Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06757, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06757
EGU General Assembly 2008

The ICE (isostasy-climate-erosion) hypothesis for the evolution of the Scandinavian Caledonides

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Tectonics and erosion are the driving forces in the evolution of mountain belts, but the identification of their relative contributions remains a fundamental scientific problem in relation to the understanding of both geodynamic processes and surface processes. The issue is further complicated through the roles of climate and climatic change. For more than a century it has been thought that the present high topography of the Scandinavian Caledonides was created by some form of active tectonic uplift during the Cenozoic. This has been based mainly on (1) the occurrence of surface remnants and accordant summits at high elevation believed to have been graded to sea level, (2) the observation of increasing erosion rates toward the present-day based on the age of offshore erosion products and the erosion histories inferred from apatite fission track data, and on (3) over-burial and seaward tilting of coast-proximal sediments. The idea of Neogene tectonic activity is by many extended to other regions of high topography around the N Atlantic and even worldwide. However, new results indicate that the evidence for tectonic uplift of the Scandinavian Caledonides is adequately explained by a model of protracted erosion of ancient topography with superimposed Cenozoic climatic transients causing height-limiting and morphology controlling glacial erosion from the late Eocene, culminating with Quaternary glacial lowering of erosional base level on basin margins. The choice of a davisian tectonic interpretation of landforms in terms of surface uplift is entirely incompatible with the ICE hypothesis, and is, anyway, uncorroborated and unconvincing. We emphasize the importance of differentiating the morphological, sedimentological and structural signatures of recent active tectonics from the effects of long-term erosion and isostatic rebound in understanding the evolution of regions of high topography.