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Structurally Controlled Hydrothermal Mineralization in the North German Basin: Inverstigations on Age and Tectonic Evolution of Fracture Systems in Permian Units

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Abstract

Structurally controlled post-Variscan vein mineralization in the North German Basin mainly hosting Zn-Pb-Fe sulfide and F-Ba deposits can be assigned to specific fault systems of late Paleozoic and Mesozoic age. As part of the BMBF-funded Project "MinNoBeck – Resource potential of covered hydrothermal mineralization in the North German Basin", this study aims to determine the role of the structural basin evolution on fracture formation and related vein mineralization. Since hydrothermal fracture mineralization is commonly related to the brittle deformation of rocks, it is crucial to understand the driving forces and the structural control on fracture development. In order to decipher the chronology of fluid migration and subsequent precipitation of related ore minerals the history and evolution of (paleo-) stressfields needs to be revealed first. Therefore, core reorientation data of seven drill cores from the Lower Saxony Basin (LSB) and two cores from the Altmark-Brandenburg Basin (ABB) in combination with outcrop data from the adjacent Flechtingen-Calvörde Block (FCB) was used to reconstruct current local and paleo-stressfields that induced formation of ore-bearing fracture systems. In addition, hot-cathode cathodoluminescence microscopy and fluid inclusion data improved our understanding on fracture formation and timing of fluid mobilization in terms of pressure and temperature; geochronological analysis on fluorite, barite, and hematite mineralization (Sm-Nd, U-Th/He) helped to compensate the lack of radiometric ages of vein mineralization from the North German Basin. While F-Ba mineralization in the ABB hosted in extension fractures of likely late Permian - early Triassic and Jurassic age is in good agreement with published data from the Harz Mountains, hematite-bearing strike-slip faults found in outcrops in the FCB show younger formation ages of late Jurassic-early Cretaceous age, which indicate wrench faulting and simultaneous fluid activity during basin extension. Fault systems in the LSB are more complex and cannot be generalized, as pre-existing fault systems were partly reactivated during both, early Triassic – late Jurassic extension and subsequent late Cretaceous – early Cenozoic basin inversion. However, core reorientation data of fractures and partly mineralized pressure solution features suggest local fluid migration and ore emplacement during both, rifting and inversion.