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LOWER CAMBRIAN OF SIBERIAN PLATFORM

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INTRODUCTION

Siberian platform is a good region for the establishment of stratigraphic boundaries of different rank for the Cambrian System. Here, we review the Cambrian geology of the Siberian Platform.

Platform position Modern reconstructions of the Siberian Platform configuration in Cambrian time with the use of paleontological data are based on the publications of Rozanov (1980, 1984) and Debrenne *et al.* (1999).The paleomagnetic scale standard for the Lower Cambrian of the Siberian Platform was first carried out by Kirschvink and Rozanov (1984). The reconstructions accomplished by Pelehaty (1996), Piper (2000), and Sears and Price (2000) with the application of the paleomagnetic method, are favored. Consensus exists among specialists that the platform was situated at equatorial latitudes and was swung 90°. As to the relations between the Siberian Platform and Laurentia, the opinions differ greatly.

Geochronology Successive series of datings from the top of the Lower Cambrian to the upper Vendian are cited from the latest publication of Khomentovsky (2000), where he analyzed the figures, obtained for the most important boundaries in the Vendian – Lower Cambrian interval using different methods, when determining an absolute age. The Tommotian stage base is dated at 545 – 550 Ma; the boundary between the Tommotian and Atdabanian stages is dated at 531 Ma; the boundary between the Atdabanian and Botomian stages is dated at 526 Ma; the base of the Toyonian Stage is dated at 522 Ma; and the top of the Lower Cambrian is dated at 518 Ma.

Chemostratigraphy Where there is a deficiency of paleontological data to substantiate the Late Vendian - Early Cambrian stratigraphic units, we often attempt to compensate by chemostratigraphic methods of correlation on the basis of the distribution of stable isotopes (carbon isotopes in the main) in the sections. In Siberia unusually light carbonates deposited in evaporite basins provide the source. Carbon isotopic trends in the Early Cambrian have been studied by numerous specialists (Brasier *et al.*, 1994; Knoll *et al.*, 1995; Brasier and Surkov, 1997; Bartley *et al.*, 1998). It is believed that carbon isotopes suggest not less than 10 cycles in the Early Cambrian, some of them are traceable throughout the world and are in phases of radiation among invertebrate groups. Four episodes of negative carbon isotopes are recognized:

Kotlin (prior to pre-Cambrian events), basal (Tommotian–Upper Tommotian) and Upper Botomian–Lower Toyonian (Brasier, 1996).

Paleogeography On the Siberian Platform in Cambrian time, carbonate sedimentation alternated with phosphate-accumulation intervals and black shales. Reefal buildups were widespread on the platform, and served as the reservoirs for oil and natural gas concentrations. Skeletal fossils occur uniformly and are abundant through the Cambrian section beginning in the second half of the Nemakit – Daldynian. On the Siberian Platform the rate of sedimentation sharply decreased in the Nemakit – Daldynian and Tommotian Ages.

Precambrian - Cambrian boundary The foremost Russian scientists (Rozanov *et al.*, 1997) thought that the official decision to choose the global stratotype for the Cambrian System is lower boundary on the Burin Peninsula, Newfoundland, on the basis of the first appearance of *Trichophycus pedum* was made without an appropriate appraisal of the biostratigraphic potential of ichnofossils. Available biostratigraphic and isotope-geochronological evidence provide no proper correlation of the Cambrian lower boundary adopted for the Burin section and the natural features of the section exclude the possibility to use C and Sr isotopic chemostratigraphic criteria for the tracing. Therefore this is a poor choice for actual stratigraphic practice. Skeletal remains form the basis of the Cambrian biostratigraphy. In the Siberian and South China sections, the Tommotian Stage lower boundary is determined by a small shelly fauna. In Siberia there are sections with the succesive development of fauna in Nemakit – Daldynian and Tommotian times (Cambrian in Siberia, 1992), though authors hold different viewpoints on the correlation of Precambrian – Cambrian boundary deposits in the north and southeast of the Siberian Platform. The correlation with the Olenek Uplift sections presents the greatest disagreement.

Russian scientists admit that in the stratotype area for the Tommotian Stage, at the Aldan River and the Uchura-Maya region, the Pestrotsvet (variegated) Formation is preceded by an obvious gap that is suggested by an mode of occurrence of this section on different horizons which underlie the Ust'-Yudoma strata. This gap is insignificant, as supported by the succession in the development of the Nemakit- Daldynian and Tommotian fauna. In the sections of the Anabar Massif, Olenek and Igarka uplifts (Fig. 1), the level of the Tommotian Stage lower boundary is not coincident with a gap in sedimentation (Luchinina *et al.*, 1997, 2000). Despite this, Geyer *et al.* (2000) alloted the place in Cambrian geochronological scale of Siberia for the significant pre-Pestrotsvet gap (Geyer *et al.*, 2000).

The type sections for four Lower Cambrian stages accepted currently in Russia are located in the south-east of the Siberian Platform. These regions have appeared to be the center of origin or the center of diversification of many groups of fauna. Russian stages were established based on a number of zones which reflect regularities in the evolution of first archaeocyaths (Rozanov, 1973) and later trilobites.

Tommotian Stage The stage lower boundary, which is the Cambrian System lower boundary at the same time, is placed at the base of the *Nochoroycyathus sunnaginicus* Zone. The Tommotian

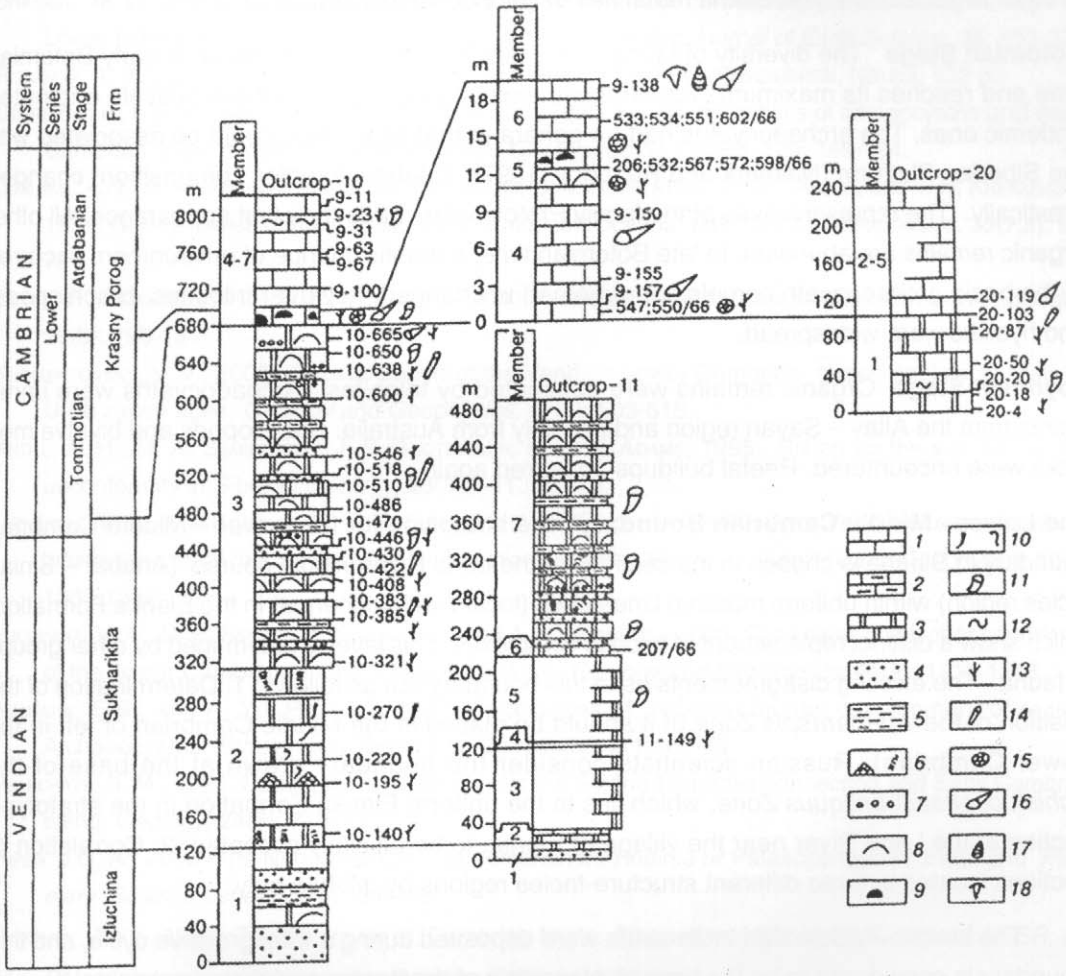

Fig.1 A chart of correlation between the sections of the Sukharikha – base of the Krasny Porog Formations on the Sukharikha River. *1* **– limestones,** *2* **– clayey limestones,** *3* **– dolomites,** *4* **– sandstones,** *5* **– siltstones,** *6* **– stromatolites,** *7* **– microphytolites,** *8* **– algal organogenic buildups,** *9* **– algae-archaeocyathid bioherms,** *10* **– Scolithos,** *11* **– burrows of soft-bodied organisms,** *12* **– crawling tracks,** *13* **– algae,** *14* **– anabaritids,** *15* **– archaeocyathids,** *16* **– hyolitha and SSF,** *17* **– brachiopods,** *18* **– trilobites.**

Stage is characterized by abundant and diverse small shelly organisms, archaeocyaths with simple morphology and also sponges, mollusks, brachiopods, and calcareous algae. Regional fauna originated on the Siberian Platform in early Tommotian time. The genera that originated at that time had a wide potential in ecological respect, therefore they dispersed widely. Howevere there existed endemic genera, which were less steady in comparison with other Tommotian representatives and they became extinct in late Tommotian – early Atdabanian time.

Atdabanian Stage At the base of the stage there occured a change in the complex of organic remains. New genera of archaeocyaths, trilobites, brachiopods, and hyoliths appear. Fauna changes occurred due to local individuals. Later, the fauna immigrated from the Altay – Sayan region, increasing the percent of similarity between the Siberian Platform fauna and the faunas

of other regions rises. The Sakha reefal belt developed intensively.

Botomian Stage The diversity of fauna in this region continues to increase in early Botomian time and reaches its maximum. Together with cosmopolitan genera there actively originated endemic ones. The archaeocyaths had no genera at that time which could be associated with the Siberian Platform (Naimark and Rozanov, 1997). Trilobite complex composition changed drastically. The representatives of the family Protolenidae made their first appearance. All other organic remains are abundant. In late Botomian time, a drastic change of environment occurred in the basin archaeocyath complexes remained unchanged, however trilobites, brachiopods, and hyoliths were widespread.

Toyonian Stage Organic remains were dominated by trilobites. Archaeocyaths were immigrants from the Altay – Sayan region and possibly from Australia. Brachiopods and bivalve mollusks were encountered. Reefal buildups appeared again.

The Lower - Middle Cambrian Boundary The stratotype for the Lower – Middle Cambrian boundary in Siberia is chosen in the sections of the Lena River middle course (Anabar – Sinian facies region) within uniform massive limestones (locally with bioherms) in the Elanka Formation, which show a distinct replacement of trilobite complexes. This level is determined by other groups of fauna. The existing disagreements as to this boundary are as follows: 1. Determination of the position of the *Anabaraspis* Zone (if it should be placed in the Middle Cambrian or left in the Lower Cambrian). Russian scientists consider the boundary drawn at the base of the *Schistocephalus antiquus* Zone, which lies in the uniform Elanka Formation in the stratotype section at the Lena River near the village of Elanka to be officially accepted. 2. Correlation of sections located in three different structure-facies regions by trilobite only.

The Lower – Middle Cambrian strata were deposited during a transgressive cycle, and this boundary is considered to be the time of integration of the basins and their deepening associated with eustatics. These events had an effect on faunal changes and were named the "Hawke Bay event." The subsequent study of Siberian sections is the key to insight into the events which took place across the Early and Middle Cambrian.

Conclusion Despite the provincial specifity of faunas of different regions, the possibility of the tracing of four stages of the Lower Cambrian is rather high. This possibility is favored by extensive material from the type sections of the Siberian Platform.

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