

Relative paleointensity record of the geomagnetic field during the past 800 kyr from the equatorial Indian Ocean

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Recent progresses of paleomagnetic studies on sediments have proposed long-term (10 to 100 kyr) secular changes of paleointensity (e.g., Guyodo and Valet, 1999). Furthermore, an intriguing correlation between inclination and paleointensity variations was reported from the sediments in the western equatorial Pacific (Yamazaki and Oda, 2002; 2004). To explain this, they have proposed a model connecting dipole-field intensity fluctuations and an inclination anomaly caused by a persistent quadrupole component. In order to test this model, we compare on the relation between inclination and intensity from the regions where the inclination anomalies are large and small.

Three piston cores (MR0503-PC1, 2, and 3) were taken from the Ninety-east ridge, the equatorial Indian Ocean, during the R/V Mirai MR0503 cruise. The lengths of these cores are 4.1, 6.0, and 10.2 m, respectively, and water depths range from 3100 to 4400 m. MR0503-PC1 and PC2 are composed of nannofossil carbonate ooze, foraminifera and nannofossil calcareous ooze, and clay rich sediments. MR0503-PC3 is dominated by clay to silty clay with minor amount of nannofossil. Three volcanic ash layers are found from these cores, which are certainly originated from the Toba caldera in the Sumatra Island. The volcanic ash layer found at the uppermost part of each core (1.0 - 1.3 m from the top) is most likely to be correlated to the youngest Toba eruption (Ninkovich et al., 1978). Other two volcanic ash layers, found from deeper part of MR0503-PC3, are probably correlated with volcanic ash C and D found at ODP Site 758 (Dehn et al., 1991).

Based on the constraint of stratigraphic levels of these volcanic ash layers, oxygen isotope record between MR0503-PC1 and ODP Site758, and magnetic susceptibility records between MR0503-PC2, 3 and ODP Site758 are correlated. This correlation provides age models for MR0503-PC1-PC3 based on the oxygen isotope age of ODP Site 758 (Chen et al., 1995). This age models give the ages of the bottom of MR0503-PC1, PC2, and PC3 core are 270, 320, and 790 ka, respectively.

Rock magnetic experiments for all cores suggest that the magnetic characteristics of these sediments of this core are mostly uniform except for volcanic ash layers and a depth interval from 250 to 320 cm of MR0503-PC2. Excluding these horizons, a relative paleointensity records are reconstructed using IRM as normalizers. The reconstructed relative paleointensity records for these cores generally agree with the Sint-800 paleointensity stack (Guyodo and Valet, 1999).

Based on the time-averaged field (TAF) models for the last 5 Myr (Johnson and Constable, 1997), the east equatorial Indian Ocean as well as the west equatorial Pacific Ocean were thought to belong to a high inclination anomaly area. However, significant inclination anomaly is not observed from MR0503-PC1-PC3 cores. On the other hand, a significant large inclination anomaly was reported from the Ontong-Java Plateau (Yamazaki, 2002), where inclination anomaly was thought to be relatively small. These suggest that the area of large inclination may extend to the central equatorial Pacific.

In order to test the model of Yamazaki and Oda (2002), we compare the inclination and intensity data from the east equatorial Indian Ocean and the west equatorial Pacific Ocean, which correspond to the areas small and large inclination anomaly, respectively. In the large inclination anomaly area, the values of inclination tend to be more negative when intensity is lower. On the other hand, there is no clear relation between inclination and intensity in the low inclination anomaly area. These results are consistent with the model of Yamazaki and Oda (2002).