

## Devonian Algal Flora of the Graz Palaeozoic and palaeo(bio)geographic implications

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The Lower to Middle Devonian (Emsian – Eifelian) calcareous green algal flora of the Graz Palaeozoic contains halimedalean representatives of the genera *Pseudolitanaia*, *Pseudopalaeoporella*, *Zeapora*, *Maslovina* and a new lanciculoid taxon. Findings within the Graz thrust complex are restricted to four localities in the Rannach Nappe and may be characterised as monogeneric mass occurrences (Fig. 1). Consequently, they are interpreted as algal bafflestones originating from halimedalean meadows.

FENNINGER & HOLZER (1978) mentioned sections of the Flösserkogel Fm containing remains of “dasyclads” in the tidal flat-deposits at Pfaffenkogel (approx. 10 km north of Graz). Although further investigations confirm the occurrence of reworked *Ortonella*-remains and pieces of Halimedaes, algal thalli suitable for taxonomic determination have not been found.

So far well-preserved determinable algae have been recorded only from the following four localities:

Locality 1: N 47°08'25"/ E 15°15'27"

At a forest road north of the Rein monastery (ca. 20 km North of Graz) dark-grey to black, micritic to pelmicritic dolomites of the Flösserkogel Fm contain small disarticulated lanciculoid algae. The algal thalli consist of 8-15 articuli; anatomic details can only be made visible by using a darkfield condensator.

Locality 2: N 47°03'40"/ E 15°22'34"

Restricted to one single outcrop area in the former illite mine on the southern slope of the Kollerkogel at the border to the urban area of Graz *Zeapora* originates from the Plabutsch Fm. The thalli occur in a graphitic horizon only a few cm above the illite at the base of the Plabutsch Fm.

Locality 3: N 47°05'25"/ E 15°22'11"

The occurrence of *Pseudopalaeoporella lummatonensis* and *Pseudolitanaia graecensis* is also located near the city of Graz (forest road Attems at the southern slope of the Frauenkogel). The upper parts of the Plabutsch Fm are characterised by alternating layers of clayey limestones, red mudstones and marls. In the clayey limestones masses of *Pseudopalaeoporella lummatonensis* and only a subordinate number of *Pseudolitanaia graecensis* thalli occur.

Locality 4: N 47°08'01"/ E 15°11'02"

Along the road about 2 km South of St. Pankrazen (30 km NW of Graz) the lower parts of the Plabutsch Fm contain a mass occurrence of *Maslovina*. The horizon lies only a few dm above the base of the shale horizon which corresponds in its position to the illite of the Kollerkogel.

Characterisation of the taxa:

*Pseudolitanaia graecensis* (HUBMANN 1990)

Thallus erect, cylindrical and continuous; central parts consist of 4 to 12, generally 8 irregular filaments with appendices which develop towards a high number of cortical filaments. Cortical filaments are more or less oblique with a significantly increasing diameter and a spatula-shape. They end up as fine filaments of second order dichotomy and their termination resembles *Pseudopalaeoporella*.

*Pseudopalaeoporella lummatonensis* (ELLIOTT 1961)

Thalli cylindrical with a medullar zone and an extensive radial envelope. Medullar zone composed of several central tubes: central filaments are arranged parallel to the thallus axis and are closely spaced. Cortical filaments develop in acute angles into numerous lateral tubes with a second and third order dichotomy. Filaments are commonly swollen just below the points of branching and widen trumpet-like.

*Zeapora gracilis* (PENECKE 1894)

Thalli clearly show numerous peripheral tubules arranged around a central axis filled with a bundle of medullar filaments. Medullar zone consists of 4 to 6 (up to 10 and more) slightly interwoven filaments. Cortical zone filled with massive carbonate deposits and perforated by roundly-elongated, densely packed filaments. Cortical filaments vary considerably in longitudinal and cross sections due to different orientation of their bowling-like shapes.

*Maslovina* sp.

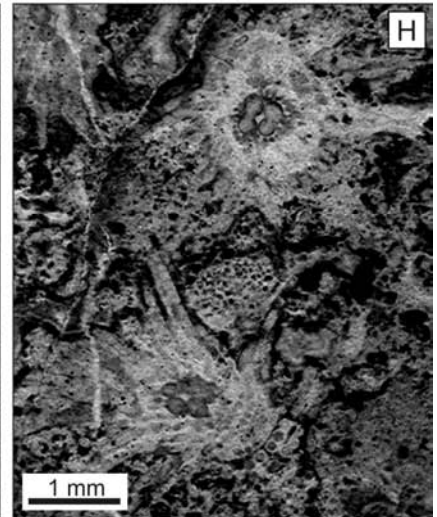
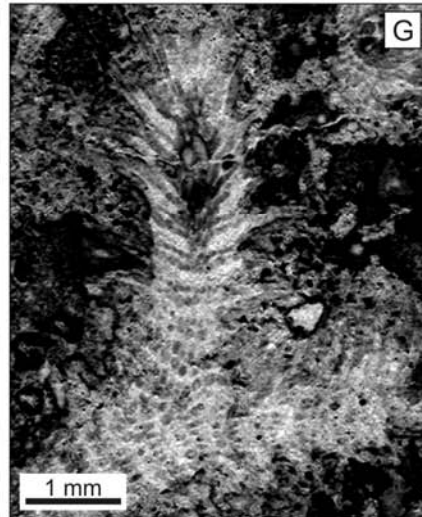
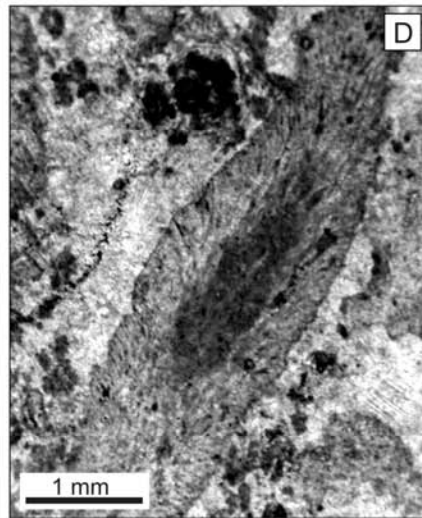
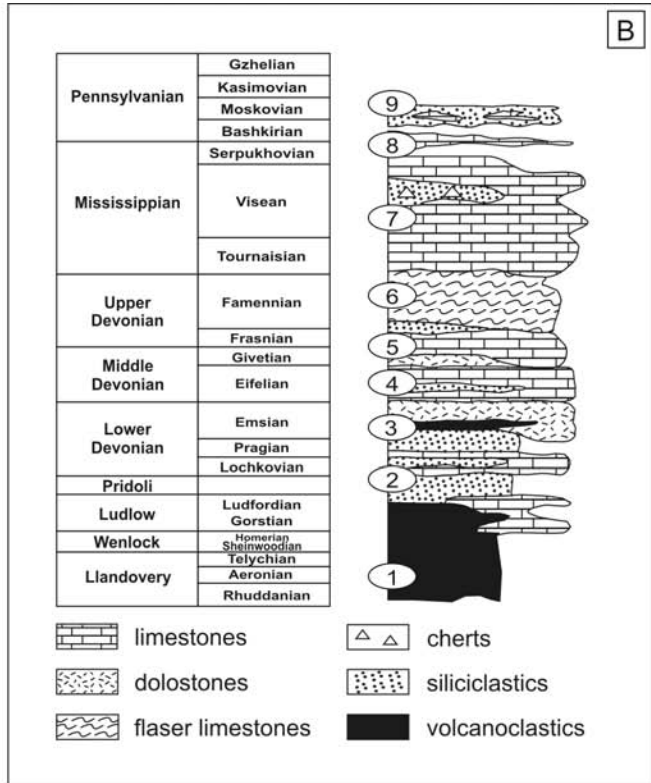
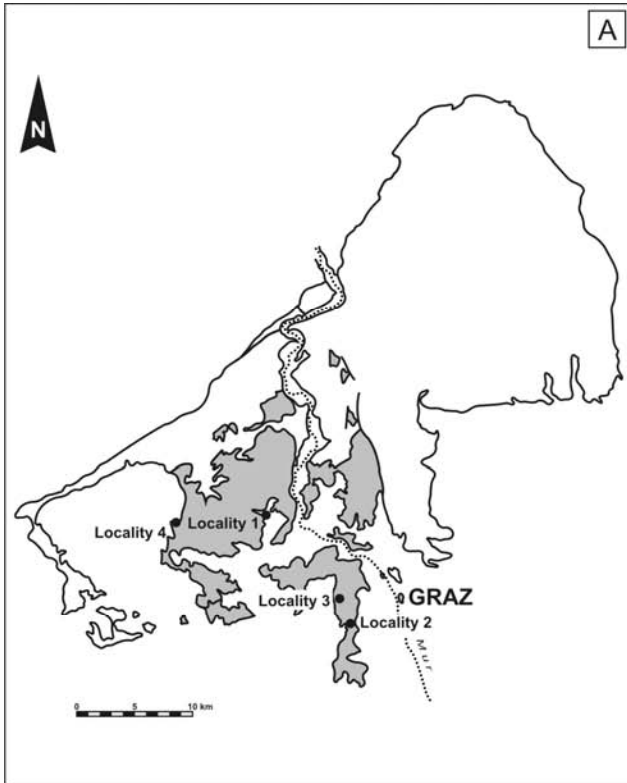
Thallus straight, occasionally undulated. Medullar part consists of a high number (>40) of interwoven filaments giving rise to finer, cortical filaments. Cortical filaments divide up dichotomously at an acute angle and reach a third order dichotomy at the outermost cortical part. At this stage cortical filaments develop towards densely packed amphora-shaped utricles which constitute the thallus surface.

## Undetermined lanciculoid alga

Regularly segmented algal bodies consisting of up to 25 bowl-shaped elements (articuli, chalices) surrounding a straight or slightly bent stem (rhachis). Occasionally thallus ramifications are observed. Internal assembly of four central filaments pervading the whole thallus; a great number of cortical filaments branch off radially and perpendicularly to the central axis decreasing their angles with growth. Each tapered segment contains two rows of cortical filaments and increases its diameter towards growth direction. Segments resemble the bell of a trumpet and are densely stacked one above the other.

The outer morphology of the articuli of our lanciculoid alga resembles the genus *Quasilancicula*, but its chalices are more compressed. Its tentacle-shaped chalice edges, however, show similarities with *Lepidolancicula*.

Fig. 1: A. Simplified sketch of the Graz Palaeozoic. Shaded patches correspond with the outcropping area of the Rannach Nappe. Numbers of localities indicate the algal findings mentioned in the text; B. Stratigraphic column of the Rannach Nappe. 1. Kehr Fm, Kötschberg Fm, 2. Parmasegg Fm, 3. Flösserkogel Fm, Bameder Fm, 4. Plabutsch Fm, 5. Kollerkogel Fm, 6. Steinberg Fm, 7. Sanzenkogel Fm, 8. Höchkogel Fm, 9. Hahngraben Fm; C. Thin-section of *Pseudolitanaia graecensis*, transversal section exhibiting dichotomous offsets of cortical filaments that branch off coarse medullary filaments. Locality 3; D. Oblique longitudinal section of *Pseudopalaeoporella lummatonensis* showing a well defined cortical zone and a poorly calcified central axis. Locality 3; E. Oblique longitudinal section of *Zeapora gracilis*; note the large peripheral tubules filled with coarse-grained sparite. Photomicrograph of thin-section illuminated by darkfield condenser; F. Longitudinal section of a fragment of *Maslovina* sp.; note arrangement of numerous, fine medullary filaments; G. Longitudinal section the lanciculoid alga. Photomicrograph of thin-section illuminated by darkfield condenser; H. Cross-section exhibiting four coarse medullary filaments. Photomicrograph of thin-section illuminated by darkfield condenser.



Palaeo(bio)geographic consideration:

Identical taxa on species level are known from the Rhenohercynian zone and the Cantabrian Mountains; in addition *Pseudopalaeoporella* is known from the Urals and Karakorum Mountains whereas *Maslovina* also occurs in Australia.

Halimedalean algae are of special interest for palaeo(bio)geographic consideration since their way of life remained unchanged during Earth's history and current palaeontological deductions can be readily applied. In summary the following is applicable to the Devonian of Graz:

The occurrence of halimedacean green algae suggests a deposition inside the 25°C isotherm (matches approximately latitude 30°) within the "Rheic Ocean".

The conspecific algal flora of the Devonian of Graz, Ardennes/Belgium, Rhenish Slate Mountains, Harz/Germany, Armorican Massif/France, and Cantabrian Mountains/Spain, and the palaeogeographic position mentioned above leads to the assumption that the Graz terrane and the Aquitaine-Cantabrian-Terrane occupied adjacent locations during Emsian and Eifelian times.

Conspecific/comparable taxa of different organisms on both sides of the Rheic Ocean suggest that no continuous and separating fold belt between the Gondwanan north shelf areas and the Laurussian south shelf areas existed.

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