100,000-year periodicity in relative paleointensity record from the equatorial Indian Ocean

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Recent progress of paleomagnetic studies on sediments have revealed long-term (10 to 100 kyr) secular changes of paleointensity (e.g., Guyodo and Valet, 1999). Furthermore, a hypothesis that the orbital eccentricity (100 kyr) modulate the geomagnetic field intensity has been proposed from sediments in the North Pacific (Yamazaki, 1999) and in the equatorial Pacific (Yamazaki and Oda, 2005). In order to examine this hypothesis, further high quality paleointensity records from different sedimentary regimes are needed. Hence, we present relative paleointensity records during the Brunhes Chron from sedimentary cores form the equatorial Indian Ocean and discuss the possibility of the orbital modulation on the geomagnetic field.

Piston cores (MR0503-PC1, PC2 and PC3) 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, and water depths are 3100 and 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 - 1.3 m from the top) is most likely to be correlated to the youngest Toba eruption (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, oxygen isotope records 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˜3 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 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, relative paleointensity records are 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-PC1-3 than ARM. The reconstructed relative paleointensity records for these cores generally agree with the Sint-800 paleointensity stack (Guyodo and Valet, 1999).

Power spectrum for the relative paleointensity and its normalizer (IRM) from MR0503-PC3, and coherency between them are obtained by using REDFIT and SPECTRUM software (Schulz and Stattegger, 1997; Schulz and Mudelsee, 2002). This spectral analyses represent that a clear power at the ˜100 kyr period in the relative paleointensity record, but not for the normalizer, suggesting a possible existence of the orbital eccentricity frequency in paleointensity records during Brunhes Chron.