Re-Os shale data reveal gravity gliding deformation and surface water circulation, Hekkingen Formation, Loppa High, Barents Sea

MARKEY, R.[1]*, STEIN, H. J.[12], HANNAH, J. L.[12], GEORGIEV, S. V.[1], PEDERSEN, J. H.[3] AND DONS, C. E.[3]

[1]AIRIE Program, Colorado State University, USA (correspondence: richard.markey@colostate.edu)
[2]CEED Center of Excellence, University of Oslo, Norway
[3]Lundin Norway AS, 1366 Lysaker, Norway

We studied shales from the Upper Jurassic Hekkingen Formation on the south flank of the Loppa High in the Barents Sea. Re-Os data from five core segments spanning the 18 m thickness provide ages of 153.3 – 148.6 Ma (after Bayesian refinements) with initial Os ratios that systematically increase with time from 0.475 to 0.603. The Re-Os results also reveal within-unit reverse faulting, which is corroborated by geochemical profiles and subtle features observed in thin section. We estimate the vertical throw on the observed reverse fault to be on the order of a few meters. We speculate that such compressional features may be the distal (i.e., down-dip) components of gravity gliding structures. Reverse faulting may have been facilitated by high fluid pressures, which are indicated by beef-like calcite veins associated with the inferred stratigraphic discontinuity. Evidence of minor normal faulting is also observed in other core intervals.

Geochemical parameters indicate that the sediments were deposited under strongly reducing conditions. High V/Mo together with high Mo concentrations indicates euxinia at least within the sediment pile. Rhenium, Cd, Mo, Ag, Zn are all highly enriched compared to average shale and correlate strongly with S, suggesting that euxinia may have extended into the water column.

Although the Hekkingen Formation at this location has high TOC contents (7-22 wt %), the ages post-date the Re-Os ages for the organic-rich Alge member elsewhere (Troms III and the Nordkapp Basin, to the SW and NE, respectively). The later onset of deposition of the Hekkingen Formation at this locality is likely due to its location high on the flank of the Loppa High. Seawater Os isotopic trends show agreement with time-correlative strata in the Hekkingen Formation at Troms III and the Nordkapp Basin, suggesting open circulation of the surface waters to the north of the Finnmark Platform during the Late Jurassic.

Support provided by the Norwegian petroleum industry under the CHRONOS project.