

Geology of the excursion area

The geological setting of Bavaria

More than 600 million years of earth's history are documented by rocks in Bavaria. Due to character, stratification and tectonic properties the following major structural units are distinguished: Alps, molasse basin, cuesta region and the basement complexes of the Bohemian massif and the Spessart (Fig. 1). The major tectonic units of the Bavarian Alps are Northern Calcareous Alps, Flysch, Helveticum and Folded Molasse. Their Mesozoic to Tertiary rocks were overthrust, folded and piled-up by plate tectonic activities mainly in Cretaceous and Tertiary times. Between Alps and Danube river, the „molasse“ basin was filled with the erosional debris of the growing Alps in Tertiary. In the south and west of the Alps traces of glaciers and adjacent gravel terraces form the landscape. From the Danube river to the Main, the cuesta region as a part of the South-German mega-block extends and reveals increasingly older sections of the Mesozoic era. The wide depression of the Nördlinger Ries is a sign of a meteorite impact in the Tertiary. In eastern and northeastern Bavaria and in parts of the Spessart, crystalline basement rocks form the landscape. They derived either from pre-existing sedimentary rocks or from intruded plutonites, which were transformed into metamorphic rocks under high pressure and temperatures during the Variscan orogenesis. Some areas of Frankenwald and Fichtelgebirge consist of weakly metamorphic rocks of Paleozoic age. Quaternary Sediments are common in all regions of the country.

Fig. 1: Geological map of Bavaria; after GeoBavaria (2004).

Cuesta Region of Franconia

Between Spessart and the Danube river the landscape is formed by Mesozoic sedimentary rocks. During the Jurassic and Triassic periods sediments were deposited within the continental to shallow-marine German Basin, which bordered the „Bohemian land“ to the east and the „Vindelician land“ to the south. In Permian, Cretaceous and Tertiary times, sediments accumulated only regionally. Due to the north drift of the Alps the stratigraphic sequences were tilted a few degrees: thus, the oldest rocks outcrop in the northwest, the younger ones in the south and east. Weathering and erosion created the typical cuesta appearance.

The geological setting of Franconian Alb

Already in the uppermost Triassic (Rhaetian), large areas of northern Bavaria were a sandy delta landscape, which was flooded by sea water from the north during Lower Liassic times. Before earliest Dogger times, mudstones and marls, partially also fossilrich bituminous oil schists and limestones were deposited in waters depleted of oxygen. Rocks of the Liassic and the earliest Dogger characterize the flat fertile foreland of the Franconian Alb.

They are overlain by brown iron sandstones with layers of iron ore, which constitute its first cuesta. The middle and Upper Dogger consist of variable and fossilrich, but thin limestones, oolitic limestones and marls.

Fig. 2: Upper Jurassic Ocean during the formation of "Solnhofener Plattenkalke" (Lower Tithon); after GeoBavaria (2004), S. 42.

During the Upper Jurassic (Malm), also the Vindelician land mass, which had acted as a continental barrier in the South of the German Basin so far, was finally flooded. In the shallow shelf sea, limestones, marls and dolomites developed in a tropical climate (Fig. 2 & 3). Their characteristic rock formations of reef dolomites and massive limestones are impressive landmarks in the Franconian Alb. Excellently preserved fossils, which were found especially in platy limestones form interreef lagoons of Uppermost Jurassic age are well known (e.g. the „archaic“ bird Archaeopteryx). The karstified Malm rocks are important groundwater formations and mass raw materials.

Fig. 3: Geological Section through Franconian Alb; after NOLLAU 1989, Abb. 2.

During the Lower and earliest Upper Cretaceous times northern Bavaria was entirely emerged land and therefore exposed to weathering and erosion (Fig. 4a). Sands, clays (occasionally colored clays) and iron ores were deposited only in karst cavities (Fig. 4b). In the upper Cenomanian, sea water from the South encroached towards the Franconian Alb. This brought in the „Gulf of Regensburg“ the deposition of sandstones and marls, which were intercalated with layers of clay, lime and conglomerate, almost through the whole Upper Cretaceous time (Fig. 4c). More to the north, continental Sedimentation with detrital sand- and mudstones predominated. In northern Bavaria sediments of cretaceous age are mainly conserved in tectonic depressions and karst cavities.

Fig. 4: Development of landscape in Northern Franconian Alb after the Jurassic; after GLASER et al. 2001, S. 35

Alb loam occurs in the Franconian Alb as a surface formation occasionally several meters thick and as filling of karst cavities. These residual deposits are the result of the tropical to subtropical carbonate weathering during the Tertiary and are often mixed with solifluction and loess loams of the Pleistocene. Additionally, alb loams contain relicts of Jurassic and Cretaceous rocks as well as Tertiary unconsolidated rocks and weathering products, e.g. bean ores (Fig. 4d). In karst cavities, relicts of land vertebrates of Tertiary or Quaternary age can be found. The Alb loam is often overlain by loess loam.

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Artikel/Article: [Geology of the excursion area 257-258](#)