NOVEMBER 2011 REPORT OF TASK GROUP TO ESTABLISH A GSSP CLOSE TO THE EXISTING BASHKIRIAN–MOSCOVIAN BOUNDARY

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Introduction

Members of the Bashkirian-Moscovian Boundary Task Group are conducting research at a variety of locations in Europe and Asia. Investigations continue to focus mainly on evolutionary transitions in conodont and fusulinid lineages. Members of the group participated in two salient events during the past year: 1) "The SCCS Workshop on GSSPs of the Carboniferous System: Carboniferous Carbonate Succession from Shallow Marine to Slope in Southern Guizhou", and 2) the preparation of a new proposal for a formal marker event for the lower Moscovian Boundary. In addition, several task-group members presented papers at the XVII International Congress on the Carboniferous and Permian in Perth, Australia.

The SCCS Workshop was convened in November, 2010 by Wang Xiangdong, Qi Yuping, Wang Yue and their colleagues with the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS). It consisted of three days of working sessions and formal presentations in Nanjing followed by a six-day field excursion to southern Guizhou. Of special relevance to this Task Group, the excursion allowed participants to examine the Bashkirian-Moscovian boundary at the shallow-water Zongdi and Luokun sections and the deeper-water Nashui section. The field excursion guidebook edited by Wang Xiangdong *et al.* contains ten chapters dealing with conodonts and foraminifers from the Viséan-Serpukhovian, Bashkirian-Moscovian, Moscovian-Kasimovian and Kasimovian-Gzhelian boundaries in southern Guizhou.

During the Workshop at NIGPAS, Qi Yuping and co-authors presented an important paper titled: “New interpretation of the conodont succession of the Naqing (Nashui) section: Candidate GSSP for the base of the Moscovian Stage, Luosu, Luodian, Guizhou, South China.” In this paper they advocated placing the base of the Moscovian Stage in the Nashui section at the joint first appearances of advanced morphotypes of *Streptognathodus expansus* and *Streptognathodus suberectus*. This level coincides with the local appearance of *Neognathodus kanumai* and it occurs approximately 4 m below the local appearance of *Diplognathodus ellesmerensis*, an event previously identified as a potential boundary marker. An article in the field excursion guidebook (Qi *et al.*, 2010) clarifies the taxonomic distinctions between stratigraphically lower morphotypes of *S. expansus* and *S. suberectus* and the higher, advanced morphotypes of the same species. This article was accompanied by a detailed range chart and seven plates in which representative specimens were illustrated. Additional work is necessary: 1) to show that the advanced morphotypes of *S. expansus* and *S. suberectus* occur elsewhere in evolutionary continuity with their respective ancestors; and 2) to test the biostratigraphic fidelity of the advanced morphotypes relative to other, potential lower Moscovian indices.

New proposal for a formal marker event for the lower Moscovian boundary

Eight members of the Bashkirian-Moscovian Boundary task group collaborated on a new proposal to mark the base of the Moscovian Stage by the first appearance datum (FAD) of the fusulinoidean genus *Eofusulina* Rauser-Chernousova *in* Rauser-Chernousova *et al.* 1951 in evolutionary continuity with its ancestor *Verella* Dalmatskaya 1951. Operationally, this level can be recognized by the lowest stratigraphic occurrence of a fusulinoidean exhibiting septal fluting across the entire length of its shell. The proposal was circulated among all members of the task group for their comments, but a formal vote was not held. A widely held concern is the relatively

few sections in which the *Verella–Eofusulina* transition might be documented with closely spaced sampling. The search for such localities will become a priority during the next fiscal year and in the future (see item 3, below).

Eofusulina triangula (Rauser-Chernousova and Beljaev *in* Rauser-Chernousova *et al.*, 1936) is among the stratigraphically oldest and most widespread species in the genus. It is distinguished from other early species in the genus by its unusual triangular shell outline. The proposal's authors do not designate this species as the boundary marker, however, because in some areas its FAD is slightly above the FAD of congeneric species that exhibit a more nearly fusiform shape. In other words, the boundary shall be marked by the advent of a genus-rank character (pole-to-pole septal fluting) rather than a species-rank character (shell shape).

The genus *Eofusulina* and its ancestor *Verella* are distinctive among early fusulinoideans in that they possess highly elongate tests with primitive, three-layered wall structure consisting of two prothecal layers and an epitheca. The two genera differ mainly in the degree of septal fluting. Septal fluting in *Verella* usually is restricted to the poles and lateral slopes, whereas in *Eofusulina* it extends across the entire length of the test. Thus, the proposed event employs the concept of morphologic grade: the boundary shall coincide with a specified point in an evolutionary morphologic continuum. Of secondary importance, the proloculus in *Eofusulina* is much larger relative to overall test size than in *Verella*. Evolutionary relationships between *Verella* and *Eofusulina* have been addressed by Leven (1979) and Ivanova (2008).

Specimens assigned to *Verella spicata* Dalmatskaya, 1951 occur widely in uppermost Bashkirian rocks and specimens assigned to *Eofusulina triangula* occur widely in lower Moscovian rocks. As implied by its name, *Verella transiens* Ginkel and Villa *in* Ginkel 1987 is intermediate between typical representatives of the two genera. Septal fluting in this species is more intense than in typical *Verella*, but less intense than in typical *Eofusulina*. The type specimens of *V. transiens* are from the lower, but not lowest Vereian of northwestern Spain. Other conspecific specimens are known from Limestone I3 in the Donets Basin of Ukraine, just below the joint appearances of *Eofusulina* sp. and *Declinognathodus donetzianus* in Limestone K1 (Nemyrovska *et al.,* 2010). Thus, the stratigraphic range of *V. transiens* spans the Bashkirian-Moscovian boundary as traditionally recognized. The existence of this morphologically and stratigraphically transitional form further demonstrates the concept of the *Verella–Eofusulina* evolutionary continuum.

The proposed marker event is attractive in that specimens of *Eofusulina* are very easy to identify. Juvenile specimens can be identified by their large proloculi and elongate shape, even in the first volution. Tangential and/or oblique sections through larger specimens can be identified by their elongate shape and intense septal fluting. The proposed marker is further attractive because of its widespread distribution in North Africa, the Arctic, Eurasia, and accreted Panthalassan oceanic carbonates in circum-Pacific areas. It is known from no fewer than 17 distinct geologic basins.

The authors noted that although *Eofusulina triangula* and other early species in the genus are widespread geographically, *Eofusulina* spp. typically do not occur as abundantly as certain other fusulinoideans. Furthermore, like all fossils, they occur only where a suitable environment allowed colonization. Where they are rare, potential sampling bias means that the lowest observed occurrence might be in rocks slightly younger than basal Moscovian as determined on independent criteria. Similarly, where they were temporarily excluded by inhospitable environments, their local appearance clearly will post-date earliest Moscovian. For these reasons it is desirable to designate auxiliary markers for the base of the Moscovian Stage.

FADs of the fusulinoideans *Profusulinella prisca* (Deprat, 1912) and *Aljutovella aljutovica* (Rauser-Chernousova, 1938) are designated as auxiliary events for marking the base

of the Moscovian Stage. Both species are widespread throughout the geographic area containing *Eofusulina* spp., and both have been utilized in formal zonal schemes for marking the base of the Moscovian.

Eofusulina and the auxiliary markers are not known to occur in Australia, Antarctica or sub-Saharan Africa. In the Western Hemisphere, *Eofusulina* is known only from an accreted terrane of Panthalassan origin. Of the areas where the various markers do not occur indigenously, only North and South America contain significant marine deposits of Bashkirian and Moscovian age. The base of the Moscovian Stage can be approximated in the Western Hemisphere by the FAD of *Profusulinella fittsi* (Thompson, 1935), which is known to coincide with *Eofusulina* in Eurasia (Solov'eva, 1963), and other early species in *Profusulinella*. Species in *Profusulinella* are thought to have arrived in the Western Hemisphere in early Moscovian time as immigrants via the Franklinian Shelf. Many North American species strongly resemble and might be conspecific with early Moscovian Eurasian counterparts (Groves *et al.*, 2007).

Fusulinoideans are rare in many deeper-water deposits. The base of the Moscovian can be approximated in the absence of fusulinoideans by the FADs of the conodonts *Declinoghathodus donetzianus* and *Diplognathodus ellesmerensis* (Nemyrovska, 1999; Qi *et al.*, 2007), and possibly by the FADs of advanced morphotypes of *Streptognathodus expansus* and *S. suberectus* (Qi *et al.*, 2010).

Additional Activities

Katsumi Ueno (Fukuoka University, Japan) and his students Mikio Shinohara, Keishi Hamachi, Naoki Hayakawa and Yusaku Hoshiki, in collaboration with Tsutomu Nakazawa (AIST, Japan), Yue Wang and Xiangdong Wang (NIGPAS) recently studied latest Bashkirian-earliest Moscovian fusulinoidean biostratigraphy of the Zongdi section in southern Guizhou Province, South China. They investigated a 50-m interval (50-100 m above the base) of the section, focusing particularly on the *Verella-Eofusulina* lineage. This interval of the Zongdi section consists chiefly of shallow-marine bioclastic limestone with frequent dolomitic levels. The interval includes four subaerial exposure surfaces (probably minor unconformities) at 83.0 m, 92.3 m, 93.0 m and 96.0 m. The exposure surfaces are underlain immediately by very thin paleosols and organically pigmented limestones with pendant cements. At Zongdi the lowest *Verella* is found at 56 m and specimens continue up to 76 m. The lowest (but poorly preserved) *Eofusulina* occurs at 80.5 m and others are commonly found up to 95 m. It is important to note that the FAD of *Eofusulina* is just below the first subaerial exposure in the studied interval, suggesting that the evolutionary first appearance event of *Eofusulina* from *Verella* might be recorded here. The Zongdi section is further important because it is one of few sections on the Yangtze Carbonate Platform of South China that yield both *Verella* and *Eofusulina*.

Demir Altiner and colleagues at Middle East Technical University (Ankara) conducted an analysis of the sequence stratigraphy and fusulinoidean biostratigraphy of Bashkirian-Moscovian boundary beds in the Tauride Belt in southern Turkey. Three overlapping sections spanning the Lower Bashkirian (Askynbashky) to Lower Moscovian (Solontsovsky) beds were measured and collected on a bed-by-bed basis. The Bashkirian-Moscovian boundary is recognized locally by the first occurrence of *Profusulinella prisca* within the *P. staffellaeformis-P. paratimanica* lineage. This level also coincides with the first occurrence of *Aljutovella aljutovica*. The lowest occurrence of the genus *Eofusulina* is slightly higher than that of *P. prisca* and *A. aljutovica*. Stacking patterns of upward-shoaling meter-scale cycles indicate the presence of two third-order sequences dated as Askynbashky to lowermost Asatausky and Asatausky to Solontsovsky. A prominent quartz arenitic sandstone intercalated within the Upper Bashkirian carbonate succession has been interpreted as a falling stage systems tract corresponding to stratal offlap during the culmination phase of the second glacial interval in the Carboniferous. Following the

sea-level fall in the earliest Asatausky, a new carbonate regime was installed in the Asatausky-Solontsovsky interval by a glacio-eustatic sea-level rise. The Bashkirian-Moscovian boundary seems to be located within the transgressive systems tract of this new carbonate regime.

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