Time indications in the Permian Rotliegend of Central Europe and the 'Pangaea Gap'

Manfred Menning*[1,2]

[1]Helmholtz Zentrum Potsdam, Deutsches GeoForschungsZentrum (GFZ) – Germany
[2]Johannes Glodny, Helmholtz Zentrum Potsdam, Deutsches GeoForschungsZentrum GFZ – Germany

Abstract

Dates for the correlation and calibration of the Rotliegend Group of Germany are integrated and presented in a new way (Menning et al. 2022). The Rotliegend of Central Europe begins in the Late Carboniferous Gzhelian Stage and ends in the Late Permian Wuchiapingian Stage. In Germany it is classified lithostratigraphically as a Group. The overlaying Zechstein Group starts with the Kupferschiefer (Copper Shale) and its equivalents which can be correlated from Ireland to Belarus and from the North Sea to the Upper Rhine Valley. Its Re-Os age is 257.3 ± 1.1 Ma.
The youngest marine horizon below the Rotliegend is the Aegir Horizon (Westphalian C, Bolsovian). According to Ar-Ar data (Lippolt et al. 1984, Fortschr. Geol. Rheinl. Westf.) its age is ≈ 311 Ma. Between the Aegir Horizon and the Kupferschiefer (≈ 311 Ma to ≈ 257.3 Ma = ≈ 54 Ma) there are only a few, thin and local marine layers in the latest Rotliegend of the Central European Basin (Southern Permian Basin). During the Phanerozoic in Central Europe there is no other time span as long as ≈ 50 Ma almost with no marine layer (Stratigraphic Table of Germany 2016).

The best time indications for the Rotliegend are found in the well-known areas of the Saar-Nahe Basin (SNB), Thüringer Wald Basin (TWB) and Central European Basin (CEB): Most dates fall in a short time interval within the earliest Rotliegend. Biostratigraphic indications are often documented only in a single area, either in the SNB or in the TWB. Central European key fossils were not found in the Carboniferous-Permian boundary key succession of the Southern Ural area except for the plant *Autunia conferta*, which appears to be isochronous in the SNB, the TWB and the Southern Ural area as indicated by radio-isotopic ages (U-Pb CA-ID-TIMS RIA, Lützner et al. 2021, Schriftenr. Dt. Ges. Geowiss., Voigt et al. 2022, Int. J. Earth Sci.).

The age of the global Carboniferous-Permian boundary has long been a matter of debate. The currently accepted age is 299 Ma, based on U-Pb CA-ID-TIMS RIA from the Southern Ural area (Ramezani et al. 2007, Earth Planet. Sci. Lett.). For Central Europe, the recently revised Rb-Sr age for the Donnersberg Formation of the SNB utilizing the revised 87Rb decay constant (Villa et al. 2016, Geochim. Cosmochim. Acta) corresponds well to the U-Pb age of 299 Ma (Menning et al. 2022). Our calculated mean age for the SHRIMP data of Breitkreuz & Kennedy (1999, Tectonophysics) is 298.6 ± 1.9 Ma which reduces the time span for the volcanic succession of the Altmark Subgroup from 302–290 Ma to ≈ 300.5–296.5 Ma.

*Speaker

In general, the Regional Stratigraphic Scale of Germany is calibrated using RIA and, in addition, in the earliest and latest Rotliegend using orbital-climatically controlled eccentricity cycles (≈ 100 ka, ≈ 400 ka). Another fundamental time marker for correlation and calibration is the Illawarra Reversal at ≈ 265 Ma.

For the first time, the Rotliegend of Germany is geochronologically subdivided into Early (≈ 300.5–295/293.5 Ma), Middle (≈ 295/293.5–266 Ma) and Late Rotliegend (≈ 266–257.5 Ma). The very long duration of the Middle Rotliegend includes numerous and also extremely long stratigraphic gaps, as caused by the amalgamation and the associated immense uplift of Pangaea in Central and Western Europe. A very large stratigraphic gap in the CEB of ≈ 15 Ma (≈ 281–266 Ma, here called the Pangaea Gap) is constrained by conchostracans, the Illawarra Reversal and highly different palaeomagnetic properties of the sediments below and above the gap.

In the SNB, the youngest RIA is 294.5 ± 2.2 Ma (Donnersberg Formation). From here on until ≈ 265 Ma (Illawarra Reversal), the numerical ages of all Rotliegend units and their connection with the Global Stratigraphic Scale are uncertain and therefore correlations between Central Europe and the global key section in the Southern Ural area, partly biostratigraphically via North America, vary greatly.

Menning, M., Glodny, J., Boy, J., Gast, R., Kowalczyk, G., Martens, T., Rößler, R., Schindler, T., Seckendorff, V. von & Voigt, S. (2022): The Rotliegend in the Stratigraphic Table of Germany 2016 (STG 2016). – Journal of Applied and Regional Geology, 173, 1: 3–139; Stuttgart.

Keywords: Geological time scale, Rotliegend, time indications, radio, isotopic data, Milankovitch cycles, palaeomagnetism, Pangaea Gap