37. MAGNETIC STABILITY OF ELEVEN BASALT SPECIMENS FROM DSDP LEG 34[1]

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ABSTRACT

Six basalt specimens from Deep Sea Drilling Project Hole 319A and five from Site 321 exhibited mixed stabilities during progressive alternating-field demagnetization and in a 500-hr test of viscous remanent magnetization. The samples from Hole 319A were generally less stable than those at Site 321. The results of 19 measurements on each specimen are given here in tabular form.

INTRODUCTION

Laboratory tests were conducted on 11 basalt specimens from DSDP Hole 319A and Site 321 to study their behavior under progressive alternating-field demagnetization and to discover their susceptibility to contamination by viscous remanence acquired in a weak field. Figure 1 shows examples of the results.

PROGRESSIVE ALTERNATING-FIELD DEMAGNETIZATION

Each specimen was measured after partial demagnetization at steps of 25, 50, 100, 200, 400, and 800 oe peak alternating field, using a two-axis tumbler exposed to the earth's field. The results are given in Tables 1 and 2.

Magnetic intensities at Site 321 decreased smoothly with increasing alternating fields, while those at Hole 319A generally were erratic, characteristic of these less stable specimens. In all but one case in Hole 319A, the magnetization initially increased, suggesting previous accumulation of secondary magnetization in directions opposite to the original remanence. Unfortunately, the 319A specimens sometimes changed their magnetization noticeably during the course of a measurement, so that their apparent demagnetization behavior may be artificial in part. At Site 321, two specimens displayed slight but perhaps insignificant increases of intensity after application of 25-oe peak alternating field.

In most of the specimens, a stable direction of original remanence was never isolated. Frequently, the directions progressed along a smooth path up to 200-oe peak field, then diverged at 400 and 800 oe. Because the progressive demagnetizations were performed in the earth's field, the acquisition of a net anhysteritic remanence (ARM) not only was possible, but actually appears to have occurred, often at 400 oe and usually at 800 oe, where the results bear little resemblance to those of weaker fields. Several years experience with our demagnetization apparatus has shown that ARM does not become significant in stable rocks until alternating fields exceeding 400 oe are applied. In the case of these rocks, however, we regret not having performed replicate demagnetizations at each level in order to identify the onset of net ARM more closely. A special test involving six-fold repetition of the 800-oe demagnetization and measurement using Samples 319A-3-4, 96-99 cm and 321-14-1, 99-102 cm showed that the spurious ARM was not systematic. The results of 400 and 800 oe generally have no value here, except that the latter served as the starting point for the test of viscous remanent magnetization (VRM).

VISCOUS REMANENT MAGNETIZATION

Immediately following the alternating-field demagnetization at 800 oe, a 500-hr test of viscous remanence (Lowrie, 1973; Peirce et al., 1974) was conducted, with measurements performed at 1, 2, 5, 10, 20, 50, 100, 200, and 500 hr into the experiment. The samples remained in a constant position during the test, except for brief periods during which they were removed for measurement. The earth's field in our laboratory was used to produce VRM nominally in the westward direction at a shallow inclination, relative to the coordinate system of the specimens. Results are given in Tables 1 and 2. Two specimens from Hole 319A were especially unstable, whereas all five from Site 321 displayed only weak VRM during the test.

DISCUSSION

Statistically significant conclusions are not possible with only five or six specimens from each site. Hopefully these data will prove useful when combined with the Hole 319A and Site 321 results of other workers, however. By themselves, the 11 specimens examined here merely confirm the common observation of magnetic instability in near-surface basalts recovered by DSDP.

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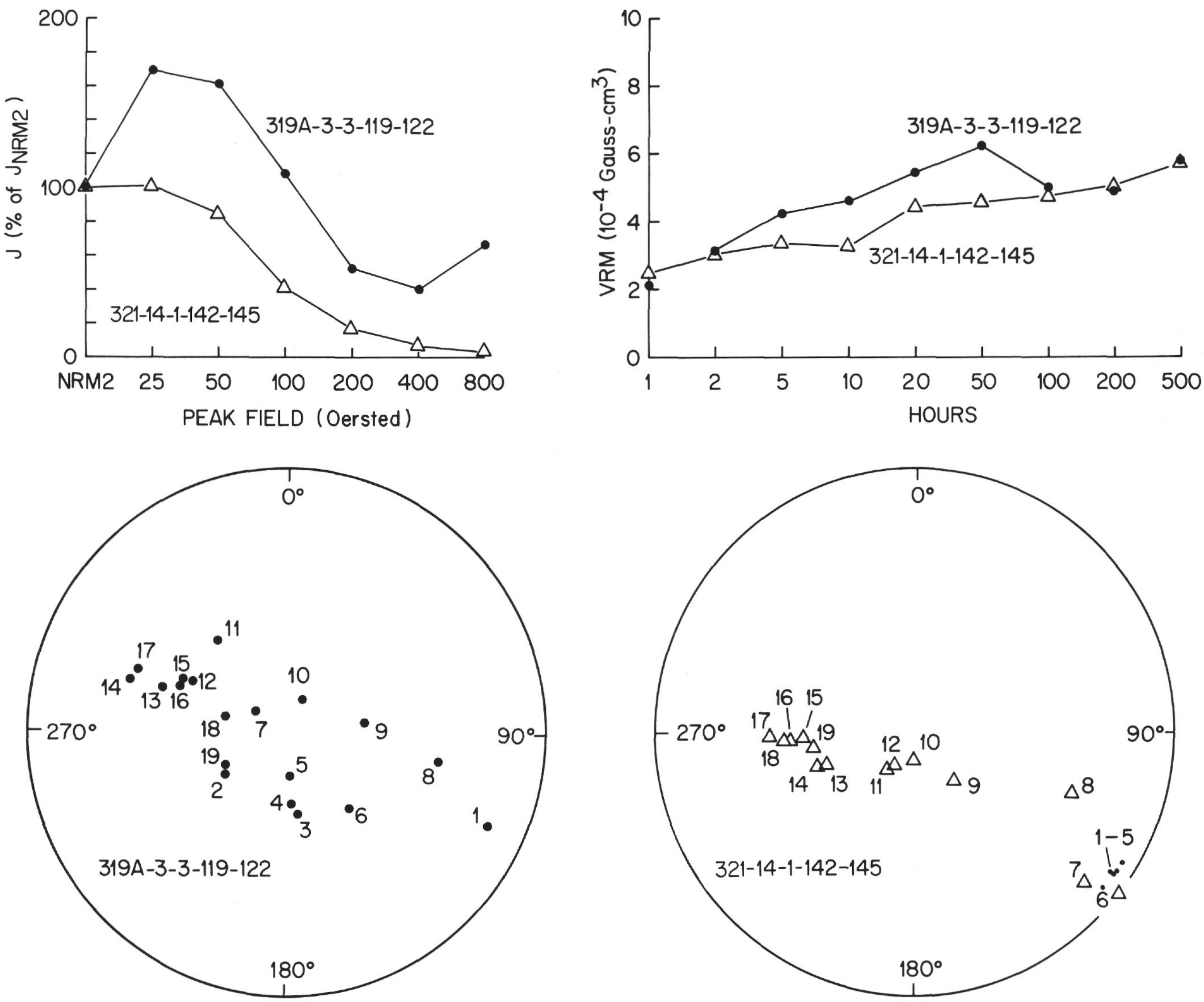

Figure 1. *Examples of results. The lower plots show 19 magnetic directions for each of two specimens, where the numbers beside each point correspond to line numbers in Table 1. All points lie on the lower hemisphere of an equal-area projection, except for five small dots at the lower right, which are upper hemisphere directions too closely spaced for larger symbols. The upper two graphs show the effect of partial demagnetization in alternating-fields up to 800 oe peak (left) and the accumulation of viscous remanent magnetization in the westward direction (relative to the sample coordinates) over a period of 500 hr. The volume in each case is 8.6 cc.*

TABLE 1
Measurements of Magnetic Direction, Hole 319A and Site 321

	3-1, 50-53 cm			3-2, 104-107 cm			3-3, 14-17 cm			3-3, 119-122 cm			3-4, 96-99 cm			3-5, 44-47 cm		
	I	D	J	I	D	J	I	D	J	I	D	J	I	D	J	I	D	J
Hole 319A																		
1 NRM1	-50	56	$4.3E^{-4}$	34	71	$7.5E^{-4}$	13	108	$2.5E^{-3}$	16	114	$1.7E^{-3}$	23	75	$1.3E^{-3}$	12	55	$4.9E^{-4}$
2 NRM2	-34	49	$2.9E^{-4}$	47	66	$6.8E^{-4}$	14	117	$1.9E^{-3}$	67	234	$8.0E^{-4}$	0	43	$7.7E^{-4}$	8	72	$4.6E^{-4}$
3 25 oe	-42	47	$3.2E^{-4}$	46	65	$6.8E^{-4}$	14	117	$2.0E^{-3}$	65	170	$1.4E^{-3}$	8	66	$1.1E^{-3}$	9	69	$4.2E^{-4}$
4 50 oe	-44	45	$3.3E^{-4}$	46	71	$7.2E^{-4}$	37	121	$2.3E^{-3}$	68	175	$1.3E^{-3}$	45	62	$1.0E^{-3}$	35	47	$2.4E^{-4}$
5 100 oe	-14	16	$2.1E^{-4}$	49	76	$7.2E^{-4}$	54	133	$2.1E^{-3}$	77	173	$8.6E^{-4}$	65	69	$6.9E^{-4}$	76	305	$3.4E^{-4}$
6 200 oe	48	7	$2.0E^{-4}$	53	76	$5.0E^{-4}$	63	134	$1.2E^{-3}$	79	305	$4.2E^{-4}$	66	80	$3.5E^{-4}$	70	275	$3.7E^{-4}$
7 400 oe	71	338	$1.9E^{-4}$	62	78	$3.1E^{-4}$	62	125	$4.2E^{-4}$	59	140	$3.2E^{-4}$	25	317	$3.7E^{-4}$	65	286	$2.9E^{-4}$
8 800 oe	42	291	$5.7E^{-5}$	53	107	$2.4E^{-4}$	78	322	$2.1E^{-4}$	40	100	$5.3E^{-4}$	-5	345	$4.2E^{-4}$	83	53	$1.5E^{-4}$
9 1 hr	35	290	$6.6E^{-5}$	60	108	$2.2E^{-4}$	55	300	$2.5E^{-4}$	65	83	$3.6E^{-4}$	-6	317	$5.3E^{-4}$	83	324	$1.5E^{-4}$
10 2 hr	35	289	$6.7E^{-5}$	62	105	$2.2E^{-4}$	48	298	$4.0E^{-3}$	79	29	$3.1E^{-4}$	-1	314	$5.8E^{-4}$	82	314	$1.5E^{-4}$
11 5 hr	34	289	$6.9E^{-5}$	61	106	$2.2E^{-4}$	47	295	$2.8E^{-4}$	55	322	$2.8E^{-4}$	1	310	$5.6E^{-4}$	80	307	$1.5E^{-4}$
12 10 hr	34	288	$7.1E^{-5}$	63	107	$2.1E^{-4}$	45	293	$2.9E^{-4}$	58	298	$3.0E^{-4}$	2	314	$4.8E^{-4}$	79	304	$1.5E^{-4}$
13 20 hr	34	287	$7.2E^{-5}$	66	106	$2.1E^{-4}$	40	290	$3.2E^{-4}$	49	289	$3.8E^{-4}$	2	304	$6.7E^{-4}$	78	299	$1.5E^{-4}$
14 50 hr	33	288	$7.3E^{-5}$	67	107	$2.1E^{-4}$	39	290	$3.4E^{-4}$	38	288	$4.4E^{-4}$	3	303	$6.9E^{-4}$	77	300	$1.5E^{-4}$
15 100 hr	32	287	$7.6E^{-5}$	67	111	$2.1E^{-4}$	39	288	$3.5E^{-4}$	54	297	$3.6E^{-4}$	3	300	$7.3E^{-4}$	76	298	$1.5E^{-4}$
16 200 hr	31	287	$7.7E^{-5}$	68	107	$2.1E^{-4}$	38	289	$3.5E^{-4}$	54	293	$3.2E^{-4}$	3	301	$6.1E^{-4}$	76	299	$1.5E^{-4}$
17 500 hr	31	287	$8.0E^{-5}$	69	112	$2.1E^{-4}$	36	288	$3.7E^{-4}$	39	292	$3.9E^{-4}$	5	297	$8.1E^{-4}$	74	295	$1.6E^{-4}$
18 25 oe	31	286	$7.9E^{-5}$	68	110	$2.1E^{-4}$	40	288	$3.4E^{-4}$	71	284	$2.3E^{-4}$	10	296	$5.2E^{-4}$	74	297	$1.6E^{-4}$
19 50 oe	31	287	$7.8E^{-5}$	68	108	$2.1E^{-4}$	43	290	$3.2E^{-4}$	69	241	$2.7E^{-4}$	34	300	$2.9E^{-4}$	75	296	$1.6E^{-4}$

	14-1, 99-102 cm			14-1, 142-145 cm			14-2, 94-97 cm			14-3, 97-100 cm			14-4, 35-38 cm		
Site 321															
1 NRM1	-10	134	$1.2E^{-2}$	-7	121	$1.4E^{-2}$	-17	150	$9.1E^{-3}$	-16	141	$1.1E^{-2}$	-10	279	$1.4E^{-2}$
2 NRM2	-9	134	$1.2E^{-2}$	-7	123	$1.2E^{-2}$	-13	147	$1.0E^{-2}$	-12	155	$1.1E^{-2}$	-10	281	$1.4E^{-2}$
3 25 oe	-11	132	$1.2E^{-2}$	-8	124	$1.3E^{-2}$	-15	153	$9.3E^{-3}$	-9	151	$1.1E^{-2}$	-14	281	$1.2E^{-2}$
4 50 oe	-8	131	$1.1E^{-2}$	-9	124	$1.1E^{-2}$	-13	159	$7.7E^{-3}$	-11	150	$7.5E^{-3}$	-14	281	$9.6E^{-3}$
5 100 oe	-8	132	$8.8E^{-3}$	-8	128	$5.1E^{-3}$	-13	161	$4.8E^{-3}$	- 9	148	$3.8E^{-3}$	-14	280	$5.5E^{-3}$
6 200 oe	-6	132	$3.9E^{-3}$	1	127	$2.1E^{-3}$	-4	163	$1.4E^{-3}$	9	142	$1.3E^{-3}$	-9	279	$1.6E^{-3}$
7 400 oe	1	131	$2.2E^{-3}$	15	130	$8.0E^{-4}$	66	189	$3.4E^{-4}$	43	91	$4.1E^{-4}$	36	352	$3.2E^{-4}$
8 800 oe	7	127	$1.0E^{-3}$	36	110	$4.6E^{-4}$	60	172	$3.9E^{-4}$	54	276	$3.3E^{-4}$	47	264	$6.9E^{-4}$
9 1 hr	8	130	$8.4E^{-4}$	71	139	$2.9E^{-4}$	54	253	$3.7E^{-4}$	21	284	$5.1E^{-4}$	41	276	$8.1E^{-4}$
10 2 hr	7	128	$9.8E^{-4}$	82	180	$2.9E^{-4}$	45	259	$4.4E^{-4}$	19	286	$6.3E^{-4}$	38	277	$8.2E^{-4}$
11 5 hr	9	131	$8.6E^{-4}$	76	217	$2.9E^{-4}$	40	264	$4.8E^{-4}$	21	287	$4.3E^{-4}$	31	275	$8.5E^{-4}$
12 10 hr	10	134	$8.1E^{-4}$	79	211	$3.0E^{-4}$	42	262	$4.6E^{-4}$	19	281	$6.0E^{-4}$	32	274	$8.3E^{-4}$
13 20 hr	13	138	$7.4E^{-4}$	61	260	$3.4E^{-4}$	32	272	$5.9E^{-4}$	13	281	$9.4E^{-4}$	26	277	$9.5E^{-4}$
14 50 hr	14	139	$7.1E^{-4}$	58	261	$3.5E^{-4}$	32	270	$5.9E^{-4}$	12	281	$9.3E^{-4}$	26	279	$1.1E^{-3}$
15 100 hr	15	141	$6.7E^{-4}$	55	267	$3.6E^{-4}$	30	271	$6.2E^{-4}$	15	279	$8.7E^{-4}$	32	278	$8.7E^{-4}$
16 200 hr	15	141	$6.7E^{-4}$	51	266	$3.9E^{-4}$	29	273	$6.7E^{-4}$	15	99	$9.2E^{-4}$	30	277	$8.4E^{-4}$
17 500 hr	15	144	$6.5E^{-4}$	44	268	$4.4E^{-4}$	68	191	$3.2E^{-4}$	13	282	$9.0E^{-4}$	28	279	$9.8E^{-4}$
18 25 oe	17	141	$6.9E^{-4}$	49	266	$4.1E^{-4}$	66	222	$3.3E^{-4}$	66	244	$3.4E^{-4}$	39	261	$5.5E^{-4}$
19 50 oe	15	138	$7.1E^{-4}$	58	261	$3.7E^{-4}$	72	225	$3.5E^{-4}$	66	333	$3.7E^{-4}$	66	295	$4.3E^{-4}$

Note: I = inclination; D = relative declination, in degrees; and J = intensity in Gauss or emu/cc for 11 basalt specimens. In the numbers expressing J, E refers to the order of magnitude. NRM1, NRM2 = Natural remanent magnetization of specimens when first received from DSDP (NRM1) and several months later when laboratory testing began (NRM2). 25-800 oe = Results of stepwise demagnetization in 25-800 oe peak AF. 1-500 hr = Results during the VRM test, with measurements conducted at logarithmic intervals up to 500 hr from the time of AF demagnetization at 800 oe. 25-50 oe = Results of AF demagnetization following the VRM test.

TABLE 2
Summary of Progressive Alternating-Field Demagnetization and Viscous Remanent Magnetization Results Given in Table 1

Sample (Interval in cm)	MDF (oe)	Directional Stability	S_W (10^{-3} Gauss)	S_W/J_{NRM2} (%)
Hole 319A				
3-1, 50-53	480	Very poor	0.0056	2
3-2, 104-107	350	Moderate	0.014	2
3-3, 14-17	230	Smoothly varying	0.063	3
3-3, 119-122	140	Very poor	0.25	31
3-4, 96-99	140	Very poor	0.15	20
3-5, 44-47	50?	Mod. above 100 oe	0.0098	2
Site 321				
14-1, 99-102	150	Good	0.18	2
14-1, 142-145	90	Good to 200 oe	0.14	1
14-2, 94-97	95	Mod. to 200 oe	0.15	2
14-3, 97-100	80	Good to 200 oe	0.29	3
14-4, 35-38	75	Good to 200 oe	0.19	1

Note: MDF is the median destructive field, chosen as the point where the magnetization fell below half of the previous highest value. S_W is the base-10 viscosity coefficient estimated from the westward (relative) component of VRM acquired in the earth's field of our laboratory. Values of S_W/J_{NRM2} show that the Site 321 specimens were less vulnerable to VRM than those of Hole 319A.