbers.

(a) During the past 2000 years the geomagnetic dipole moment has apparently decreased by about one-third of its peak value to the present directly observed value of $8{\cdot}0 \times 10^{25}$ gauss.cm^3 (Fig. 5). Prior to the year 0 the dipole moment was increasing. The scatter of the points in Fig. 5 is large; and hence in order to show the main trend of the result more clearly the RDMs have been meaned in groups of ten commencing with the youngest. The results of this are shown in Fig. 6.

Figure 12. From Smith (1967).

These linear trends were derived by averaging the 4 pt. running averages of stable inclination and declination values, for each of the two long cores. The graphs in Figures 5, 6, 7, 8 and 9 are based on all the available data, where as the graphs in Figures 10 and 11 do not contain unreliable (index "3") data. The four point averaging precess may dampen some real non-linear trends in the secular variation, but given the noise level in the data, we must be satisfied, for the time being, with establishing secular variation trends.

IV Conclusions and suggestions

This study of secular variation should be extended. With certain improvements, we feel that the course of post glacial secular variation can be accurately determined for Eastern Canada, which could prove to be a very useful dating tool. The following remarks outline the improvements which Dalhousie University and B.I.O. must make, before accurate dating by secular variation is possible.

Dalhousie - Effort should be made to increase the precision of measurements within the long cores. Some noise can certainly be eliminated by improved sample preparation. To cut down on sample disturbance during the analysis, we should first freeze dry the mini-cores, then impregnate them with a resin dissolved in a volatile solvent. Other techniques for sample impregnation are described by Stanley (1971). Also, we recommend multiple spins, repeating each measurement at

each of the 100, 150, and 200 demagnetization steps to improve the reproducibility of the analysis. If sample impregnation proves unsuccessful, then tumbling during demagnetization should be eliminated, and three axis demagnetization should be used. X-ray analysis of the magnetic carriers, and SEM photographs of the samples may also aid in correlating cores from the Northumberland Strait. Also, the pebbles should be examined for their remanent magnetization.

B.I.O. - If B.I.O. wishes to extend the study, I propose the following:

(1) Additional sites - Pinpointing the post glacial secular variation in the geomagnetic field requires the best quality samples. If the samples are sediments, they must be datable, show proper magnetic behaviour during demagnetization, have had a continuous deposition rate for periods extending over thousands of years, and must have a minimum of sample defects. In this regard, the type A "mixed bottom" is not the best of samples. Large inland lakes might be more suitable. Bras-d'or in Cape Breton and Kejumkujik or Lake Rossignol in South Central Nova Scotia are possibilities. Also, since Pugwash mud (type 8A Kranck, 1971) occurs in thicknesses up to 20 m, examination of longer cores of this material might ellucidate any non linear trends in secular variation.

(2) Core orientation - Secular variation cores must be accurately oriented. Scuba divers need only orient the cores, not implant them. It should be a simple matter to build underwater housings for two Brunton compasses which could

be securely mounted by scuba divers, on the top of a piston implanted core. Accurate declination and inclination values could then be obtained at the surface or back at the laboratory.

(3) Sediment disturbance in the field - Accurate measurements require the absolute minimum of sample disturbance. A larger diameter core should decrease the volume % of disturbed sample. Also, the plastic core holder must have a very sharp, smooth edge to slice through the sediment.

(4) It is strongly recommended that B.I.O. accurately date the mini-cores from cores 1 and 2. At this point, it is nearly impossible to compare the results with other secular variation studies which were done thousands of kilometers away from the Maritimes, especially because the distribution of secular change is characterized by complex regional features. The comparison will have much more meaning when the dates are provided.

Pugwash Mud Bibliography

M. Barbetti and M. McElhinny, 1972. Evidence of Geomagnetic Excursion 30,000 yr B.P. Nature 239 (5371) p. 327-330.

K Creer and J. Kopper, 1974. Paleomagnetic Dating of Cave Paintings in Tito Bustillo Cave, Asturias, Spain. Science, vol. 186, p. 348-350.

B. Ellwood, 1971. An Archeomagnetic Measurement of the Age and Sedimentation Rate of Climax Cave Sediments, Southwest Georgia. Am. Jour. Sci. 271, p. 304-310.

K. Kranck, 1971. Surficial Geology of the Northumberland Strait. Marine Science Paper 5. Geological survey of Canada paper 71-53.

J. Nelson, L. Hurwitz and D. Knapp, 1962. Magnetism of the Earth. U.S. Dept. of Commerce Coast and Geodetic survey. Publication # 40-1.

M. Ozima and Y. Aoki, 1972. Quiet Secular Variation in Japan during the last 9500 years. J. Geomag. and Geoelect. vol. 24(4) p. 471-477.

L. Smith and J. Ade-Hall, 1975. The Natural remanent magnetization inclinations for Beaufort Sea sediment core # 69-050-809.

P. J. Smith, 1967. The Intensity of the ancient Geomagnetic Field: A review and analysis. Geophys. J. R. astr. Soc. 12, p. 321-362.

Stanley, D., 1971. Sample Impregnation. Offprint from Procedures in Sedimentary Petrology by R. Carver. Wiley & Sons, Inc. Chapter 9.

Strangway, D. 1970. History of the Earth's magnetic field. McGraw-Hill Book Co., New York.

R. Thompson, 1973. Nature (Lond.) 242, 182.

K. Yaskawa, T. Kakajima, N. Kawai, M. Torii, N. Natsuhara, S. Horie, 1973. Paleomagnetism of a core from Lake Biwa (I). J. Geomag. and Geoelectr. 25, 447-474.

K. Yaskawa, 1974. Reverals, excursions and secular variations of the geomagnetic field in the Brunhes Normal polarity epoch. Paleolimnology of Lake Biwa and the Japaneese Pleistocene, vol. 2. Ed. S. Horie, Otsu Hydrobiological Station of Kyoto University, Otsu 520-01.

RAW DATA

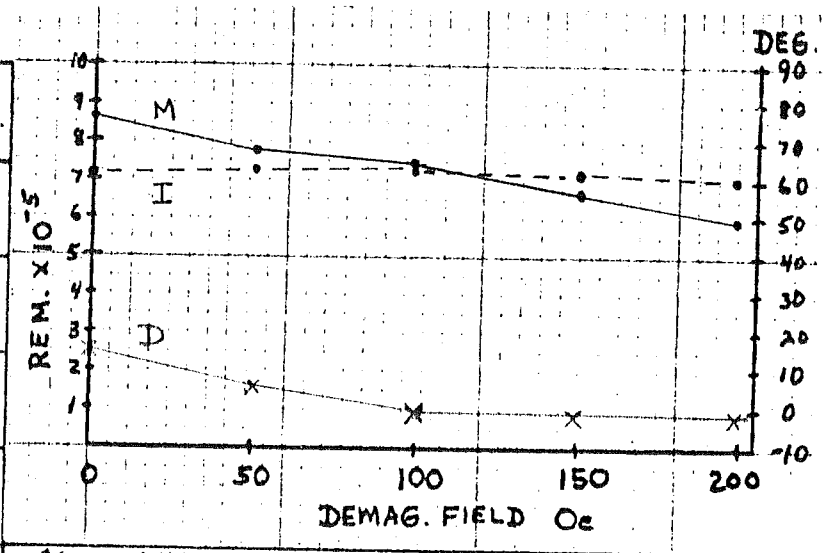
SAMPLE # PM-1-1, 1-2

1-1

Z = 4.4 cm. C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	14.9	61.4	8.76-5
50	5.6	62.8	7.77-5
100	-1.5	62.4	7.47-5
150	-2.5	62.4	6.61-5
200	-0.9	60.4	5.96-5
$\frac{X_{100}+X_{150}}{2}$	-2.0	62.4	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	-1.6	61.7	—



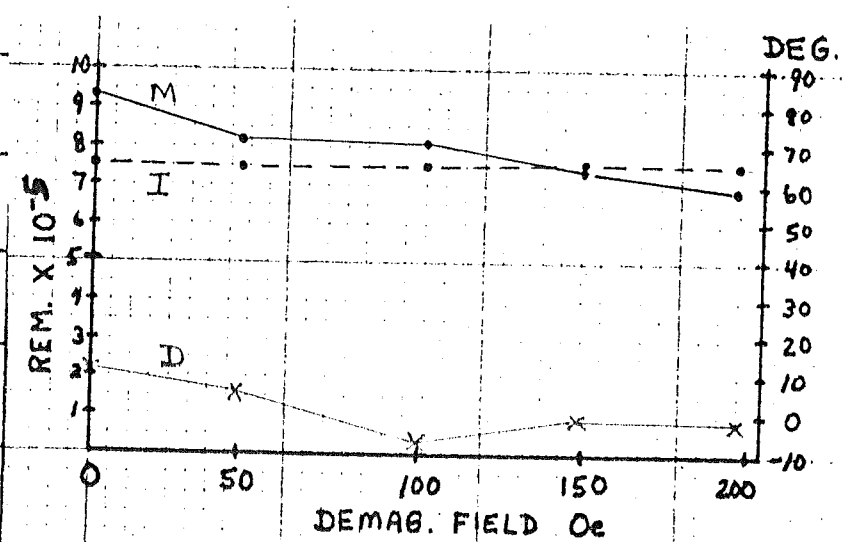
COMMENTS
Pugwash mud - NO pebbles, one x-ray crack, bedding not distinct

MAGNETICS D.M. STEADY

D, I STEADY BETWEEN 100 - 200 Oe (STABLE)
D (—)

1-2 Z = 7.3 cm. C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	11.4	66.1	9.32-5
50	5.7	65.0	8.24-5
100	-8.0	65.4	8.32-5
150	-2.4	66.2	7.47-5
200	-3.0	66.2	6.94-5
$\frac{X_{100}+X_{150}}{2}$	-5.2	65.2	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	-4.5	65.6	—



COMMENTS
Pugwash mud - no pebbles, cracked x-ray bedding not distinct

MAGNETICS D.M. steady

D, I stable between 100-200 Oe

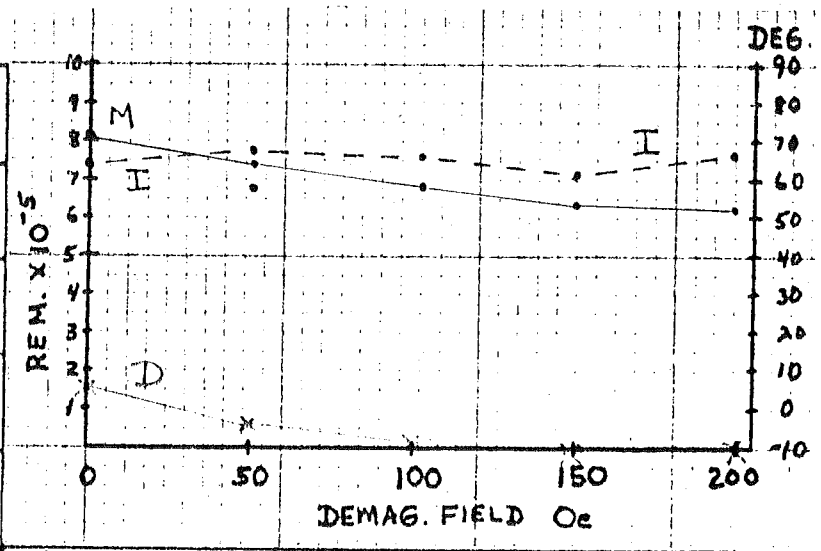
SAMPLE # P.M 1-3 1-4

1-3

Z = 10.0 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	5.5	64.7	8.01-5
50	-4.4	67.7	7.46-5
100	-9.1	65.9	6.78-5
150	-11.0	63.3	6.41-5
200	-10.4	65.1	6.11-5
$\frac{X_{100}+X_{150}}{2}$	-10.0	64.6	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	-10.2	64.8	✓ —



COMMENTS

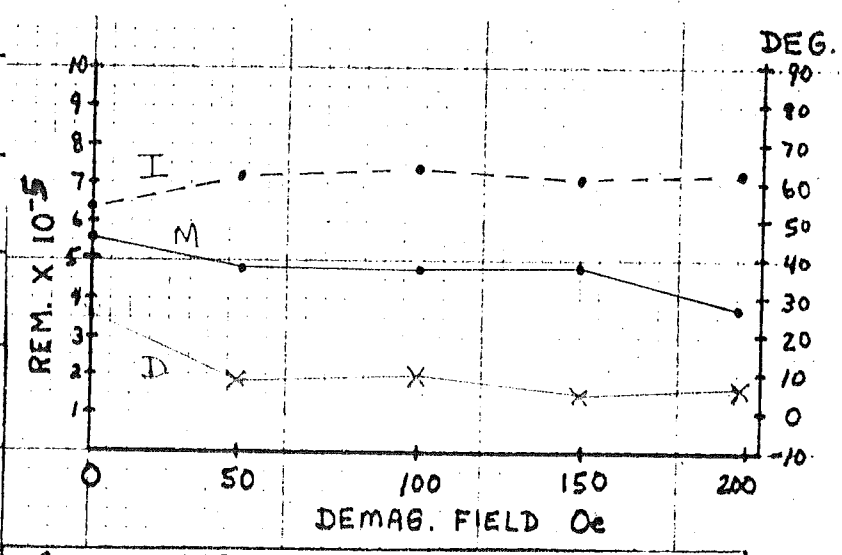
X-ray Pugwash Mud - No Pebbles, large cracks in Center, bedding not distinct

MAGNETICS D.M. Steady

D, I stable bet. 100 - 200 Oe

1-4 Z = 13.1 cm C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	25.7	54.5	5.55-5
50	9.0	61.0	4.75-5
100	9.8	63.8	4.72-5
150	5.1	61.9	4.71-5
200	7.6	61.5	3.71-5
$\frac{X_{100}+X_{150}}{2}$	7.4	62.8	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	7.5	62.4	✓ —



COMMENTS

X-ray Pugwash mud - No pebbles - cracked - bedding not distinct

MAGNETICS D.M. N.T STEADY

D, I stable bet. 100 - 200 Oe

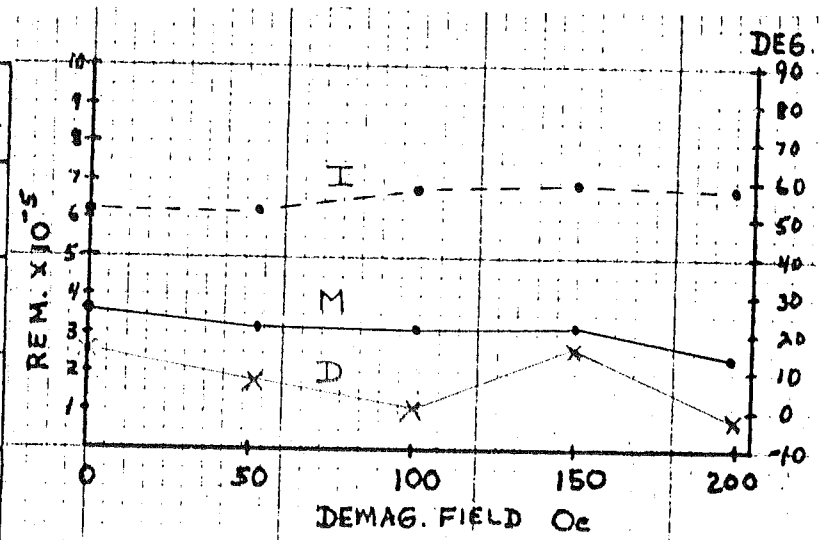
SAMPLE # P.M 1-5, 1-6

1-5

Z = 16.2 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	15.1	51.4	3.62-5
50	8.0	52.1	3.19-5
100	1.4	57.0	3.15-5
150	16.8	59.7	3.24-5
200	-3.2	57.9	2.42-5
$\frac{X_{100}+X_{150}}{2}$	9.10	58.4	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	5.00	58.2	—



COMMENTS

X-ray Pugwash mud - No pebbles - bedding not distinct

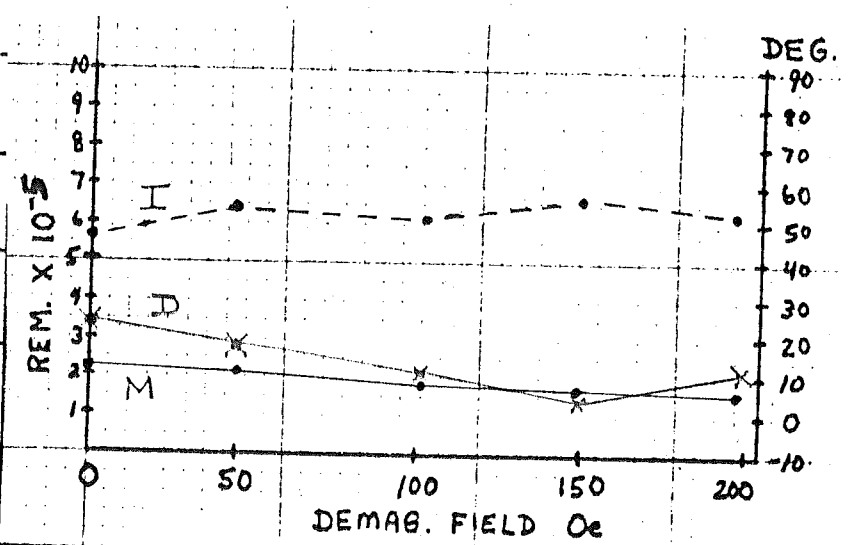
MAGNETICS D.M. NOT STEADY

I Stable between 100-200 Oe

D erratic but 100-200 Oe

1-6 Z = 19.1 cm. C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	23.7	46.8	2.07-5
50	18.3	53.9	2.10-5
100	10.7	42.5	1.88-5
150	4.3	55.6	1.77-5
200	12.9	52.1	1.61-5
$\frac{X_{100}+X_{150}}{2}$	7.5	49.0	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	9.3	50.1	—



COMMENTS

X-ray One large pebble - bedding not distinct

MAGNETICS D.M. Steady

D, I Stable bet. 100-200 Oe.

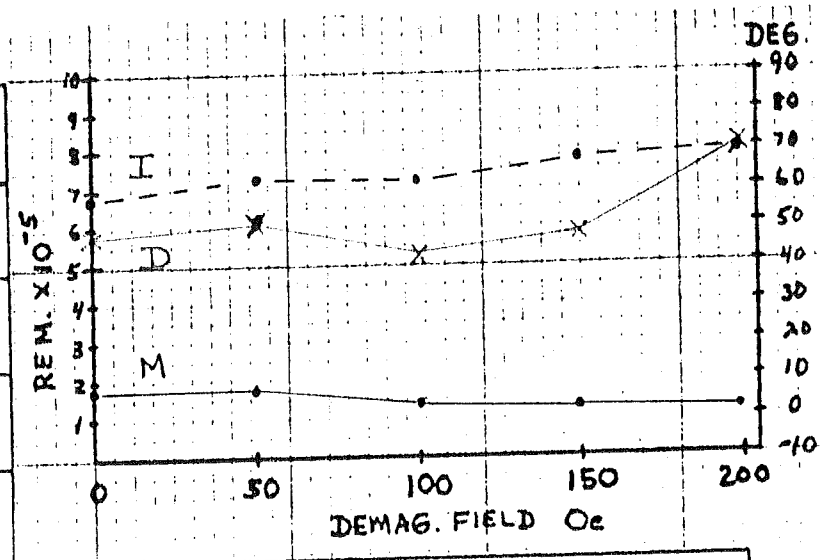
P.M.
SAMPLE # 1-7 ; 1-8

1-7

Z = 22.2 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	48.8	58.5	1.88-5
50	50.0	62.3	1.84-5
100	43.1	62.3	1.33-5
150	48.7	68.8	1.23-5
200	71.7	69.9	1.12-5
$\frac{X_{100}+X_{150}}{2}$	45.9	67.0	✓ —
$\frac{X_{100}+X_{150}+X_{200}}{3}$	54.5	67.0	—

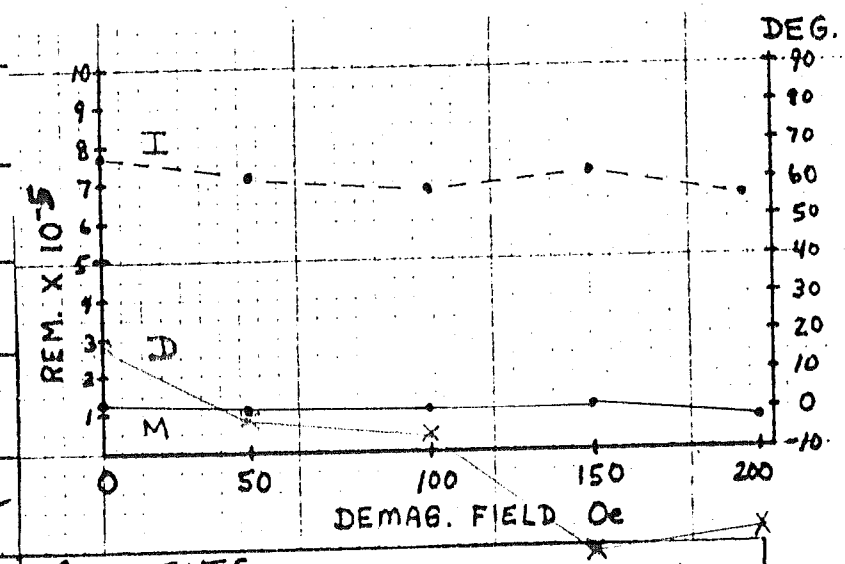


COMMENTS
One large pebble, - Bedding not x-ray distinct, -

MAGNETICS L.M. Steady
I increases steadily @ demag
D stable bet. 100 - 150

1-8 Z = 25.0 cm. C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	17.8	67.5	1.23-5
50	-1.6	60.8	1.14-5
100	-7.3	59.0	1.17-5
150	-31.8	61.6	1.14-5
200	-32.5	56.1	9.65-6
$\frac{X_{100}+X_{150}}{2}$	-19.6	60.3	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	-23.9	58.9	✓ —



COMMENTS
Some small pebbles - Cracked - x-ray Bedding not distinct

MAGNETICS D.M. Steady
I stable bet. 100-200 Oe
D NOT STABLE - unreliable
SAMPLE ROTATION IN THE HOLDER

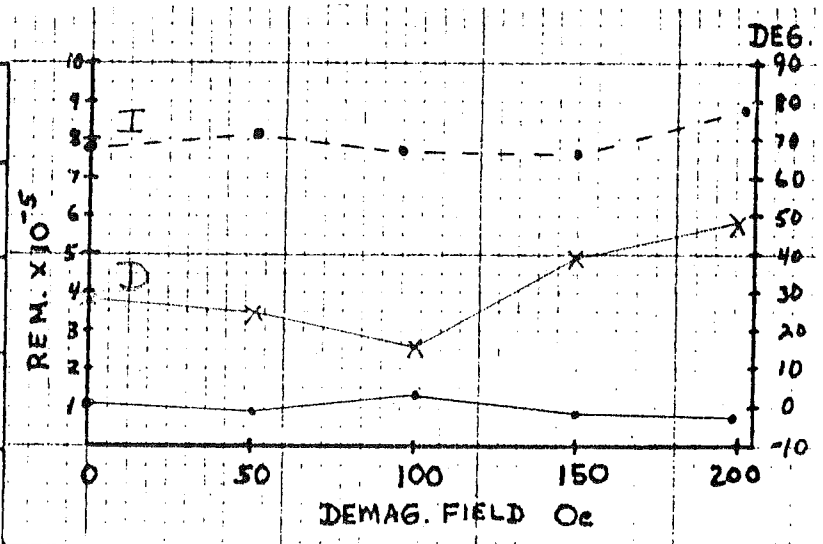
SAMPLE # P.M. 1-9; 1-10

1-9

Z = 28.5 cm. C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	28.3	68.6	1.07-5
50	24.8	71.5	9.57-6
100	15.5	67.5	1.36-5
150	39.8	66.2	8.48-6
200	47.4	77.9	7.29-6
$\frac{X_{100}+X_{150}}{2}$	27.6	66.8	✓ —
$\frac{X_{100}+X_{150}+X_{200}}{3}$	34.2	70.5	—



COMMENTS

X-ray One pebble - Bedding not distinct

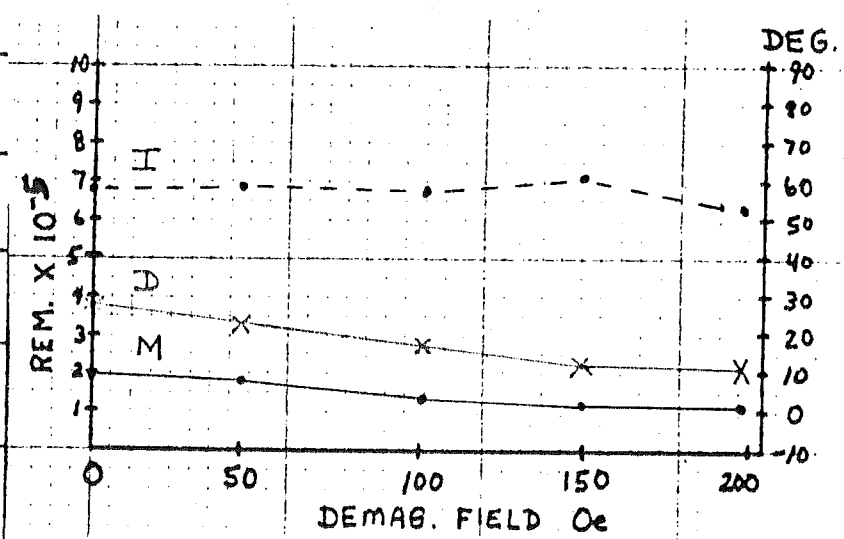
MAGNETICS D.M. NOT STEADY

I Stable up to 150

D NOT STABLE

1-10 Z = 31.6 cm C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	27.8	58.2	1.95-5
50	23.4	59.5	1.69-5
100	16.9	58.3	1.47-5
150	12.0	61.5	1.19-5
200	10.8	55.4	1.06-5
$\frac{X_{100}+X_{150}}{2}$	14.5	59.9	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	13.2	58.4	✓ —



COMMENTS

X-ray Sandy mud - Cracked -

MAGNETICS D.M. STEADY

I Stable up to 150 Oe

D NOT STABLE - steady decrease

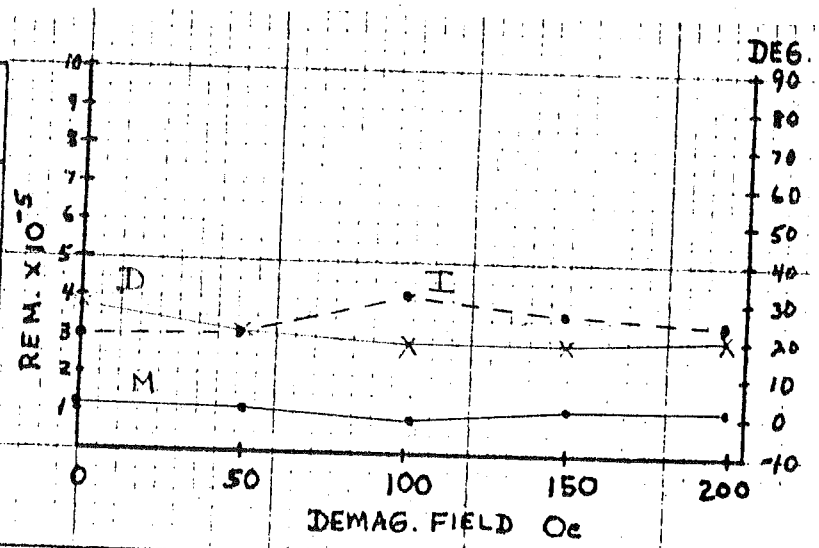
SAMPLE # P.M. 1-11; 1-12

1-11

Z = 34.4 cm. C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	27.9	20.0	1.13-5
50	21.4	22.3	1.09-5
100	18.3	30.7	9.83-6
150	18.1	26.1	1.18-5
200	20.6	23.7	1.06-5
$\frac{X_{100}+X_{150}}{2}$	18.2	28.4	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	19.0	26.8	✓ —



COMMENTS

X-ray Sandy mud - pebbles - bedding not distinct

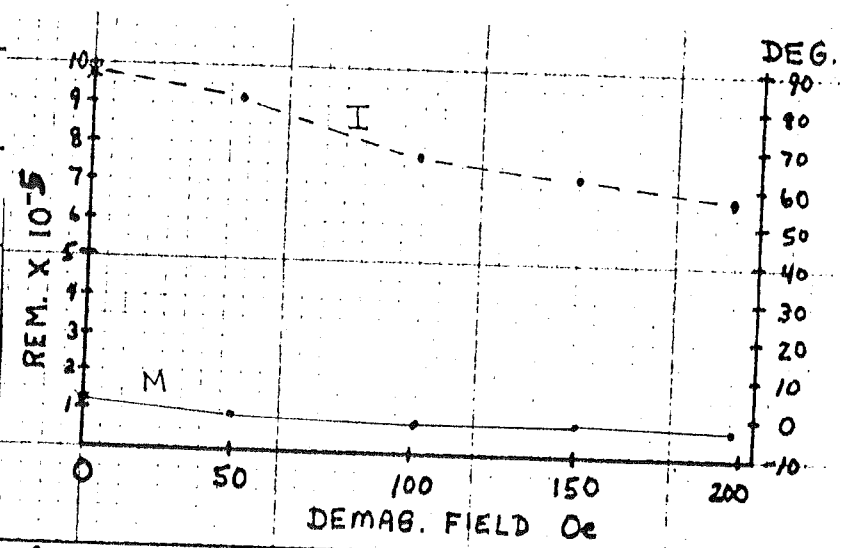
MAGNETICS D.M. STABLE

DEC. STABLE BET. 100 - 200 Oe

INC. STABLE BET. 100 - 200 Oe

1-12 Z = 37.1 cm C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	2.3	87.2	1.12-5
50	253.6	81.2	8.94-6
100	203.8	77.3	7.21-6
150	219.2	72.2	7.15-6
200	188.0	59.6	6.28-6
$\frac{X_{100}+X_{150}}{2}$	211.5	74.8	✓ —
$\frac{X_{100}+X_{150}+X_{200}}{3}$	203.7	69.7	—



COMMENTS

X-ray Sandy mud -

MAGNETICS D.M. STEADY

D Unreliable

I Unstable - decreases

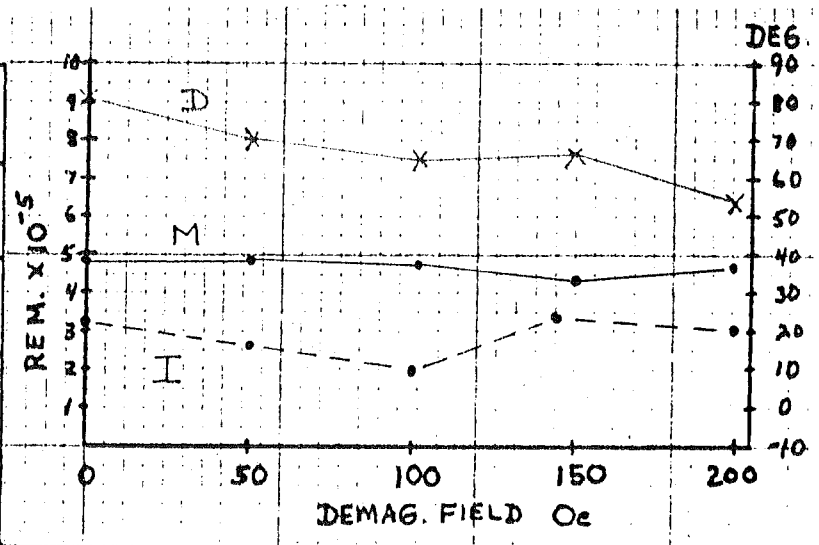
SAMPLE # P.M 1-13 ; 1-14

1-13

Z = 40.0 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	80.6	21.7	4.88-6
50	70.1	15.5	4.98-6
100	65.9	10.2	4.77-6
150	66.6	34.0	4.28-6
200	54.8	20.2	4.68-6
$\frac{X_{100}+X_{150}}{2}$	66.3	17.7	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	62.4	17.1	✓ —

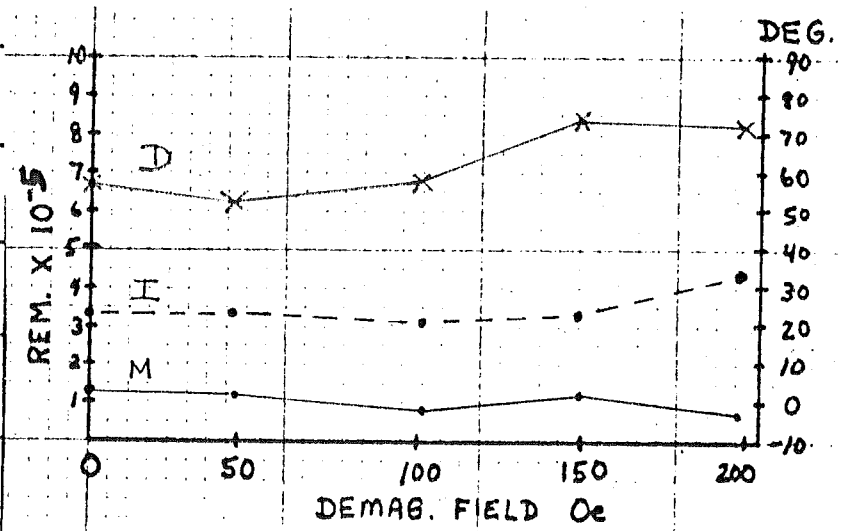


COMMENTS
X-ray Large pebble - large cracks - sandy

MAGNETICS D.M. NOT STEADY
D NOT STABLE above 150 Oe
I NOT STABLE

1-14 Z = 43.0 cm. C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	56.9	23.0	1.31-5
50	53.3	24.5	1.05-5
100	59.3	20.3	8.71-6
150	74.7	24.3	1.13-5
200	71.0	34.9	6.85-6
$\frac{X_{100}+X_{150}}{2}$	67.0	22.3	✓ —
$\frac{X_{100}+X_{150}+X_{200}}{3}$	68.3	26.5	—



COMMENTS
X-ray Sandy mud - pebbles -

MAGNETICS D.M. NOT STEADY
D NOT STABLE
I NOT STABLE ABOVE 150 Oe

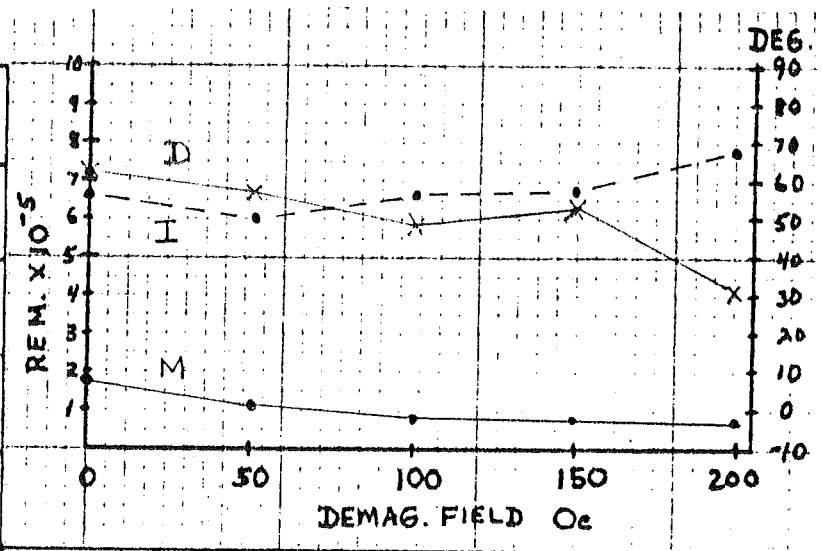
SAMPLE # P.M 1-15; 1-16

1-15

Z = 45.6 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	69.2	55.9	1.90-5
50	56.8	50.3	1.02-5
100	49.5	56.1	9.92-6
150	53.7	58.2	8.93-6
200	31.0	69.3	8.77-6
$\frac{X_{100}+X_{150}}{2}$	51.6	57.2	✓ —
$\frac{X_{100}+X_{150}+X_{200}}{3}$	44.7	61.2	—



COMMENTS
X-ray Sandy mud - pebbles

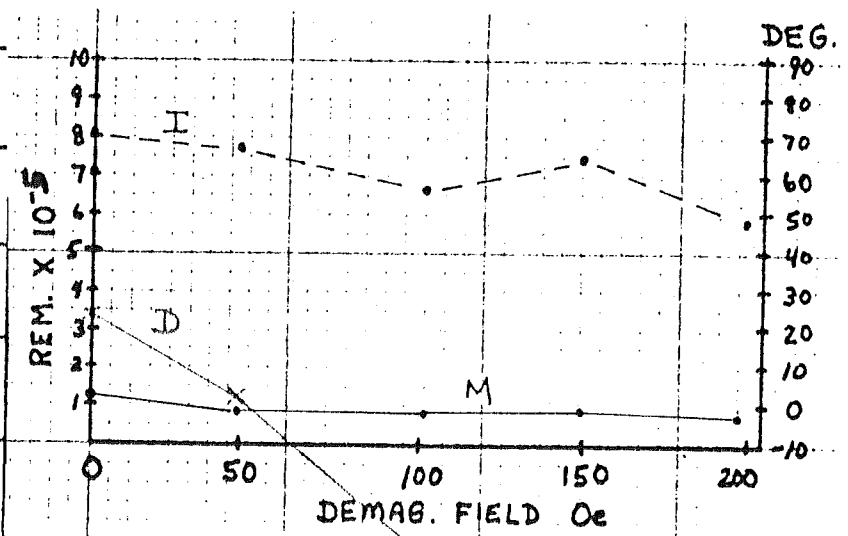
MAGNETICS D.M. STEADY

D NOT STABLE ABOVE 150 Oe

I NOT STABLE - INCREASES

1-16 Z = 49.0 cm C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	23.6	70.2	1.12-5
50	3.0	68.3	9.16-6
100	-28.1	56.4	8.54-6
150	-34.3	65.4	9.39-6
200	-61.5	49.6	6.76-6
$\frac{X_{100}+X_{150}}{2}$	-31.2	60.9	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	-41.3	57.1	✓ —



COMMENTS
X-ray Sandy mud - pebbles

MAGNETICS D.M. STEADY

I NOT STABLE - DECREASES ERATICALLY

D " " "

SAMPLE ROTATION IN THE HOLDER

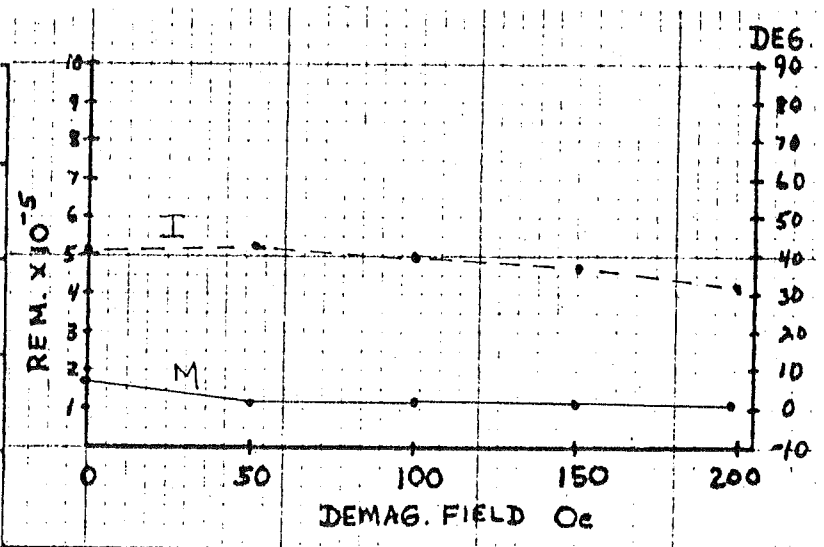
SAMPLE # P.M 1-17; 1-18

1-17

Z = 51.8 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	-30.0	41.0	1.90-5
50	-43.8	43.0	1.21-5
100	-34.4	39.9	1.28-5
150	-40.1	27.1	1.15-5
200	-37.0	33.2	1.09-5
$\frac{X_{100}+X_{150}}{2}$	-37.3	33.5	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	-37.2	33.4	✓ —



COMMENTS

X-ray Sandy mud - pebbles

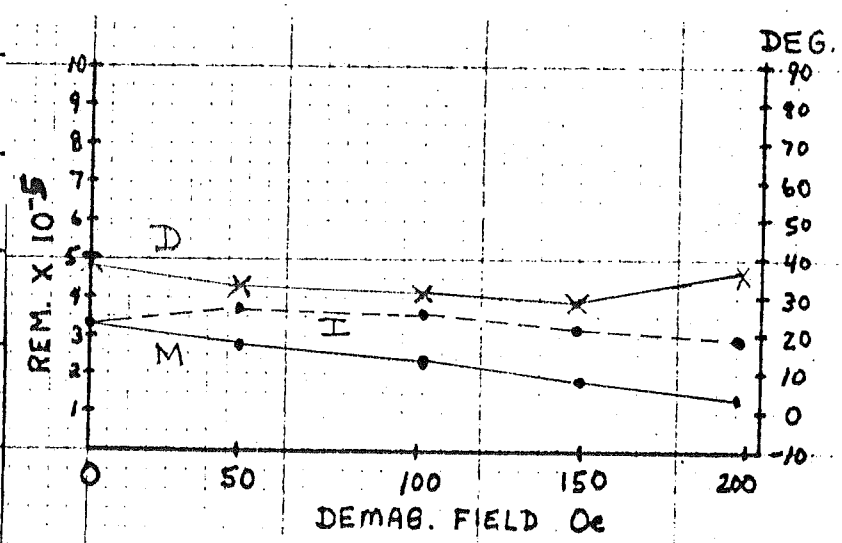
MAGNETICS D.M. STEADY

D Anomalous - Stable above 100 Oe

I Decreases steadily

1-18 Z = 54.3 cm C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	39.5	22.8	3.11-5
50	33.4	27.5	2.71-5
100	31.2	25.0	2.39-5
150	28.2	20.1	1.93-5
200	36.1	19.1	1.33-5
$\frac{X_{100}+X_{150}}{2}$	29.7	22.6	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	29.2	21.4	✓ —



COMMENTS

X-ray Large pebbles - cracked -

MAGNETICS D.M. STEADY

D NOT STABLE

I NOT STABLE DECREASES

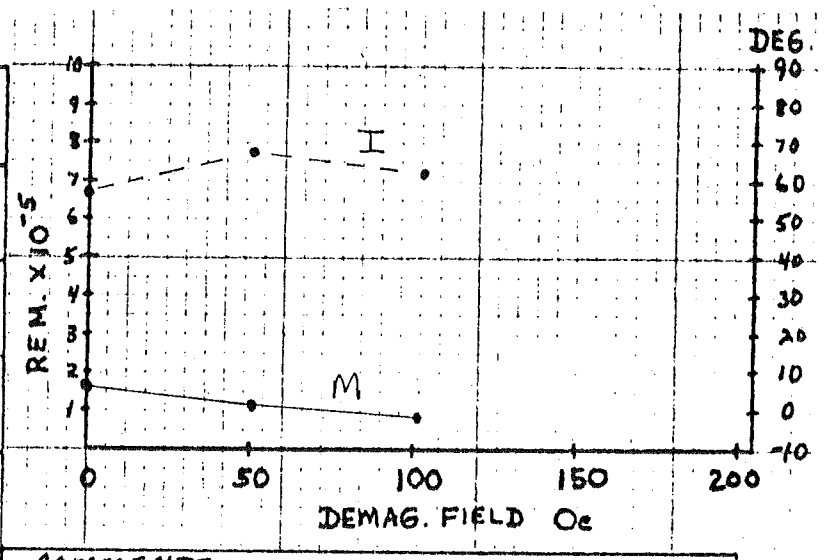
SAMPLE # P.M. 1-19

1-19

Z = 56.9 C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	105.5	57.4	1.62-5
50	125.0	68.1	1.11-5
100	147.1	61.3	9.16-6
150	SAMPLE FELL APART! —	—	—
200	—	—	—
$\frac{X_{100}+X_{150}}{2}$	147.1	61.3	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	—	—	—

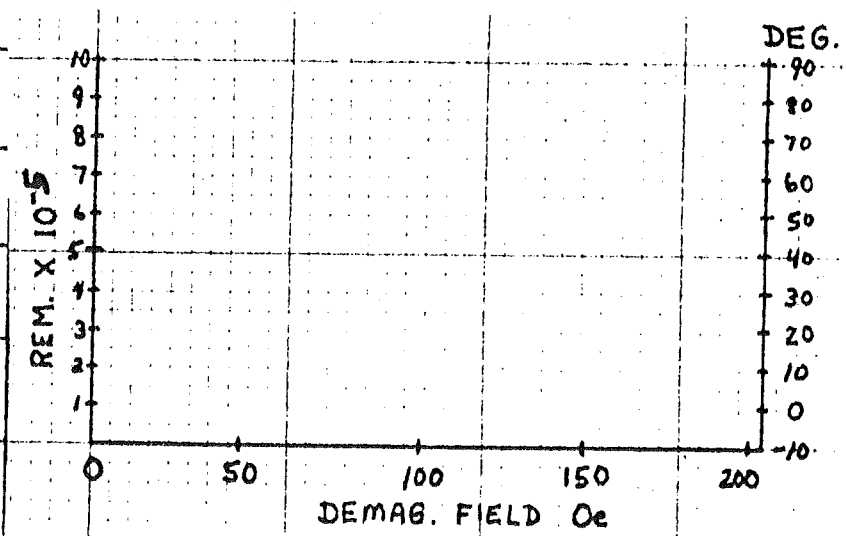


COMMENTS
Pebbles - Voids - cracks
X-ray

MAGNETICS DM. STEADY
D NOT RELIABLE
I STABLE

_____ Z = _____ C.P. = _____

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0			
50			
100			
150			
200			
$\frac{X_{100}+X_{150}}{2}$			—
$\frac{X_{100}+X_{150}+X_{200}}{3}$			—



COMMENTS
X-ray

MAGNETICS

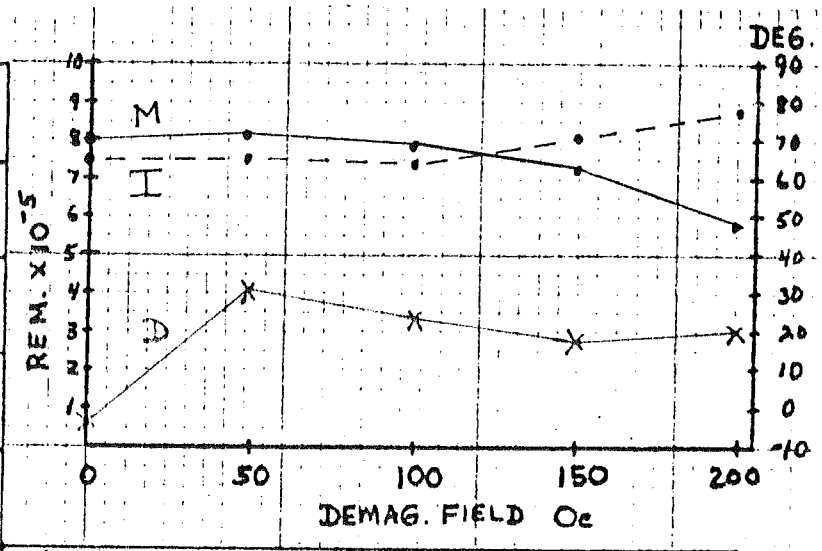
SAMPLE # P.M. 2-1, 2-2

2-1

Z = 4.7 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	-4.0	65.2	8.02-5
50	30.1	65.7	8.20-5
100	23.8	64.7	7.90-5
150	18.7	71.4	7.27-5
200	19.9	68.9	5.83-5
$\frac{X_{100}+X_{150}}{2}$	21.3	68.1	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	20.8	68.3	✓ —



COMMENTS
Pugwash mud - One crack -
X-ray Bedding not distinct

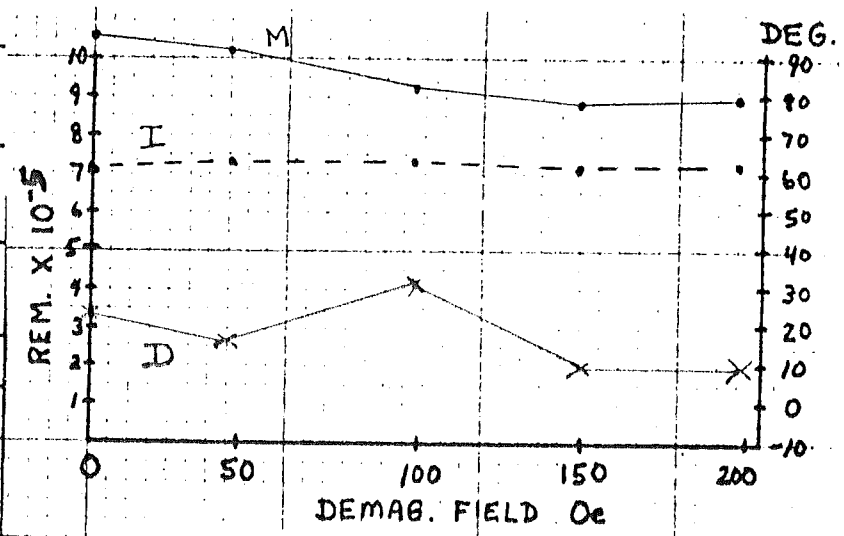
MAGNETICS D.M. STEADY

I INCREASES NOT STABLE

D STABLE ABOVE 100 Oe

2-2 Z = 7.8 cm. C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	23.3	60.2	1.13-4
50	16.0	64.3	1.04-4
100	13.1	63.3	9.32-5
150	9.5	60.7	8.93-5
200	9.5	62.8	9.02-5
$\frac{X_{100}+X_{150}}{2}$	11.3	62.0	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	10.7	62.3	✓ —



COMMENTS
Pugwash mud - One crack -
X-ray Bedding not distinct

MAGNETICS D.M. STEADY

I STABLE BET. 100-200 Oe

D ERRATIC - STABLE ABOVE 150 Oe

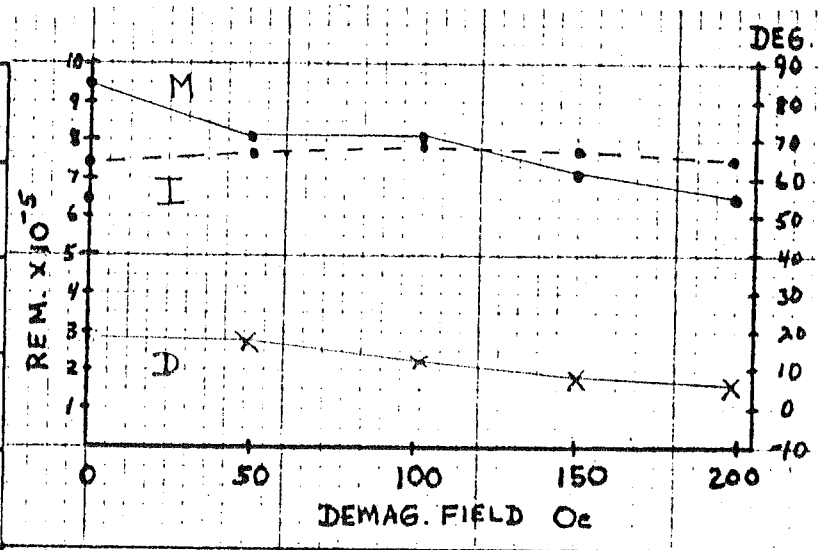
SAMPLE # P.M. 2-3; 2-4

2-3

Z = 10.8cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	18.6	64.7	9.49-5
50	17.9	66.0	8.05-5
100	11.8	69.4	8.08-5
150	8.0	67.4	7.09-5
200	5.6	64.5	6.47-5
$\frac{X_{100}+X_{150}}{2}$	9.9	68.4	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	8.5	67.1	✓ —



COMMENTS
Pugwash mud - Voids at westend
X-ray of mini-core - Bedding not distinct

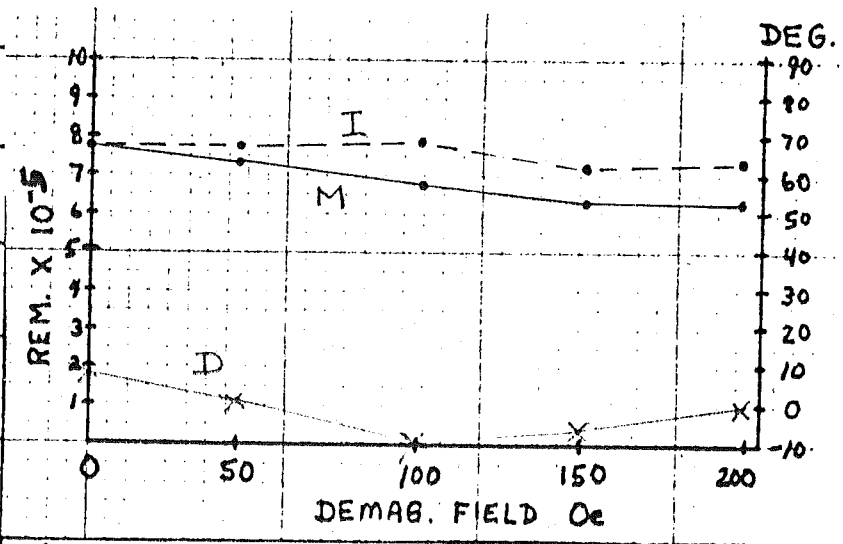
MAGNETICS DEMAG STEADY

I STABLE BET 100-200 Oe

D UNSTABLE DECREASES

2-4 Z = 14.0cm C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	7.6	68.4	7.84-5
50	1.1	68.1	7.40-5
100	-9.9	68.9	6.72-5
150	-7.0	62.4	6.25-5
200	-.4	63.6	6.24-5
$\frac{X_{100}+X_{150}}{2}$	-8.5	65.7	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	-5.8	65.0	✓ —



COMMENTS
Pugwash mud. Increased absorbance of X-rays over 2-3 - Bedding not distinct
X-ray
NO pebbles

MAGNETICS D.M. STEADY

I STABLE BET 100-200 Oe

D UNSTABLE - DEC. THEN INC.

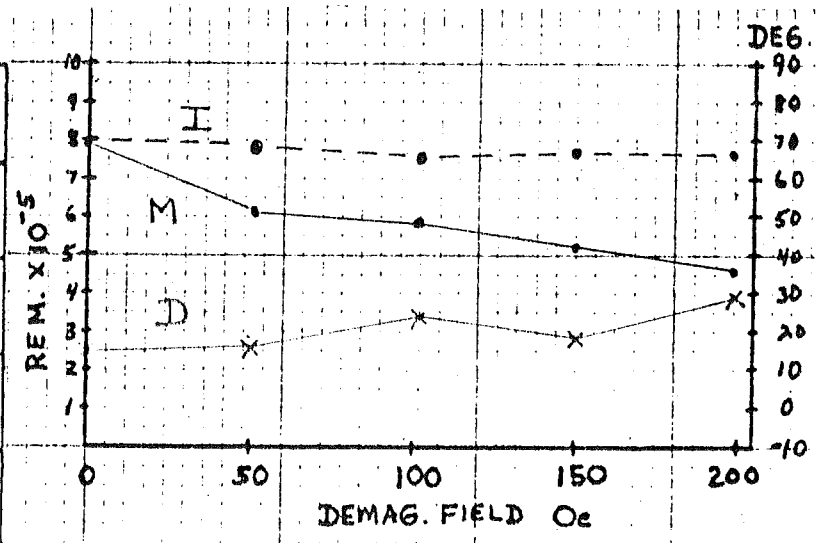
SAMPLE # P.M. 2-5; 2-6

2-5

Z = 16.8 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	15.5	69.9	7.96-5
50	16.0	68.2	6.09-5
100	24.5	65.5	5.90-5
150	16.6	68.4	5.20-5
200	29.8	67.2	4.56-5
$\frac{X_{100}+X_{150}}{2}$	20.6	67.0	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	23.6	67.0	✓ —



COMMENTS Pugwash mud - High X-ray absorbance - Bedding not X-ray distinct - No pebbles

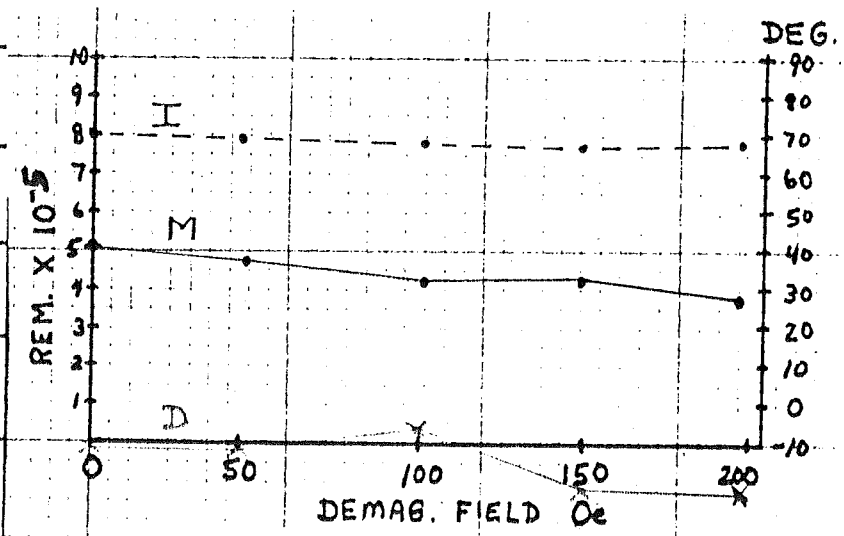
MAGNETICS D.M. STEADY

I STABLE BET. 100-200 Oe

D UNSTABLE

2-6 Z = 19.3 cm C.P. 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	-11.8	70.2	5.13-5
50	-12.2	69.9	4.74-5
100	-6.7	68.1	4.25-4
150	-23.4	67.1	4.09-5
200	-24.5	68.2	3.63-5
$\frac{X_{100}+X_{150}}{2}$	-15.1	67.7	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	-18.2	67.8	✓ —



COMMENTS Pugwash mud - High X-ray absorbance - Bedding not X-ray distinct - No pebbles

MAGNETICS D.M. STEADY

I STABLE BET 100-200 Oe

D ANOMALOUS

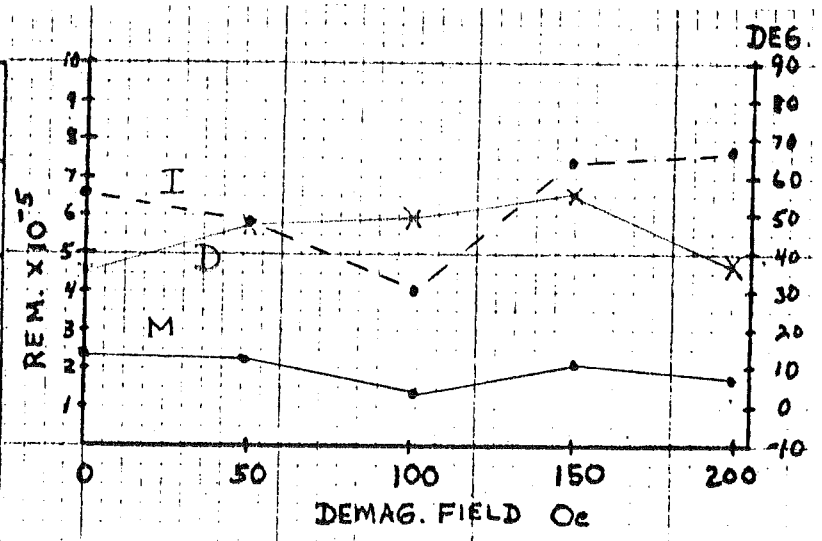
SAMPLE # PM2-7, 2-8

2-7

Z = 22.2 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	36.5	66.7	2.36-5
50	47.5	48.3	2.24-5
100	49.0	30.0	1.40-5
150	55.4	64.4	2.07-5
200	27.6	66.8	1.78-5
$\frac{X_{100}+X_{150}}{2}$	52.2	47.2	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	44.0	53.7	✓ —

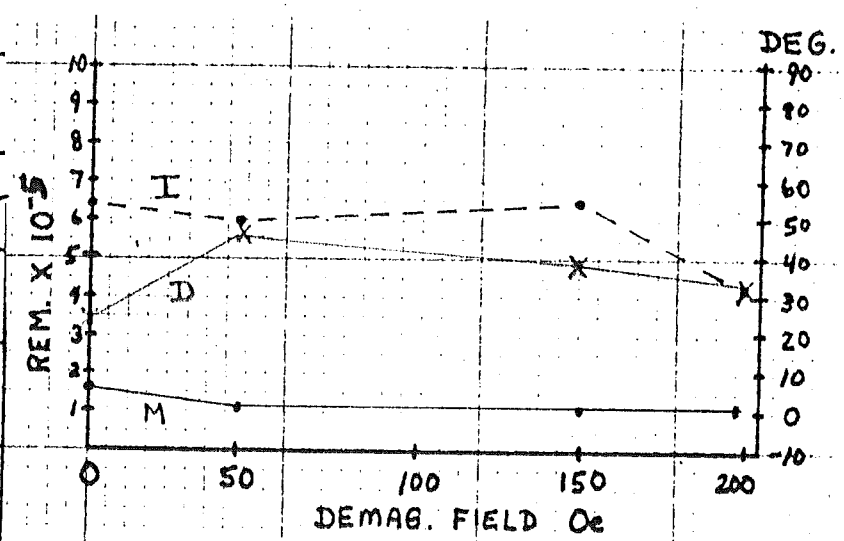


COMMENTS Many pebbles - Discontinuity
X-ray Bedding not distinct

D.M.
MAGNETICS NOT STEADY
D NOT STABLE
I NOT STABLE

2-8 Z = 25.2 C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	24.0	53.8	1.57-5
50	45.9	50.5	1.09-5
100	—	—	—
150	39.8	55.3	1.07-5
200	32.5	30.9	1.08-5
$\frac{X_{100}+X_{150}}{2}$	36.2	43.1	✓ —
$\frac{X_{100}+X_{150}+X_{200}}{3}$	—	—	—



COMMENTS
X-ray No pebbles - small void at bottom of mini-core - Bedding not distinct

MAGNETICS D.M. STABLE
I NOT STABLE
D NOT STABLE DEC.

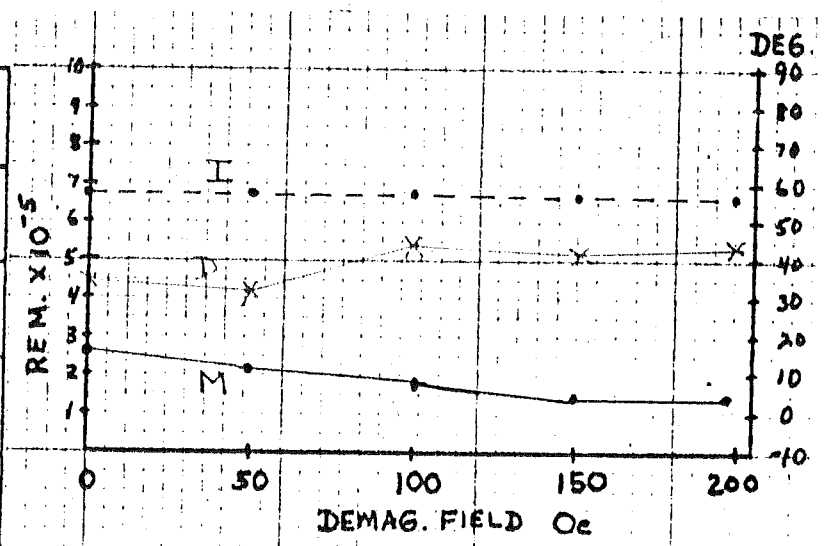
SAMPLE # P.M. 2-9 ; 2-10

2-9

Z = 28.0 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	34.4	58.2	2.57-5
50	32.2	57.2	2.04-5
100	44.2	57.5	1.83-5
150	42.4	57.4	1.55-5
200	43.0	56.3	1.54-5
$\frac{X_{100}+X_{150}}{2}$	43.3	57.5	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	43.2	57.1	—



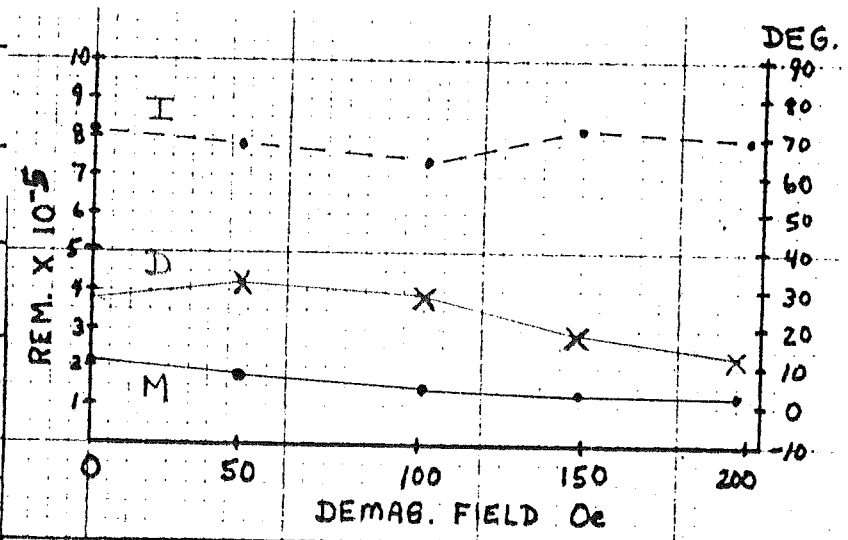
COMMENTS One small pebble - Bedding skewed 1/3 cm. towards bottom of X-ray mini core

MAGNETICS D.M. STEADY

I STABLE BET 100-200 Oe

2-10 Z = 30.9 cm C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	28.8	72.6	2.01-5
50	31.7	68.2	1.73-5
100	29.0	64.4	1.50-5
150	17.7	72.2	1.29-5
200	13.6	69.9	1.34-5
$\frac{X_{100}+X_{150}}{2}$	23.4	68.3	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	20.1	68.8	—



COMMENTS No pebbles - Similar to # 2-9 X-ray

MAGNETICS D.M. STEADY

D unstable
I unstable

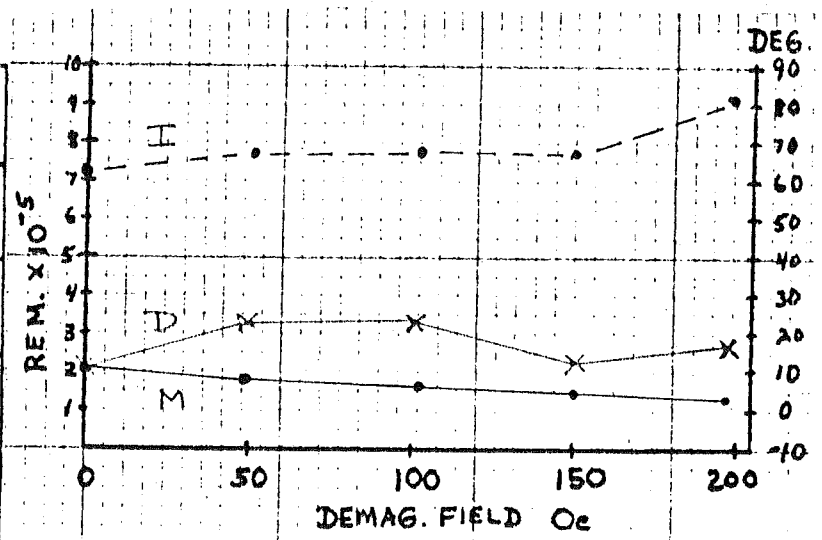
SAMPLE # P.M. 2-11 ; 2-12

2-11

Z = 33.3 cm. C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	11.4	63.0	2.08-5
50	23.7	67.3	1.66-5
100	24.4	68.4	1.61-5
150	13.0	66.8	1.53-5
200	16.6	82.5	1.25-5
$\frac{X_{100}+X_{150}}{2}$	18.7	67.6	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	18.0	50.0	—



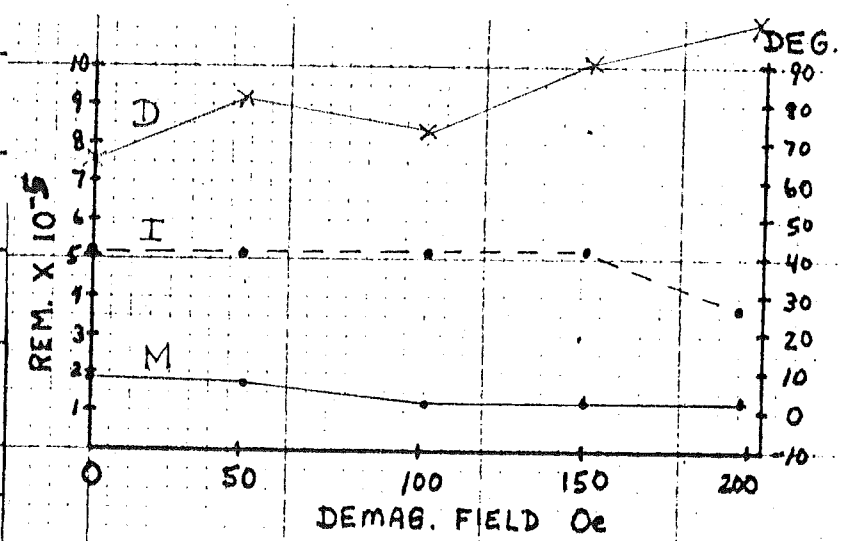
COMMENTS Bedding skewed by one cm. towards bottom.
X-ray

MAGNETICS D.M. STEADY

I Unstable
D Unstable

2-12 Z = 36.2 cm C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	66.0	41.8	1.80-5
50	82.6	42.9	1.69-5
100	73.3	41.7	1.33-5
150	91.2	42.8	1.21-5
200	99.9	27.1	1.16-5
$\frac{X_{100}+X_{150}}{2}$	82.3	42.3	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	88.1	37.2	—



COMMENTS
Pebbles - sediment disrupted - Bedding skewed 1/3 cm. towards bottom
X-ray

MAGNETICS D.M. NOT STEADY

D NOT STABLE
I NOT STABLE ABOVE 150 Oe

SAMPLE ROTATION WITHIN HOLDER ?

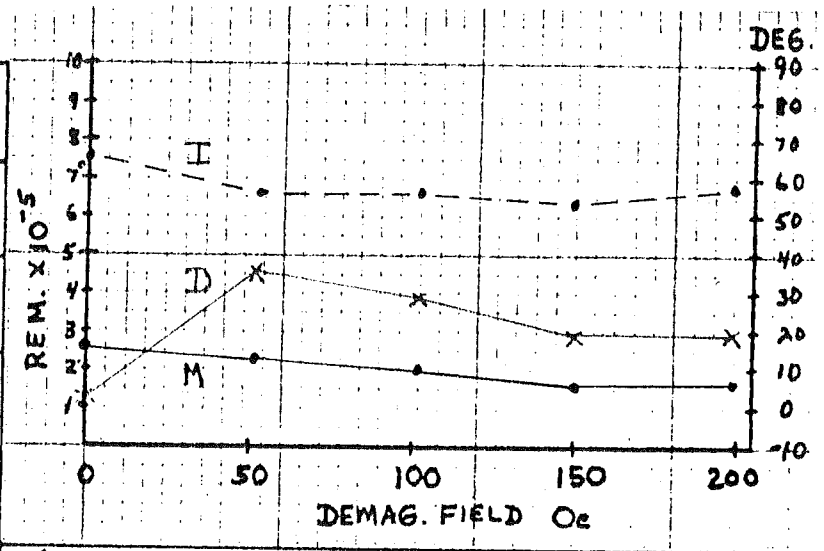
SAMPLE # P.M. 2-13, 2-14

2-13

Z = 39.0 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	2.8	66.4	2.57-5
50	35.6	55.7	2.29-5
100	29.6	55.3	2.07-5
150	17.7	54.8	1.63-5
200	18.6	59.3	1.69-5
$\frac{X_{100}+X_{150}}{2}$	23.7	55.1	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	22.0	56.5	✓ —



COMMENTS Small pebbles - cracked - Misoriented
X-ray in photo - Near worm burrow

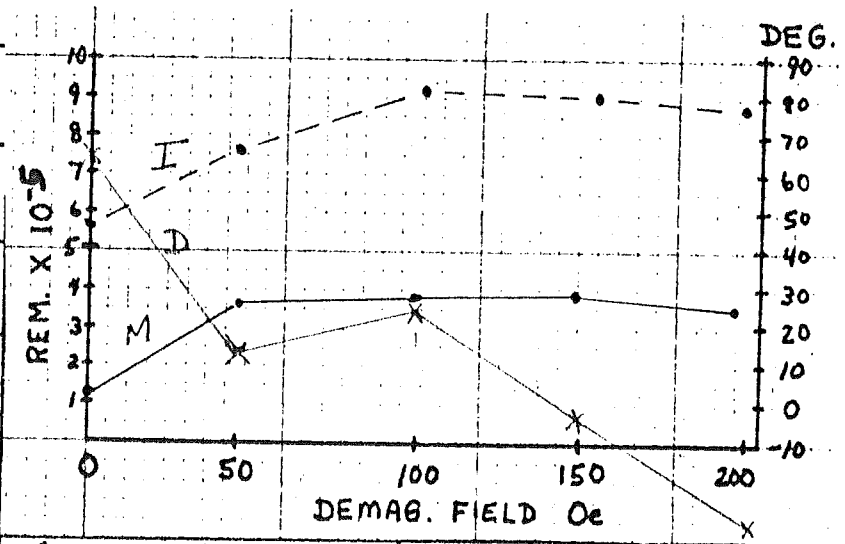
MAGNETICS D.M. STEADY

I STABLE BET 100-200 Oe

D NOT STABLE

2-14 Z = 42.0 cm C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	64.0	45.8	1.24-5 ~~1.0~~
50	13.5	66.6	3.59-5
100	24.6	82.1	3.87-5
150	-3.1	80.8	3.99-5
200	-22.1	77.0	3.47-5
$\frac{X_{100}+X_{150}}{2}$	10.8	81.5	✓ —
$\frac{X_{100}+X_{150}+X_{200}}{3}$	-6.2	80.0	—



COMMENTS Bedding faint - Some pebbles - Cracks - Low absorbance of
X-ray X-rays

MAGNETICS D.M. NOT STEADY

I STABLE ABOVE 100 Oe

D NOT STABLE

SAMPLE ROTATION IN THE HOLDER

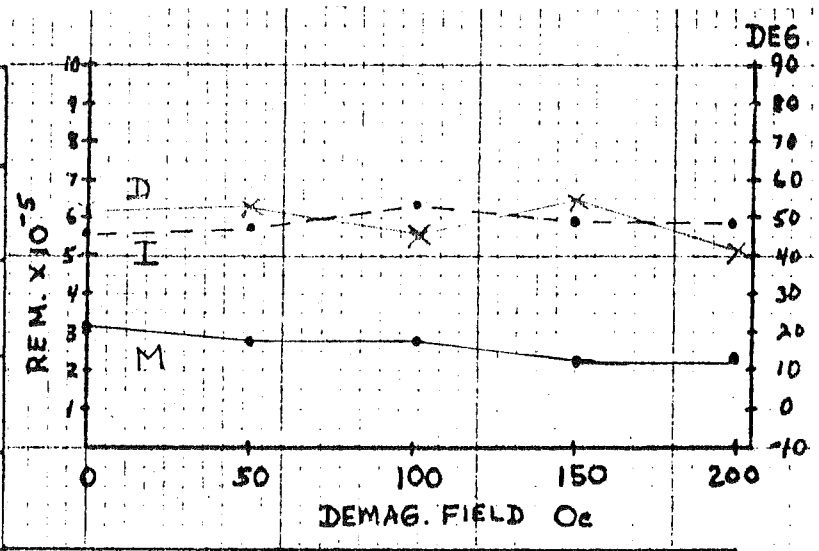
SAMPLE # P.M. 2-15; 2-16

2-15

Z = 44.8 C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	52.0	46.3	3.12-5
50	53.5	48.5	2.79-5
100	45.8	54.0	2.69-5
150	55.6	48.0	2.29-5
200	40.7	48.0	2.41-5
$\frac{X_{100}+X_{150}}{2}$	50.7	51.0	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	47.4	50.0	—



COMMENTS Pebbles, voids, cracks - X-ray High absorbance of X-rays

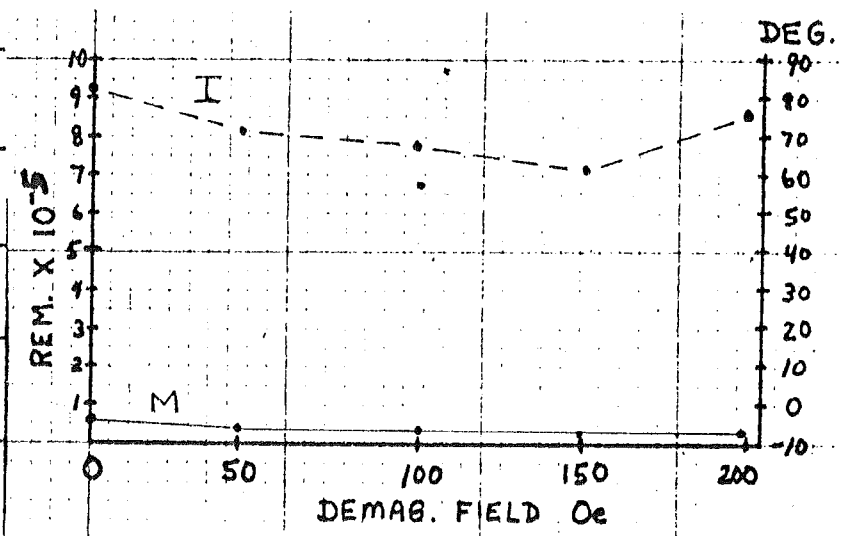
MAGNETICS D.M. STEADY

~~D NOT STABLE BET~~ D NOT STABLE

I STABLE BET. 100-200 Oe

2-16 Z = 42.7 C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	268.3	82.7	5.90-6
50	119.4	71.7	4.38-6
100	147.1	67.3	4.02-6
150	155.9	61.0	2.90-6
200	103.4	75.7	2.20-6
$\frac{X_{100}+X_{150}}{2}$	151.5	64.2	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	135.4	68.0	—



COMMENTS One large pebble in west end of mini-core - Bedding X-ray skewed

MAGNETICS D.M. STEADY

D ANOMALOUS

I NOT STABLE

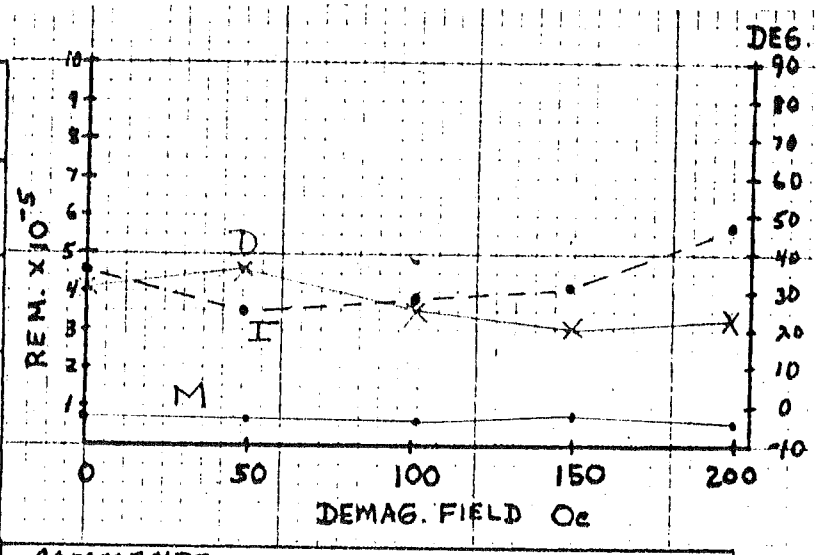
SAMPLE # P.M. 2-17; 2-18

2-17

Z = 50.0 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	30.1	36.4	7.31-6
50	36.6	25.1	6.76-6
100	25.3	27.8	6.17-6
150	21.5	31.0	7.18-6
200	23.8	40.8	5.17-6
$\frac{X_{100}+X_{150}}{2}$	23.4	29.4	✓ —
$\frac{X_{100}+X_{150}+X_{200}}{3}$	23.5	33.2	—



COMMENTS
Pebbles - Bedding skewed
X-ray

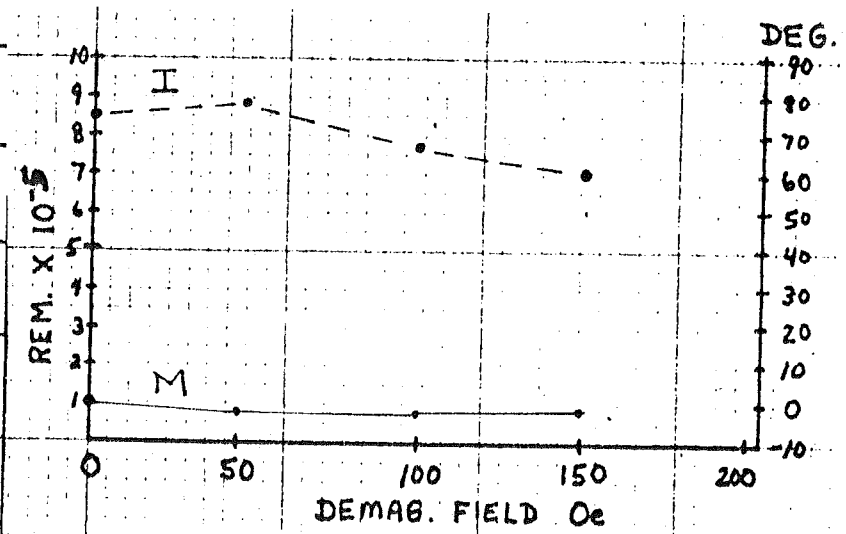
MAGNETICS D.M. NOT STEADY

D STABLE BET 100-200 Oe
I NOT STABLE INCREASES

2-18

Z = 53.1 cm C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	257.0	75.1	1.07-5
50	208.4	77.9	7.63-6
100	220.2	67.7	6.69-6
150	243.3	60.9	8.38-6
200	—	—	—
$\frac{X_{100}+X_{150}}{2}$	231.7	64.3	✓ —
$\frac{X_{100}+X_{150}+X_{200}}{3}$	—	—	—



COMMENTS
Large flat pebble - Bedding not distinct
X-ray

MAGNETICS D.M. STEADY - STABLE

D ANOMALOUS
I NOT STABLE

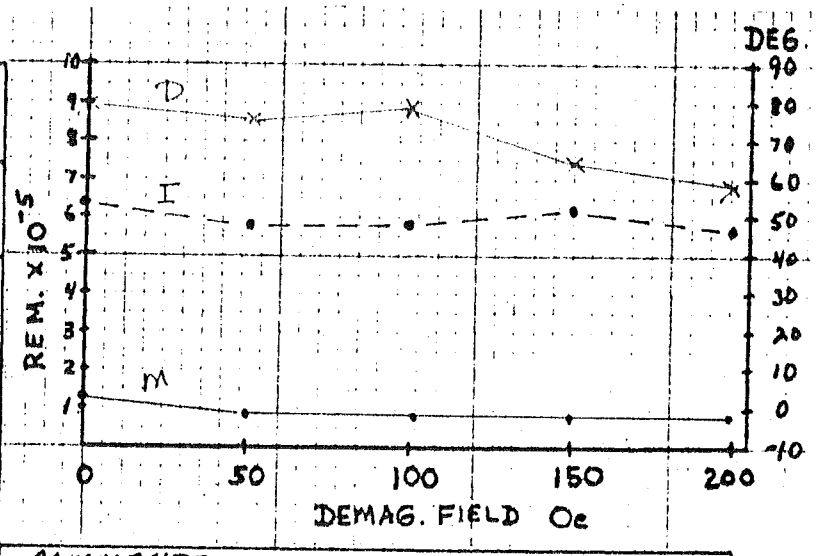
SAMPLE # P.M 2-19 : 2-20

2-19

Z = 55.8 C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	78.8	54.3	1.36-5
50	76.8	48.5	9.92-6
100	79.5	48.2	8.78-6
150	64.9	53.8	7.85-6
200	52.3	46.3	6.93-6
$\frac{X_{100}+X_{150}}{2}$	72.2	51.0	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	67.2	49.4	—

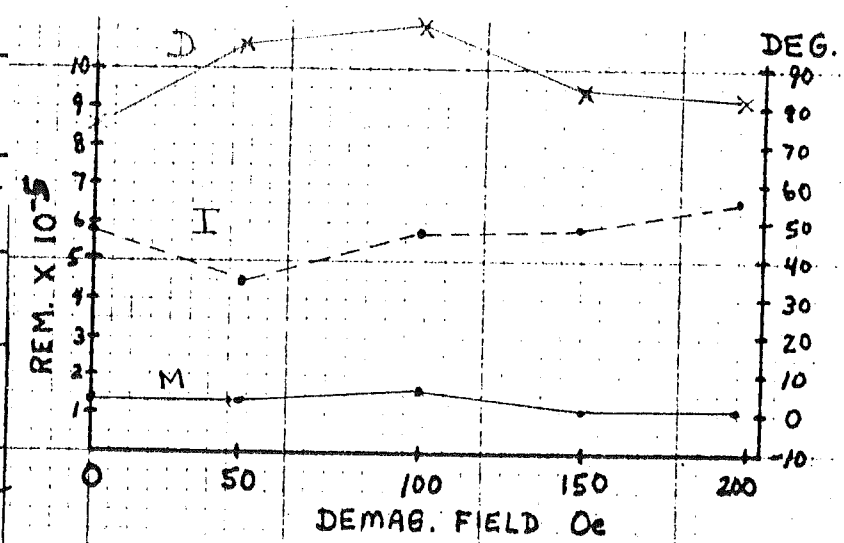


COMMENTS
X-ray Some pebbles - Two voids - Bedding not distinct

MAGNETICS D.M. STEADY
I STABLE BET 100-200 Oe
D NOT STABLE DECREASES

2-20 Z = 58.5 C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	76.9	48.4	1.33-5
50	96.4	34.6	1.38-5
100	100.8	48.9	1.61-5
150	84.2	49.4	1.07-5
200	82.5	56.7	1.14-5
$\frac{X_{100}+X_{150}}{2}$	92.5	49.2	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	89.2	51.7	—



COMMENTS
X-ray Small pebbles - Bedding not distinct.

MAGNETICS D.M. NOT STEADY
I NOT STABLE
D NOT STABLE

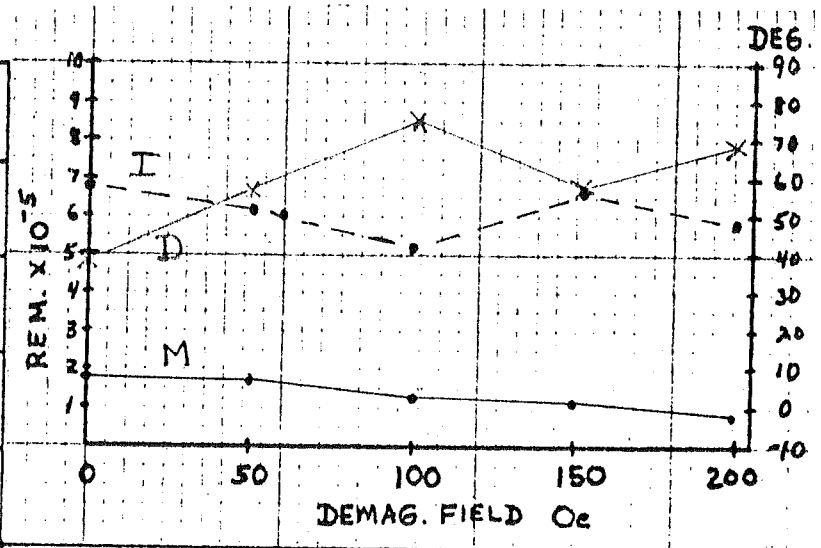
SAMPLE # P.M. 2-21 ; 2-22

2-21

Z = 61.2 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	39.7	58.1	1.77-5
50	57.6	50.0	1.72-5
100	75.4	41.7	1.34-5
150	57.2	57.2	1.09-5
200	68.2	46.9	7.55-6
$\frac{X_{100}+X_{150}}{2}$	66.3	49.5	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	66.9	48.6	✓ —



COMMENTS
X-ray: Small pebbles - Bedding distinctly skewed by 2/3 cm. at bottom of mini-core.

MAGNETICS D.M. STEADY

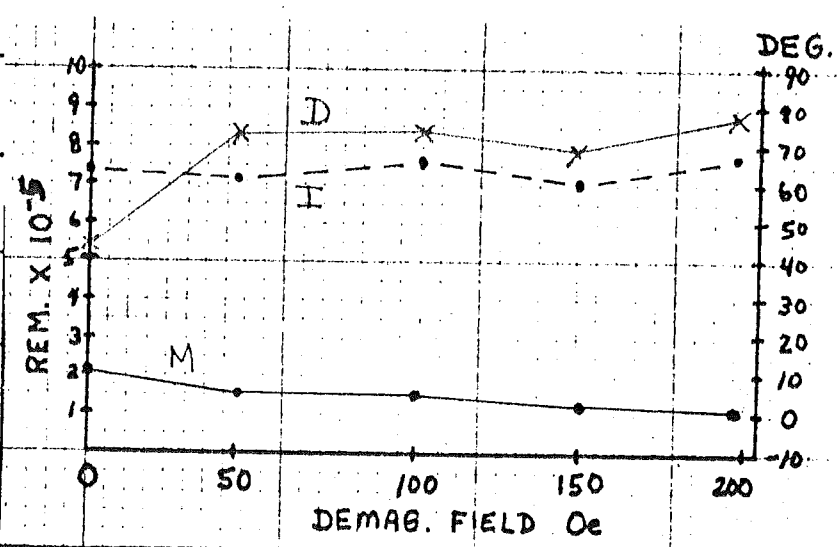
I NOT STABLE

D NOT STABLE

2-22

Z = 67.0 cm C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	43.7	63.9	2.14-5
50	73.0	61.5	1.48-5
100	73.8	66.0	1.37-5
150	69.8	60.1	1.22-5
200	78.8	66.3	1.10-5
$\frac{X_{100}+X_{150}}{2}$	71.8	63.1	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	74.1	64.1	✓ —



COMMENTS
X-ray: Small pebbles - Bending distinctly skewed downwards by 1½ cm. Sandy and gritty.

MAGNETICS D.M. STEADY

D STABLE BET. 100-200 Oe

I STABLE BET 100-200 Oe

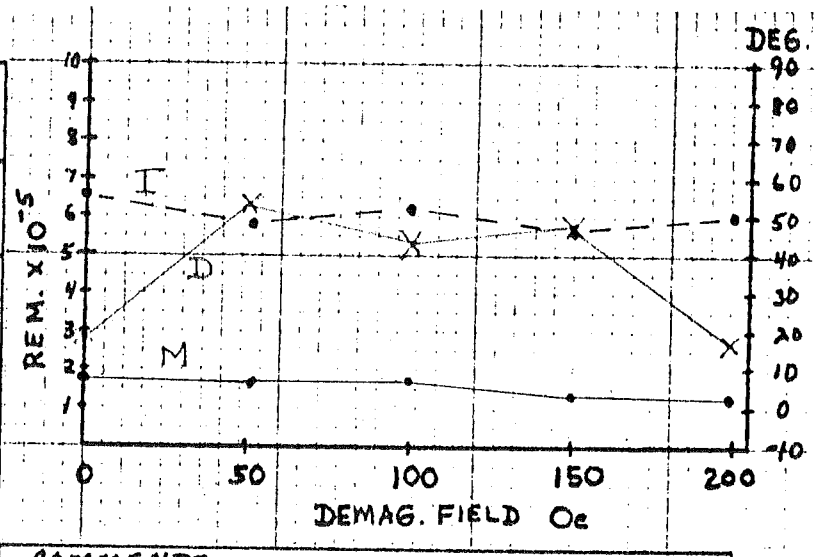
SAMPLE # P.M. 2-23 ; 2-24

2-23

Z = 67.0 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	19.0	56.1	1.80-5
50	52.6	48.5	1.62-5
100	43.4	52.4	1.69-5
150	47.9	46.2	1.40-5
200	17.2	50.0	1.18-5
$\frac{X_{100}+X_{150}}{2}$	45.7	49.3	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	36.2	49.5	—



COMMENTS

X-ray Small pebbles - Bedding not distinct. Sandy and gritty

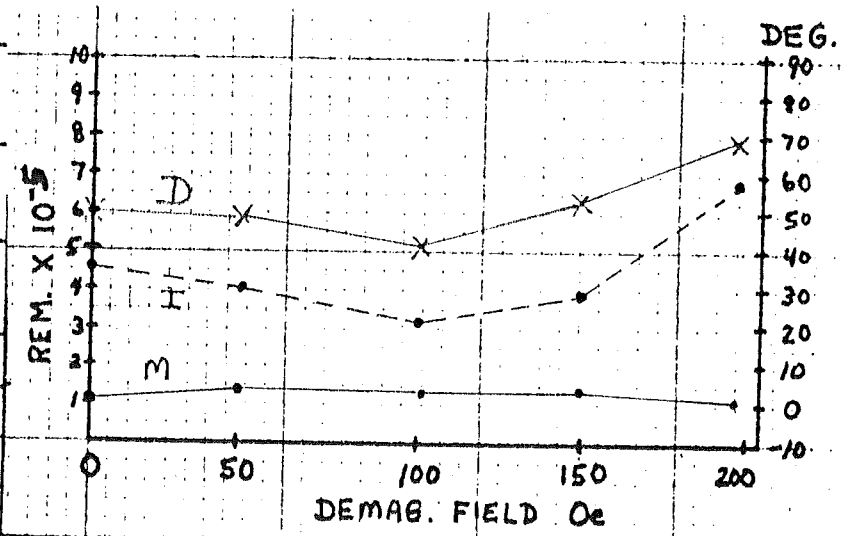
MAGNETICS D.M. STEADY

I STABLE BET 100-200 Oe

D NOT STABLE

2-24 Z = 70.5 cm C.P. = 2

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	50.4	35.6	1.20-5
50	49.1	30.7	1.42-5
100	43.0	22.0	1.35-5
150	53.4	28.9	1.45-5
200	69.4	59.7	1.16-5
$\frac{X_{100}+X_{150}}{2}$	48.2	25.5	—
$\frac{X_{100}+X_{150}+X_{200}}{3}$	55.3	36.9	—



COMMENTS

X-ray Small pebbles - Bedding not distinct - Sandy and gritty

MAGNETICS D.M. NOT STEADY

I NOT STABLE

D NOT STABLE

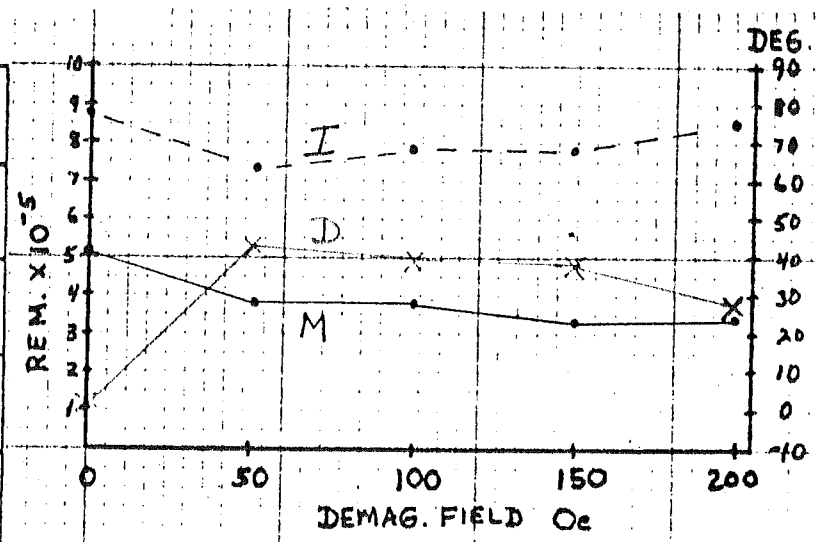
SAMPLE # P.M. 2-25

2-25

Z = 2.2 cm C.P. = 2

MAGNETIC PARAMETERS

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0	1.7	77.5	5.08-5
50	43.6	63.6	3.76-5
100	39.6	68.3	3.76-5
150	37.0	68.0	3.25-5
200	27.1	75.0	3.37-5
$\frac{X_{100}+X_{150}}{2}$	38.3	68.2	✓ —
$\frac{X_{100}+X_{150}+X_{200}}{3}$	34.6	70.4	—



COMMENTS Top of core #2 - One pebble
X-ray Bedding disturbed in the field.

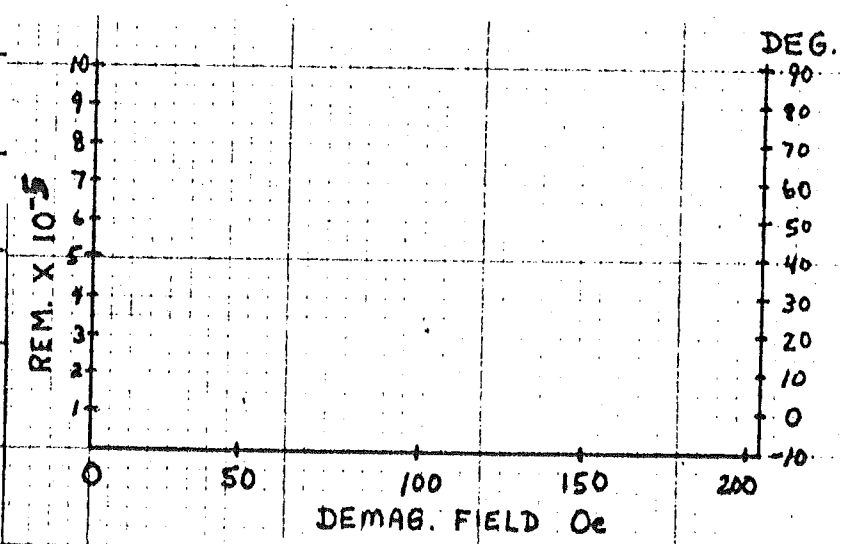
MAGNETICS D.M. STEADY

I STABLE BET 100-200 Oe

D NOT STABLE

#_____ Z=_____ C.P.=_____

A.F. DEMAG.	DEC.	INC.	Σ MOM.
0			
50			
100			
150			
200			
$\frac{X_{100}+X_{150}}{2}$			—
$\frac{X_{100}+X_{150}+X_{200}}{3}$			—



COMMENTS

X-ray

MAGNETICS

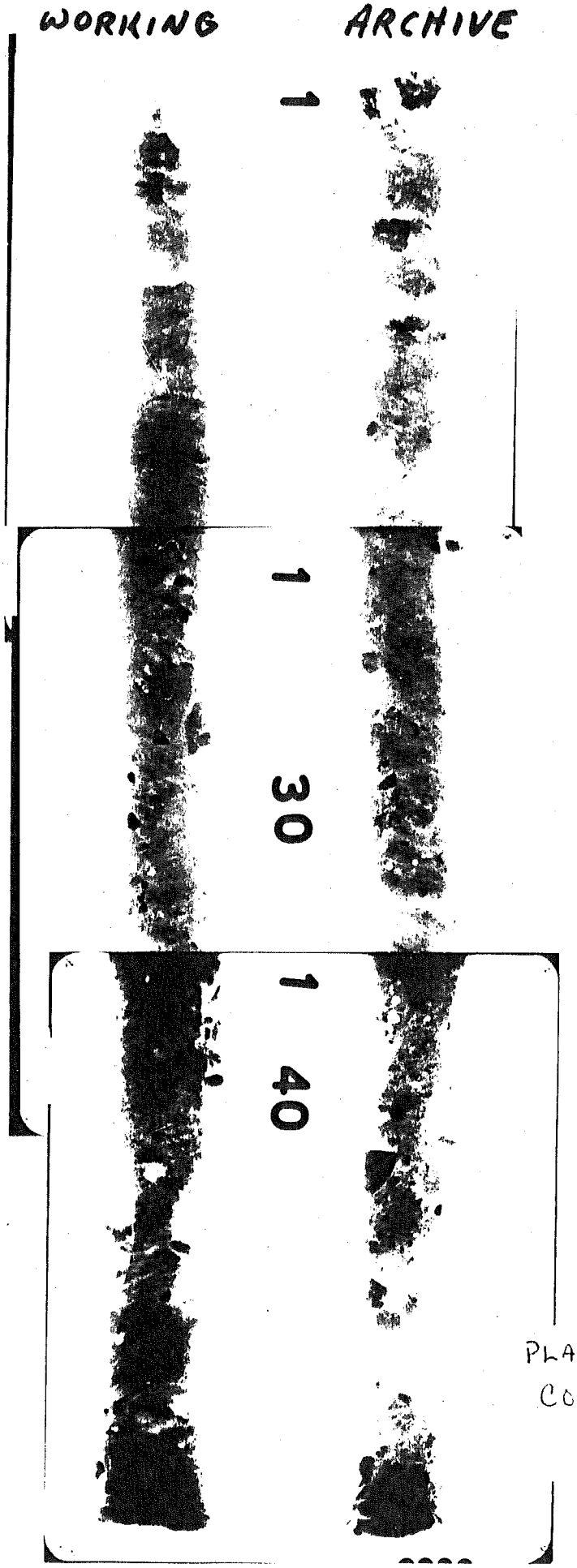


PLATE 1a. Split halves
CORE 1

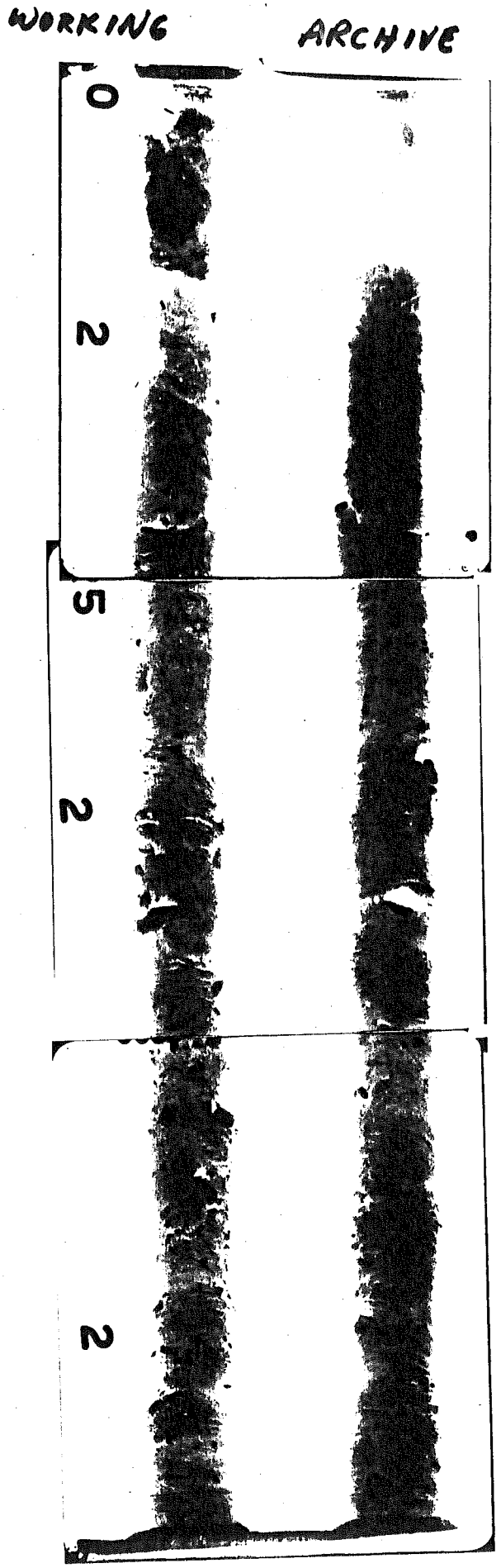


Plate 1b Split halves
Core 2.

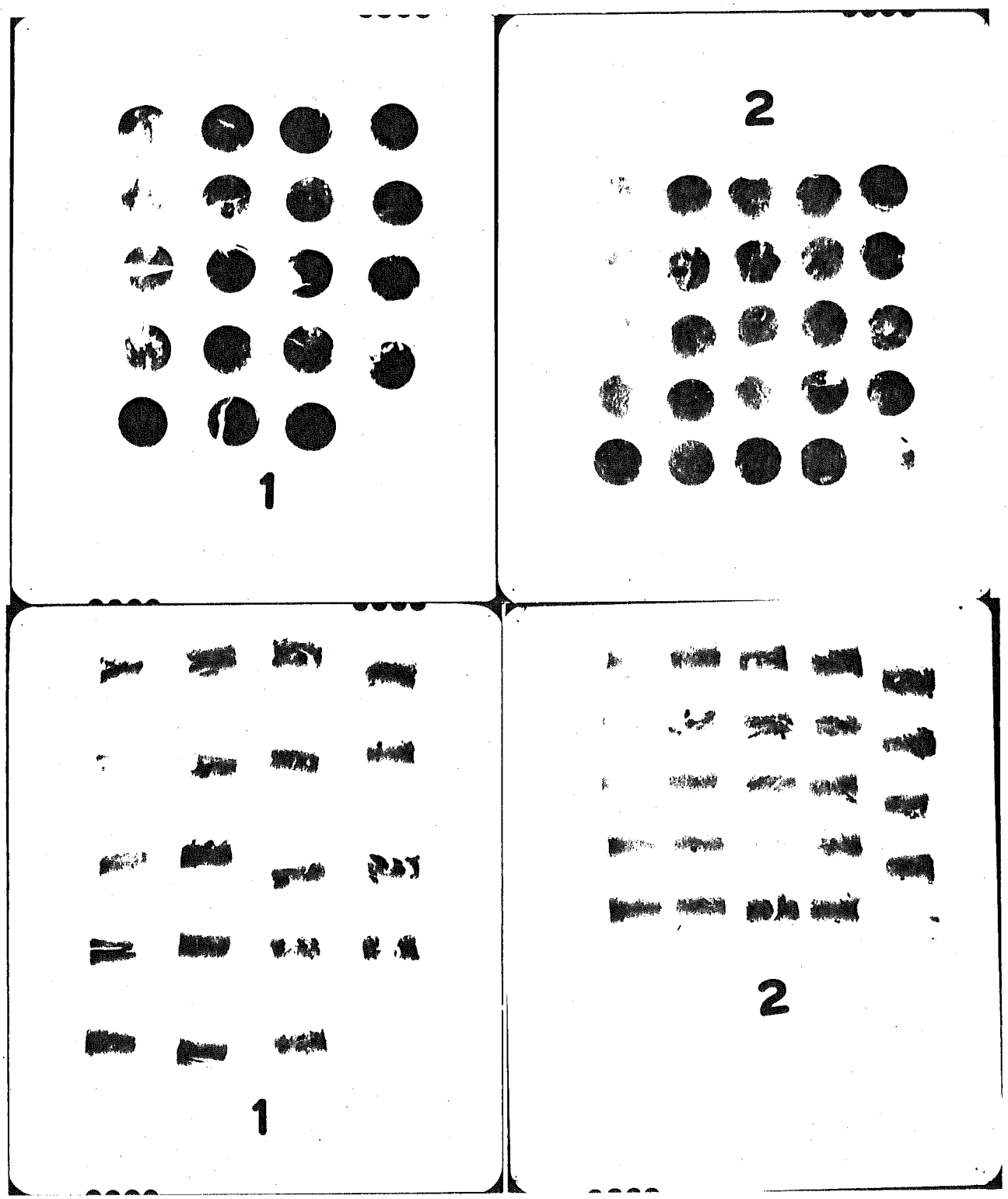


Plate 1c, Mini-cores from Cores 1 and 2

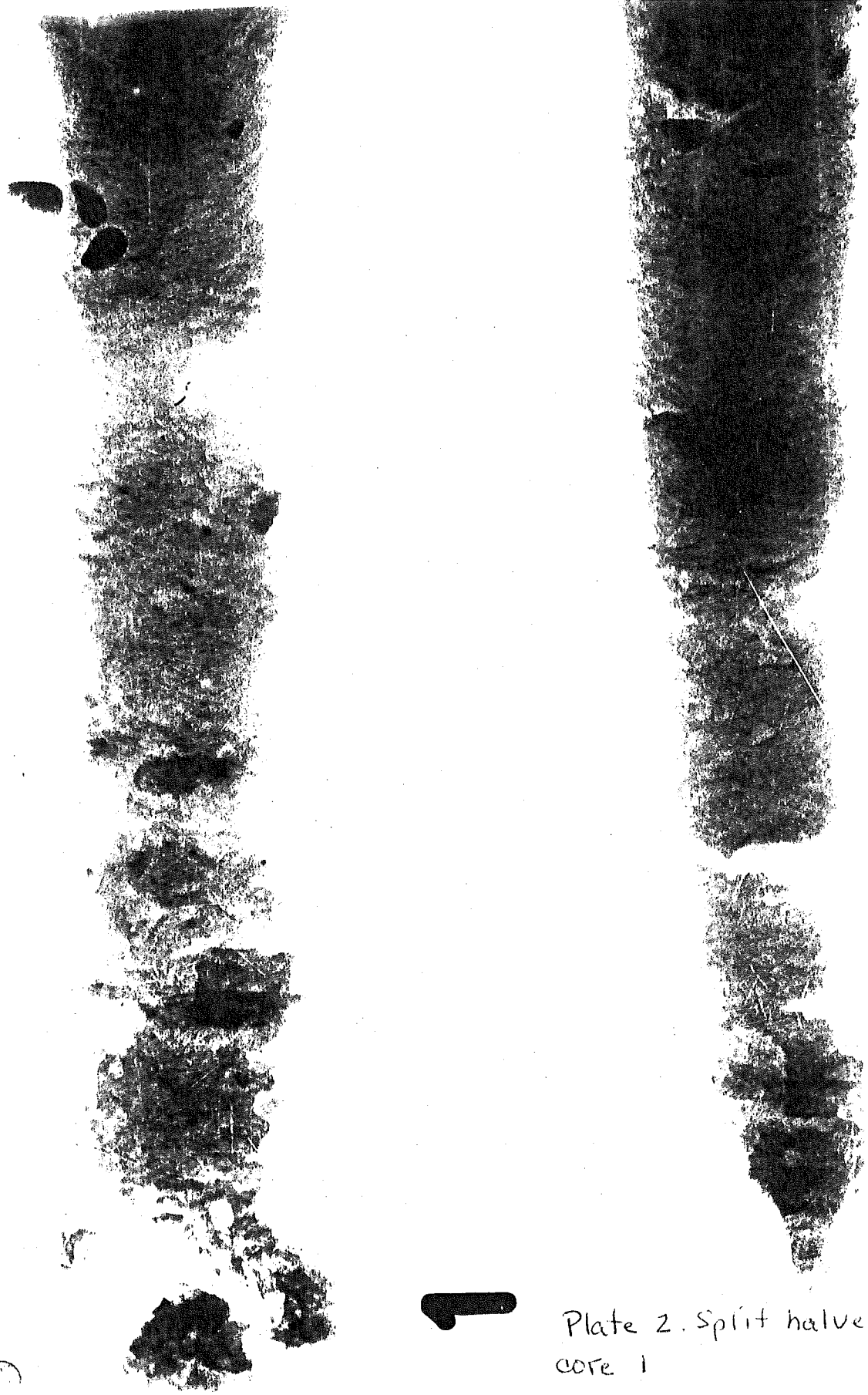


Plate 2. Split halves
core 1

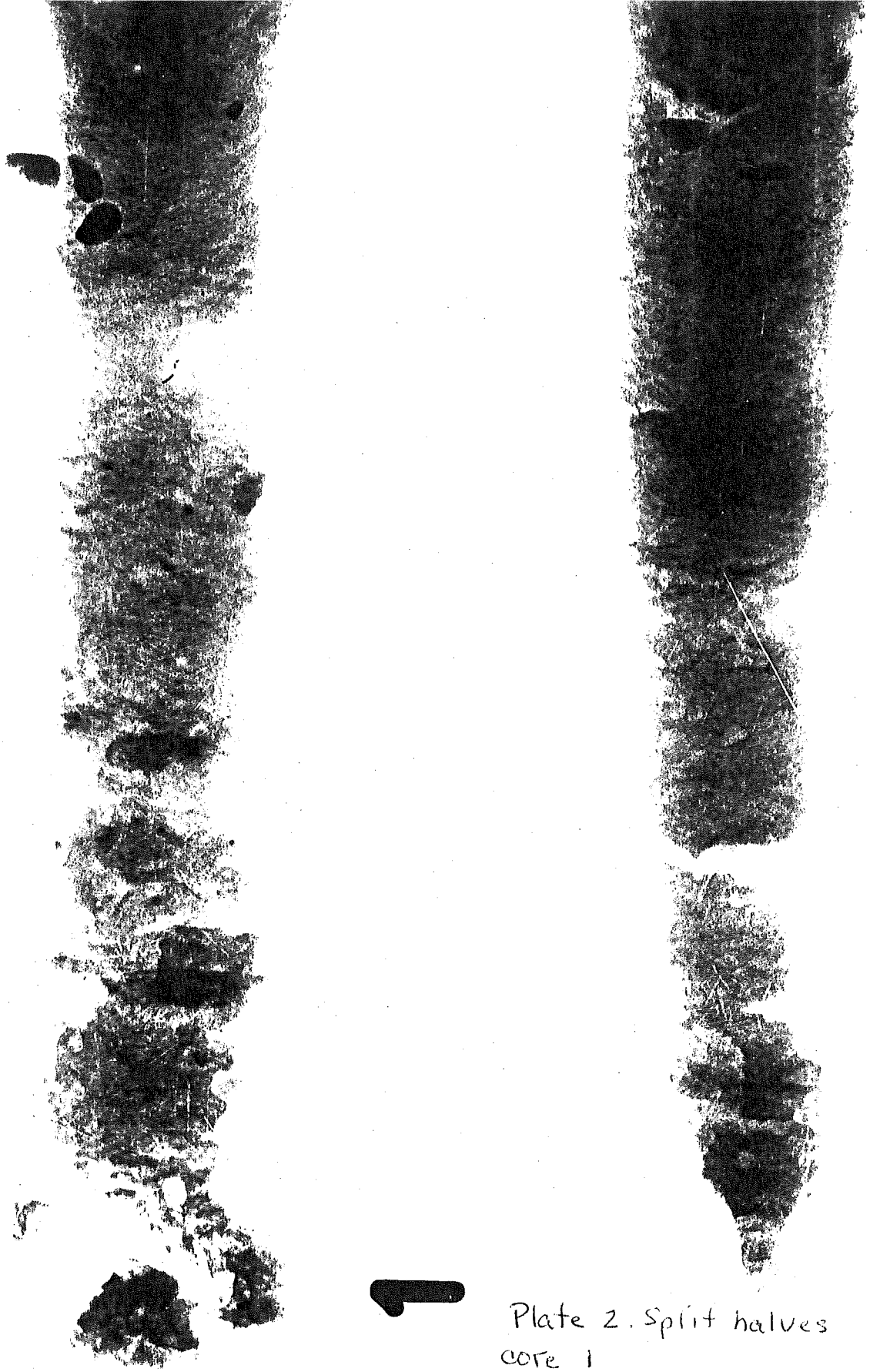


Plate 2. Split halves
core 1

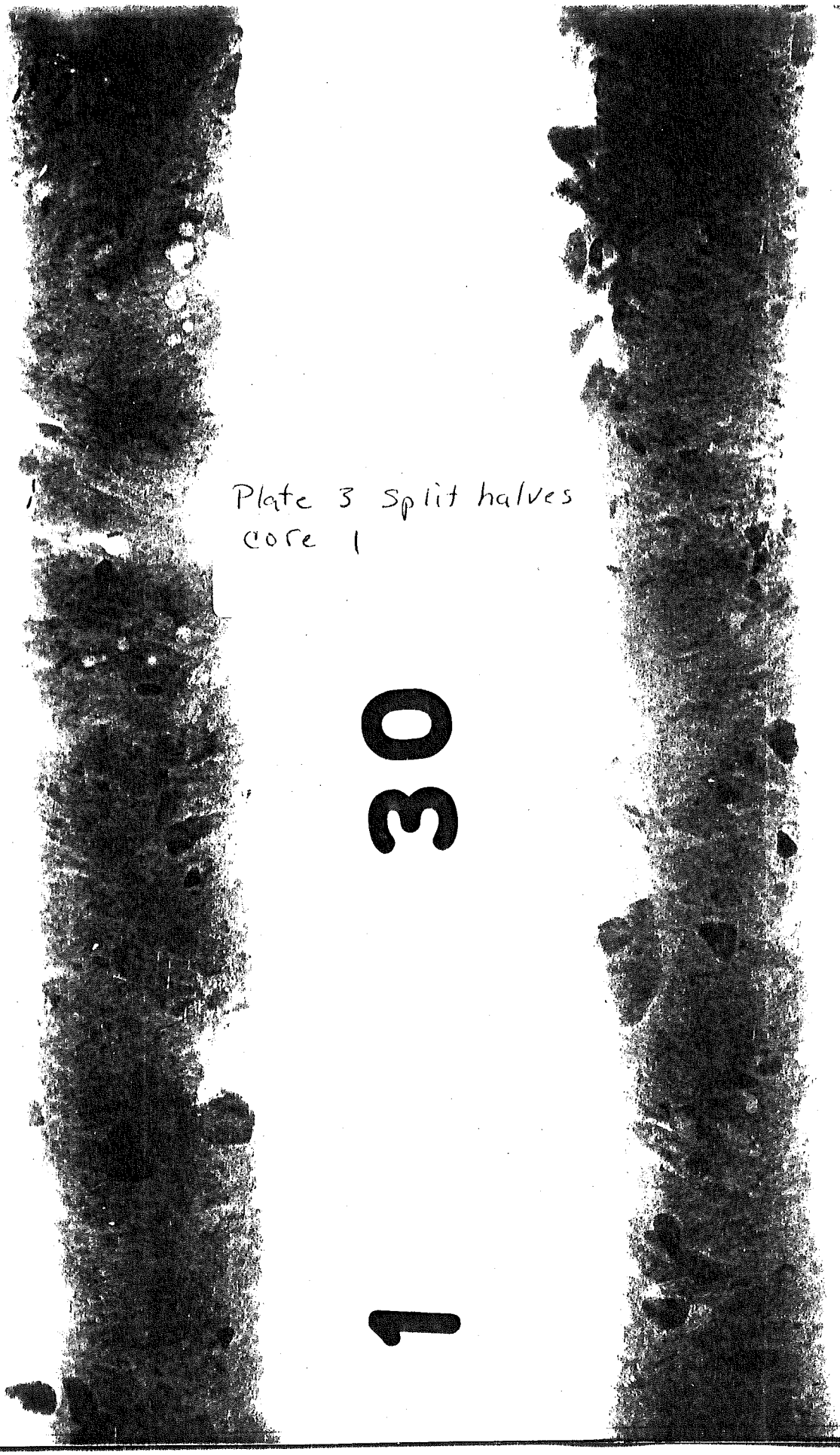


Plate 3 split halves
core 1
03
1

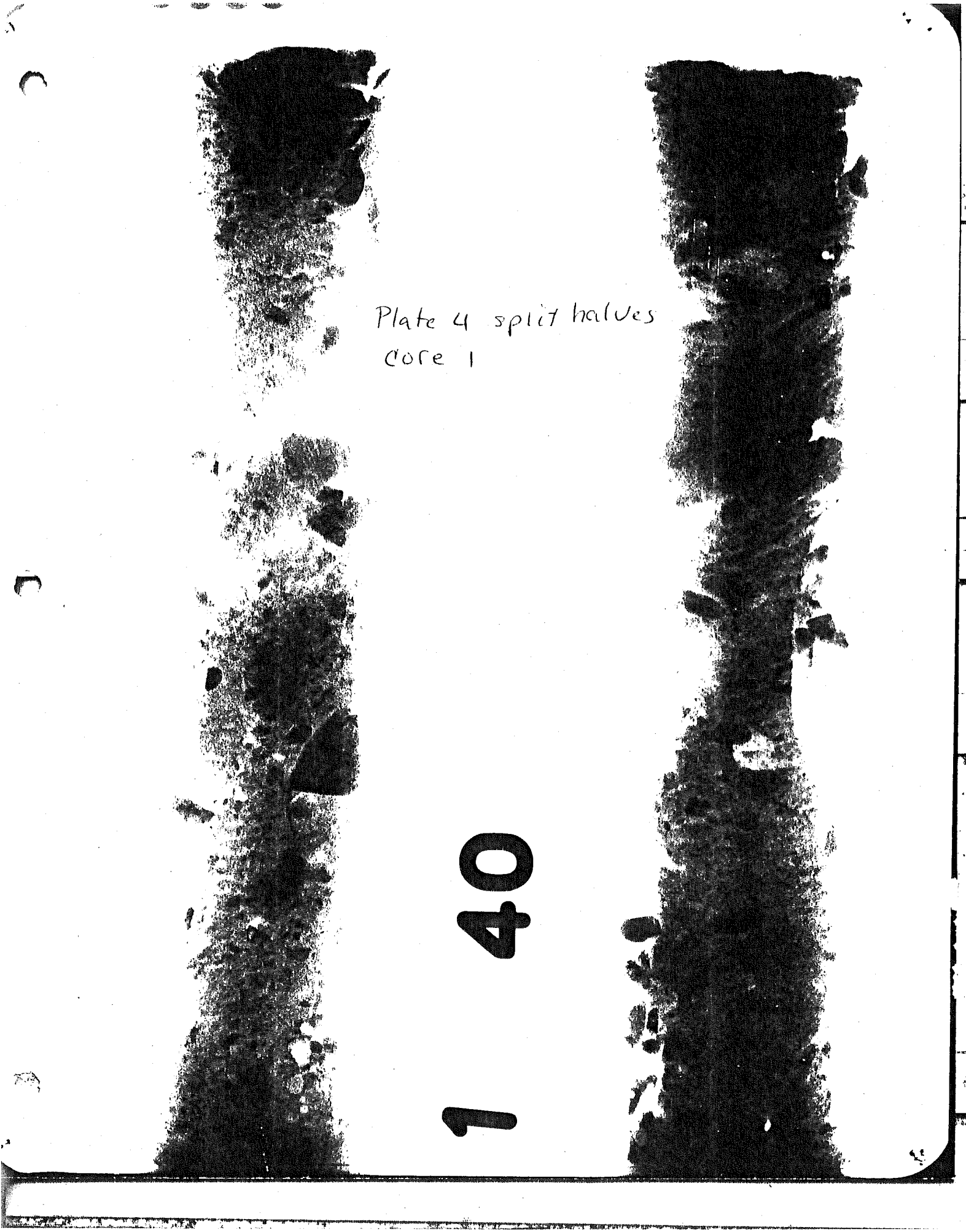


Plate 4 split halves
core 1
40
1

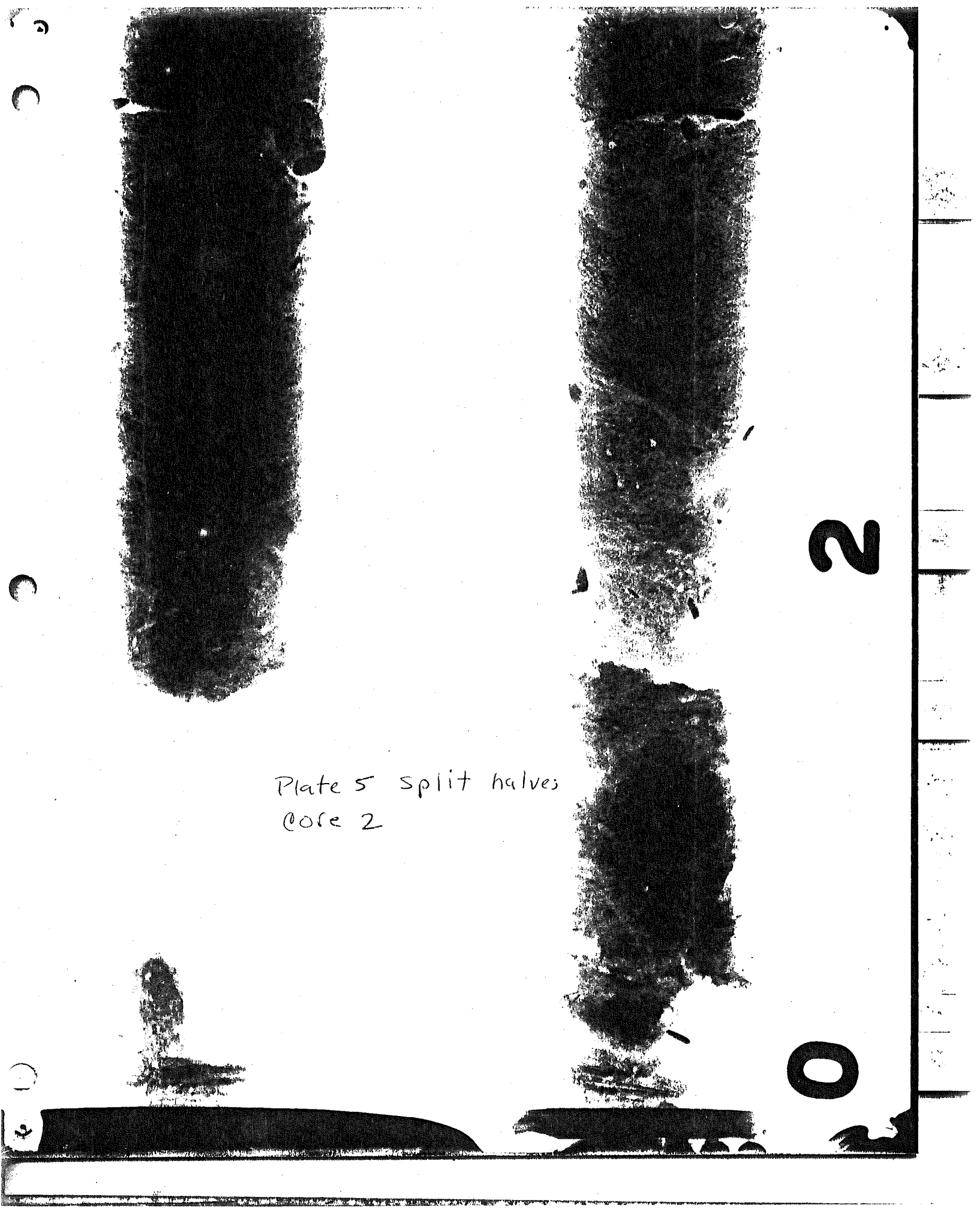


Plate 5 split halves
core 2

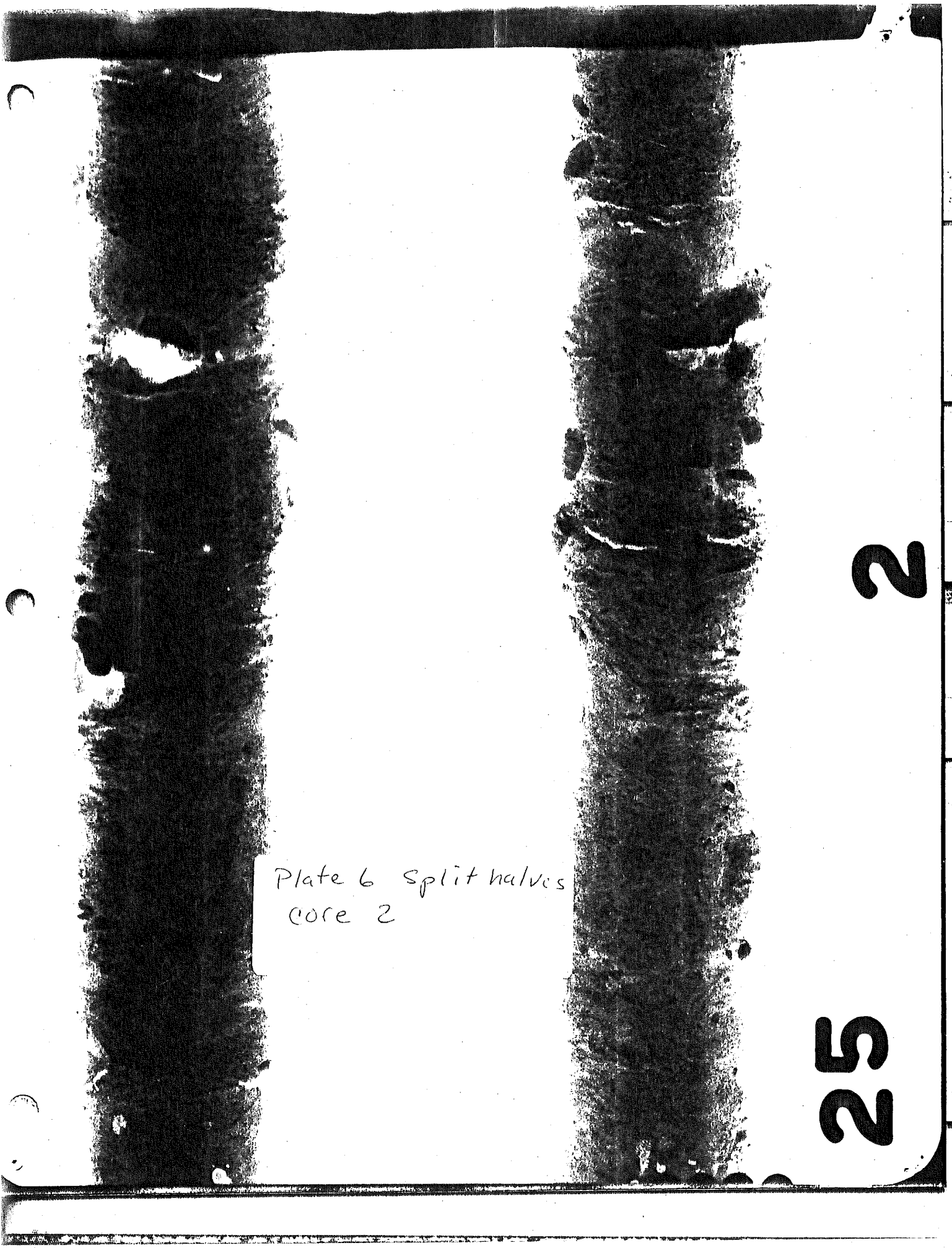


Plate 6 split halves
core 2
2
25

2

Plate 7 split
halves case 2

1

Plate 8 mini-cores
core 1

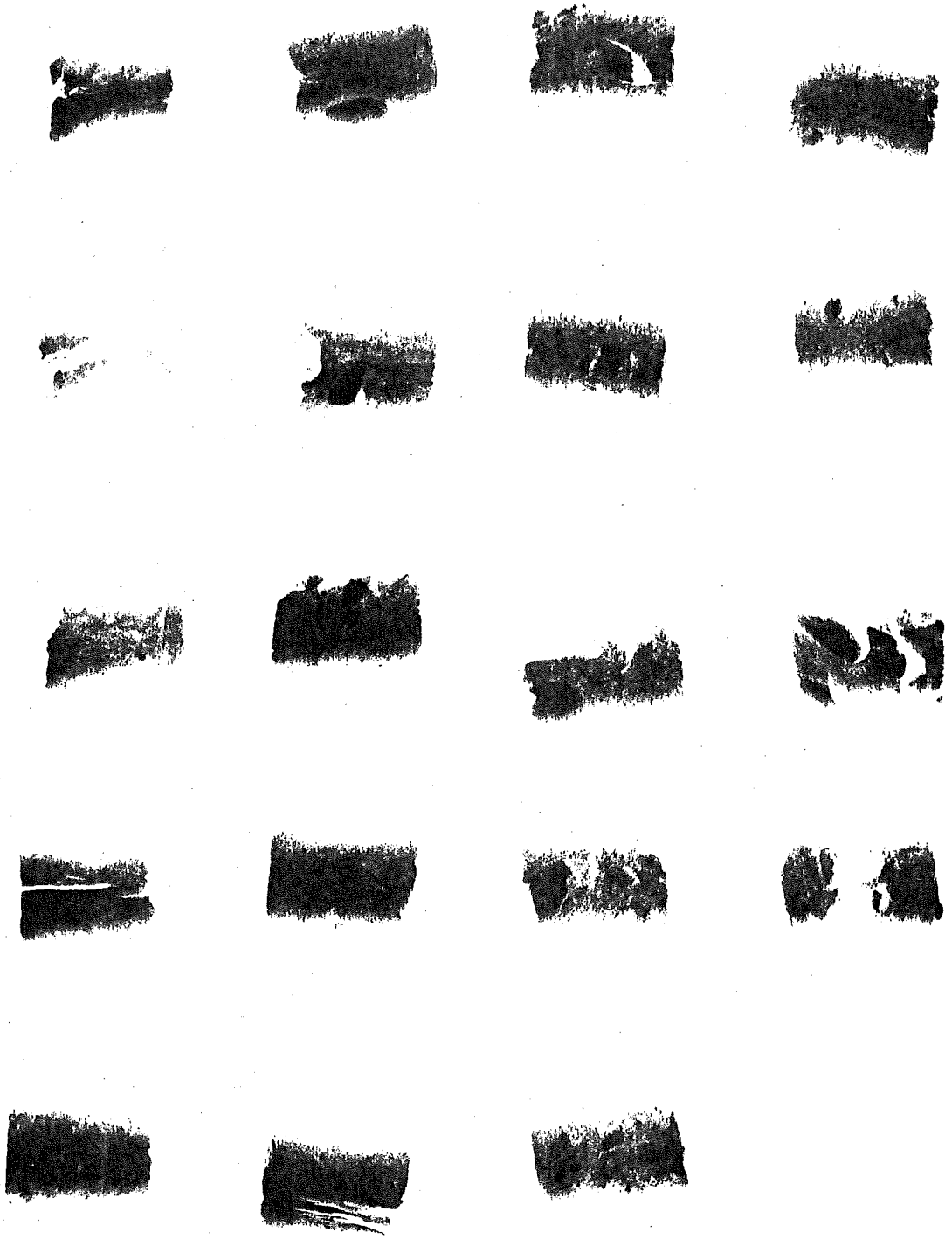


Plate 9 mini-cores
Core 1

1

2

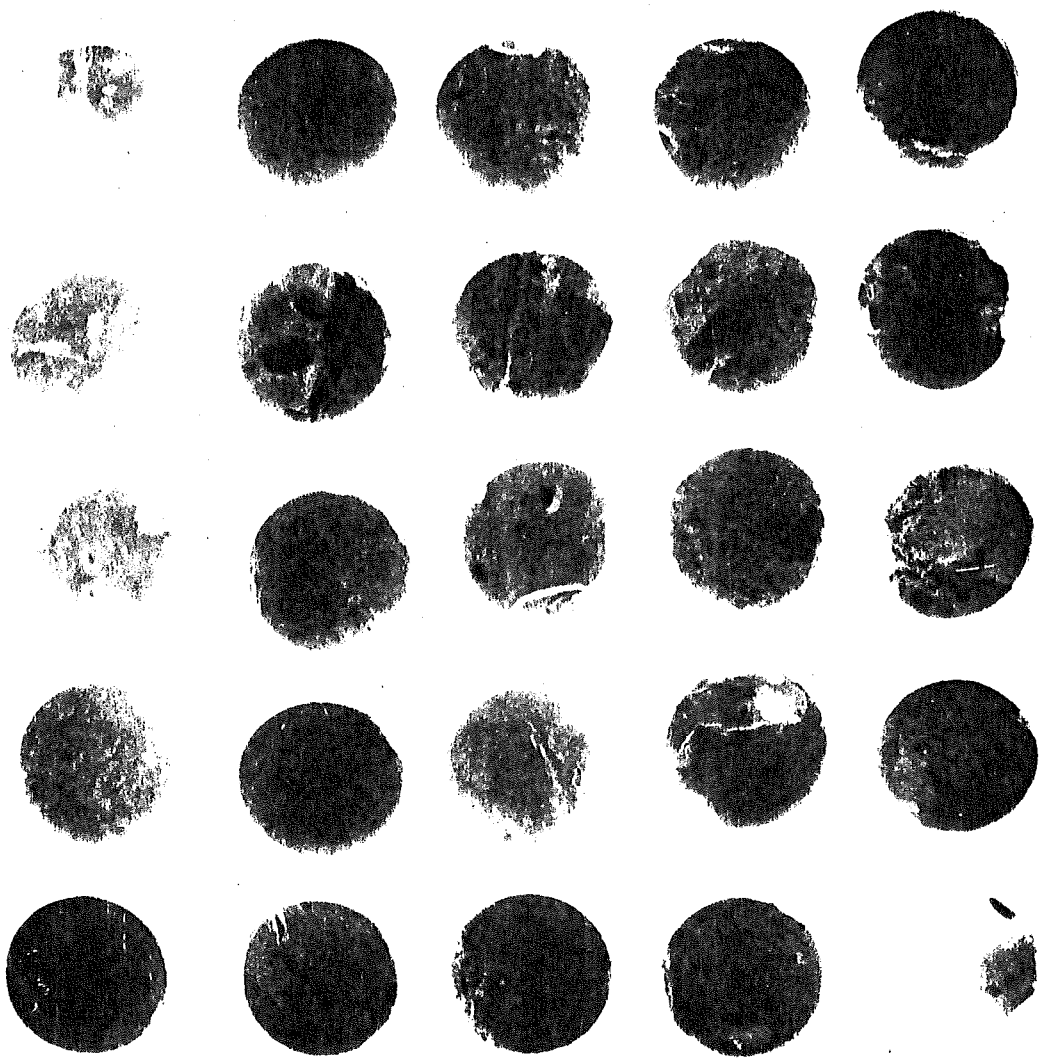
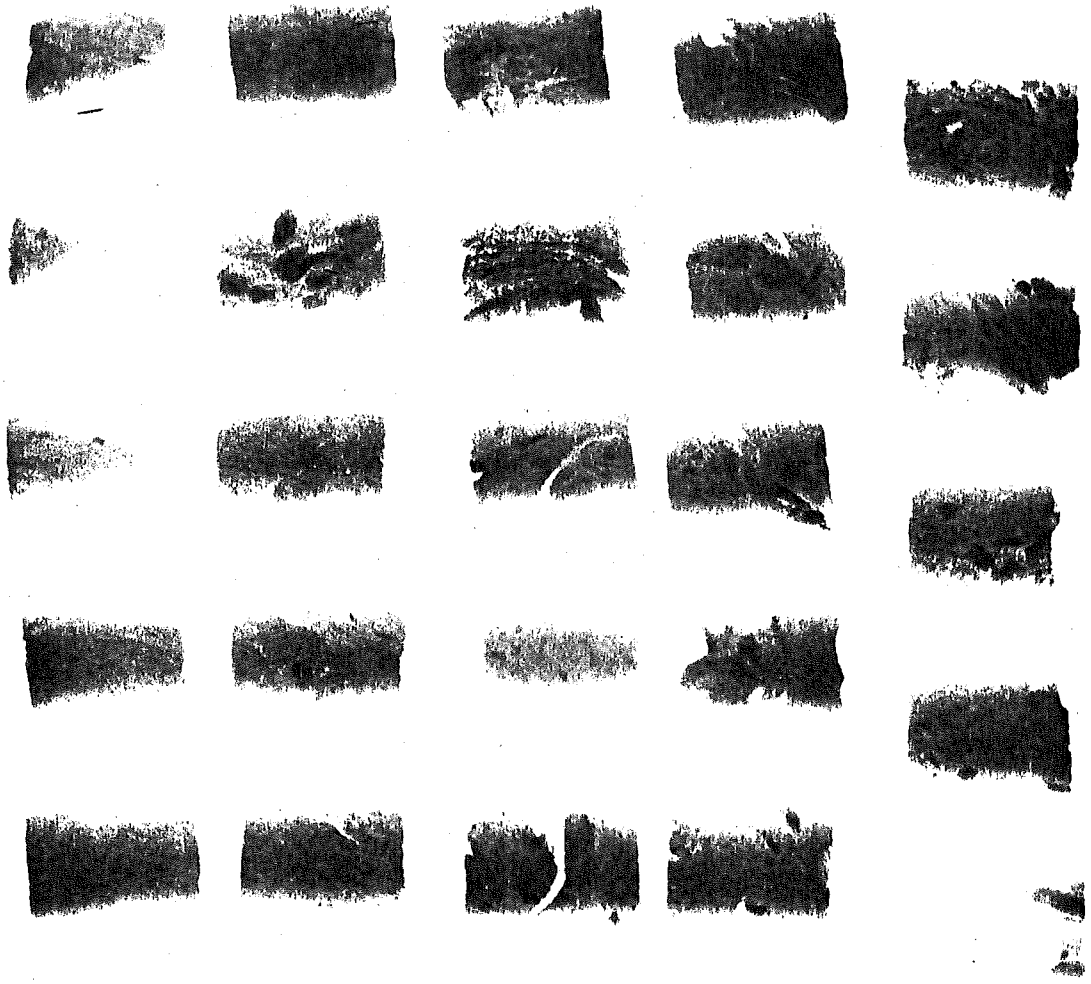


Plate 1D Mini-cores
Core 2



2

Plate 11 Mini-cores
Core 2