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A concealed half-graben along the Trollfjorden-Komagelva Fault Zone in Varangerfjorden, N.Norway: a new element in the fault reactivation story

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Varanger Peninsula in northernmost Norway is divided in two by the NW-SE-trending Trollfjorden-Komagelva Fault Zone (TKFZ), a structure that can be traced into northern coastal areas of Kola Peninsula (Rybachi and Sredni peninsulas) in Russia and farther southeast into the Timans. It also extends northwestwards into the southwestern Barents Sea. Geological evidence onshore indicates that the history of this major crustal lineament ranges from extensional movement in early Neoproterozoic time, through inversion during Timanian (Ediacaran) orogenesis to significant dextral strike-slip following Caledonian (Early Ordovician) folding and metamorphism but prior to intrusion of Devonian dolerite dykes. Minor structures and veining ascribed to at least two phases of normal to oblique, dip-slip reactivation followed, the ages of which have been open to speculation – from Late Devonian to Cretaceous. Barents Sea drillcore data and seismics, however, have provided firm evidence of Carboniferous and Mesozoic components of fault movement offshore associated with the development of major sedimentary basins.

In the Norwegian sector of outer Varangerfjorden, separating the Varanger and Rybachi peninsulas, reflection-seismic profiling and multibeam bathymetric data have revealed the presence of a concealed half-graben in the hangingwall of the offshore extension of the TKFZ. The basin is at least 10 km in width and would appear to extend southeastwards into the Russian part of the fjord. The basin infill is estimated to have a maximum thickness of c. 600 m and is overlain by a thin cover of Quaternary sediments. Intense glacial ice streaming and erosion, reported in an earlier study of the bathymetric data, is considered to have removed several hundred metres of the basinal deposits. The age of the sedimentary succession is currently unknown. However, from what we know of the geology and structure of the nearby offshore Finnmark Platform, based mainly on drillcore data, we consider that deposition in the half-graben is likely to date to Carboniferous (Visean) time, and could possibly have commenced in the Late Devonian. Minor folding of the infill close to the TKFZ may conceivably be associated with Mesozoic inversion.

The bathymetric data show several interesting features including two, deep, glacially eroded basins, a shallower basin located above the older half-graben, and conspicuous NW-SE to NNW-SSE-trending ridges and troughs on the seabed linking comparable Timanian structures mapped onshore on the Rybachi and Varanger peninsulas. In addition, a series of seafloor escarpments trending ESE-WNW across Varangerfjorden south of the TKFZ, which are also clearly visible in the seismic records, can be readily linked to specific, resistant, Neoproterozoic quartzitic sandstone formations onshore on Varanger Peninsula and also possibly on Sredni Peninsula.