

NOVEMBER 2011 REPORT OF TASK GROUP TO ESTABLISH THE VISÉAN-SERPUKHOVIAN BOUNDARY

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Introduction

During the past fiscal year, the task group to establish the Viséan-Serpukhovian boundary made encouraging progress toward the selection of a GSSP for the Viséan/Serpukhovian stage boundary. Most importantly, the group continues to find that the first evolutionary appearance of the conodont *Lochriea zieglerei* Nemirovskaya, Perret & Meischner 1994 in the lineage *Lochriea nodosa* (Bischoff, 1957) - *Lochriea zieglerei* presents the best potential for boundary definition. *L. zieglerei* appears in the upper part of the Brigantian substage, which is slightly below the current base of the Serpukhovian as defined by its lectostratotype section in the Zaborie quarry near the city of Serpukhov in the Moscow Basin, Russia (Kabanov, 2003, 2004; Kabanov *et al.*, 2009). Members of the task group are conducting research on biostratigraphy, sedimentology and lithostratigraphy, stable-isotope geochemistry and magnetic susceptibility at a variety of locations in Europe, Russia, China and North America. Because the first evolutionary appearance of the conodont *L. zieglerei* in the lineage *L. nodosa*-*L. zieglerei* has unofficially been selected by the task group as the best potential for boundary definition, biostratigraphic investigations continue to focus on refining the biostratigraphic work done on the conodonts, ammonoids, foraminifers corals and other fossil groups.

Members of the group participated in two important meetings during the November 1st - October 31st 2011 fiscal year - 1) "The SCCS Workshop on GSSPs of the Carboniferous System - Carboniferous Carbonate Succession from Shallow Marine to Slope in Southern Guizhou Province, China" [November 22 - 29, 2010] and 2) the XVII International Congress on the Carboniferous and Permian in Perth, Australia [July 3-8, 2011]. During the fiscal year, the most important accomplishment was the completion of a comprehensive study of the foraminifers spanning the Viséan/Serpukhovian boundary in southern Guizhou Province, China by John Groves and his co-authors. The biostratigraphic studies are much further advanced than the other aspects of the work and the focus in the 1st November 2011- 31st October 2012 fiscal year needs to be on the stratigraphy, sedimentology and geochemistry.

Meetings

"The SCCS Workshop on GSSPs of the Carboniferous System: Carboniferous Carbonate Succession from Shallow Marine to Slope in Southern Guizhou Province, China"

The SCCS Workshop, held in Nanjing China from November 22nd to 24th 2010 was organized by Xiangdong, Wang, Yuping, Qi, Yue, Wang and their colleagues and held at the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS) in Nanjing. It consisted of two days of working sessions (examination of conodonts and other fossil groups by task-group members and a day of oral presentations (November 24th). Talks of principal interest to the task group were: 1) Foraminiferal basis for recognizing the Viséan-Serpukhovian boundary at Yashui - by Groves, J., Wang, Y. and Wang, W.; 2) Research progress on both conodonts and foraminifers from the candidate GSSP of the Carboniferous Viséan-Serpukhovian boundary in the Naqing (Nashui) section of South China - by Qi, Y. *et al.*; 3) New results from the Verkhnyaya Kardailovka section (south Urals) - a candidate for the Viséan-Serpukhovian boundary GSSP - by Nikolaeva, S.V., Richards, B.C., Kulagina, E.I., Alekseev, A.S., Pazukhin, V.N. and Konovalova, V.A.; 4) Global ammonoid biostratigraphy of the Viséan/Serpukhovian boundary - by Nikolaeva, S.V.; and 5) The Viséan/Serpukhovian

boundary - an overview and progress report - by Richards, B.C. The workshop was followed by a six-day field excursion (November 25th to 30th) to Carboniferous and latest Devonian exposures in southern Guizhou province. The 2010 field excursion guidebook "Carboniferous carbonate succession from shallow marine to slope in southern Guizhou" 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. The excursion enabled the field-meeting participants to examine the Viséan/Serpukhovian boundary at the shallow-water (peritidal to non marine) Yashui section, the deep-water (lower to middle slope and basin) Nashui (Naqing) and Luokun sections, and the intermediate section at Dianzishang (slope turbidites disrupted by impressive submarine slump to landslide deposits).

XVII International Congress on the Carboniferous and Permian in Perth, Australia (July 3rd -8th, 2011)

Several task-group members attended the congress in Perth, organized by the convener Zhong Qiang Chen and his colleagues at the University in Western Australia, and gave presentations at Symposium 2 - "SCS: Carboniferous stage boundaries" convened by B. Richards, X. Wang and K. Ueno. Of special relevance to the project were the papers: 1) Correlation of the base of the Serpukhovian Stage in northwest Europe and North America - by Sevastopulo and Barham (2011); 2) Summary of research at the Verkhnyaya Kardailovka section (south Urals) - a candidate for the Viséan-Serpukhovian boundary GSSP - by Nikolaeva *et al.* (2011); 3) Global correlations and the Viséan -Serpukhovian stage boundary - by Richards and task group (2011); and 4) Progress on the study of conodonts from candidate GSSPs for the bases of Carboniferous stages in South China - by Qi *et al.* (2011). Task-group members also presented papers in other sessions. The scientists that presented papers plan to have them published in two special journal issues organized by Zhong Chen and his colleagues. The first special issue, provisionally titled-"Multidisciplinary studies of global Carboniferous stage boundaries: toward a better definition and global correlations", will be published in the Geological Magazine in 2012 and the second special issue in the Geological Journal in 2014.

Field activities

Task-group field activities were conducted in several parts of North America, Western Europe and Asia. During late November and early December of 2010, their field work was concentrated in southern Guizhou province, People's Republic of China. In August of 2011, field activities were concentrated in the southern Ural Mountains of Russia.

Southern Guizhou province, Nashui section

From December 1st to 3rd, 2010 a small team including task-group members Qi Yuping and Barry Richards along with two students Wang Wei-jie and Hu Keyi briefly visited the Nashui section (by village of Naqing) near the city of Luodian in southern Guizhou province to finish measuring and sampling the boundary interval for lithostratigraphic and sedimentologic data. Ten metres of strata on either side of the Viséan/Serpukhovian boundary, as defined by the first evolutionary appearance of the conodont *Lochriea zieglerei* Nemirovskaya, Perret & Meischner, 1994 in the lineage *Lochriea nodosa* (Bischoff, 1957) - *Lochriea zieglerei*, were measured at a bed-by-bed level for lithological and geochemical studies. In addition, about one metre of strata on either side of the boundary was sampled continuously by extracting large blocks from each bed in that interval. The beds will be sliced into slabs to reveal sedimentary structures and the nature of depositional events within the beds. The Viséan/Serpukhovian boundary is currently placed at 60.1m above the base of the original section measured by Qi and Wang (2005), which is equivalent to a position 17.94 m above the base of the new section measured and permanently marked by aluminum pins glued into drill holes by the task group in 2008. The base of the 2008

section was placed substantially higher in the succession because a thrust fault and associated tectonic deformation was recognized in the underlying Viséan component of the section.

In the Nashui section, conodonts within the *L. nodosa* - *L. ziegleri* lineage are well preserved and abundant (Qi, 2008). Elements transitional between *L. nodosa* and *L. ziegleri* are plentiful, occurring in several samples, and the oldest representatives of *L. ziegleri* could be readily distinguished from the associated transitional forms of *L. nodosa*. Unfortunately, the conodonts do not allow direct correlation from the Nashui section to the nearby shallow-water Yashui section because of their paucity in the neritic to restricted-shelf facies at the latter locality. During the fiscal year, John Groves and colleagues completed their study of the foraminifers across the boundary interval in the section (Groves *et al.*, in press). The association of foraminifers from a 20 meter-thick interval centered about the boundary at Nashui lack species diagnostic of the boundary but contain ones whose previously established ranges were known to extend from the upper Viséan into the lower Serpukhovian.

Southern Guizhou province, Yashui section

The Yashui section, situated near the city of Huishui in Guizhou province, is important because it contains abundant rugose corals and foraminifers (Wu *et al.*, 2009) and is dominated by shallow-marine neritic to supratidal facies. A major reason for studying the section is to determine the relationship of the coral and foraminiferal zones to the *L. nodosa* - *L. ziegleri* transition in south China. In February 2010, 101.4 m of the Yashui section were measured and sampled (bed by bed) from the upper Viséan into the upper Serpukhovian. From the 4th to the 6th of December of 2010, the measurement of the section at a bed-by bed level was extended into the lower Bashkirian at 121.12 m. Conodont samples collected from the section in 2008-2009 have been processed but yields were poor and the *L. nodosa* - *L. ziegleri* transition could not be precisely located. Additional samples were collected in 2010. Although conodonts have not been recovered, valuable sedimentologic and paleogeographic data were obtained from the section and the diverse coral and foraminifer faunas have proven worthy of study. The section provides an excellent opportunity to see what the shallow-marine and supratidal platform facies are like in southern Guizhou Province. John Groves and his colleagues (Groves *et al.*, in press) completed a comprehensive study of the foraminifers, using samples he collected in May 2008 while Richards was measuring the lower part of the section, gluing aluminum marker pins in holes drilled at 1 metre intervals and starting a sedimentological analysis. Groves *et al.* found that the base of the Serpukhovian could be approximated using foraminifers but a precise correlation with the first evolutionary occurrence of *L. ziegleri* in the Nashui section could not be established because of the lack of foraminiferal indices for the boundary in the Nashui section and the paucity of conodonts through the boundary level at Yashui.

The foraminiferal successions across this boundary in the type area of the Serpukhovian Stage in the Moscow Basin of Russia (Kabanov *et al.*, 2009; Gibshman *et al.*, 2009), the Uralian region of Russia (Nikolaeva *et al.*, 2005; 2009a,b) and in the central United States suggest that the appearances of *Asteroarchaediscus postrugosus* (Reitlinger, 1949), *Janischewskina delicata* (Malakhova, 1956), “*Millerella*” *tortula* Zeller, 1953 and *Eolasiodiscus donbassicus* Reitlinger, 1956 are useful auxiliary indices to the base of the Serpukhovian. The stage boundary at Yashui is provisionally identified at 41.6 m above the base of the section on the appearance of *Janischewskina delicata*. “*Millerella*” *tortula*, another possible index to the base of the Serpukhovian, appears at 49 m above the base of the section (Groves *et al.*, in press).

Asteroarchaediscus postrugosus and *Eolasiodiscus donbassicus*, useful markers for the base of the Serpukhovian elsewhere in Eurasia and North America, have not been observed at Yashui.

Southern Urals, Verkhnyaya Kardailovka section

During August 2010, task-group members Svetlana Nikolaeva, Vera Konovalova, Elena Kulagina, and Barry Richards along with students and several other SCCS members including Alexander Alekseev and Yuriy Gatovsky visited worked at the condensed, deep-water, carbonate section along the Ural River opposite the village of Verkhnyaya Kardailovka on the eastern slope of the southern Ural Mountains in southern Russia. Nikolaeva and her colleagues have worked on the Kardailovka section for several years and published several syntheses about the ammonoids, conodonts, foraminifers and ostracodes (Nikolaeva *et al.*, 2005, Nikolaeva *et al.*, 2009b; Pazukhin *et al.*, 2010). Their syntheses demonstrate the first evolutionary appearance of *Lochriea ziegleri* occurs in the lower part of the limestone-dominant component of the section (basal part bed 22a in Pazukhin *et al.*, 2010) immediately above an interval containing elements transitional between *Lochriea nodosa* and *L. ziegleri*.

In August 2010 and 2011, the lower 22 m of the Verkhnyaya Kardailovka section was extensively excavated with hydraulic equipment (backhoes and front-end loaders). Following the excavations, the section was permanently marked with aluminum pins glued into drill holes at one metre intervals commencing in the upper part of a Viséan crinoid-lime grainstone to packstone unit and ending in lower Bashkirian limestone. In August 2011, the limestone-dominant component of the section was also measured and sampled bed-by-bed for lithology and geochemical samples from about 12 m to 35 m above the section's base. The underlying deposits are dominated by thin-bedded to laminated shale, siltstone and volcanic ash that are not measurable at a bed-by-bed level of detail. During August 2011, the section was systematically sampled for conodonts from 12 m to 20 m above its base. Conodont samples had been collected from the section on several prior occasions but additional sampling was required to more precisely tie the conodont biostratigraphy into the new measurements and to confirm the FAD of *L. ziegleri*.

Future work

Now that several excellent stratigraphic sections containing the *Lochriea* lineage have been located, the task group's goals will be to more precisely establish the FAD of *L. ziegleri* in some of the sections and better document the occurrence of the other biostratigraphically useful fossils. A comprehensive study of the ammonoids is considered particularly significant and is being actively pursued by Svetlana Nikolaeva. Foraminifers are the other main fossil group with substantial biostratigraphic utility and are being actively studied by several task-group members including John Groves, Nilyufer Gibshman, and Elena Kulagina. The regional stratigraphy, geochemistry, sedimentology and geophysical attributes of the GSSP candidate sections for the boundary are not well known; consequently, the Nashui and Verkhnyaya Kardailovka sections are being aggressively studied, and the two best Spanish sections will be studied in the current fiscal year.

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