

Very low-grade regional metamorphism in Devonian metabasalts of the Elbingerode Complex, Harz Mountains, Germany – implications of chlorite and phengite composition

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The Devonian metabasalts of the Elbingerode Complex (EC) in the Harz Mountains (central Rhenohercynian belt) were affected by Variscan very low-grade (upper anchizone) regional metamorphism. In the metabasalts a non-diagnostic metamorphic mineral assemblage occur, consisting of chlorite-phengite-albite ± calcite, sphene (titanite), quartz, while Ca-silicate index minerals are missing and probably suppressed by CO₂-bearing fluids. Because of the lack of index minerals, the estimated P-T conditions of regional metamorphism in the EC are essentially based on the composition of Al-rich chlorite and Si-rich K white mica (phengite). Both Fe-Mg phyllosilicates reveal a significant compositional spread controlled by the bulk rock chemistry. Nevertheless, chemical equilibrium is suggested by the regular partitioning of iron and magnesium between coexisting chlorite and white mica. The P-T conditions were deduced from several methods including empirical and thermodynamic approaches of chlorite geothermometry, phengite geobarometry and the results of multi-equilibrium P-T calculations for the chlorite-phengite-quartz-H₂O assemblage. This multi-methodological approach yields peak metamorphic conditions of 5 kbar ± 1 kbar at 280 °C ± 20°C (Friedel 2008). The P-T estimates are proved by P-T data obtained from pelitic rocks (illite crystallinity, coal rank, b₀ parameter). The estimated P-T conditions indicate a medium-pressure style of metamorphism commonly thought to be restricted to the Northern Phyllite Zone at the southeastern boundary of the Rhenohercynian belt.

The available P-T data support an accretion related setting for the Harz Mountains as proposed for the Rhenish Massif (Oncken 1997). This setting can be characterized by basal accretion, involving all units of the Lower and Middle Harz, and by frontal accretion in the Upper Harz north of the Acker-Bruchberg-Zone.

References

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