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Paleomagnetic Inclination Shallowing in Deep-Sea Sediments

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Þórður Arason
College of Oceanography, Oregon State University, Corvallis, Oregon, U.S.A.

Abstract

In this thesis anomalous downcore shallowing of paleomagnetic inclinations is interpreted to be caused by sediment compaction. Thus, compaction-induced inclination shallowing may influence tectonic reconstructions that are based on inclinations from deep-sea sediment cores.

Progressive downcore shallowing of the remanent inclination was observed in a 120-m section of Plio- Pleistocene sediments at Deep Sea Drilling Project (DSDP) site 578 in the northwest Pacific. Near the top of the section the average inclination corresponds to the expected geocentric axial dipole value of 53° but shallows downcore by about 6° to 8°. In sediments spanning the same time interval of neighboring site 576, no inclination shallowing was observed. This second site has considerably lower sedimentation rates, and the Plio-Pleistocene is represented by a 26-m sedimentary section. The inclination shallowing at site 578 was correlated to a downhole decrease in porosity, and these results are interpreted to suggest that both the downhole inclination shallowing and decrease of porosity in site 578 were caused by sediment compaction.

Microscopic models demonstrate that sediment compaction may lead to inclination shallowing of the magnetic remanence. Furthermore, it is shown that inherent initial within-sample dispersion of the magnetic moments will transform any form of microscopic mechanism to an equation of a standardized form: $\tan (I - \Delta I) = (1 - a\,\Delta V) \tan I$, where I is the inclination of the ambient field, ΔI is the inclination shallowing, a is a constant and ΔV the compaction.

Paleomagnetic inclinations of Cretaceous DSDP sediments from the Pacific plate are known to be systematically shallower than predicted from paleolatitudes of hot spot reconstructions. Published paleomagnetic data were reexamined and the shallow Cretaceous inclinations explained as a result of sediment compaction. The Cretaceous data are used to estimate the parameter a. The resulting a values are comparable to those of previous studies of compaction-induced inclination shallowing, both from laboratory experiments and the considerably younger deep-sea sediments at site 578. Values of the parameter a suggest that it might be controlled by sediment lithology with greater shallowing for clayey than calcareous sediments.

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