Field trip guide; July 24, 2009; Stop 1:

The Rüdersdorf Muschelkalk Quarry

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The Muschelkalk Quarry in Rüdersdorf is situated about 25 km east of the centre of Berlin (N 52°28'40", E 13°47'12") and represents the most significant geological and palaeontological quarry in the larger Berlin area. Natural exposures of Mesozoic sediments are very rare in the states of Berlin and Brandenburg, due to glacial abrasion and subsequent deposition of glacial till during the Pleistocene.

The Rüdersdorf Muschelkalk lies at the northern flank of an anticline formed by salt tectonics and is positioned on the western border of the Northern German-Polish Salt Diapir Basin, which spans from the North Sea to the Polish mountain ranges. Here, an accumulation of more than 2500 m of salt in the underlying Permian Zechstein sediments caused an uplift of overlying sediments up to the erosional surface level. The strata around Rüdersdorf are part of such a dome and all sediment in the quarry shallowly dip with 15-20° to the north. The complete structure is divided in two parts by a large fault with an offset of 200-300 m. The remaining joints and faults are arranged in a radial pattern and are often infilled with interesting minerals, such as the coelestin deposits within the Wellenkalk.

The Rüdersdorf locality is of special economic importance because it is the northernmost deposit of Muschelkalk limestone in Eastern Germany and because of its vicinity to Berlin. Quarrying of limestone began as early as the 13th century and today the company Rüdersdorfer Zement GmbH is one of the largest cement producers in central Europe. The impressive quarry now includes an area that is about 4 km long, 1 km wide, and 60 m below the groundwater table. Rock is quarried from three 30 m cliffs. The century-long quarrying has exposed a Triassic profile (Fig. 1) ranging from the Upper Buntsandstein (*Pelitröt-Folge*) up to the Upper Muschelkalk (*Hauptmuschelkalk-Folge*).

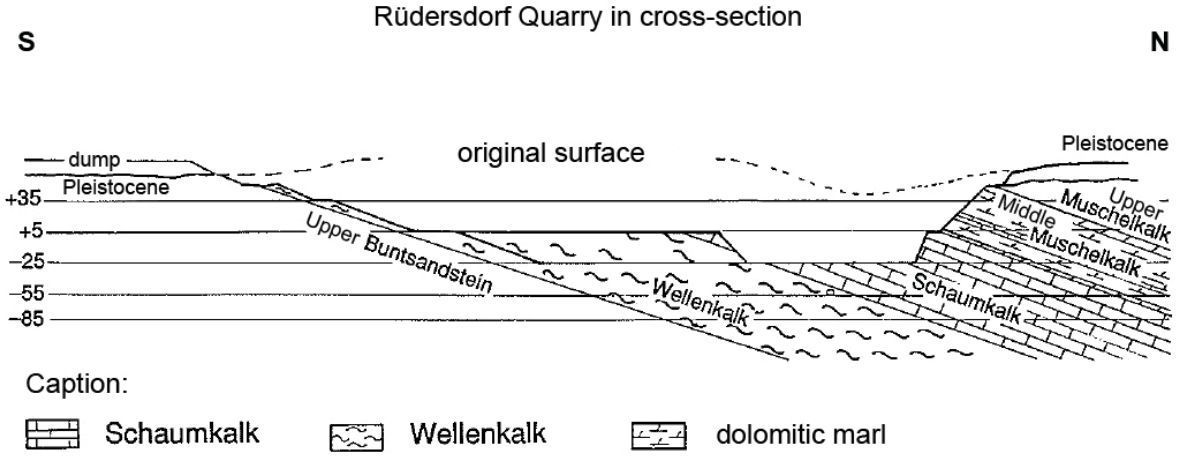

Fig. 1. Cross-section of the quarry. Modified from Streichan (1990).

The Middle Triassic Muschelkalk (literally: shell limestone) Group is lithostratigraphically divided in Germany into three subgroups, Lower, Middle and Upper Muschelkalk, which comprise of several regional formations each, most of which are restricted to Southern Germany. The Lower Muschelkalk, sometimes called *Wellenkalk* (literally: wave limestone), is divided into five lithostratigraphic formations

and consists mainly of limestone, calcareous marls, and clayey marls. Some beds are composed of porous cellular limestone (*Schaumkalk*, literally: foam limestone), which were formed by dissolution of ooids. The Middle Muschelkalk is divided in five formations which typically consist of evaporites (gypsum, anhydrite and halite). The Upper Muschelkalk (Hauptmuschelkalk) is divided into nine formations. It is more similar to the Lower Muschelkalk and consists of regular beds of shelly limestones, marls and dolostones. The lower portion (*Trochitenkalk*) is often composed entirely of fragmentary stems of the crinoid *Encrinus liliiformis*; younger beds commonly yield ceratites.

In the Rüdersdorf Quarry, the contacts of the Lower Muschelkalk with the Bundsandstein below and the Middle Muschelkalk above have been determined on the basis of technical criteria instead of internationally used geological features. The exposed Muschelkalk section is geochemically divided into "quality horizons" A to T (Fig. 2), mainly on the basis of differing carbonate contents. Quality horizons R, S and T are currently not exposed in the quarry. The Wellenkalk, a marly limestone, is used for cement production, the Schaumkalk, a clean limestone, is used for quick lime production. The magnesium-rich Middle Muschelkalk marls are used as fertilizer in agriculture.

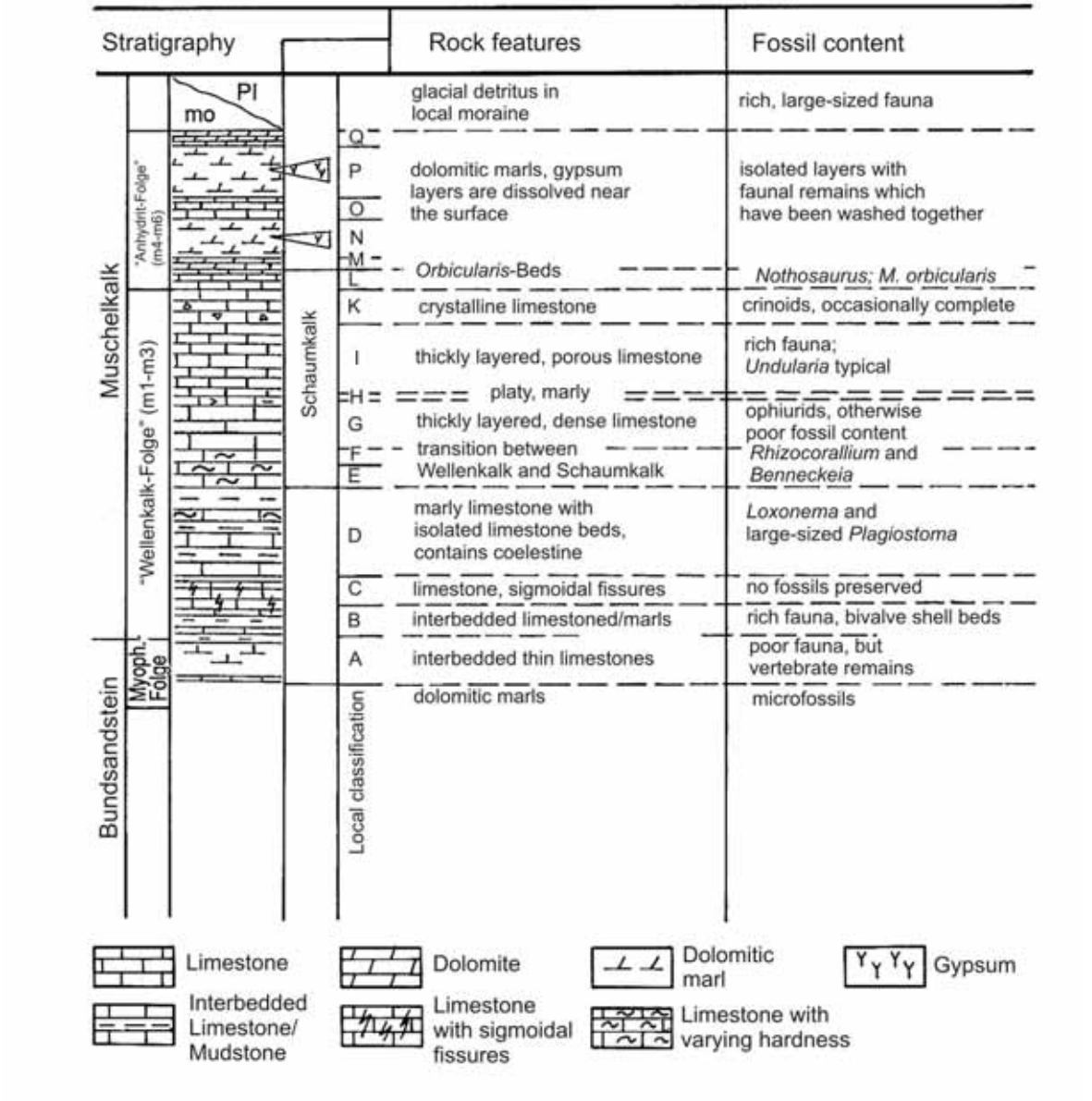

Fig. 2. Stratigraphic profile and fossil content of strata exposed in Rüdersdorf Quarry. Modified from Streichan (1990).

While the spectrum of fossils found in Rüdersdorf is generally similar to other Muschelkalk localities, there are some distinctive features. The special palaeogeographical position near the Southeast-European Faunal Passageway during the Lower Muschelkalk and the shallow exposure of the Rüdersdorf area with other nearby shelf areas resulted in rapidly changing ecological conditions and varying fossil preservation. Two stratigraphic units within the profile are especially rich in well-preserved fossils: 1. the transition of the Myophorien-Folge to the Wellenkalk-Folge (Horizons A and B9) and 2. the upper 40 m of the Schaumkalk (Horizons I and K).

The Upper Muschelkalk is very rich in invertebrate fossils, such as cephalopods (ceratites, nautilids), bivalves, brachiopods, gastropods, and echinoderms (crinoids, ophiuroids, echinoids). Vertebrate remains are comparatively rare, but may be found with some luck, for example in the basalmost layer of Horizon A.

Isolated teeth, fin rays, and scales of fishes are the most common vertebrate fossils in the Muschelkalk. The German Triassic Basin has preserved a unique association of fossil fishes, which is generally depauperated in genera and species relative to surrounding oceans. This is also demonstrated by the fossil fishes from Rüdersdorf. Fossil selachians are known only by isolated remains, especially the teeth of the small hybodontid sharks *Hybodus*, *Acrodus*, and *Palaeobates*. Actinopterygians are represented mainly by remains of archaic taxa from the Palaeozoic, such as the conical teeth of the predatory *Saurichthys* und *Birgeria*. However, rounded teeth of the durophageous taxon *Colobodus* demonstrate also the presence of more advanced neopterygians in Rüdersdorf. The most common scales are the diagonally grooved ganoid scales of *Gyrolepis*. Fossil reptiles are mostly represented by commonly abraded isolated teeth and bones of sauropterygians. The most common sauroperygian fossils are the slender, slightly curved, and strongly grooved teeth of *Nothosaurus* and the black and rounded durophageous teeth of *Placodus*. Placodontians were common elements of the German Muschelkalk and fed on the rich shellfish fauna of the Muschelkalk-ocean. Nothosaur remains are even more common in Muschelkalk deposits and are regarded as index fossils, but they are mostly represented by isolated bones. Hence, the find of a complete skeleton of *Nothosaurus marchicus* in Rüdersdorf is of special significance. The specimen is now on display at the Museum für Naturkunde Berlin.

In addition to its significance as a Triassic Muschelkalk exposure, the Rüdersdorf Quarry is also of historical importance for glaciology. In the year 1875, Otto Torell discovered grooves on limestone surfaces, which he correctly interpreted as glacial striations. This was the final proof of that Scandinavian glaciation once extended south of the Baltic Sea.

Please note that the complete quarry area of Rüdersdorf must only be entered with permission of the general management. Permission is given to guided groups only.

Further reading:

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