Clay Tectonics and deformations of the Kortrijk Formation in the Princess Elisabeth Zone, Belgian Continental Shelf

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A thorough investigation of the subsurface structure is required for planning and risk assessment of the future wind energy developments in the Princess Elisabeth Zone (PEZ) on the Belgian Continental Shelf. The PEZ is underlain by the Kortrijk Clay Formation, of Eocene age, which is characterized by the presence of a dense and complex intraformational (i.e. affecting the formation itself but not the over- and underlying deposits) system of faults and other deformations, often referred to as Clay Tectonic features. A detailed understanding of the fault behaviour and attributes (e.g., geometry, orientation, depth, damage zone, displacement, and density) is currently lacking although this is highly relevant for the project planning and would provide important clues on the origin and processes that have led to these clay tectonic features.

We utilise ultra-high-resolution seismic reflection surveys with dense spacing to investigate the subsurface structures and their attributes in three carefully selected study areas. In preliminary observations, distinct structural styles among the three blocks in the PEZ were observed: Fairy Bank, Noordhinder Zuid, and Noordhinder Noord. In the Fairy Bank block, the structural style is dominated by regularly spaced (ranging from 20 to 120 m) normal faults with relatively uniform fault geometry. Faults in this zone also feature layer bending towards the fault plane, marking the fault damage zone. In Noordhinder Zuid, fault spacing is larger (90 to 490 m) and its depth varies, as indicated by shallow fault tips terminating at different depths and layers, dividing the faults into two types: major and minor faults. In Noordhinder Noord, faults are narrowly spaced (10 to 40 m) with irregular geometry and depth and here also reverse faults are present.

This distinct variation in structural style in a relatively limited area put into question which processes and parameters control the deformation within the Kortrijk Clay Formation and to which degree. The detailed mapping based on the seismic survey is currently on-going to build a robust structural model of the region and to provide a better understanding in the genesis and development of the faults within the Kortrijk Clay Formation. In turn, these novel insights will prove highly valuable for the development of the PEZ, as well as for other offshore construction projects in fine-grained sediments characterized by similar deformations.

Keywords
Clay Tectonics; Princess Elisabeth Zone; Belgian Continental Plate; Renewable Energy