Relative paleointensity record of the geomagnetic field during the past 750 kyr from the equatorial Indian Ocean

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Recent progresses of paleomagnetic study for sediments have proposed long-term (10 to 100 kyr) secular changes of paleointensity (e.g., Guyodo and Valet, 1999; Yamazaki and Oda, 2005). 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, it is important to obtain additional data from the regions where inclination anomaly (delta-I) is large. We hence targeted the equatorial Indian Ocean, where large delta-I is estimated from time-averaged field (TAF) models for the last 5 Myr (e.g., Hatakeyama and Kono, 2002).

Three piston cores (MR0503-PC1, 2, and 3) were taken from the Ninety-east ridge, the equatorial Indian Ocean, during the R/V Mirai cruse MR0503. 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 MR0503-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 at Sumatra Island. The volcanic ash layer found at the uppermost port of each core (1.0 - 1.4 m from the top) is most likely to be correlated to the youngest Toba eruption, which is dated as 73-75 ka (Ninkovich et al.,1978; Chesner et al., 1991). 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, magnetic susceptibility records of MR0503-PC1˜3 and ODP Site758 are correlated. This correlation provides a primary age model for MR0503-PC1˜3 using the oxygen isotope age of ODP Site 758 by Chen et al. (1995). This age model suggests that the ages of the bottom of MR0503-PC1, PC2, and PC3 are 260, 440, and 800 ka, respectively.

Preliminary paleomagnetic and rock magnetic experiments for MR0503-PC1 suggest that the magnetic characteristics of sediments of this core are mostly uniform except for volcanic ash layers and their neighboring sediments. Excluding these horizons, a relative paleointensity record is reconstructed using ARM and IRM as normalizers. Although both relative paleointensity records show almost similar behavior, the relative paleointensity normalized by ARM shows a correlation with magnetic susceptibility, which is a proxy of magnetic concentration. This may suggest that IRM is better suited for normalization of remanent intensity for the sediments of MR0503-PC1 than ARM. The reconstructed relative paleointensity record for 260 ka agrees with the Sint-800 paleointensity stack (Guyodo and Valet, 1999). Although further rock and paleomagnetic investigations are needed, these results suggest that MR0503-PC1˜3 are suitable for a relative paleointensity study.