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The geodynamic Situation of the North German Basin during the Lower Carboniferous – new Magnetotelluric Results

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Since about 10 years, magnetotelluric (MT) soundings have been carried out within the area of the North German Basin, in order to detect electrically highly conducting layers in pre-Permian sediments. As shown in detail, such conductors are most probably caused by highly coalified bitumen- and pyrite-rich black shales. Utilising their high conductivity, the MT method may allow discriminating between the Lower Carboniferous stillwater (black/Alum shales) facies and the less conductive Carboniferous limestone or flysch facies.

Highly conducting layers in pre-Permian sediments are encountered in the most northeasterly part of the basin, on the islands of Rügen and Usedom and the mainland adjacent to the south, up to the Anklam fault. Here they are correlated with Cambro-Ordovician black shales (Scandinavian Alum shales). In contrast, good conductors southwest of the Lower Elbe may be correlated with black shales of the Lower Carboniferous stillwater facies (Rhenohercynian Alum shales). In the centre of the basin, good conductors are missing in the pre-Permian. Particularly the missing of the Lower Carboniferous conductor may be explained by the formation of a 'North German Carbonate Platform', which was encountered in numerous drill holes on Rügen Island, and by the distribution of the Lower Carboniferous flysch facies, also known from many drill holes in North Germany.

Recent MT results from the Emsland and East Friesland profiles are of specific interest for the understanding of the regional distribution of Lower Carboniferous black shales in the North German Basin. MT models suggest that the good conductor observed

in the area of the Pompeckj-Block at depths of 7 to 9 km may be correlated with Lower Carboniferous black shales. This deep conductor is missing underneath the more mobile Lower Saxony Block to the south, but is replaced by another conductor at shallower depths between 5 and 6 km. This seems to be a regional peculiarity and may be correlated with Westphalian coal seams that acquired high coalification by deep subsidence during the Jurassic and Lower Cretaceous followed by Upper Cretaceous inversion of this block. The absence of the deeper black shale layer is probably due to the existence of a 'Lower Saxony Carbonate Platform', instead of stillwater facies sediments.

The MT results thus give the clue to the Lower Carboniferous facies distribution. Palaeogeographic maps of the North German Basin during the Lower Carboniferous will have to be modified because the black shales of the stillwater facies most probably extend much further to the north than previously suggested. Furthermore, a link between the Rhenohercynian Culm facies and the so-called Bowland shale facies or equivalents of the southern North Sea and Central England via the 'East Friesland Basin' cannot be excluded. The Lower Carboniferous sedimentation area is characterised by typical horst and graben structures with corresponding patterns of carbonate and black shale facies distribution. The MT results suggest that the Cleaver Bank High of the southern North Sea and the eastern Netherlands may extend into the Lower Saxony Block and that the Northwest German Basin may form a genuine part of the Lower Carboniferous large-scale horst and graben system.