25. PALEOMAGNETISM OF IGNEOUS SAMPLES[1]

William Lowrie and Neil D. Opdyke, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York

ABSTRACT

Remanent magnetization measurements were made on diabase specimens from Sites 136, 137, 138 and 141. The specimens from Site 137 and one from Site 138 were too unstable magnetically to be of any paleomagnetic use. The Site 136 remanent directions were in approximate agreement with the Cretaceous field direction for that site. However, stable remanent inclinations for Site 138 and Site 141 specimens were too low to correspond to a Cretaceous field direction.

Six diabase specimens from Sites 136, 137, 138 and 141 of Leg 14 were examined for their paleomagnetic directions. The only known orientation for each specimen was the downward vertical direction. From each specimen two cylindrical specimens, A and B, were drilled. The axis of A was vertical and that of B was horizontal. The angle between the horizontal axis of sample B and a fiducial line inscribed on the top horizontal surface of sample A was measured. This enabled a comparison to be made between the directions of A and B samples from the same specimen. As the azimuth of the horizontal fiducial line on the A samples was not known, observed declinations of magnetization are otherwise arbitrary.

The intensities and directions of the remanent magnetizations of the samples were measured with a 105 Hz spinner magnetometer. The magnetic susceptibilities (k) were measured with a commercial AC bridge.

The cylindrical samples were one-half inch in diameter and slightly over an inch in length. The demagnetizing factors of samples with such length to diameter ratios are not ideal for paleomagnetic measurements. However, the sample susceptibilities were around 5×10^{-4} Gauss/Oe, which is too low for anisotropic effects related to sample shape to influence either the sample magnetization directions or the alternating field (AF) demagnetization process.

Each of the samples was subjected to stepwise partial AF demagnetization in fields up to 400 Oe, above which anhysteretic remanent effects became noticeable. The variations in intensity are shown in Figures 1, 2 and 3. Stereographic projections of the remanent directions during these progressive demagnetizations are shown in Figures 4, 5 and 6. The directions of natural remanent magnetization (NRM) and the magnetization remaining after a 100 Oe AF treatment are listed in Table 1.

The intensity of saturation isothermal remanent magnetization (SIRM) and the remanent coercivity (H_{cr}) of SIRM were measured, and the alternating field required to reduce the NRM to half of its initial intensity was read off the demagnetizing curves. These median destructive fields (m.d.f.) and the values of SIRM and H_{cr} are also listed in Table 1.

At Sites 136, 137 and 138 the identification of fossils in the overlying sediments together with the local age of the oceanic floor inferred from sea-floor spreading suggest that the specimens may be Cretaceous. A Cretaceous pole position for the African continent (Gough and Opdyke, 1963) was used to calculate the inclination of the Cretaceous field at the sites. These inclinations and the inclinations of the present axial dipole field are also listed in Table 1.

The Core 137-7 samples yielded unreliable data. Although the intensity variations of the A and B specimens were almost identical in demagnetizing fields higher than 50 Oe (Figure 1), the directions were very unstable (Figure 4). The A specimen had a constant direction between 75 and 200 Oe. However, the direction of the B specimen continued to vary throughout the demagnetization.

Similarly, both A and B samples from Core 138-7 had identical demagnetization curves in AF fields above 75 Oe (Figure 2), and both A and B samples showed great directional variability during demagnetization (Figure 5).

Our inability to define for these specimens a stable direction is due to the low coercivity of the NRM. They were eliminated from further paleomagnetic considerations. Each of the other samples had an apparently stable direction of magnetization whose inclination was approximately the same in the A and B samples.

At Site 136 the inclinations are fairly close to what might be expected for a Cretaceous field inclination. However, at Sites 138 and 141 the observed inclinations are much lower than expected. At Site 141 the material comes from an apparently diapiric structure. If this is younger than the surrounding basement, its direction should be closer to the present axial field direction. At each of these sites the present axial field inclination is less than the Cretaceous inclination and the observed inclinations are even less.

Several explanations might be offered for the discrepancy between the observed inclinations and expected values. For example, important secondary components of magnetization may be present, or the true age of the diabase may be much older than the assumed age. At the present stage it is not possible to offer a satisfactory explanation.

REFERENCES

Gough, D. I. and N. D. Opdyke. 1963. The paleomagnetism of the Lupata alkaline volcanics, *Geophy. J.* **7**, 457.

[1]Lamont-Doherty Geological Observatory of Columbia University, New York, Contribution No. 1730.

TABLE 1
DSDP 2 Leg 14 Summary of Results

								Magnetization Inclination		Magnetization Intensity (10^{-3}G)		NRM				
Site	Core	Section	Specimen	Latitude (N)	Longitude (W)	Axial Dipole Inclination	Cretaceous Field Inclination	NRM	After 100 Oe.	NRM	SIRM	SIRM %	k (10^{-4})	Q_n	H_{cr} (Oe)	m.d.f. (Oe)
136	9	1	2A	34.2	16.3	54	52	57.1	44.7	11.1	366	3.0	6.83	16.3	76	39
			B					24.4	38.8	11.3	400	2.8	6.32	17.9	79	43
137	7	1	2A	25.9	27.1	44	50	50.5	19.6	3.68	155	2.4	5.60	6.6	91	41
			B					40.6	0.3	6.34	151	4.2	5.63	11.3	84	24
138	7	1	5A	25.9	25.6	44	50	41.8	26.1	4.91	334	1.5	5.96	8.2	136	40
			B					7.6	18.9	2.94	283	1.0	5.44	5.4	156	109
138	7	1	14A	25.9	25.6	44	50	32.2	39.0	6.09	255	2.4	5.97	10.2	89	22
			B					20.2	38.3	1.42	284	0.5	6.44	2.2	106	32
141	10	1	28A	19.4	24.0	35	41	28.2	16.9	4.22	290	1.4	3.39	12.5	156	95
			B					10.2	12.6	4.50	268	1.6	3.29	13.7	163	109
141	10	1	130A	19.4	24.0	35	41	24.4	16.8	4.15	320	1.3	2.71	15.3	203	152
			B					1.5	19.5	3.75	315	1.2	2.88	13.0	197	138

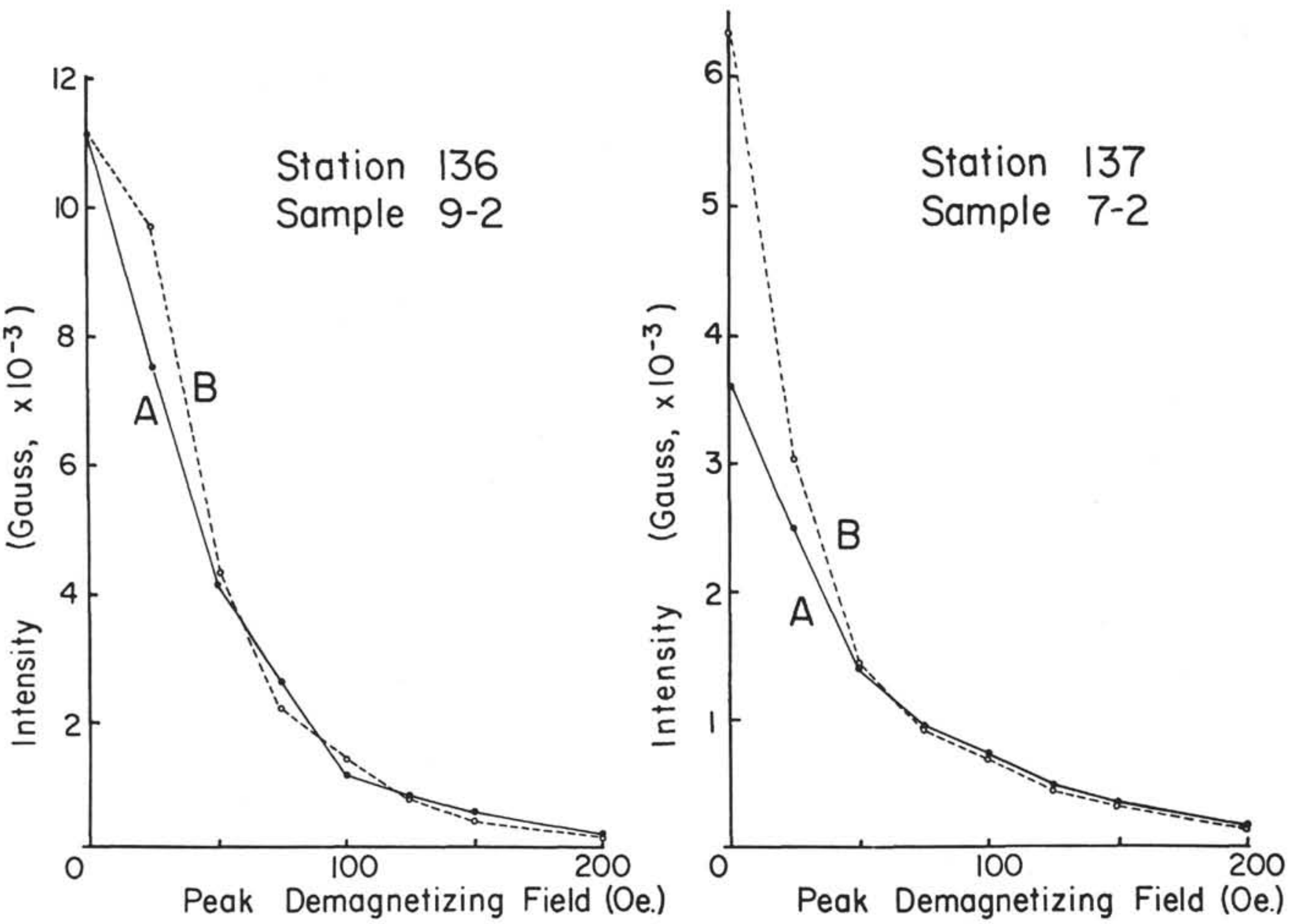

Figure 1. *Variation of intensity of remanence during AF demagnetization of samples from Sites 136 and 137.*

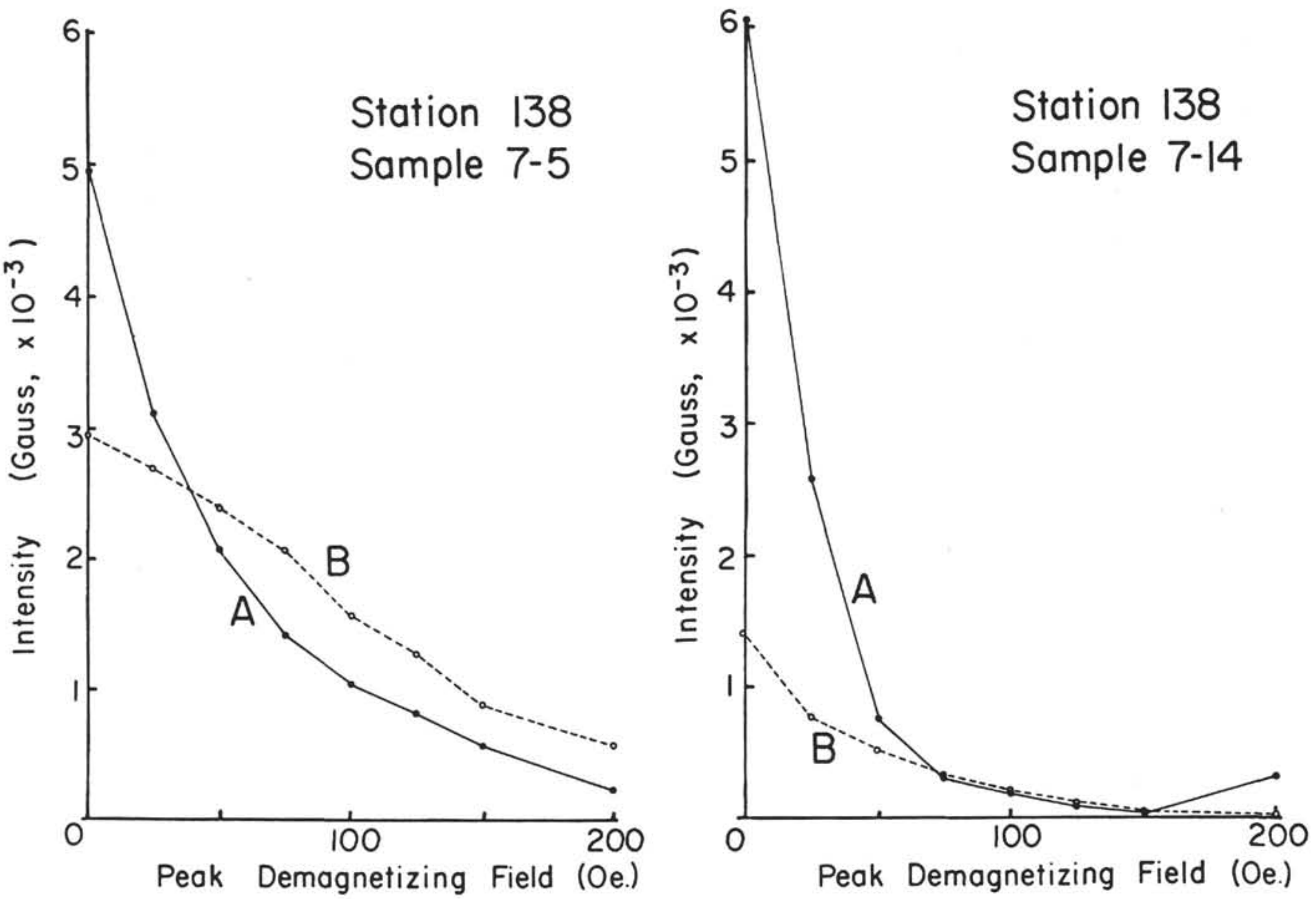

Figure 2. *Variation of intensity of remanence during AF demagnetization of samples from Site 138.*

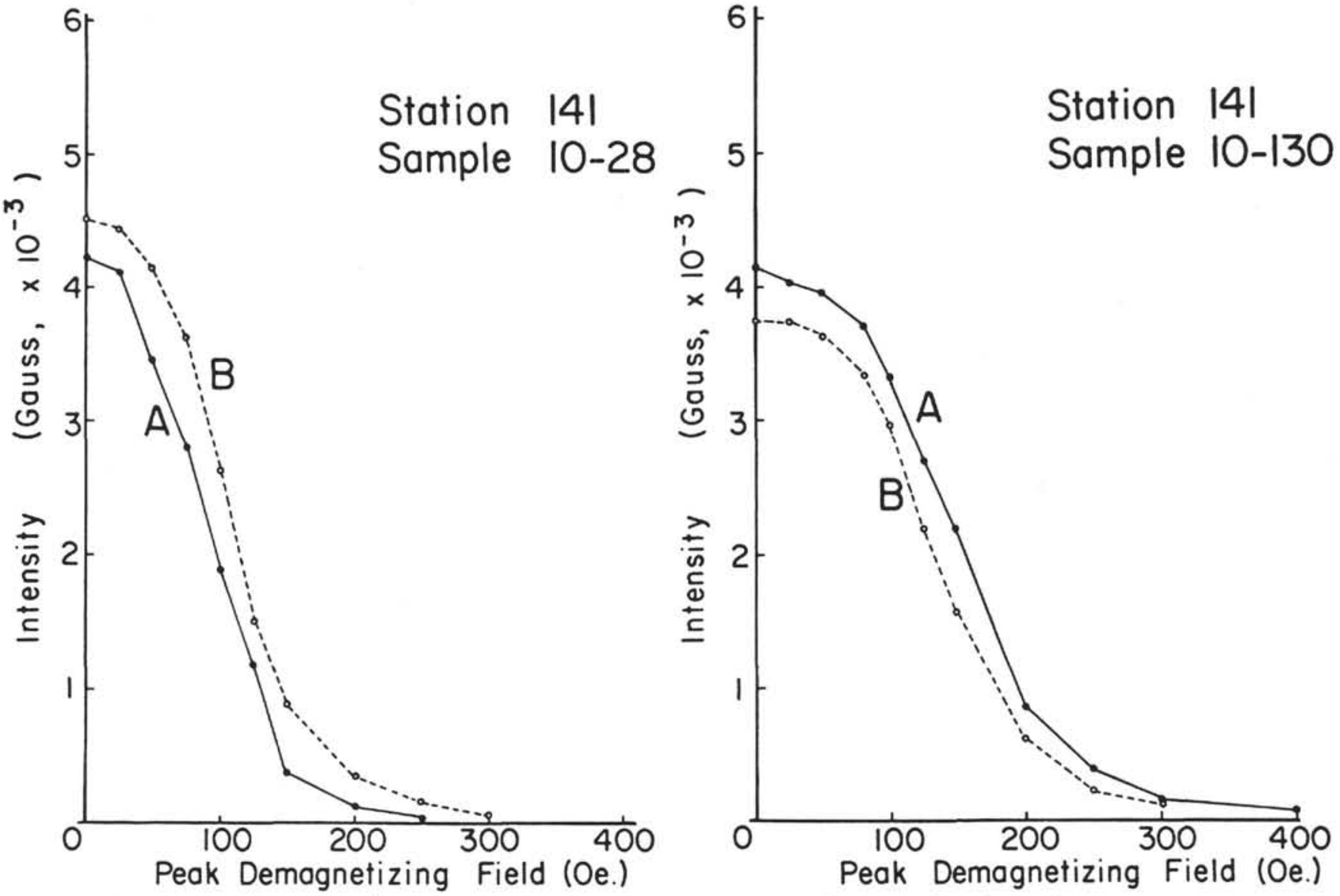

Figure 3. *Variation of intensity of remanence during AF demagnetization of samples from Site 141.*

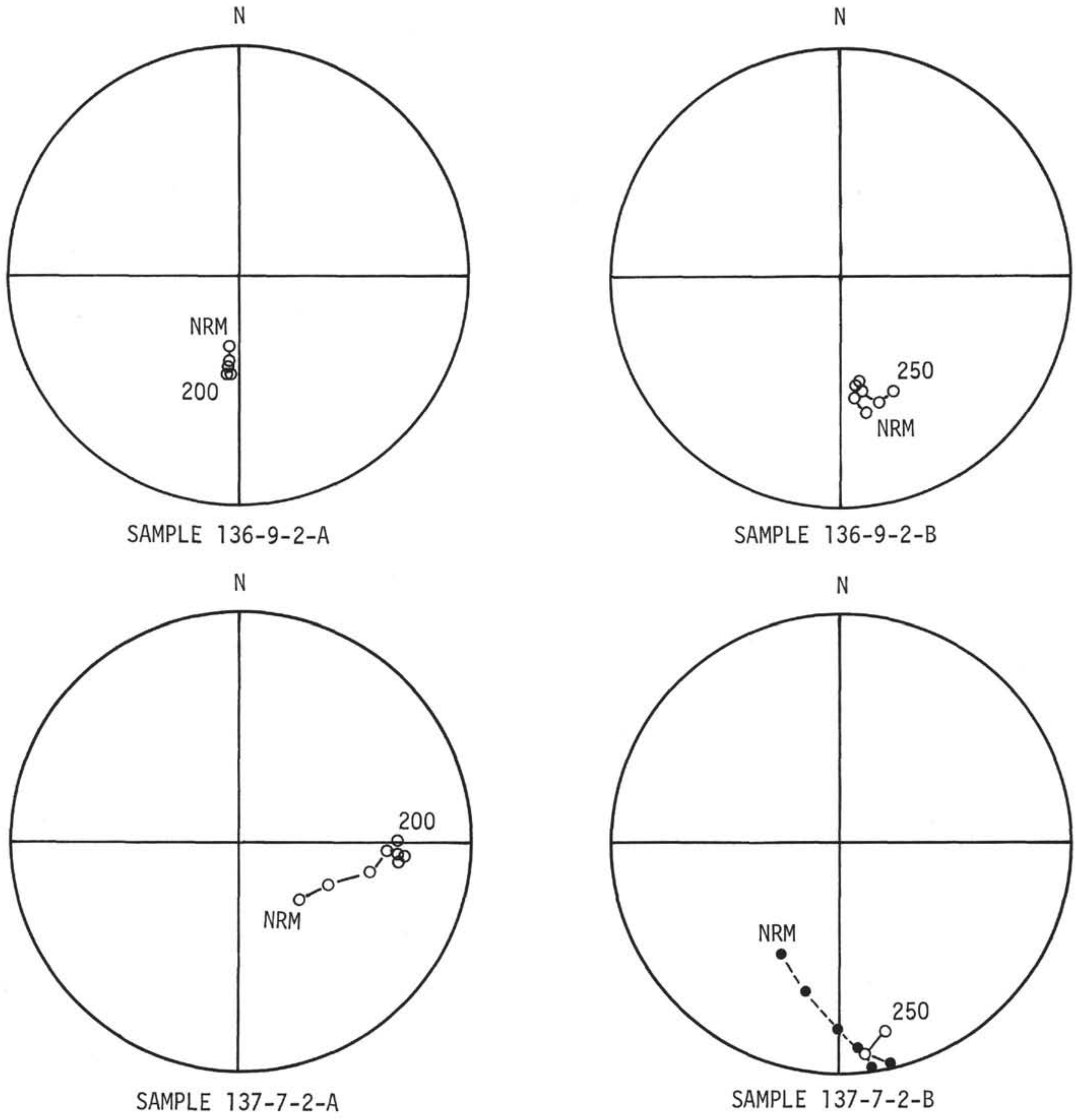

Figure 4. *Variation of direction of remanence during AF demagnetization of samples from Sites 136 and 137.*

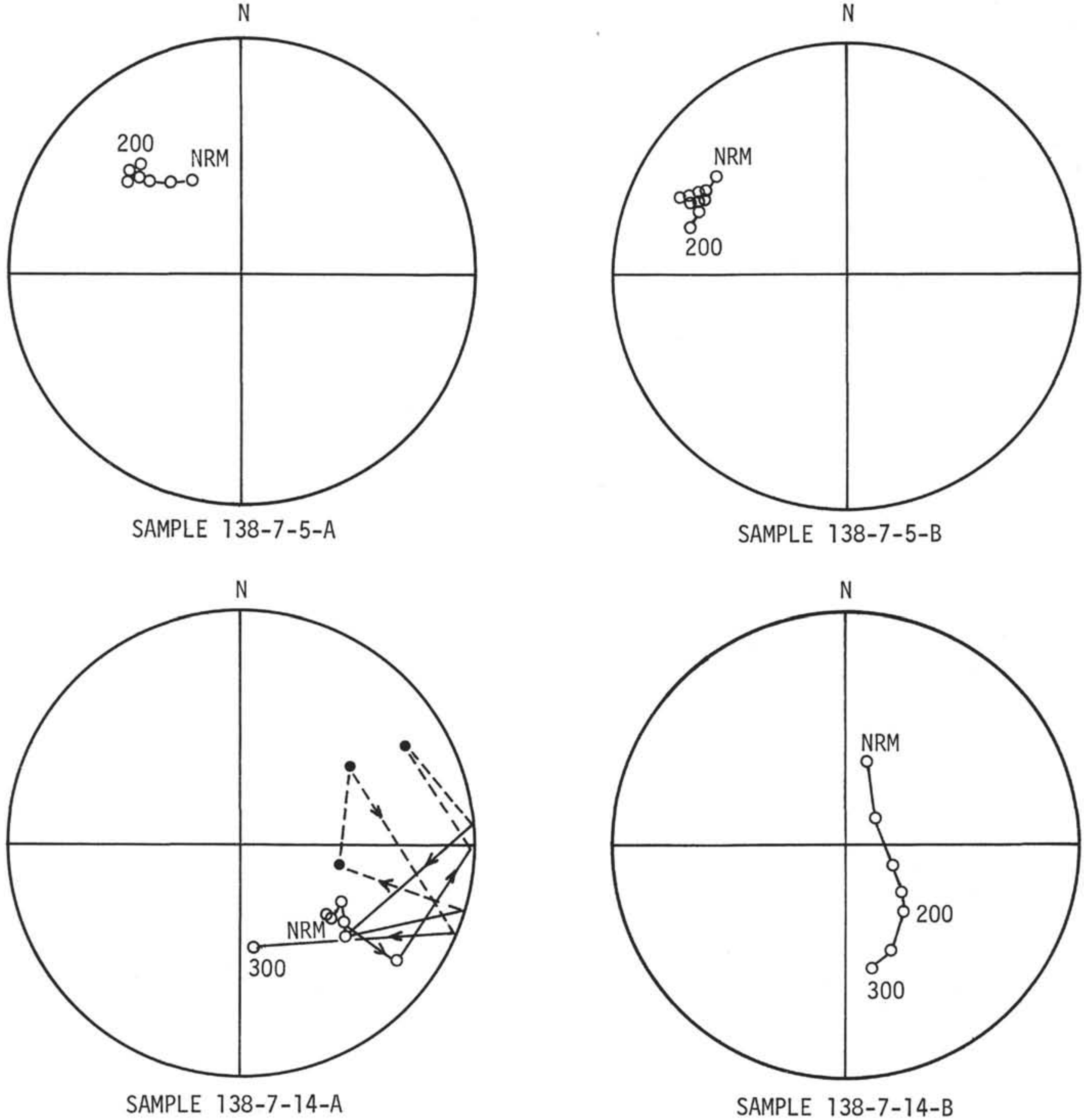

Figure 5. *Variation of direction of remanence during AF demagnetization of samples from Site 138.*

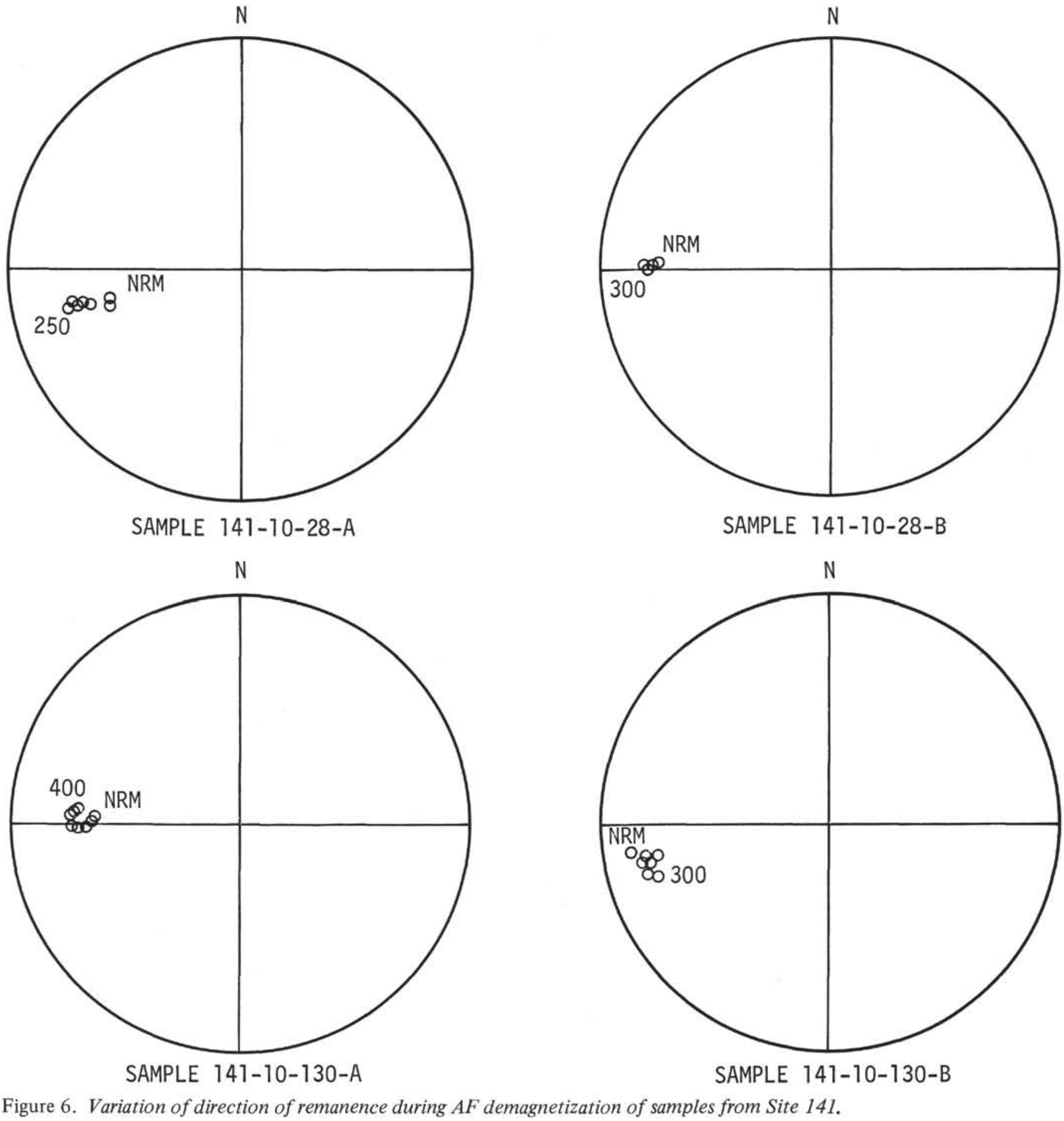

Figure 6. *Variation of direction of remanence during AF demagnetization of samples from Site 141.*