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Long-term changes of relative paleointensity from sediments: geomagnetic field behavior or rock magnetic artifact?

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Since the 1960s, possible correlation between geomagnetic field strength and polarity length on 10^6 years or longer time scale has been suggested, and its relation to geodynamo processes has been discussed (e.g., Cox, 1968). Paleointensity estimation using single crystal silicate indicated that the geomagnetic field was stronger during Cretaceous Superchron, when polarity reversal was inhibited in geodynamo (e.g., Tarduno et al., 2001). However, it has not yet been understood well whether such correlation exists when polarity reversals frequently occur. Tauxe and Hartl (1997) suggested a weak correlation using Oligocene sediments (ca 23-34 Ma) from DSDP Site 522. This is the only continuous paleointensity data of these ages published so far.

We have conducted a paleomagnetic study of sediment cores of Eocene and Oligocene ages taken at Sites U1331, U1332, and U1333 of IODP Exp. 320/321 "Pacific Equatorial Age Transect (PEAT)". The objective includes better understanding of long-term changes in relative paleointensity and revisiting the issue of intensity-polarity length correlation. Relative paleointensity records from individual sites showed good between-site consistency for variations of 10^4 to 10^5 year time scale, suggesting that geomagnetic field behavior was successfully recovered on these time scales. The results confirmed usefulness of relative paleointensity for high-resolution inter-core correlation, that is, paleointensity assisted chronostratigraphy. On the other hand, long-term changes (ca 10^6 years or longer) in normalized intensity showed obvious anti-correlation with ARM/SIRM, a rock magnetic proxy of magnetic grain size and/or magnetostatic interactions among magnetic grains. Furthermore, the normalized intensity showed correlation with sedimentation rates. The emergence of significant correlation between normalized intensity and ARM/SIRM and sedimentation rates is not limited to PEAT cores, but occurs also in the Oligocene South Atlantic DSDP 522 cores of Tauxe and Hartl (1997). These results indicate lithological contamination to relative paleointensity records. For reliable estimation of long-term paleointensity changes from sediments, it is imperative to understand physical mechanism of such correlation and develop a method for correction.

Keywords: paleointensity, sediment, east Pacific, IODP, Oligocene, polarity reversal