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Comparison between the temporal spectrums of geomagnetic paleointensity and paleomagnetic direction: A case study

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Continuous estimates of relative geomagnetic field intensity from sediments have been the essential data for determining the geomagnetic temporal spectrum. The geomagnetic spectrum is believed to reflect the dynamics in the outer core, and it may change through geological time in accordance with the deep earth evolution. However, it would be difficult to obtain high quality continuous paleointensity data for geological past. Paleomagnetic direction can be obtained with higher accuracy. Directional data were used for spectral analysis in early days (e.g., Barton and Lowes, 1982). Apparently, the spectrums obtained from the directional data are similar to that from relative paleointensity. To check the practical resolution of directional spectrum, we examine the relationship between paleointensity and directional (inclination) spectrums using existing data from marine sediments. Records from low sedimentation rate sites revealed remarkable similarity between the directional and intensity spectrums at frequencies from 10^{-3} to 10^{-1} [1/kyr]. Both spectrums resolve a corner frequency at ca. 200 [1/kyr] observed in the SINT-2000 global paleointensity stack. Records from some high sedimentation rate sites (e.g., ODP Leg 162) also revealed the similarity at frequencies below 10^{-1} [1/kyr]; however, at higher frequencies, the power of directional variation becomes increasingly lower compared to the paleointensity variation. This disagreement may reflect different behavior between dipole and non-dipole components at high frequencies, lower accuracy of inclination data due to the lack of stacking, or site-specific systematic inclination error. In any case, our results indicate that paleomagnetic directional data may be used to reconstruct ancient geomagnetic spectrum at least below 10^{-1} [1/kyr], given high resolution stratigraphy and rapid demagnetization techniques are available. In the presentation, we will also introduce the preliminary development of continuous thermal demagnetizer for this purpose.

Keywords: paleomagnetism, spectral analysis, core, paleointensity