43. MAGNETOSTRATIGRAPHY OF MIDDLE–UPPER MIOCENE AND UPPER MIDDLE EOCENE SECTIONS IN HOLE 512[1]

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ABSTRACT

The polarity of the remanent magnetization of hydraulically piston-cored sediments from Hole 512 has been determined. The polarity reversal patterns are correlated to the magnetic reversal time scale, using the initial onboard biostratigraphic reports as a guide for correlation. The upper (middle–upper Miocene) section from 1 to 20 meters sub-bottom depth is correlated to early Chron 10 to late Chron 11 (11.3–11.8 Ma). The lower section (middle Eocene) from 20 to 76 meters sub-bottom depth is correlated to the time scale from Magnetic Anomaly 18 to slightly younger than Magnetic Anomaly 20 (40.9–43.7 Ma). Sedimentation rates for the upper and lower sections are 1.0 cm/1000 y. and 1.7 cm/1000 y., respectively.

INTRODUCTION

The application of magnetostratigraphy to the dating of deep sea sediments is now a routine process in the examination of standard piston cores. When combined with even limited biostratigraphic data, an accurate correlation to an established magnetostratigraphic time scale is usually possible, since the pattern of polarity reversals is often unique within some intervals of the time scale.

The use of the Hydraulic Piston Corer on the *Glomar Challenger* has opened a new dimension in magnetostratigraphy of deep sea sediments, because old sections now may be sampled with undisturbed cores suitable for paleomagnetic investigation (Kent and Spariosu, 1980; Tauxe et al., 1980). This new dimension will provide a valuable method both for dating sedimentary sections and for establishing ages for biostratigraphic events (e.g., Berggren, 1972; Hardenbol and Berggren, 1978) which can be applied to rotary-drilled cores or other sediments where magnetostratigraphy cannot be applied. The magnetostratigraphy of sediments from Hole 512 provides ages for sediments recovered at the site and allows dating of siliceous microfossil events which may be found in older rotary-drilled DSDP cores from the Southern Ocean (Ciesielski, this volume; Gombos, this volume; Shaw and Ciesielski, this volume).

METHODS

Plastic boxes (8 cm^3) were pressed into the split face of the core while maintaining a vertical orientation. A sampling interval of approximately 25 cm was employed in Cores 1 through 5 in the interval 1–19 meters sub-bottom depth, and an interval of 50 cm was used in Cores 6 through 10 from 20–77 meters. Sections of highly disturbed sediment were avoided. Unfortunately, several important cores (e.g., 4-1) were heavily sampled, and the interval was adjusted accordingly.

Six pilot samples were chosen to determine the optimum alternating field (AF) demagnetization level (Fig. 1) to be applied to the remaining samples in order to determine the remanent magnetization (RM). The intensity of natural remanent magnetization was determined for each sample using a Schonstedt SSM-1A spinner magnetometer. Average J_0 for the core was 0.2×10^{-6} G total moment, with a range from 0.1 to 0.6×10^{-6}. The J_0 was used to normalize the intensity of the remanent magnetization (J_n) at AF demagnetization field strengths (H_c) of 50, 100, 150, and 200 Oe (Fig. 1) using a three-axis tumbler AF demagnetizer. An optimum partial AF demagnetization field of 100 Oe was chosen, since the intensity of the remanent magnetization reached a nearly steady value (Fig. 1) and inclination angles reached maximum values at that field strength.

The inclination of the remanent magnetization after 100-Oe demagnetization was plotted with depth in core for both sections examined in Hole 512 (Figs. 2 and 3). Inclination values less than $\pm 5°$ were not used to assign paleomagnetic polarity, since the low values are anomalous for a high latitude site. The polarity of the remaining samples was assigned in the standard convention of negative inclination for normal polarity and positive for reversed polarity in the southern hemisphere. Polarity intervals consisting of one point were not used for correlation.

RESULTS

The average inclination value in the upper section (Cores 1–5) is 45° in both the normal and reversed sections. The inclination values are too shallow for the latitude of the site, but since both normal and reversed sections have the same magnitude inclination, no magnetic overprint is common to the whole core. Therefore, the RM at 100 Oe is considered to be the original detrital magnetization. The shallow inclination values may be due to an inclination error at deposition, to compression effect, or to movement poleward since acquiring the magnetization.

The average inclination value in the lower section (Cores 6–19) is 80° in both the normal and reversed sections. The inclination values are appropriate for the high latitude of the site.

The paleomagnetic polarity of sediment from Cores 1 through 5 was correlated to the late–middle Miocene section of the magnetostratigraphic time scale (Fig. 2) based on the foraminiferal biostratigraphy (Basov and Krasheninnikov, this volume). The late/middle Miocene boundary was chosen on the basis of the first appearance of *Globorotalia acostaensis* between Sections 512-1,CC and 512-2,CC. Since that foraminiferal datum has been inferred to be approximately 10.5 Ma (Berggren, 1972; Opdyke, et al., 1974), the correlation to the mag-

[1] Ludwig, W. J., Krasheninnikov, V. A., et al., *Init. Repts. DSDP*, 71: Washington (U.S. Govt. Printing Office).

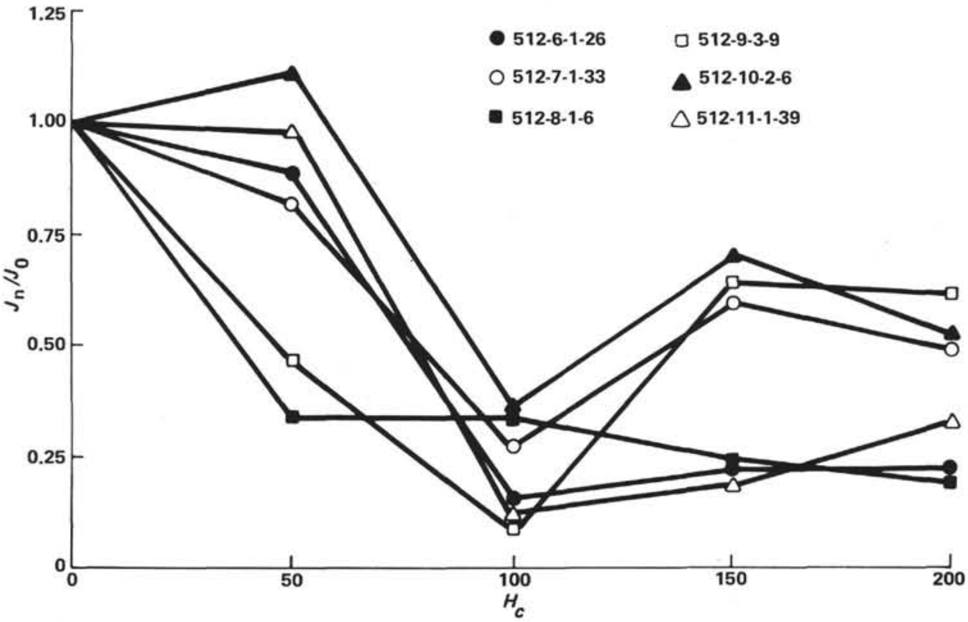

Figure 1. The ratio of remanent magnetic intensity (J_n) and natural remanent magnetic intensity (J_0) is plotted at alternating magnetic field demagnetization steps (H_c) for several pilot samples. A partial demagnetization field of 100 Oe was chosen for demagnetization of the remaining samples, since the remanent magnetization changed very little at higher fields.

netostratigraphic time scale was attempted for the time encompassed by Magnetic Chrons 10 through 12 (Fig. 2). The correlation is based on the one datum and pattern recognition of the polarity reversals in the period from 10–12 Ma (Opdyke et al., 1974; LaBrecque, et al., 1977).

The paleomagnetic polarity of sediment from Cores 6 through 19 was correlated to the middle Eocene section of the magnetostratigraphic time scale (Fig. 3), based on foraminiferal biostratigraphy (Basov and Krasheninnikov, this volume). Therefore the pattern of polarity reversals was compared to the magnetic anomaly reversal pattern for Anomalies 16–20 (LaBrecque et al., 1977; Ness et al., 1980).

DISCUSSION

Since an unconformity separates middle-upper Miocene sediment from middle Eocene sediment at Site 512, the two sections are treated separately. This was further necessitated since correlations to different magnetostratigraphic time scales was required, owing to the age of the two sections.

Middle-Upper Miocene Sediment

The major reversal boundary near the top of Core 2, Section 2 is correlated to the Chron 10/11 boundary (Fig. 2) of the sedimentary magnetostratigraphic time scale (Opdyke et al., 1974) and the end of Anomaly 5A of the magnetic anomaly time scale (LaBrecque et al., 1977). The correlation was chosen on the basis of the first appearance of *G. acostaensis* between 1,CC and 2,CC (Krasheninnikov, this volume), which has been dated as late Chron 11 by extrapolation of the foraminiferal datum onto the polarity time scale, using a siliceous biostratigraphy as the stratigraphic control (Opdyke et al., 1974). The long reversed section from the top of Core 3, Section 3 to the base of Core 5, Section 1 is correlated to the reversed interval within Chron 11 (Anomaly 5A). The short duration (single sample) normal polarity intervals within Chron 11 are not recognized in the late Chron 11 sedimentary time scale (Opdyke et al., 1974) and the early Chron 11 equivalent of the magnetic anomaly time scale (LaBrecque et al., 1977; Ness et al., 1980). The normally magnetized sediment at the base of the section is correlated to the lower normal portion of Chron 11 (Fig. 2).

The correlation of major reversal boundaries in the middle-upper Miocene section in Hole 512 with the magnetostratigraphic time scale assumes no disconformities in the recovered sedimentary section. The age of the sediments, therefore, is 11.3 to 11.8 m.y. and the sedimentation rate calculated on the basis of the three identified time horizons is 3.0 cm/1000 y. The magnetostratigraphically assigned ages for the upper-middle Miocene section of Hole 512 may be used to date important biostratigraphic horizons (Basov and Krasheninnikov, this volume; Gombos, this volume) which can be correlated to DSDP rotary-drilled sites where paleomagnetic analysis is not possible.

Middle Eocene Sediment

The long predominantly normal polarity zone from Core 6, Section 1 to Core 8, Section 1 is correlated to the older normal polarity section of Anomaly 18 (Fig. 3) of the magnetic anomaly time scale (Ness, et al., 1980). The shorter predominantly normal polarity zone in Core 15 is correlated to Anomaly 19. The correlation is based on the foraminiferal biostratigraphy, which indicates a

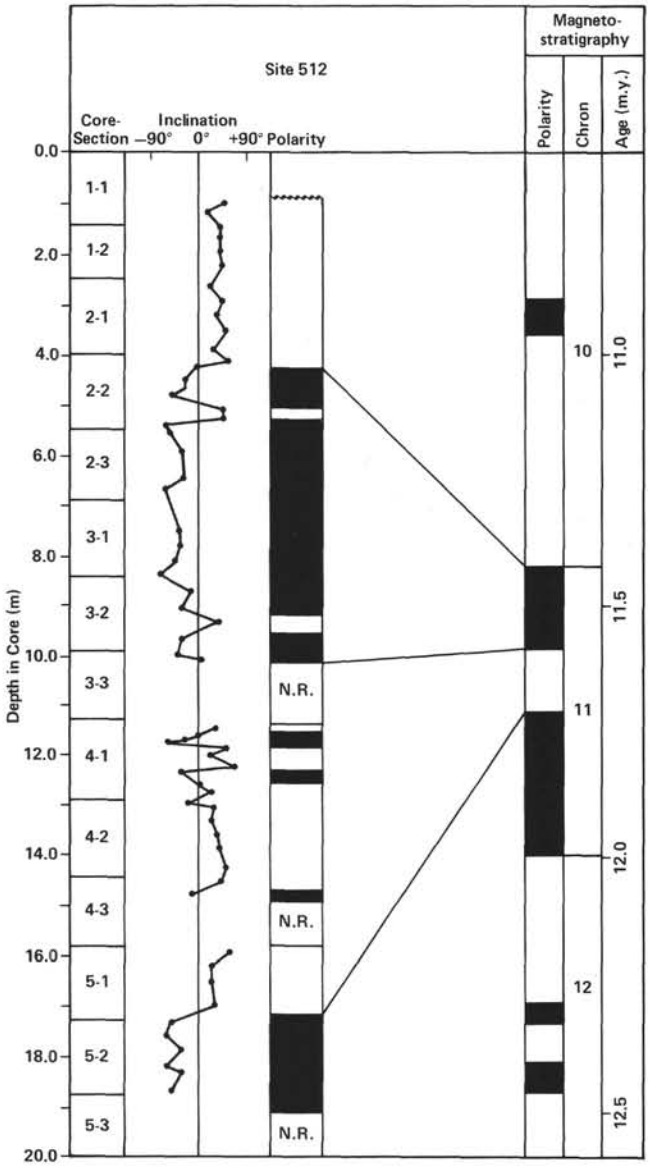

Figure 2. The polarity of the inclination of remanent magnetization after 100-Oe alternating field partial demagnetization is compared to the magnetic anomaly (LaBrecque et al., 1977; Ness et al., 1980) time scale. Correlation to the polarity time scale at the Chron 10/11 boundary was accomplished by the presence of the first appearance of *Globorotalia acostaensis* between 1,CC and 2,CC (Basov and Krasheninnikov, this volume). The *G. acostaensis* datum marks the middle/late Miocene boundary at approximately 11.4 Ma. (Polarity time scale ages are from Ness et al., 1980. N.R. = no recovery or disturbed.)

middle Eocene age (Basov and Krasheninnikov, this volume). Since no other portion of the middle Eocene magnetostratigraphy has a pattern consistent with the polarity in Hole 512, the correlation is made on that basis. Correlation to Anomalies 20 and 21 is consistent with the polarity patterns but is too old to fit the biostratigraphic age.

The correlation of major reversal boundaries in the middle Eocene section of Hole 512 with the magnetic anomaly time scale (Ness, et al., 1980) assumes no disconformities in the recovered sedimentary section. The age of the sediments, therefore, is 40.9 to approximately

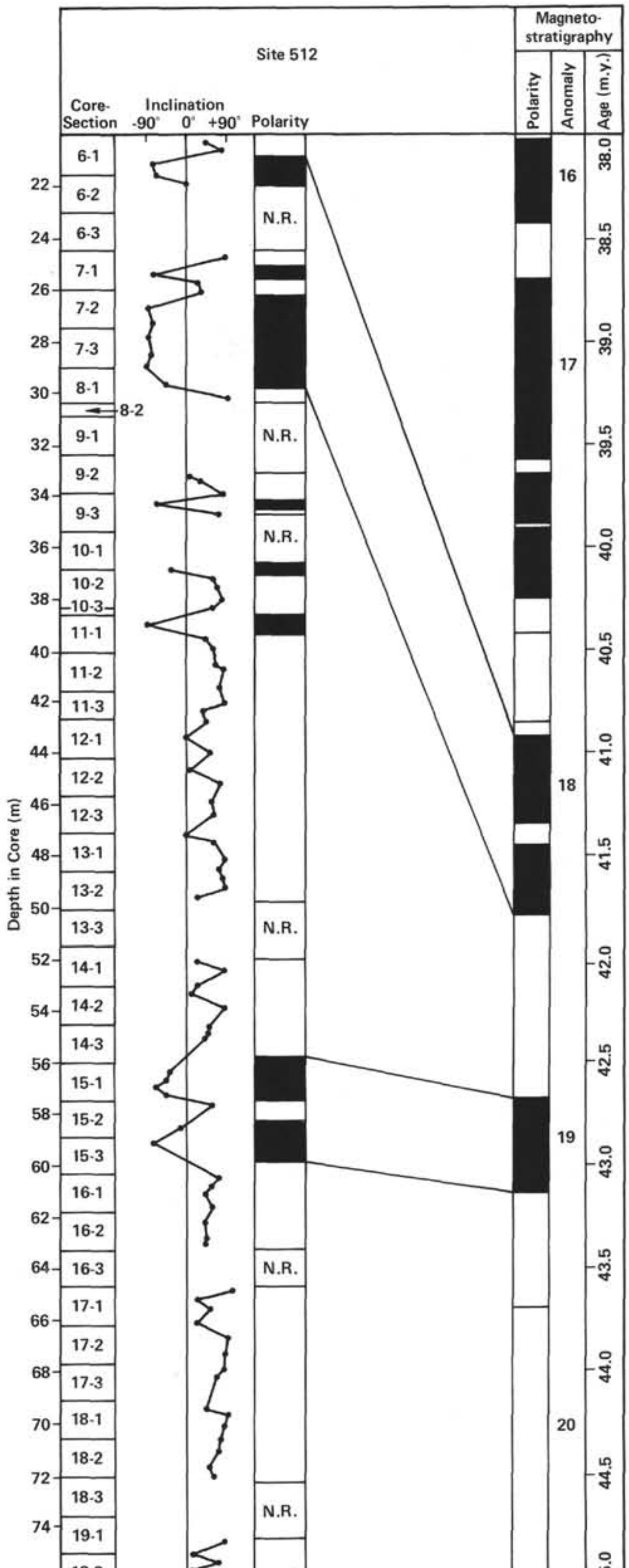

Figure 3. The polarity of the inclination of remanent magnetization after 100-Oe alternating field partial demagnetization is compared to the magnetic anomaly time scale (Ness et al., 1980). Correlation to Anomalies 18 and 19 was accomplished by pattern recognition within a middle Eocene section (Basov and Krasheninnikov, this volume). (Polarity time scale ages are from Ness et al., 1980. N.R. = no recovery or disturbed.)

43.7 m.y., and the average sedimentation rate for the section is 1.7 cm/1000 y. The magnetostratigraphically assigned ages for the middle Eocene section may be used to date important biostratigraphic horizons (Shaw and Ciesielski, this volume; Basov and Krasheninnikov, this volume) which can be correlated to DSDP rotary-drilled sites where paleomagnetic analysis is impossible.

CONCLUSIONS

The magnetostratigraphy of the sediments from Hole 512 was correlated to the magnetostratigraphic time scale, using foraminiferal biostratigraphy to establish the stratigraphic interval under study. Sediments from the interval 1 to 20 meter sub-bottom depth were assigned an early Chron 10 to late Chron 11 age (11.3–11.8 Ma). Sediments from 20 to 76 meter sub-bottom depth are correlated to the magnetic anomaly time scale from Anomaly 18 to slightly younger than Anomaly 20 (40.9–43.7 Ma). Sedimentation rate for the younger section is 3.0 cm/1000 y. and for the older section is 1.7 cm/1000 y.

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