

Fig. 9. Forest road Attems. Section of the Plabutsch Fm. subdivided into 5 biofacial sections: a: Siliciclastic Brachiopod-Trilobite-Biofacies ("Chonetenschiefer" = Gaisberg Bed) with: *Chonetes* sp., *Maladaia* sp., and crinoids; b: Coral-Stromatoporoid-Biofacies with: *Actinostroma* sp., *Thamnophyllum stachei*, *Thamnophyllum murchisoni*, *Favosites styriacus*, *Thamnopora* sp., *Striatopora* sp., *Pachycanalicula barrandei*, *Heliolites* cf. *peneckeii*, Crinoids; c: Coral-Brachiopod-Biofacies with *Thamnophyllum stachei*, *Thamnophyllum murchisoni*, *Thamnopora reticulata*?, *Thamnopora* sp., *Striatopora* (?) *suessi*, *Favosites* sp., *Chonetes* sp., "Spiriferids", Crinoids; d: Algae-Biofacies with *Pseudopalaeoporella lummatonensis*, *Pseudolitanaia graecensis*; e: Brachiopod-Coral-Biofacies with: *Zdimir* cf. *hercynicus*, *Thamnopora* cf. *reticulata*, *Striatopora* (?) *suessi* (modified from HUBMANN, 2003).

3.3. Stop 3 – Quarry Trolp/Forstkogel

Topic: Devonian–Carboniferous boundary; type locality of Lower Sanzenkogel Formation; type locality of the conodont taxon *Polygnathus styriacus*.

Locality: Abandoned quarry "Trolp", 47°04'7"N/15°19'18"E.

Lithostratigraphy: Steinberg Formation and Lower Sanzenkogel Formation (type section).

Biostratigraphy: *Bispathodus costatus* Zone to the *Gnathodus typicus* Zone.

Chronostratigraphic age: Famennian/Tournaisian boundary.

Description: The abandoned quarry exhibits an overturned stratigraphic sequence of the upper parts of the Steinberg Formation (Frasnian–Famennian) and the Lower Sanzenkogel Fm.; it is the type locality of the Famennian conodont taxon *Polygnathus styriacus*.

In the eastern face of the quarry an overturned section from the latest Devonian *Bispathodus costatus* Zone to the *Gnathodus typicus* Zone is exposed. This section includes the site which was discussed as a favourite for the international Devonian–Carboniferous boundary stratotype (SANDBERG et al., 1983; ZIEGLER & SANDBERG, 1984), the type section of the 220 cm Tournaisian Lower Sanzenkogel Fm. and a 20 cm thick horizon with shale, lydite and



Fig. 10. Typical fossils of the Plabutsch Formation. 1) *Thamnophyllum stachei* PENECKE, 1894, x 1,5; 2) *Thamnophyllum purchisoni* PENECKE, 1894, x 1,5; 3) Fragment of a calyx of *Tryplasma devonica* (PENECKE, 1894), x 1,5; 4) Fragment of a calyx of *Zelophyllia cornuvaccinum* (PENECKE, 1894), x 0,75; 5) *Disphyllum caespitosum* (GOLDFUSS, 1826), x 1,5; 6) *Pachycanalicula barrandei* (PENECKE, 1887), x 1,5; 7) *Thamnopora reticulata* (BLAINVILLE, 1830), x 2,2; 8) *Thamnopora vermicularis* (M'COY, 1850), x 2,2; 9) „*Striatopora*“ *suessi* PENECKE, 1894, x 2,2; 10) *Thamnopora boloniensis* (GOSSELET, 1877), x 2,2; 11) *Favosites styriacus* PENECKE, 1894, x 1,5; 12) *Atrypa reticularis* LINNE, x 1,5; 13) *Zeapora gracilis* PENECKE, 1894, x 3. All specimens are from the private collection of Fritz Messner.

phosphorite nodules (Trolp Phosphorite Bed) at the bottom of the Upper Sanzenkogel Fm. (Figs. 11, 12).

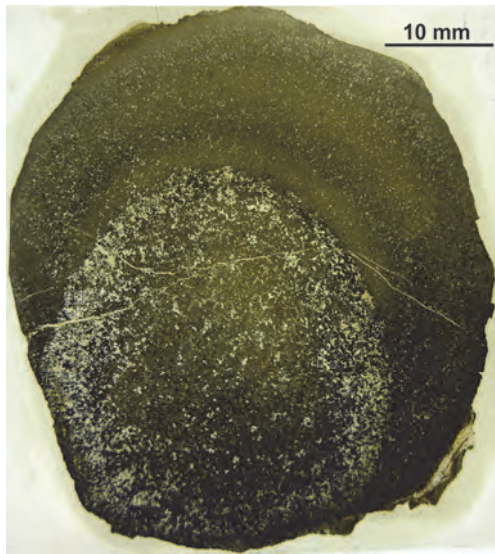


Fig. 11. Thin section of a phosphorite nodule with radiolarians from the Trolp Phosphorite Bed.

The sparsity of macrofossils and siphonodellid conodonts excluded this section as international boundary stratotype. In the section (Fig. 13) the beginning of the Carboniferous is indicated by the first occurrence of *Protognathodus kuehni*. *Siphonodella sulcata* as the international index conodont for the base of the Carboniferous was not yet found in the lowermost 20 cm of the Lower Sanzenkogel Fm. (EBNER, 1980; SANDBERG et al., 1983; ZIEGLER & SANDBERG, 1984; KAISER, 2005).

The boundary section is part of a 220 cm intensively investigated (conodonts, microfacies, stable isotope geochemistry) section (KAISER, 2005). The light-grey to ochre, sometimes nodular and flaser-bedded marly cephalopod limestones are rich in conodonts (CAI ~4.5) and represent a complete succession from the latest Famennian *Siphonodella praesulcata* to the Tournaisian *Siphonodella sulcata* Zone. At top

of bed 9 there is a lithological change in form of a 1 cm thick argillaceous layer followed by thin bedded (~1–2 cm) marly limestones (mud- and wackestones) above which the base of the Carboniferous was recognised by the occurrence of *Protognathodus kuehni*. Due to the poor conodont fauna the marly bed is correlated with the main extinction phase of the Hangenberg event at top of the middle *Siphonodella praesulcata* Zone. This level is characterised by a positive $\delta^{13}\text{C}$ isotope excursion which coincides also with a main extinction phase during the deposition of the Hangenberg black shale in Germany and

indicates a global perturbation of the carbon cycle during a period of warm seawater (KAISER, 2005).

The Tournaisian Trolp-Phosphorite Bed at the base of the Upper Sanzenkogel Fm. includes lydite with fragments of radiolarians (EBNER & HUBMANN, 2012). It indicates the deepening of the environment resulting in the formation of phosphorite nodules along upwelling zones of the Carboniferous shelf margin (EBNER et al., 2000).

References: NÖSSING (1974), EBNER (1980), EBNER et al. (2000), EBNER & HUBMANN (2012), KAISER (2005).



Fig. 12. Type section of the Tournaisian Lower Sanzenkogel Fm. and the 20 cm thick horizon with shale, lydite and phosphorite nodules (Trolp Phosphorite Bed) at the bottom of the Upper Sanzenkogel Fm.

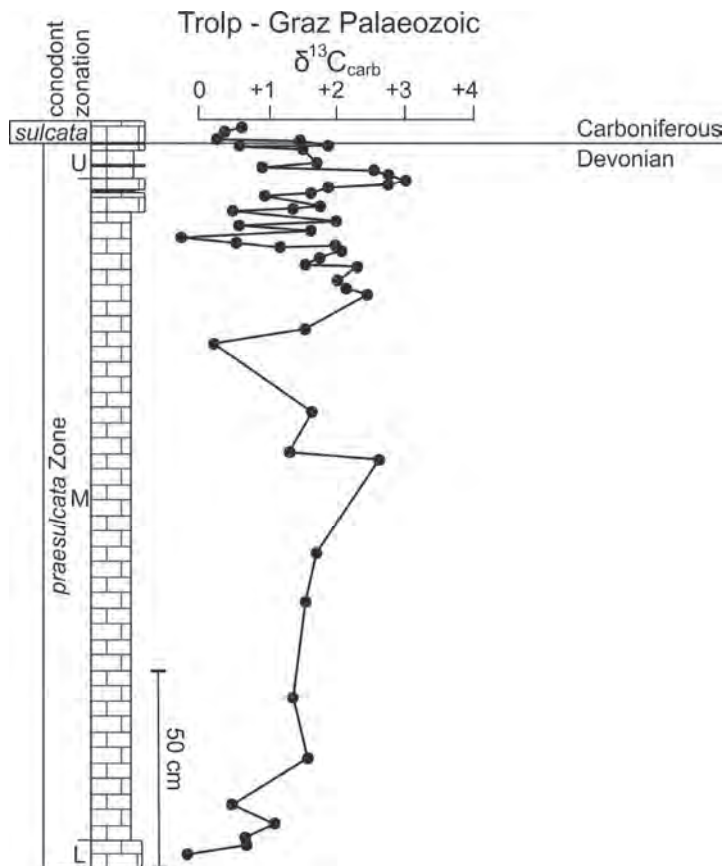


Fig. 13. Detail section across the Devonian–Carboniferous boundary (Steinberg Fm.–Lower Sanzenkogel Fm.) in the Trolp Quarry with the range of the conodonts and $\delta^{13}\text{C}_{\text{carb}}$ values (KAISER, 2005). Note the isotopic excursion in bed 10 and 11 and that in nature the section is inverted.

3.4. Stop 4 – Eastern slope of Höllerkogel (as an alternative to Stop 2 – Forest road Attems)

Topic: Shallow marine succession, very rich in tabulate and rugose corals and stromatoporoids.

Locality: Forest road at the eastern slope of Höllerkogel, 47°09'20"N/15°12'28"E.

Lithostratigraphy: Plabutsch Formation.

Biostratigraphy: –

Chronostratigraphic age: Eifelian; locally the sequence may range from upper Emsian to lower Givetian.

Description: The recently exposed section through the Plabutsch Formation along a forest path at Höllerkogel (near St. Pankrazen; W-Styria) provides an outstanding insight into a sequence of bioclastic limestones very rich in fossils.

In the course of forestry work a new profile through the upper portions of the Plabutsch Fm. was exposed which is built of mostly thick beds of dark grey-blue limestones. These beds (up to 60 to 80 cm) often result in layers strongly enriched fossil detritus. Corals or branches of coral respectively are often enriched suggesting that they did not have wide transport (Fig. 14). Presumably they derive from a thamnoporid coral carpet, which was destroyed by storm events.

References: EBNER & HUBMANN (2012), HUBMANN (1993, 2003), HUBMANN et al. (2003), HUBMANN & MESSNER (2005).