Andersonian faulting, paleostress analysis and deformation in Chalk

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In the upper crust, where deformation is considered quite low, in the north west Europe, Chalk rocks are good markers of brittle deformation. Faults and joints can be used as an estimator of the tectonic regime. In particular, Andersonian faulting is used to reconstruct the palaeostress evolution of the European platform. The geometrical characteristic of different fault systems have been defined and the chronology between these faulting regimes has been established using synsedimentary, inherited or locked stratigraphically faults. After an analysis in terms of stress tensor determination based on the direct inversion method, a succession of palaeostress is proposed for different chalk districts (Mons Basin, NE of Belgium, Boulonnais, Kent, Sussex, Isle of Wight). Strike-slip regime has been correlated to the inversion phase well known in the North of the European platform and related to Alpine collision and the Atlantic dynamics.

In the Cretaceous rocks, in each case, inversion phases are related to crustal movements of main regional structure in transpression, the North Artois Shear Zone in the Boulonnais for example. Extensional periods are quite long and corresponding palaeostresses are not necessarily synchronous. The stress field was not homogeneous during the Mesocenozoic. The palaeostress analyses revealed a more complex tectonic history with development of neoformated mesofaults along crustal reactivated structures. The Chalk formations recorded well the palaeostress variations, resulting in development of numerous faults and joints. Compressional events related to inversion phases are accurately dated to the end of the Late Cretaceous (Maastrichtian) and to Eocene-Oligocene boundary. This observation leads to consider that inversion tectonics during the Cretaceous-Tertiary was active in a relay zone between Atlantic opening and Tethyan basin development.

The palaeostress field evolution in NW Europe recording in Chalk formations is complex but representative of a relay zone between the Atlantic opening and the Tethysian dynamics, where compressional events along crustal regional structures periodically interrupted a regional extensional regime.

Using petrophysical analysis of texture modifications in white chalk, faulting is interpreted as due to an initial ductile shearing. Along Cretaceous fault planes, the rock material has an anisotropic behaviour, due both bvertical tectonic microcracking and calcitic barriers resulting from cementation.

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