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Basin inversion constrained by numerical models and plate reconstructions: a Barents Sea example

Susanne J.H. Buiter and Trond H. Torsvik

Centre for Geodynamics, Geological Survey of Norway, Leiv Eirikssons vei 39, 7491 Trondheim, Norway (susanne.buiter@ngu.no)

The eastern Barents Sea basins, west of Novaya Zemlya, are characterised by a large width (over 400 km) and a substantial thickness of the basin sediments of more than 10 km on average. Mild folds in the basin sediments and large thrusts at the eastern basin margin indicate that the region underwent shortening at a time between the Late Permian and Early Jurassic. It is assumed that Novaya Zemlya was thrust westward, but the magnitude of this compressive movement is not well known. Our aim is to provide an order-of-magnitude constraint on the amount of shortening associated with the displacement of Novaya Zemlya and the inversion of the eastern Barents Sea basins by combining numerical models and plate reconstructions in an iterative process.

We use a 2D thermo-mechanical finite-element method to model inversion of a predefined basin. The total amount of shortening imposed on the models is first constrained by plate reconstructions for the Barents Sea region for the late Palaeozoic to early Mesozoic. The magnitude of the westward movement of Novaya Zemlya in these reconstructions is, however, highly uncertain due to the allochthonous nature of the rocks of the island and the scarcity of palaeomagnetic data in the region. Shortening localises immediately in the model basins and leads to shear zone formation and uplift and folding of the basin fill. By comparing the inversion obtained in the numerical models to the inferred inversion structures in the eastern Barents Sea basin we further constrain the amount of shortening that caused the inversion and therewith improve the plate reconstructions for the region. Our models indicate that the westward movement of Novaya Zemlya occurred in the Late Triassic-Early Jurassic (220-190 Ma) and was limited in magnitude (100-200 km), which is considerably less than previous (loose) estimates (500-700 km).