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Crustal architecture and basin evolution in the Barents Sea

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The Barents Sea comprises a wide range of crustal and sedimentary basin architectures that formed in response to different geological processes. In particular there are major differences between the western and eastern Barents Sea. The eastern Barents Sea is underlain by a wide (300-400 km) and deep (15-20 km) sedimentary basin that extends for more than 1000 km in a north-south direction. The basin formed by rapid subsidence in Late Permian-Early Triassic times. There are few signs of faulting associated with basin formation and it does not look like typical rift basins. There is a clear spatial correlation between the deep East Barents Sea Basin and the thickness of a high-velocity body in the upper mantle, and there is a temporal link between the main phase of basin formation and Siberian Traps magmatism. However, the links between the shallow and deep structure and any regional effects of the igneous activity are not well understood. The deep East Barents Sea Basin was filled by thick Triassic sediments prograding westwards from uplifted source area in the SE (Urals). Subsidence analysis assuming crustal stretching/thinning as the main driving force for sedimentary basin formation implies large Beta-values and a relatively hot basin scenario. However, taking into account the dimensions of the broad sag basin and the general lack of faulting it is not obvious whether this is a valid assumption. Alternatively, we are studying the role of phase transitions in the crust and upper mantle and how they could have contributed to subsidence in a colder basin scenario. In the western Barents Sea we find more typical rift basins formed in response to at least three major post-Caledonian rift phases: Carboniferous, Late Jurassic-Early Cretaceous, and Late Cretaceous-early Paleogene. The rifting activity migrated westwards through successive tectonic phases. Carboniferous rifting affected the entire western Barents Sea and gave rise to NE-SW to N-S trending horst and graben structures following a Caledonian basement grain. Late Jurassic-Early Cretaceous oblique extension in the deep SW Barents Sea basins was linked to the North Atlantic-Arctic plate tectonic evolution. A Late Cretaceous-Early Paleogene mega-shear system along the western Barents Sea-Svalbard margin (De Geer Zone) linked rifting, breakup and initial opening of the Norwegian-Greenland Sea and the Arctic Eurasia Basin. Most Barents Sea basins have also been affected by regional magmatism, compressional deformation and inversion and/or late uplift and erosion. These overprinting processes may have had important implications for the basin evolution and the petroleum systems. The different basin architectures and development are compared and discussed in relation to timing, deep crustal and upper mantle structures, and histories of vertical motion, basin filling and temperature.