

# FUSULINOIDEAN BIOSTRATIGRAPHY OF THE UPPER CARBONIFEROUS (GZHELIAN) MIXED CARBONATE-SILICICLASTIC RAMP DEPOSITS IN THE KARAVANKE MTS. (SOUTHERN ALPS, SLOVENIA)

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Sections of the Carboniferous late to post-Variscan sequence in the Karavanke Mts. are commonly exposed in narrow bands or scattered outcrops as a result of a strong overprint by the Alpine tectonics, which is the reason why detailed facies relationships and the biostratigraphic subdivision are still vague. However, a composite lithostratigraphic column of the Upper Carboniferous beds in the Southern Karavanke Mts. shows a very similar succession compared to the Auernig and Schülterkofel Formation described in Carnic Alps (Austria/Italy), e.g. [Forke, 2002; Forke et al., 2006].

## The oldest post-Variscan marine deposits

Late Carboniferous molasse-type deposits unconformably overlie the Variscan flysch (Hochwipfel Formation) and other older basement rocks. The oldest fossil fauna in the Southern Karavanke Mts. has been described by Kochansky-Devidé [1965] from shaly siltstones and sandstones with limestone intercalations containing fusulinids. Within an association of *Quasifusulina longissima* (Moeller), *Schubertella subkingi* Putrja, and *Oketaella?* sp. she described a new subspecies *Protriticites pramollensis serior* as a younger, advanced form of *Fusulinella* [→ *Protriticites*] *pramollensis* Pasini, with keriothecal wall in the outer volutions and a dark, porous diaphanotheca in the inner volutions. She correlated these beds with the middle Kasimovian of the Moscow Basin. Recently Forke [Forke, Samankassou, 2000] and Elisa Villa (pers. comm.) mentioned close similarities of *Protriticites pramollensis serior* Kochansky-Devidé, 1965 with the species *Montiparus subcrassulus* Rozovskaya and thus pointed to a correlation with the late Khamovnikian, possibly Dorogomilovian age of these beds.

In 1986 Kahler described the oldest fusulinoidean assemblages in the Carnic Alps and listed — partly referring to Kochansky-Devidé [1971] and Ramovš [1976] — also localities in the Southern Karavanke Mts. with beds containing *Quasifusulinoides* sp., *Fusiella?* sp., *Fusulinella* sp., *Protriticites* sp., and *P. pramollensis* (Pasini) species. He correlated them with the zone C<sub>3</sub>A<sub>1</sub> (*Fusulina quasicylindrica* – *Obsoletes obsoletus*) of the early Kasimovian (Krevyakinian) in the Donets Basin.

## Sections of Gzhelian rocks

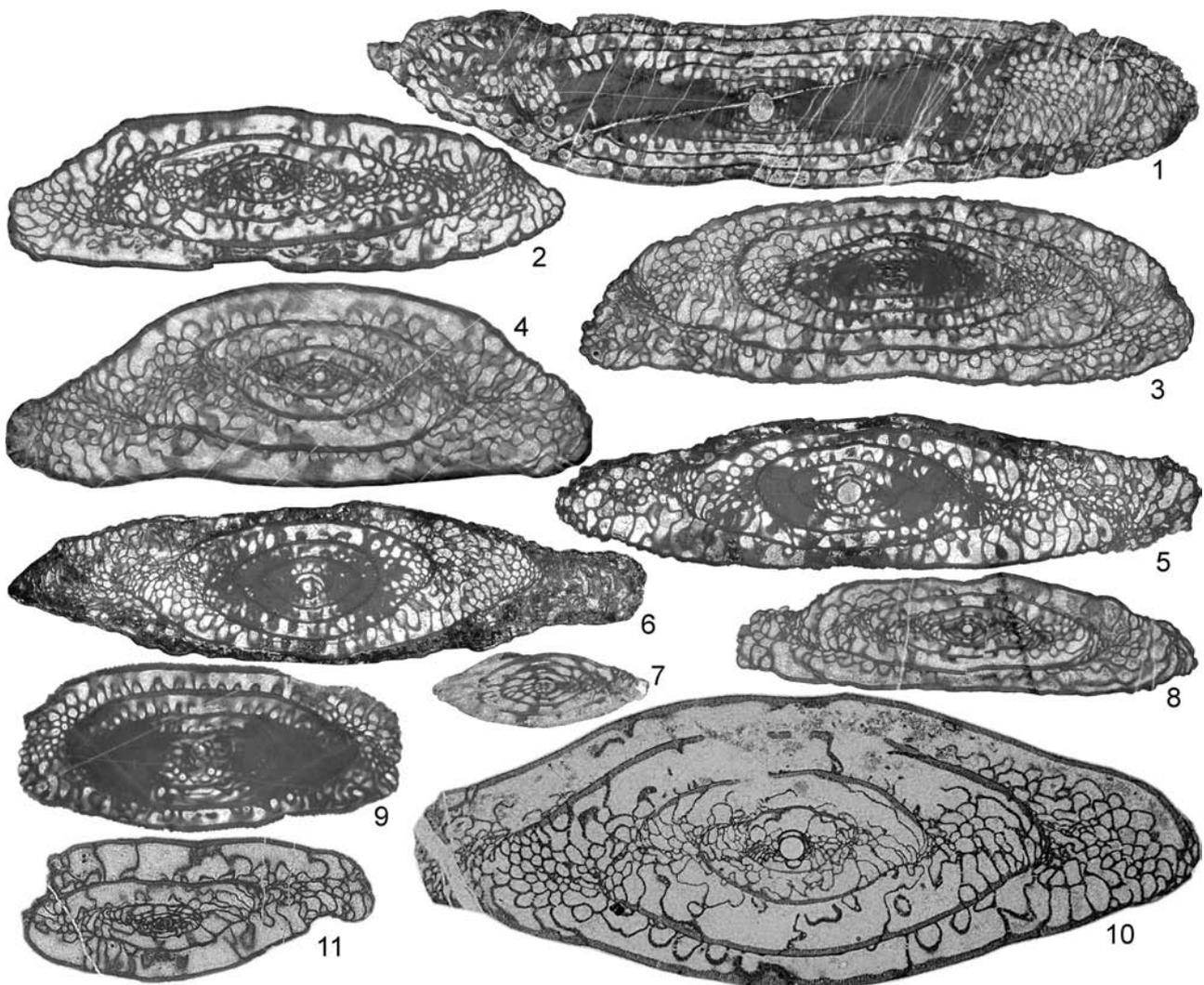
Kochansky-Devidé and Ramovš [1966] have subdivided younger Upper Carboniferous rocks of the Karavanke Mts. into a Gzhelian and Orenburgian stage. A recent restudy of two classic Upper Carboniferous/Permian localities on the southern slope of the Košuta range, the Dovžanova soteska [Novak, 2007] and the Košutnik river section [Forke, 2002], led to a refined fusulinoidean zonation and correlation with adjacent areas.

In the Dovžanova soteska (DS), the sedimentary succession is composed of quartz-rich conglomerates, trough and hummocky cross-bedded sandstones and bioturbated siltstones. Thick limestone complexes between siliciclastics represent algal mounds in which basal, core, flanking and capping beds can be distinguished. Basal beds are usually very rich in fusulinids, smaller foraminifera, ostracodes, gastropods, brachiopods, and bryozoans. Almost unbroken thalli of *Anthracooporella spectabilis* and *Archaeolithophyllum missouriense* build the framework of the massive micritic mound core. In flanking beds, they are accompanied by fragments of phylloid algae *Epimastopora* and *Eugonophyllum*, and encrusted with *Tubiphytes* or small sessile foraminifera *Tuberitina*, *Calcitornella*, and *Calcivertella*. The capping beds are composed predominantly of crinoid debris.

Fusulinoideans in the lower part of the succession are represented by *Daixina (Daixina) alpina* (Schellwien), *D. (D.) communis* (Schellwien), *Dutkevitchia* aff. *multiseptata* (Schellwien), and *Quasifusulina longissima ultima* Kanmera. A similar assemblage is known from the lithologically identical Auernig and Carnizza Members (upper part of Auernig Formation) in the Carnic Alps. It can be correlated with the *Daixina sokensis* zone (Gzhelian E) on the Russian Platform [Krainer, Davydov, 1998; Forke, 2007].

In the upper part of this sequence large inflated forms belonging to the subgenus *Daixina (Bosbytauella)* Isakova occur together with *Dutkevitchia expansa* (Lee), *Rugosofusulina stabilis* (Rauzer-Chernousova), *Schwageriniformis* sp., and *Ruzhenzevites* aff. *parasolidus* (Bensh).

Similar assemblage to the one in the upper part of the Dovžanova soteska occur in the Košutnik river (KR) section which was misinterpreted as a Lower Permian “clastic Trogkofel development” [Kochansky-Devidé et al., 1973]. Well bedded fossiliferous shallow marine limestones alternating with massive algal mounds and quartz-rich clastic beds yield guide fusulinids *Daixina (Bosbytauella) postgallowayi* Bensh, *D. (B.) bosbytauensis* Bensh and *Dutkevitchites alpinus* (Kahler and Kahler, 1941) [Forke, 2002].



**Fig. Fusulinoidean fauna of Gzhelian rocks in the Southern Karavanke Mts. ×10 magnified**

1. *Quasifusulina longissima ultima* Kanmera, 1958; Auernig Fm., DS. 2. *Daixina (Daixina) alpina* (Schellwien, 1898); Auernig Fm., DS. 3. *Dutkevitchia* aff. *multiseptata* (Schellwien, 1898); Auernig Fm., DS. 4. *Daixina (Daixina) communis* (Schellwien, 1898); Schulterkofel Fm., DS. 5. *Ruzhenzevites* aff. *parasolidus* (Bensh, 1962); Schulterkofel Fm., DS. 6. *Dutkevitchia expansa* (Lee, 1927); Schulterkofel Fm., DS. 7. *Schwageriniformis* sp.; Schulterkofel Fm., DS. 8. “*Schellwienia*” sp; Schulterkofel Fm., DS. 9. *Rugosofusulina stabilis* (Rauzer-Chernousova, 1938); Schulterkofel Fm., DS. 10. *Daixina (Bosbytauella) postgallowayi* Bensh, 1962; Schulterkofel Fm., KR. 11. *Dutkevitchites alpinus* (Kahler and Kahler, 1941); Schulterkofel Fm., KR

This assemblage corresponds to the fusulinoidean fauna of the Schulterkofel Formation (former Lower *Pseudoschwagerina* Limestone) in Carnic Alps and indicates the *Daixina* (*B.*) *bosbytauensis*-*Daixina* (*B.*) *robusta* zone (Gzhelian F) in the Darvaz area (Central Asia) and in the Southern Urals [Kahler, Krainer, 1993; Forke et al., 1998; Krainer, Davydov, 1998; Forke, 2002].

Lithofacies types in both described sections indicate sedimentation on a gently steeping ramp with storm dominated depositional mechanisms in a coastal to shallow marine setting and strong influence of coarse-grained fluvial/fan-deltaic deposits from the hinterland. Just below the storm wave base calcareous algae formed massive mounds [Novak, 2007]. However, in the Auernig Formation nearshore facies types predominate, while the deposition of the Schulterkofel Formation shifted to a more open marine inner shelf environments. The sedimentary succession shows a clear cyclic siliciclastic-carbonate depositional pattern, known as Auernig cyclothems in the similarly developed units in Carnic Alps (Austria/Italy). Rapid facies changes reflect both high frequency and high amplitudes of sea-level changes due to glacio-eustatic control associated with waxing and waning of the Gondwanan ice sheet [Samankassou, 1997].

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