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Cenozoic transtensional to transpressional basin development at the sheared Western Barents Sea - Svalbard Margin

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The Western margin of the Barents Sea evolved as a sheared margin in response to early Cenozoic continental breakup and subsequent opening of the Norwegian-Greenland Sea. An Oligocene change in spreading direction led to oblique opening of the Fram Strait between Greenland and Eurasia and ended the transform margin stage.

In such a sheared margin setting, sedimentation is strongly controlled by tectonic uplift and subsidence which vary in space and in time. The tectonic evolution of sedimentary basins associated with a sheared margin is determined by (1) the orientation of the margin with respect to the relative displacement of the plates, as well as (2) changes in spreading direction and (3) earlier tectonic events affecting the crustal thickness and shaping the basement grain.

The Western Barents – Svalbard margin may be subdivided in different segments based on its geometry. South of Bjørnøya, the margin forms a releasing bend with right stepping dextral shear zones and is characterized by transtension and pull-apart basin formation (Tromsø and Sørvestsnaget basins and Vestbakken volcanic province). Transpression was dominant in the restraining bend to the north, leading to the formation of the Paleocene-Eocene West Spitsbergen fold and thrust belt and its associated 'foreland basin'. Before it evolved into a sheared margin, the southern part of the margin experienced a series of post-Caledonian rift episodes which caused crustal thinning and formed the basement grain of major horst and graben structures trending in a generally NE-SW to N-S direction. The northern part, in contrast, has been largely unaffected by rifting since Carboniferous time. Besides the two main stages in the first order plate tectonic model for the region, recent refined models (e.g. Gaina et al., 2009) propose local complexities due to minor changes in the spreading direction.

The margin segments are thus characterized by distinct structural and magmatic styles, expressed in the geometry and kinematics of the Cenozoic sedimentary basins along the margin. Not only the style, also the age of the basin forming events changes along strike due to the factors mentioned above: different areas are in the same tectonic setting at different points in time. Interpretation of seismic reflection and refraction data combined with insight from analogue and numerical modelling allowed us to highlight the differences and similarities in the evolution of the sedimentary basins in the different margin segments.

Reference:
Gaina, C., Gernigon, L. and Ball, P., 2009. Palaeocene-Recent plate boundaries in the NE Atlantic and the formation of the Jan Mayen microcontinent. Journal of the Geological Society, 166: 601-616.