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Analysis of magnetic mineral composition of a central North Pacific sediment core and its implications to RPI estimations

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Abstract: Marine sediments contain considerable amounts and different types of magnetic mineral particles. Magnetic minerals in sediments may be statistically aligned to the direction of the ambient geomagnetic field so that sediments potentially preserve geomagnetic intensity records in the past. However, different types of magnetic minerals should preserve the remanent magnetization in different manners. And the compositional variation of magnetic mineral assemblages in marine sediments may hinder us from extracting reliable geomagnetic paleointensity records. The purpose of our research is to achieve more reliable relative paleointensity (RPI) estimations by understanding lithological contamination caused by compositional variations in marine sediments. We have made some progress regarding to this problem. Our research indicated that biogenic magnetite may possess lower RPI recording efficiency than terrigenous components in sediments taken from the Ontong-Java Plateau (OJP) in the western equatorial Pacific (Li et al., 2021, JpGU meeting). This is rather an unexpected result, contradictory to some previous studies (Ouyang et al., 2014; Chen et al., 2017). In order to achieve a more comprehensive understanding of the influence of compositional variations in sediments to RPI estimation, a sediment core taken from the central North Pacific (Core KR0310-PC1) was studied. Sedimentary environments in the central North Pacific are different from those in the western equatorial Pacific, which receive larger eolian dust inputs. The terrigenous component ought to be dominant in the central North Pacific sediments. Behaviors of different magnetic components to RPI recording can be expected to be deduced from sediments with a distinct lithological composition. RPIs were obtained by normalizing natural remanent magnetization (NRM) with both isothermal remanent magnetization (IRM) and anhysteretic remanent magnetization (ARM). The ratio of ARM susceptibility (k_{ARM}) to saturation isothermal remanent magnetization (SIRM) (k_{ARM}/SIRM) shows a downcore increasing trend which indicates an increasing proportion of biogenic to terrigenous magnetic minerals in the studied sediments. Estimations of relative proportion between biogenic and terrigenous components based on first-order reversal curve (FORC) diagrams are consistent with the increasing trend in the k_{ARM}/SIRM ratio. The results from FORC diagrams also indicate that the RPI records of high coercivity intervals are carried more by biogenic magnetites while the RPI records of low coercivity intervals are carried more by terrigenous magnetic minerals. On the other hand, NRM-IRM demagnetization diagrams show curvature, which indicates that the coercivity distributions of NRM and IRM are different. RPI recording efficiencies of different components were then assessed by recalculating the slopes in NRM-IRM demagnetization diagrams in corresponding coercivity intervals. The result indicates that biogenic magnetite possesses a higher RPI recording efficiency than the terrigenous components. This is the opposite of our previous conclusion from the western equatorial Pacific sediments. We speculate that different concentrations of silicate-hosted magnetic inclusions due to different sedimentary environments may be a possible reason for the contradiction. The contribution of the inclusions to NRM is minor in the western equatorial Pacific sediments (Li et al., 2021, JpGU meeting), while that in the central North Pacific sediments may be significant. Further studies on silicate-hosted magnetic inclusions with the help of chemical extraction experiment should help us to better understand its behavior in recording remanent magnetization in sediments.

Keywords: geomagnetic paleointensity, silicate-hosted magnetic mineral inclusion, biogenic magnetite, central North Pacific