NOVEMBER 2012 REPORT OF TASK GROUP TO ESTABLISH A GSSP CLOSE TO THE EXISTING BASHKIRIAN–MOSCOVIAN BOUNDARY

Chairman Alexander Alekseev
[1]Alexander, S. Alekseev and Task Group
[1]Department of Paleontology, Geology Faculty, Moscow State University, 119991 Moscow GSP-1, Russia
E-mail: aaleks@geol.msu.ru

Introduction

Significant progress was achieved by the task group during last fiscal year. They have located a couple of conodont taxa that appear to have good potential for defining the base of the Moscovian Stage at a level near its current position (base of Vereian Russian regional Substage) and have located a new index that could be used if the base was raised one substage higher. The Task group has also been evaluating several successions to locate suitable GSSP candidate sections. Around 10 taxa (conodonts and fusulinids) were proposed during last five years as potential indices for the lower boundary of the Moscovian Stage, but only two - *Diplognathodus ellesmerensis* Bender, 1980 and *Declinognathodus donetzianus* Nemirovskaya, 1990 have received even moderate support from the task-group members. The relatively restricted geographic distribution of most of the proposed taxa has been the most important factor limiting their utility for boundary definition. Another problem that has inhibited substantial progress on selecting a suitable taxon is that many members of the task group are working on several other task groups and lack sufficient time to devote to the study of faunas associated with the Bashkirian-Moscovian boundary.

Boundary definition

Data from the Nashui section in Guizhou province, South China (Qi *et al*., 2007; 2010; Groves and task group, 2011) continue to indicate that the first evolutionary occurrence of the conodont *D. ellesmerensis* in the lineage *Diplognathodus coloradoensis* Murray & Chronic, 1965 - *D. ellesmerensis* is one of the best potential markers the task group has investigated. Elements of *D. ellesmerensis* are easy to identify, the species has a wide geographic distribution (China, Russia, North America), and it occurs in the lowermost Moscovian strata (Alyutovo Formation; Kashirian Russian regional Substage) in the type Moscovian area (Makhlina *et al*., 2001, pl. 14, fig. 17). A shortcoming of the species is its long range - occurring not only in the lower Moscovian, but also in upper Moscovian (Podolskian regional Substage) strata in the Moscow Basin, South Urals (Dalniy Tyulkas) and Arkhangelsk Region.

The FAD of *D. donetzianus* has long been consider as a potential index for the base of the Moscovian but its apparent absence in North American successions prevented it from being an ideal candidate. Specimens of the species have, however, been recently located in the Appalachian Basin in the eastern U.S.A. (Work *et al*., 2012). They reported *D. donetzianus* in the lower Atokan Magoffin Member of the Four Corners Formation in eastern Kentucky, the first discovery of the taxon in the Western Hemisphere. Because of the new discovery, the FAD of *D. donetzianus* warrants further evaluation as a potential marker.

Progress in Donets Basin, Ukraine

During the second half of September 2012, Tamara Nemyrovska together with Isabel Montanez and Jlie Griffit (California, Davis University) participated in field work in the Donets Basin, Ukraine. Near the town of Malonikolaevka, they sampled in detail the Bashkirian-Moscovian boundary interval including the marine-shale interval above limestone K_1. The conodonts from all of the limestone and shale beds will be studied for stable-oxygen isotopes to permit the reconstruction of paleoclimatic fluctuations, which are potentially important for long-distance correlations.

In the last few years, Katsumi Ueno and Tamara Nemyrovska have been working in the Donets Basin on the Bashkirian-Moscovian boundary in the Zolotaya and Malonikolaevka

sections in the Lugansk region, eastern Ukraine. During the first half of October 2012, they continued with that work and collaborated with Titima Thassinee (Bangkok University, Thailand) to investigate a new section near the town of Shterovka, sampling the latter exposure for conodonts and fusulinids. They also collected additional samples from limestones I_3 and I_4 in the Malonikolaevka section. In these sections, strata of the C_2^4 (I) and C_2^5 (K) formations (from limestones I_2 to K_3) are exposed. The Shterovka section, which includes limestones I_2 to K_3^1, is situated several kilometers west of the Malonikolaevka section. In the Donets Basin, the Bashkirian-Moscovian boundary has traditionally been placed somewhere in the basal or lower part of the C_2^5 (K) formation (Putrya, 1956; Einor, 1996). Of the three sections, the Malonikolaevka section recently provided some important information on the Bashkirian-Moscovian boundary (Ueno and Nemyrovska, 2008; Nemyrovska *et al*., 2010). In the Malonikolaevka section, the conodont and fusuline composite biostratigraphy was examined, with special attention given to the lower boundary of the Moscovian. It is important to note that, in the latter section, limestone K_1 registered the first occurrence of the conodont *Declinognathodus donetzianus*, which has been considered one of the best conodont species for defining the Bashkirian-Moscovian boundary (Groves and task group, 2004, 2005, 2009). Moreover, this limestone records the first occurrence of strongly Moscovian-type *Eofusulina* in the fusuline fauna. The latter genus is also considered to have considerable potential as an index for defining the base of the Moscovian Stage (Groves and task group, 2011). Thus, Nemyrovska *et al.* (2010) consider the base of the Moscovian in the Donets Basin to lie within limestone K_1.

Saori Tanaka, a student of Katsumi Ueno, recently studied additional samples from the Malonikolaevka section for her Bachelor of Science thesis and provided interesting information on fusulines (Tanaka, 2012). In limestone I_2^2 she found an elongate fusuline, which looks like a species of *Eofusulina*, and another elongated form that resembles specimens of *Verella transiens* reported from the Cantabrian Mountains of northern Spain (van Ginkel, 1987). Another important occurrence from limestone I_2^2 is a large rhomboidal *Profusulinella* somewhat similar to *P. rhombiformis* (but definitely larger than the types). This peculiar *Profusulinella* species, also occurring commonly in limestone I_2^2 of the nearby Zolotaya section, resembles *Profusulinella albaensis* originally reported from the Alba Limestone (≈lower Kashirian) of the Cantabrian Mountains (van Ginkel, 1965). From the viewpoint of the evolutionary characteristics of fusulines, the relevant *Profusulinella* from limestone I_2^2 does not look like a Bashkirian form. Evidence from the fusulines suggests that limestone I_2^2 can be correlated with the *Verella transiens*-bearing strata in the Cantabrian Mountains. Interestingly, that level has been correlated to the Vereyan of the earliest Moscovian (van Ginkel, 1987; Villa, 1995). Whatever its exact age, the peculiar species resembling *Profusulinella albaensis* provides a good level of inter-regional correlation near the Bashkirian-Moscovian boundary. So far the age of limestone I_2^2 has not been precisely determined and a discrepancy may occur between fusuline-based correlations and those based on conodonts because in the Malonikolaevka and Zolotaya sections fusulines of Moscovian aspect occur in strata below the conodont-based Moscovian base (i.e. FAD of *Declinognathodus donetzianus*).

Progress in South China

Yuping Qi, Lance Lambert, and Tamara Nemyrovska are collaborating to study large collections of conodonts from deep-water (carbonate slope) sections that were sampled in detail in southern Guizhou province, South China. The collections contain several lineages spanning the mid-Bashkirian to early Moscovian interval. In ascending order the lineages include species of the *Streptognathodus expansus* Igo & Koike, 1964 to *Streptognathodus suberectus* Dunn, 1966 lineage, the *Gondolella –Mesogondolella* group, *Diplognathodus coloradoensis* - *Diplognathodus ellesmerensis* lineage and a group of *Neolochriea* species. For the Bashkirian-Moscovian boundary, only *D. ellesmerensis* has substantial potential as an index for the boundary GSSP and can be used for the regional and global correlation of sections lacking

Declinognathodus donetzianus Nemirovskaya, 1990. Qi and his colleagues are preparing a manuscript with illustrations for the next issue (v. 31) of the "Newsletter on Carboniferous Stratigraphy" describing all the lineages and including a recommendation for the marker taxon.

In the Naqing section, there are several important conodont lineages that span the Bashkirian-Moscovian boundary (see paragraph above). One of them, the FAD of *D. ellesmerensis* could be proposed for the marker of this boundary; however, more specimens are required to document the transition from its ancestor *Diplognathodus coloradoensis*. Yuping Qi has discovered two new sections that span the Bashkirian-Moscovian boundary in nearby areas of southern Guizhou, South China in 2011. There are many more fusulinid beds in the new sections because they consist of lithofacies that were deposited at shallower water depths than those in the Nashui section. Both the conodonts and fusulinids from the new sections are being studied.

In the summer of 2012, Yuping Qi visited the U.S.A. for three months; there, he worked with Jim Barrick and Lance Lambert on Bashkirian-Moscovian conodonts from South China and the United States. It was a productive trip because Qi found that *Diplognathodus ellesmerensis* is common in some North America collections. Thus, Jim Barrick, Lance Lambert and Yuping Qi think the FAD of *D. ellesmerensis* is the best marker for the base of the Moscovian and global correlation at that level. Although there are transitions for different morphologies of *Streptognathodus expansus* and *S. suberectus* in the Naqing (Nashui) section that may have utility for global correlations (Qi *et al*., 2010), it is thought their stratigraphic first occurrence is too low to permit their use as the basal marker of the Moscovian Stage. For this reason, Yuping Qi and some students went to the Naqing section to collect more samples below the FAD of *D. ellesmerensis* in late October.

Progress in Moscow Basin

Goreva and Alekseev (2012), on the basis of conodont data from the Moscow Basin, proposed moving the lower boundary of the Moscovian one substage higher than the position discussed above; that is from the base of the Vereian regional Substage (lowermost Moscovian substage) to the base of Kashirian regional Substage. A proposed marker for the new level is the FAD of *Neognathodus bothrops* Merrill, 1972 from its ancestor *Neognathodus atokaensis* Grayson, 1984. Both species occur in the Midcontinent region of the U.S.A., Moscow Basin and South Urals of Russia, and the Donets Basin in Ukraine. A few specimens have also been reported from South China. The section containing the components of this lineage is the Yambirno quarry (Kabanov and Alekseev, 2011a, b), an abandoned quarry in the eastern part of the Ryazan region of central Russia (ca. 400 km southeast of Moscow). Although the Vereian-Kashirian boundary interval is not presently exposed in the quarry, it can be excavated and restudied in detail.

If the base of the Moscovian is shifted upward to the base of the Kashirian as proposed by Goreva and Alekseev (2012), both the Bashkirian and Moscovian will require redefinition and the Vereian Substage included in the upper Bashkirian. There is some justification for shifting the boundary because the Vereian ammonoid assemblage closely resembles that of the former regional Russian Kayalian stage (= upper part Bashkirian and Vereian) (Ruzhencev, 1969). In addition, the Vereian brachiopods have characteristics that are typical of the Bashkirian taxa (Lazarev in Makhlina *et al*., 2001). The conodont assemblage of the Vereian Substage consists mainly of genera that are widely distributed in the Bashkirian and include the important genera *Idiognathoides* and *Declinognathodus*, a taxon that does not cross the Vereian-Kashirian boundary.

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Members of the Bashkirian - Moscovian Boundary GSSP Task Group

Chairman: Alexander Alekseev: Russia, aaleks@geol.msu.ru, specialty – conodonts; Demir Altiner: Turkey, demir@metu.edu.tr, specialty – foraminifers; Uwe Brand: Canada, uwe.brand@brocku.ca, specialty – geochemistry; Alexandra Dzhenchuraeva: Kyrgyzstan, djenchuraeva@yahoo.com, specialty - fusulinoideans; Elena Kulagina: Russia, elenkul@mail.ru, specialty – foraminifers; Lance Lambert: U.S.A., lance.lambert@utsa.edu, specialty – conodonts; Tamara Nemyrovska: Ukraine, tnemyrov@mail.ru, specialty – conodonts; Svetlana Nikolaeva: United Kingdom, s.nikolaeva@nhm.ac.uk, specialty – ammonoids; Vladimir Pazukhin: Russia, pazukhin@mail.ru, specialty – conodonts; Vladislav Poletaev: Ukraine, vlad_poletaev@ukr.net; Qi Yuping: Peoples Republic of China, ypqi@nigpas.ac.cn, specialty – conodonts; Katsumi Ueno: Japan, katsumi@fukuoka-u.ac.jp, specialty – fusulinoideans; Elisa Villa: Spain, evilla@geol.uniovi.es, specialty – foraminifers; Wang Xiangdong: Peoples Republic of China, xdwang@nigpas.ac.cn, specialty – corals; Wang Yue: Peoples Republic of China, yuewang@nigpas.ac.cn, specialty - fusulinoideans