Geophysical Research Abstracts
Vol. 21, EGU2019-15009, 2019
EGU General Assembly 2019

Seismic imaging and preserving ancient landscapes

Christopher Jackson

Department of Earth Science & Engineering, Imperial College, London, United Kingdom (c.jackson@imperial.ac.uk)

3D seismic reflection data provide relatively high-resolution images of the Earth's subsurface. To-date, these data have been most commonly applied to understanding the development of submarine 'seascapes'; i.e. relief formed in response to submarine channel incision and mass-wasting. In this talk I will show how seismic reflection and borehole data can also reveal the detailed morphology and stratigraphic context of ancient 'landscapes'; i.e. relief formed above sea-level by fluvial systems and related landsliding processes. The first example comes from the Faroe-Shetland Basin, NE Atlantic, where a spectacular latest Paleocene-earliest Eocene (c. 56 Ma) landscape is preserved c. 1.5 km below the seabed. 3D seismic data image a complex network of fluvially cut valleys, incised into and capped by, marine and nonmarine rocks respectively. Maximum vertical relief of the landscape locally exceeds 900 m. The second examples comes from the East Shetland Basin, Northern North Sea, where a landscape that is slightly younger than that in the East Shetland Basin, is now buried c. 1.5 km beneath the seabed. Geochemical analyses of cuttings from wells indicate the presence of angiosperm debris; when combined with the presence of coarse clastic material, seismically imaged beach ridges, and a large dendritic drainage network, these data indicate this landscape also formed subaerially. Key to the formation, and just as critically, preservation of these two landscapes appears to relate to the causal process; i.e. relatively rapid (<3 Myr) transient uplift (of several hundred metres) and subsequent subsidence of the crust, driven by the passage of a pulse of anomalously hot, Iceland Plume-sourced asthenosphere at depth. The final example comes from the North Viking Graben, offshore SW Norway, where a landscape has recently been discovered in Permo-Triassic nonmarine strata. Potentially representing the oldest and most deeply buried (>2 km) example yet-imaged in seismic reflection data, this landscape defines c. 500 m of vertical relief and is characterised by multiple branching valley networks. The origin of this landscape is not yet known, although it may have formed due to local uplift in the footwall of a rift-related normal fault. It is likely more landscapes will be discovered in the future, given the growing availability of high-quality, 'mega-merge' type seismic reflection datasets. Revealing the detailed geomorphology preserved in these landscapes requires line-by-line seismic mapping and quantitative geomorphological analysis; this effort is worthwhile, however, given these landscapes represent a rich archive of the temporal and spatial evolution of mantle convective processes, as well as tectonic motions in the overlying upper crust.