FORCE seminar "Norway-East Greenland Conjugate Margins", January 30-31, 2013, Stavanger, Norway

Influence of ice sheet loading and glacial erosion on the topography of Greenland and South Norway

Sergei Medvedev (1), Ebbe H. Hartz (2,1), Alban Souche (1) and Daniel W. Schmid (1)

(1) Physics of Geological Processes, Oslo University, Norway (sergeim@fys.uio.no),

(2) Det norske oljeselskap, Oslo, Norway

The mechanism responsible for regional uplifts in South Norway and Greenland, after the NE Atlantic breakup, remains still enigmatic given that both regions are tectonically inactive since. Yet, significant young topography characterizes their landscapes. The purpose of this work is to quantify the uplift assigned to the presence of ice in these areas. Using specifically developed numerical model we study two components that could be involved in shaping the topography: ice sheet loading and glacial erosion. Assuming that the lithosphere behaves as an elastic plate, we quantify the deflection under the Greenland icecap and the related flexural bulge. While the first effect is significant, the flexural bulge is only on the order of 20 meters and thus has little influence on the overall landscape. The glacial erosion that carved out the fjords and valleys along the East Greenland incised as much as 4 km the paleosurface. This represents a major local weight loss. Our numerical experiments show that this localized glacial erosion combined with the long wavelength response of the flexing lithosphere resulted in significant uplift. The effect is most significant in the region cut by the largest fjords in East Greenland, where the uplift resulting from erosion exceeds one kilometer and thus can explain the uplift of Mesozoic marine sediments to such elevations. The main mountain chain running inland of the major fjords in East Greenland displays little erosion and thus was not uplifted dramatically due to unloading. Application of the model to South Norway results in vertical motions in the order of 600 meters. This represents a significant contribution to the total elevation of South Norway. Combining the model results with AFT data not only demonstrates the robustness of the model, but also allows for estimating the erosion rates in South Norway during the Mesozoic.