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Loza, LLC
to the General Director
Makbulov I.R.

Conclusion on the age of a geological object

CONCLUSION
ON THE ABSOLUTE GEOCHRONOLOGIC AGE OF STROMATOLITIC LIMESTONES OF THE KATAVA FORMATION OF THE UPPER RIPHEAN AT THE ANNOVSKOYE FIELD

(license CHEL 80065 TE for the right to use subsoil, issued to Loza, LLC on 24.09.2007) in Katav-Ivanovsky District, Chelyabinsk Region, Russian Federation.

According to the K-Ar isotope method, the age of the Katava Formation was about 1 billion years: 964 million years according to constants 1964 [Harris, 1964] or 938 million years according to refined constants 1976 [Riphean Stratotype, 1983]. A detailed description is attached (appendix on 4 sheets).

Director of Institute,
Professor of the Russian Academy of Sciences,
Doctor of Geological and Mineralogical Sciences /signed/ Zedgenizov D.A.

Round seal: Federal Agency of Scientific Institutions
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Conclusion on the age of the Katava Formation

The Katava Formation is part of the Riphean stratotype section of Russia on the western slope of the Southern Urals in the structure of the Bashkirian megacyclinorium [Riphean Stratotype, 1983]. The Riphean sediments here comprise a complex of volcanogenic-terrigenous and carbonate rocks with a total thickness of more than 15 km. The accumulation of this multi-kilometer sequence of sediments occurred in the time interval from 1750 to 600 Ma on the territory of the Baltica paleocontinent, long before the formation of the modern Ural Mountains [Semikhatov et al., 2015]. In the Precambrian General Stratigraphic Scale, the Riphean has the rank of a subeonoteme within the Upper Proterozoic eonoteme [Stratigraphic Code, 2019].

The Riphean section is composed of three series of rocks, each of which begins with volcanogenic (basalts, rhyolites) and coarse clastic (conglomerates, sandstones) sediments of continental genesis, and up the section is replaced by clay-carbonate (shales, limestones and dolomites) marine shelf sediments. There are stratigraphic breaks in sedimentation between the series. The lower series (Burzyanskaya) consists of the Ayskaya, Satkinskaya and Bakalskaya formations, the middle (Yurmatinskaya) is represented by the Mashakskaya, Zigalginskaya, Zigazino-Komarovskaya and Avzyanskaya formations, and the upper (Karatavskaya) by the Zilmerdakskaya, Katavskaya, Inzerskaya, Minyarskaya and Ukskaya formations.

The Katava Formation is one of the most recognizable Riphean units. Its sections extend up to 200 km along the western slope of the Bashkir megacyclinorium from the town of Minyar and the Bakalo-Satka district in the north to the settlement of Biktashevo on the Bolshoi Nugush River in the south (Fig. 1). It is composed of predominantly mottled clayey limestones, dolomites and marls colored in pink, purple or greenish and pale tones. Terrigenous clayey rocks are rare and confined to the layers bordering the underlying Zilmerdak and overlying Inzer formations. The thickness of the Katava Formation varies between 200-300 m. The deposits of the Katava Formation were formed in a shallow-marine basin.

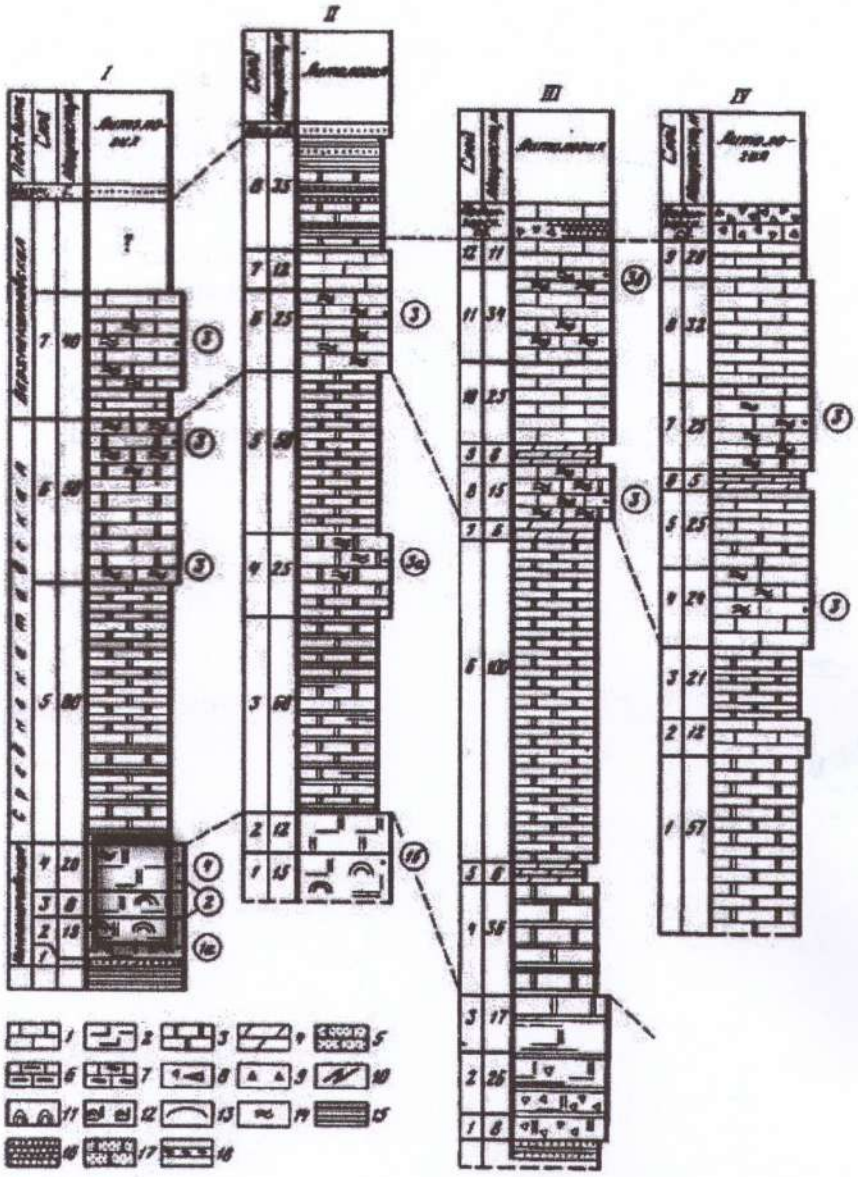

Fig. 13. Reference sections of the Katava Formation
Areas: I - Bederysh, II - Inzer, III - Minyar, IV - Bakeyeva
Symbols to Fig. 13, 14, 16, 18
1-3 – limestones, dolomitized limestones, dolomites: 1, 2 – gray-colored (1 - platy and clear-layered; 2 - massive), 3 – pestiferous and red-colored; 4 – marls and clayey dolomites; 5 – sandy limestones; 6 – limestones and dolomitized limestones with admixture of carbonaceous material; 7 – inclusions and layers of flints in limestones and dolomites; 8, 9 – conglomerato-breccias: 8 - carbonate, 9 – other: 10 – problematic structures in carbonate rocks; 11-14 – stromatolites: 11, 12 – columnar (11 – conophytons; 12 – other), 13 – columnar-sheeted and nodular, 14 – stratified; 15 – mudstones, clay-siltstone shales; 16 – fine-grained sandstones, siltstones; 17 – med ium- and coarse-grained quartzitic sandstones; 18 – conglomerates, gravelites
Numbers in circles – organic remains: 1a, 1b – Inzeria tjomusi Kryl. (1a – sample 4329/491*: 1b – sample 4580/60): 2 - Jurusania cylindrica Kryl. (sample 4329/104): 3, 3a, 3b - Malginella Kom. (3a, 3b – M. zipandica Kom.; 3a – sample 4580/38): 4 – Tungussia sp.

Fig. 1 Reference sections of the Katava Formation [Riphean Stratotype, 1983] and the location of the Annovo quarry in the sediment section (red rectangle).

The Katava Formation is subdivided into three sub-formations, the Lower, Middle, and Upper Katava sub-formations, which are distinguished by the predominant rock color and texture. Red-colored (less frequently gray-colored) thickly layered rocks predominate in the Lower Katava Subformation, and a number of sections are characterized by stromatolitic limestones and lenses of carbonate breccias. Stromatolites are columnar, belonging to the species Jurusania cylindrica, Inzeria tjomusi [Riphean Stratotype, 1982]. The Middle Katava Subformation contains interbedded multicolored plate-like carbonate rocks, while the Upper Katava Subformation is characterized by the predominance of greenish-gray thinly layered limestones with Malginella zipandica Komar stromatolites [Riphean Stratotype, 1982].

The columnar stromatolites of the Lower Katava Subformation form extended bioherms, which are massive bodies of stromatolitic limestone up to fifty meters thick, spread over several kilometers. Large bioherms are known in the vicinity of Bederysh village, including the Annovskoye deposit of stromatolitic limestone, which is developed as an ornamental raw material.

The age of the Katava Formation was determined by the K-Ar method using glauconite, which is an impurity in the slab limestone. Glauconite is a green-colored mineral, a layered aluminosilicate belonging to the group of ferruginous hydrated micas with high potassium content, suitable for application of the K-Ar isotopic age determination method. Sample 7-1, collection of V.A. Romanov, was collected from an outcrop on the Bolshoi Shishenyak River above the village of Nugushevo.

The age of the Katava Formation was about 1 billion years: 964 million years according to the constants of 1964 (Harris, 1964) or 938 million years according to the refined constants of 1976 [Riphean Stratotype, 1983].

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