STUDIES OF THE MAGNETIZATION OF THE CAMBRIAN LAMOTTE FORMATION IN MISSOURI

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Paleomagnetic investigations of Cambrian rocks of U.S.A. have so far yielded inconclusive information. There is need for more data, not only to fill in gaps in the record of the history of the geomagnetic field, but also to seek new evidence for the drifting apart of America and Europe.

The Lamotte sandstone formation of Southeastern Missouri, though weakly magnetized, possesses the necessary attributes which render it suitable for paleomagnetic study. The fact that weakly magnetized white sediments have rarely been used for paleomagnetic purposes makes this study all the more challenging.

The Lamotte sandstone was sampled in two stages, in 1966 and 1967, and a total of 134 oriented specimens was obtained from six localities covering approximately the full stratigraphic section of the formation. On application of standard magnetic cleaning techniques, three groupings of significant directions of natural remanent magnetization became apparent, two of which were associated with the lower coarse grained part of the formation and one with its fine grained upper layers. The first two, designated as group I with paleomagnetic pole at 173°W and 30.3°N and locality E with paleomagnetic pole at 137°E and 31.9°N, are believed to carry secondary chemical remanent magnetization not representing the direction of the Cambrian geomagnetic field.

The third designated as group II, subdivides into sub-groups II(a) and II(b) based on results of paleomagnetic sampling of a columnar section near the top of the formation. The paleomagnetic poles of these two sub-groups are situated at 168°W, 38°S and 155°E and 11.5°S respectively and are thought to represent the Upper Cambrian geomagnetic field.

The experimental evidence for the above conclusions was obtained by statistical analysis of the directions of magnetization of the two main types of rock, study of their magnetic properties, and identification of magnetic constituents. Statistical analysis revealed that the directions of magnetization of group I and locality E possessed too small a scatter to be associated with detrital remanent magnetization (DRM), while the magnetization of group II possessed the characteristics of DRM, typified by two significantly different directions of groups II(a) and II(b). Coercivity spectra and stability tests showed that the magnetization of group II was more stable than that of the coarse grained part of the formation. Thermomagnetic analysis, measurement of saturation magnetization, low temperature analysis and mineralogical studies established that the magnetic constituents carrying the natural remanent magnetization (NRM) of the Lamotte formation are members of the ilmenite-hematite series $[xFeTiO_3 \cdot (1-x)Fe_2O_3]$. Specular hematite is the predominant magnetic mineral in rock of

group II and titanohematite in group I and locality E. It was also established that imperfections in antiferromagnetism of hematite make it behave as a ferrimagnetic mineral with a Curie point at 725°C.

The possibility of secondary partial thermoremanent magnetization of the formation resulting from burial was eliminated by performing a thermal demagnetization experiment. The conglomerate test applied to the lowest beds suggested that the NRM of these beds was of chemical origin (CRM). Investigation of isothermally and thermally imposed magnetization of virgin and baked samples confirmed the presence of DRM in group II and of secondary CRM in group I and locality E. Baking at 735°C of specimens of group II simulated on a laboratory scale a chemical process which takes place in nature.

The paleomagnetic results suggest that the pole obtained from group II(a) represents, in fact, the Upper Cambrian geomagnetic field. At a later period, but still during the Cambrian, the pole moved westward and assumed the position obtained from group II(b). The paleomagnetic pole obtained from analysis of magnetization at locality E correlates well with the Carboniferous poles obtained by other workers. The results for group I, not representing the Cambrian field, are inconclusive and require further detailed investigation. Comparison of groups II(a), II(b), and E with European Cambrian and Carboniferous poles confirms the drifting apart of Europe and North America.