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SUBSIDENCE AND UPLIFT ALONG THE FAROE-SHETLAND MARGIN: A MANTLE MASS TRANSFER PHENOMENON

A.D. Carr[1] and D. Ellis[2]

[1]Advanced Geochemical Systems Ltd, Towles Fields, Burton on the Wolds, Leicestershire, LE12 5TD. UK.
[2]Statoil (UK) Ltd., 11a Regent Street, London, SW1Y 4ST.

The geological history of the FSB is dominated by a series of Mesozoic rifting events and Tertiary (Paleocene-early Eocene) volcanic and inversion events. Many authors maintain the main tectonic feature associated with the Paleocene-Eocene volcanism is underplating. This apparently either uplifts or produces subsidence within the basin depending on the thickness of underplated layer. This linking of subsidence or uplift to the amount of underplating arises from the isostatic re-equilibration induced by the volcanic mass added to the base of the crust. However, if this underplating produces subsidence, then it must provide the energy for the work being done at depth within the mantle. An analysis based on the first law of thermodynamics shows that that there is insufficient energy within the underplated column (including the overlying crust and sediment load) to produce the subsidence. The importance of this analysis is that no process is possible if it defies the laws of thermodynamics. If basins do not subside due to the load, then the mechanism by which basins subside needs to be addressed.

The amount of energy required to move mass in the mantle must come from the mantle itself, and is supplied in the form of convection cells and the mass removed from beneath a basin is then transferred into margins of the basin. This mass is not magmatic, but normal mass typical of the fluid low viscosity layers within the lithosphere. The energy used to remove mass from beneath the subsiding basin is no longer available to be supplied into the overlying basin, and heat flow flows fall accordingly in such basins. Along the basin margins the transferred mass results in uplift and increased heat flows. We illustrate this process with reference to the uplift and subsidence history of the Faroe-Shetland Basin.