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# The Norwegian branch of the TopoEurope initiative; scientific challenges and goals

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The strongly integrated TopoEurope initiative has attracted great interest in the Norwegian geoscientific community, acknowledging that: (1) Continental topography is a product of the interaction between processes taking place deep in the Earth, on its surface and in its atmosphere. (2) Topography influences society, not only in terms of slow processes of landscape change, but also in terms of climate change and dynamics that create natural disasters (earthquakes, rockslides, tsunamis, river floods). (3) The present state and behavior of the Shallow Earth System is a consequence of processes on a wide range of time scales (e.g. tectonic long-term effects of uplift and subsidence, river systems, residual effects of ice cover fluctuations on crustal movement, natural climate and environmental changes and anthropogenic impacts). The impact of mantle- and lithosphere-scale processes affecting intraplate areas are recognized as important and it is realized that a great need exists to enhance the understanding of the interaction between such processes and their effects on the topography.

For western Scandinavia and the Norwegian continental margin, recent studies have revealed that post-Caledonian tectonic regimes of vertical displacements are characterized by a composite pattern of long-wavelength, intermediate-wavelength and short-wavelength movements. For example, a number of studies have documented basin inversion and areas of domal uplift along the northeastern Atlantic margin. Comparison of the inverted and uplifted areas, however, reveals a great variety of shapes, uplift patterns and timing and it is natural to suggest that this variety is due to a number of different uplift mechanisms working in concert. It is realized that such effects include those related to processes taking place both at great lithospheric depth and those due to shallow processes. Because their occurrence at different depths and scales, these

processes are bound to interfere with each other, implying that any subsidence (or uplift) curve at any point in the investigated basin or margin area reflects the sum of the effects of several processes. Subsidence/uplift analysis is further complicated by other factors, for example the influence from local structural elements developing during the active extension of the crust, diachronous effects due to structural and thermal heterogeneities in three dimensions and shifting rheological properties on a basin-wide scale.

The contemporary stress situation on the Norwegian mainland and continental shelf is well documented in several recent reports applying onshore and offshore data. This strongly suggests that the present stress is influenced by a combination of remote, NW-SE-directed compression interfering with regional, post-glacial domal uplift. However, the regional uplift characteristics reveal a more complex and irregular uplift pattern of the Norwegian mainland, suggesting that deep-seated crustal processes contribute to the total contemporary vertical uplift situation.

The regional resultant stress field of the northeastern North Atlantic has shifted dramatically throughout the Phanerozoic. The Caledonian orogeny, which was characterized by NW-SE contraction (reference to present North), was followed by a collapse with transport both parallel and transverse to the mountain chain. The Late Palaeozoic - Mesozoic saw several stages of E-W to NW-SE extension, varying in time and position along the border zone. Local episodes of inversion are traced in some cases, particularly in connection with deep-seated and long-lived zones of weakness. The Cenozoic has to a larger degree been affected by compression, including folding and basin inversion. Again, some of the more pronounced effects of local inversion are related to pre-existing fault systems. Recently, Neogene uplift of its western mountainous area has been reinvestigated by means of gravity data.. It is concluded that, assuming that the region is close to isostatic equilibrium, these uplifted areas must be supported at depth by substantial volumes of low-density material within the crust or the mantle, or at the crust/mantle or lithosphere/asthenosphere interfaces.

Although the understanding of the complex pattern of vertical displacement of the post-Caledonian western Fennoscandia is steadily improving, a coordinated effort within the framework of a TopoEurope initiative is necessary to generate a model that explains its observed complexity.