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Brittle tectonics in Boknafjord region (western Norway)

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This study is part of the site investigation for a new tunnel connecting Randaberg, Kvitsøy and Bokn, and has been funded by the National Public Roads Administration (Western Region). The study area is mainly covered by Caledonian allochthons. In Bokn and south of Randaberg, the autochthonous crystalline basement is exposed. The area under investigation is bordered to the west of Kvitsøy by the N-S striking (Permo-Triassic or/and Jurassic?) Karmsundet sedimentary rift basin (Bøe et al. 1992). Regional lineament interpretation was performed using a Landsat ETM scene as well as a high-resolution topographic/bathymetric model. Fieldwork was also carried out by three of us. There are several predominant sets of lineaments apparent in the remotely sensed data. The lineament sets and outcrop observations are summarized below. (1) N-S: This set of lineaments is observed from the Boknafjord area to the north. It has been previously identified by Gabrielsen et al. (2002) as the Bergen zone of lineaments and corresponds in Bergen area to large normal faults and dykes related to Permian extensional tectonics (Gabrielsen et al. 2002 and references herein). In Boknafjord region, there are also a large number of N-S normal faults (2) NNE-SSW: This set of lineaments is mainly present as large lineaments in the same area as the N-S set. They are also striated normal faults on outcrops and have probably the same origin that the N-S one. These two first overprint the oldest structural grains. Their inversion in term of paleo-stresses well defines an E-W extension. We argue that the Permian extensional tectonics have strongly affected the Boknafjord region. Seismic activity concentrates on the wide Bergen zone with reactivation of these N-S trending faults. (3) NE-SW: This set of large lineaments has been also clearly identified by Gabrielsen et al. (2002) as a major Precambrian structural grain of southwestern Norway. At the scale of the outcrops, this NE-SW set is composed of fractures, displaying normal

slickensides and developed under a NW-SE extensional regime. We propose that a large NE-SW fault along the wide Boknafjord has been rejuvenated under a Devonian NW-SE extension as a copy of the better-known NE-SW Hardangerfjord fault zone (that is some 100 km north of Boknafjord). (4) ENE-WSW: This set of lineaments is also typical and predominant on the autochthonous basement of Southwestern Norway (Gabrielsen et al. 2002). These lineaments are not commonly identified at the scale of the outcrops. Considering that the field sites were mainly in the allochthons and that this trend characterizes the autochthonous basement, we can propose that it has been poorly reactivated later on. (5) NW-SE: This is a well defined set of lineaments on the remotely sensed data making linear topographic lows between islands. Nonetheless, they have been difficult to identify in the field, and where found, are mainly closely spaced joints or mineral-filled fractures (possibly tension structures). (6) A WNW-ESE trend was commonly observed in the field. These were mainly joints. Geophysical (gravimetric, magnetic, seismic, geoelectric) data have been acquired specifically along the trace of the planned tunnel. Combined with data described here, they help to locate the major normal faults and to better constrain the offsets in the pile of Caledonian thrust sheets and/or in the autochthonous basement. We propose a new tectonic map of the Boknafjord area and a set of profiles parallel to the trace of the tunnel.

References

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