



Avalonian crustal controls on basin evolution: implications for the Mesozoic basins of the southern North Sea

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Little is known of the Southern North Sea Basin's (SNSB) Pre-Permian basement due to a lack of outcrop and cores. The nature and structure of the East Avalonian crust and lithosphere remain even less constrained in the absence of deep seismic (refraction) lines. However, various studies have hinted at the importance of the Reactivation of the Early Carboniferous fault network during each consecutive Mesozoic and Cenozoic tectonic phase, demonstrating the key role of weak zones from the Early Carboniferous structural grain in partitioning of structural deformation and vertical basin motions at various scales. Although the older basin history and the basement attract increasing attention, the Pre-Permian tectonics of the SNSB remains little studied with most attention focused on the Permian and younger history.

The strong dispersal of existing constraints requires a comprehensive study from Denmark to the UK, i.e. the East Avalonian microplate, bordered by the Variscan Rheic suture, the Atlantic and Baltica. Based on an extensive literature study and the reinterpretation of publicly available data, linking constraints from the crust and mantle to stratigraphic-sedimentological information, we complement the map of Early Carboniferous rifting of East Avalonia and propose a new tectonic scenario. From the reinterpretation of the boundary between Avalonia and Baltica we propose a new outline for the Avalonian microplate with implications for the tectonics of the North German Basin. Furthermore, we highlight the nature and extent of the major crustal/lithospheric domains with contrasting structural behaviour and the major boundaries that separate them.

Results shed light on the effects of long lived differences in crustal fabric that are responsible for spatial heterogeneity in stress and strain magnitudes and zonations of fracturing, burial history and temperature history. The geomechanical control of large crustal-scale fault structures will provide the constraints and geometrical and compositional input for local models of stress and strain. Results will be further used to validate and to test inferred erosion patterns and the potential effect on stress differentiation, in view of the exploration and production of (un)conventional hydrocarbons.