Brittle tectonics and palaeostress records in Cretaceous formations in NW Europe: extensional and strike-slip events in relationships with Cretaceous-Tertiary inversion tectonics along crustal regional structures.

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We present a synthesis of palaeostress studies carried out in NW Europe (Isle of Wight, Sussex, Boulonnais, North of France, Mons Basin, NE of Belgium), principally on small tectonic features such as striated faults and joints in chalky Cretaceous rocks. Particular attention is focused on the relationship between palaeostress and inversion of regional tectonic structures. In each region, detailed lithostratigraphic studies allowed stratigraphic location of the different fractures systems observed. Field investigations indicate that chalk is commonly affected by conjugate fault sets during sedimentation and diagenesis. Hence, each successive palaeostress state is likely to have created new conjugate fault sets. For each palaeostress state, newly-formed faults are much more abundant than inherited ones. For this reason, the direct inversion method INVDIR (Angelier, 1990) was considered applicable in this work. The age of the different tectonic events recorded in the Chalk formations in the NW European platform was deduced partly from the age of rock formations affected, and partly by relative dating of tectonic features.

Throughout the region studied, each area shows a similar palaeostress history: an extensional regime punctually interrupted by strike-slip events generating inversions. Although extensional events during the Cretaceous did not occur simultaneously throughout the studied area, the present analysis suggests that the Cretaceous tectonics in this part of Europe was dominated by extensional tectonics. During the Cenozoic, an extensional regime was predominant in the eastern part of the studied domain. In the Isle of Wight, the inversion is marked by folding, but also by strike-slip faults developed prior to, during and after the flexure process, accompanied in the post-flexure stage by development of reverse faults. In the Sussex cliffs, a strike-slip system with N-S oriented σ_1 is also identified and related to the same inversion dynamics. In different cases study, during Cenozoic, meso-faults and palaeostresses are associated with inversion phases along well known regional structural axis. Evolution of palaeostress fields recorded by Cretaceous formations in NW Europe is mainly characterised by an extensional regime interrupted by strike-slip events related to inversion episodes. The stress field was not homogeneous during the Cretaceous. The Chalk formations well recorded the palaeostress variations, resulting in development of numerous faults and joints. The Cretaceous was characterised by extensional events and strike-slip events. The post-Cretaceous period was predominantly in extension, excepted during the Tertiary inversion in the Wessex basin. The post-Cretaceous extensional palaeostress field events are recorded in the whole NW Europe.

Extensional periods are quite long and corresponding palaeostresses are not synchronous. Compressional events related to inversion phases are accurately dated, to the end of the Late Cretaceous and to Eocene-Oligocene boundary. This contrast is certainly due to stress transmission of the collision activity of the Tethys domain to the north European platform. So, palaeostress analysis revealed a complex tectonic history with development of neoformated mesofaults along crustal reactivated regional structures. 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 (Fig.2). In this case, Alpine collisional phases in the Tethysian domain can initiate the premary crustal movement and the deformation is transferred to the northern part of the European plate.

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Figure 1. Late Cretaceous reconstructions of the Atlantic-Tethys domain (Vandycke 2002 modified from Ziegler, 1989). The NW European platform is a dextral transpressional relay zone between the collisional Tethysian domain and the opening Central Atlantic. (Inset, 1: cratonic and orogenic highs, 2: oceanic basins, 3: continental to shallow marine sedimentary basins on continental crusts).

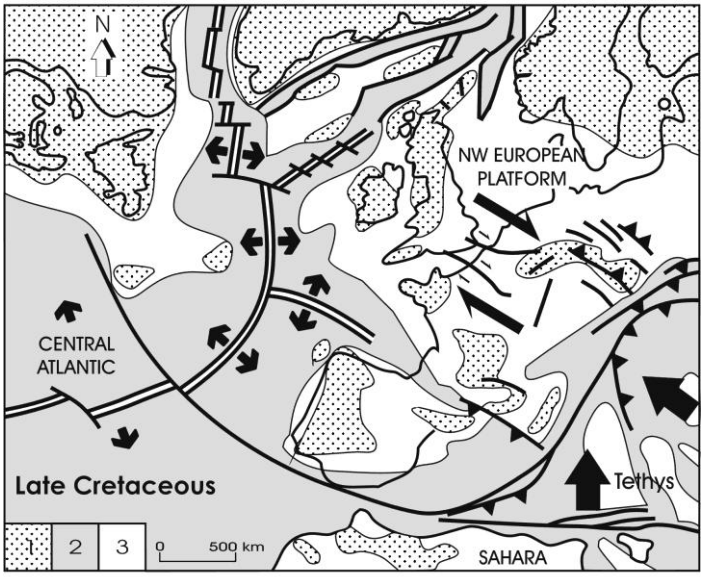

Figure 2. Palaeostress field evolution recorded in Cretaceous rocks observed n the six main studied areas. Synthetic approach integrating NW European inversion tectonics (from Vandycke, 2002).