The Viséan-Serpukhovian boundary beds in the Beleuty Section (Zhezkazgan, Central Kazakhstan)

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Abstract

The definition of the base of the Serpukhovian (Mississippian, Carboniferous) has for many years been a focus of global stratigraphic research. The official Viséan-Serpukhovian boundary at the base of the E1 ammonoid Zone in Europe (*Uralopronorites-Cravenoceras* ammonoid Genozone in Kazakhstan and the Urals) is difficult to precisely identify in many sections, as ammonoids are infrequent. Several alternative markers have been proposed, with the FAD of the conodont *Lochriea ziegleri* one of the primary candidates in northern hemisphere sections (Qi et al., 2018; Nikolaeva et al., 2020). However, its exact position needs to be accurately documented relative to the foraminiferal and ammonoid scales, especially in sections with boundary intervals lacking conodonts. The Beleuty section in Zhezkazgan Region, Central Kazakhstan (Litvinovich et al., 1969; 1985) is among the most complete successions spanning the Viséan-Serpukhovian boundary and containing foraminifers, ammonoids and conodonts. The foraminiferal-based Viséan-Serpukhovian boundary in Kazakhstan was traditionally drawn between the *Eostaffella ikensis - E. tenebrosa - Bradyina rotula - Howchinia gibba* and *Neoarchaediscus parvus-Kasachstanodiscus* Zones (Marfenkova, 1991; Zhaimina, 2002). However, *Neoarchaediscus parvus* (Rauser-Chernousova, 1948) (= *Asteroarchaediscus parvus*) is known from the uppermost Viséan (e.g., Kulagina, 2017), while *Kasachstanodiscus* first appeared in the Middle Viséan, and none of its species seem to be restricted to the Serpukhovian. Therefore, the base of the Serpukhovian defined by foraminifers is being revised in this section, with new zonal species proposed. There are several reported levels with ammonoids in the Beleuty section, the lower one with *Pachylyroceras*, usually found in equivalents of the P2 Zone (= *Hypergoniatites-Ferganoceras* Genozone in Kazakhstan) and upward in the section, several levels with *Cravenoceras*, usually restricted to the E1 Zone. Conodonts, including species of *Gnathodus,* are mostly confined to the Viséan. The Beleuty section is at the southern end of the Ulytau Uplift, 120 km south of Karsakbay. The Beleuty section is on the eastern flank of a trough. The Upper Viséan deposits (mostly Dalnenskian Regional Substage) are conformably overlain by the Beleutian Regional Substage (Zhaimina, 2007, 2010). The Dalnenskian uppermost unit includes limestones (dominant), sandy limestones, siltstones, and less commonly shales. Dalnenskian fossils include Late Viséan ammonoids, foraminifers, conodonts, brachiopods and ostracods (ammonoids: *Pachylyroceras newsomi*, nautiloids: *Endolobus litvinovichae*; conodonts: *Gnathodus girtyi collinsoni*, *G. girtyi girtyi*;

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brachiopods: *Ovatia jagovkini*, *Echinoconchus elegans, E. subelegans*, *Neospirifer nalivkini*, *Spirifer logani latus*, *Productus concinnus*, *Composita trinuclea*, etc.; ostracods: *Shishaella claytonensis*, *Healdianella darwinuloides*, etc. (Zhaimina, 2010). The Beleutian Regional Substage is composed of sandstones, siltstones, shales, various nodular, micritic and argillaceous limestones with ammonoids, foraminifers, corals, brachiopods, bryozoans, gastropods, bivalves, etc. (Litvinovich et al., 1985; Zhaimina, 2007; 2010). The base of the Beleutian was traditionally drawn near the earliest occurrence of *Cravenoceras*. Ammonoids from the lowermost unit are represented by *Cravenoceras beleutense, C. arcticum, C. malhamense, Kazakhoceras hawkinsi*, *Sudeticeras varians karagandense*, *Neoglyphioceras litvinovichae,* and *Beleutoceras carinatum*. Foraminifers include *Eostaffella minuta, Eostaffellina* cf. *paraprotvae*, *Pararchaediscus tumidus*, *P. convexus*, *Archaediscus* cf. *krestovnikovi*, *Howchinia gibba*, *H. gibba longa*, *H. beleutensis*, *Monotaxinoides* aff. *subplanus*, etc. The most informative foraminifer for fixing the base of the Serpukhovian in the section are *Monotaxinoides* aff. *subplanus* and *Eostaffellina* cf. *paraprotvae*, currently revised to be correlated with occurrences of *Pachylyroceras* and *Cravenoceras* in the same section.
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