

Rhaetian palaeo-Vertisol in Upper Franconia/Germany

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Schirmer, W. (2020): Rhaetian palaeo-Vertisol in Upper Franconia/Germany. – Z. Dt. Ges. Geowiss., 171: 45–70, Stuttgart.

Abstract: The Rhaetian of northeastern Franconia exhibits palaeo-Vertisols of notable lateral and vertical extent introduced for the first time here. The so-called Hauptton („Main Clay“) in the higher Rhaetian is represented by a stack of at least three superimposed palaeo-Vertisols (named Itz Member). These fossil soils show most properties of recent Vertisols such as gilgai surfaces or wavy subsoil textures, polyhedral soil structure (wedges), slickensides, diagonal shear planes, which all are characteristics of strong peloturbation. The pelitic deposits (mudstone) are characterised by the clay minerals smectite, kaolinite and minor illite. The palaeo-Vertisol is accompanied by Vertisol varieties such as Stagnic Vertisol and Gleyic Vertisol both with striking colours. In addition, the monotonous clay sequence is locally interrupted by sandy channels consisting of coarse- to fine-grained and sometimes chlorite-rich (Green Bed) sediments. Sediments and palaeosoils point to an at least locally wooded flat landscape upgrowing by alluvial sheet flows with clayey load and few sandy and muddy channels originating from a mountainous hinterland with subtropical–tropical weathering.

Kurzfassung: Das Rhät (Exter-Formation) im nördlichen Franken beherbergt in großer horizontaler und vertikaler Reichweite Paläo-Vertisole, die bislang dort zeitlich und räumlich nicht bekannt waren. Der sogenannte Hauptton in der höheren Exter-Formation stellt dort einen Stapel aus wenigstens drei Paläo-Vertisol-Böden dar (Itz-Subformation benannt). Die fossilen Böden zeigen fast alle wesentlichen Eigenschaften rezenter Vertisole, wie Gilgai-Oberflächen oder wellige Bodentexturen, Polygonstruktur aus keilförmigen Bodenkörpern, Gleitspiegel auf Bodenkörpern und große diagonale Scherflächen; sämtlich also Ergebnisse kräftiger Peloturbation, dazu Pelitsedimente mit den Tonmineralen Smektit und Kaolinit, untergeordnet Illit. Zusätzlich zu den normalen Vertisol-Böden treten auffallend gefärbte Pseudogley-Vertisole und Gley-Vertisole auf. Die tonreichen Boden-Komplexe sind gelegentlich von fein- bis grobkörnigen Quarz-Sandsteinrinnen durchzogen, unter anderem der chloritreichen Grünen Bank. Sedimente und Böden weisen auf eine wenigstens lokal bewaldete Landschaft hin, die durch schlammige Schichtfluten langsam aufgehöhht wurde, von schmalen sanderfüllten Abzugsrinnen durchzogen. Sie muss in einem hügeligen Hinterland wurzeln, das subtropisch-tropischer Verwitterung unterlag.

Keywords: Rhaetian, palaeo-Vertisol, gilgai, mukkara, wavy subsoil textures, sheet flow, Franconia/Germany

Schlüsselwörter: Rhät, Exter-Formation, Itz-Subformation, Paläo-Vertisol, Gilgai, Mukkara, wellige Bodentexturen, Schichtfluten, Franken

1. Introduction

In Upper Franconia (Fig. 1), the Rhaetian Stage, lithostratigraphically corresponding to the Exter Formation, presents a 20–40 m thick series, which is composed of alternating claystone, mudstone and quartz sandstone (Fig. 2). The sandstone forms channels that are considered to be of marine nature in the lower part and fluvial nature in the upper part (Dobner et al. 2005). The Exter Formation is underlain by a terrestrial deep red clay, the Feuerletten (Trossingen Formation), and is overlain (Fig. 3) by early Jurassic deposits, either fluvial sandstones, of the Gumbel Sandstone (Bayreuth Formation) and Rhaetolias Sandstone (Fig. 4), or by the thin marine sandy Einberg Layer at the basis of thick marine

shales (Bamberg Formation). (Fig. 3 ends with the Einberg Layer at its top).

The following text presents the upper part of the Exter Formation as a stack of palaeo-Vertisols.

2. Setting of the palaeo-Vertisols within the Exter Formation

The Rhaetian Exter Formation of Upper Franconia offers a terrestrial flat subtropical to tropical landscape framed between the Bohemian-Vindelician Massif in the east and southeast, and a marine basin in the west. This marine basin is roughly 100 km wide bounded in the west by the Rhenish

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