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Fault-growth deposit in a Carboniferous rift-basin: the Billefjorden Trough, Svalbard

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The Billefjorden Trough is a N-S to NNW-SSE trending rift basin that developed in the Carboniferous during the early stages of the North-East Atlantic rifting. The basin displays an asymmetric, half-graben geometry with major down to the East displacements along the N-S trending, right-stepping fault segments of the Billefjorden Fault Zone (BFZ). The location of the BFZ in Pyramiden corresponds to a major scarp in the landscape where a ca. 30 m-wide, poorly-sorted deposit made up of heterogeneous material was observed directly in the hanging-wall of the BFZ. The deposit shows blocks of different lithologies with grain sizes that range from meter-scale boulders to clayish particles. The identified lithologies include a yellowish to greenish, very fine to fine-grained sandstone, hydrocarbon-bearing dolomite blocks, carbonates showing millimeter-scale, spherical dissolution features, and blocks of dark micritic carbonate beds. Previous works have described such lithologies in the Carronelva and Terrierfjellet Members of the Carboniferous Minkinfjellet Formation. Bedding and fractures surfaces within the blocks of the deposit show trends and dip directions that are similar to those of surrounding deposits in the hanging-wall of the BFZ. They do, however, display a significantly higher spread in dip-angle as shown by sub-vertical bedding surfaces and sub-horizontal fractures. This likely reflects post-depositional rotation of the blocks of Minkinfjellet Formation lithologies that became (re)-deposited in the poorly-sorted deposit adjacent to the BFZ. In addition, below some of the boulders, poorly-consolidated clayish to sandy material showed sigmoidal-shaped fabrics that resemble ductile shear zone fabrics. These possibly reflect sliding of the blocks over the underlying, softer, fine-grained material. We suggest that the poorly-sorted deposit corresponds to a landslide that formed by gravity-driven processes due to high relief contrast across the BFZ, tentatively related to a major event of fault growth along the BFZ. The landslide must post-date lithification of the Carronelva and Terrierfjellet Members of the Minkinfjellet Formation, but pre-dates lithification of the overlying, late syn-rift sediments of the Wordiekammen Formation, as blocks derived from the latter do not appear to occur in the landslide deposit. A late Carboniferous age is, therefore, suggested for the probable landslide deposit and potentially associated faulting event.