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Magnetostratigraphic method in geology: current state, problems and the ways to their solutions

Andrey Y. Guzhikov[1]

[1] N.G. Chernyshevsky Saratov National Research State University

aguzhikov@yandex.ru

Magnetostratigraphy is a branch of modern stratigraphy involved in studying magnetic properties of supracrustal rocks with the aim at revealing the spatial-temporal relationships. One of its purposes consists in developing the General Magnetostratigraphic Scale.

The boundaries of the polarity magnetozones are determined from the events isochronous on a planetary scale – geomagnetic reversals, that is why magnetostratigraphic comparisons result in the most precise global correlations, as compared to other methods. The sequence of magnetic polar zones acts as an independent “ruler” for calibrating the detailed biostratigraphic scales from remote regions. In certain instances, the paleomagnetic characteristics are chosen as the primary markers of boundaries for the general stratigraphic units (e.g., for the base of the Thanetian).

To solve the problems of the local and the regional stratigraphy, alongside with the polarity magnetozones, magnetostratigraphy makes use of the units of petromagnetic substantiation, recognized from the magnetic properties associated with the rock material compositions and structural-textural features. Basically, the petromagnetic units represent a variety of lithostratigraphic ones.

Magnetostratigraphy in itself is not capable of precise dating of the rocks. But being integrated with other methods (primarily, with the biostratigraphic one), the paleomagnetic data play an important and occasionally a decisive role in further specification of the deposit ages and in procuring more detailed correlations.

A common methodological error in integrated stratigraphic research (exclusive of the Quaternary stratigraphy) consists in regarding the paleomagnetic data as the secondary one as compared to the paleontological materials. If the results from the magneto- and the biostratigraphic methods are contradictory, the paleomagnetic information is frequently ignored or (which is still worse), with the assumed priority of paleontological information, used as the basis for some false geological conclusions (e.g., on the occurrences of depositional breaks). As a rule, such situations arise from the ignorance regarding the true potentials of the biotic methods for solving the problems of modern stratigraphy. In particular, the results of the infrazonal correlations from various paleontological groups are practically always contradictory. But consistency of all the available materials was and still remains the major principle of stratigraphic interpretation, and the paleomagnetic data should not represent any exclusion in this respect. Especially since there are numerous cases of successful reconsideration of the previously established stratigraphic notions with regard to the paleomagnetic information.

An important blunder in compiling unified stratigraphic charts lies in combination of the regional and the local units with the paleomagnetic scales developed in other localities. This very methodological error is inherent in the Geological Time Scale (GTS) [1], with the sequence of geomagnetic reversals “mechanically” integrated with the zonal standards of various paleobiochores, inclusive of those from the areas not studied magnetostratigraphically. Similar manipulations are known to have shaped false ides of the magnetic polar structures of biostratigraphic zones in some regions. To avoid this, the taxonomic units of the stratigraphic charts and the GTS provincial zones should be labeled with epyinformation on the availability or the lack of real paleomagnetic characteristics. Whenever possible, boundary diachroneity of the local, regional and detailed biostratigraphic units should be shown relative to the geomagnetic reversals.

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[1] F.M. Gradstein, J.G. Ogg, M.B. Schmitz and G. Ogg, eds., Geologic Time Scale 2020, Elsevier, Amsterdam; Oxford; Cambridge, 2020.