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Study of biomineralization of iron oxyhydroxides by magnetometric methods

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Rift valleys of mid-ocean ridges (MOR) are an expression of the spreading axis in the relief of the ocean floor: in the midparts of MOR, the oceanic crust is newly formed, they are characterized by high values of heat flow, increased seismicity, intense magmatism, and often by high hydrothermal activity. Unique conditions for the formation of various mineral associations. Biomineralization processes are active here, including the formation of magnetic iron-bearing minerals. Biogenic iron minerals with ferrimagnetic properties are found in many living organisms: magnetotactic bacteria, some species of protists (algae and protozoa), and eukaryotes (insects, mollusks, fish, birds, and mammals). These minerals are involved in the magnetotaxis processes, as a means of iron storage, and for tissue strengthening. Such processes are fairly well studied (primarily magnetite formation in magnetotactic bacteria). The mechanisms of iron mineral formation and its physiological functions in eukaryotic protists, particularly foraminifera, remain largely unknown. In this case, foraminifera shells are porous microparticles of calcium carbonate. Under the influence of hydrothermal fluids, protist communities accumulate chemical elements on the surface and inside the carbonate shells. According to literature data, iron oxyhydroxides, in particular goethite and ferromanganese formations, which are represented by small isometric clusters on the shell surface, are formed here. Such particles, which can be controlled by an external magnetic field, are of particular interest to researchers.

The structure, chemical and mineral composition, and magnetic properties of the shells of planktonic foraminifera (species Globigerinoides ruber, Globigerinoides conglobatus, Globigerinoides sacculifer, Globigerinoides tenellus, Orbulina universa, Globorotalia inflate, Globorotalia truncatulinoides, and Globorotalia menardii) and ferromanganese formations from carbonate sediments of the Mid-Atlantic Ridge (MAR) rift zone, one of the largest MORs.

For the ferromanganese formations, experiments were also performed to extract and identify organic matter from the sample to confirm their biogenic origin.

The magnetometry data, including those at cryogenic temperatures, were compared with the new author's data on magnetosomes isolated from lyophilized magnetotactic bacteria.