

## Presumably bacterial remains in banded iron formations: beginning of investigations

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### Abstract

Ancient Archaean and Proterozoic rocks are the model objects for investigation of rocks comprising astromaterials. Judging by their age these terrestrial rocks are the nearest to the rocks of meteorites. They are represented as a rule by deeply metamorphized layers of volcanogenic and volcanogenic-sedimentary rocks and bacterial-paleontological investigations of these rocks usually meet some difficulties. But paleontological studies of these rocks usually meet some difficulties. One of these difficulties is usual high metamorphization of rocks. That is why investigation of Archaean banded iron formations is of great importance.

Banded iron formations are known everywhere. The oldest banded iron formations are met in Archaean. Their widest distribution was in Proterozoic. They are constituent part of metamorphic complexes of all ancient shields. Formation of these units ended in Phanerozoic. Peculiarity of their development in time, thin layering, rhythmic repetitiveness are reasons of great interest to these formations.

Banded iron formations are sedimentary rocks. Interbedding of ferruginous (magnetite, hematite, siderite etc.) interlayers and siliceous layers are typical to these formations. Stratification is thin, thickness of interlayers is less than 1-2 mm. Iron content exceeds 15%. Potentially all minerals of ferruginous interlayers could be of biogenic nature because both for oxygenized (hematite) and reduced (magnetite and siderite) minerals direct mechanism of bacterial production is

established by microbiologists. Basic ore mineral of banded iron formations is magnetite. But magnetite origin is not clear till nowadays and this problem is very actual [2].

Nevertheless bacterial remains by themselves have not been found and it is not surprising. It is proved that finely dispersed non-completely formed magnetite compose basic mass of magnetite formed for example by thermophilic iron-reducing bacteria. Processes of structure arrangement and crystal enlargement are occurred under sediment ageing and abiogenic magnetite recrystallization [1]. That is why in nature in case of ancient sediments and metamorphic rocks it is almost impossible to reveal biogenic origin of magnetite [3].

We decided to begin studying problem of banded iron formations origin because of its great interest. Archaean (2.75 GA) banded iron formations of Olenegorsk deposit (Kola Peninsula) were chosen as a model object. Material was kindly lent us by our colleagues from Institute of Precambrian Geology and Geochronology - S. Felitsyn and N. Alfimova.

Interesting results were received while bacterial-paleontological studying. Thread-like, coccoidal, dumbbell-like etc. forms presumably of bacterial nature were discovered.

The most abundant and diverse forms are those close to coccoidal – the very cocci, oval, dumbbell-like etc. forms. Sizes of the most part of discovered objects about 1  $\mu\text{m}$ .

Thread-like forms are met less often and mainly are represented by long thin single threads.

The most part of biogenic structures was found in ferruginous interlayers. The whole rock fragments often consist almost completely from such structures, biogenic forms sink into rock matrix, some images show their location inside rock sample. There are no reasons to doubt that these biogenic forms were found *in situ*.

In siliceous interlayers presumably biogenic forms are very rare. There are mainly long thin thread-like forms merged with the rock.

As can be seen from the above it is possible to make preliminary conclusion about Archaean of banded iron formations biogenic origin and about microorganism participation in the process of banded iron formations formation. Investigations are continuing.

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## References

[1] Chistyakova N.I., Rusakov V.S., Zavarzina D.G., et al.: Formation of the magnetotaxing phase by thermophilic Fe (III)-reducing bacteria: Mossbauer study, Physics Metals Metallogr., V. 92, Suppl. 1, pp. S138-S142, 2001.

[2] Zavarzina D.G.: The role of dissimilatory Fe (III)-reducing bacteria in transformation of

iron minerals, Paleont. Journ., No 3, pp. 1-8, 2004.

[3] Zavarzina D.G. Formation of magnetite and siderite by thermophilic Fe (III)-reducing bacteria, Paleont. Journ., No 6, pp. 3-8, 2004.