Testing Experimentally-Derived Concepts for the Development of Salt-Related Structures

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A wealth of new information is now available from scaled analog-and numerical-model experiments designed to investigate the development of structures associated with salt tectonics. In this paper we review data from experiments designed to simulate diapirism and graben growth, and to investigate the influence of sub-salt basement structures on supra-salt overburden, then compare those results with data from salt basins around the world.

Extension, a process which thins the overburden and creates accommodation, has been shown to be an efficient mechanism for initiating and maintaining the growth of a graben-diapir system. When trying to understand diapir development, it is important to consider how the space for the diapir was created. Graben-diapir systems have been shown to develop in a predictable series of stages– reactive, active, and passive– that reflect differing modes of space creation. These stages can represent a developmental sequence through time at a single location, or different stages of development along the trend of an individual graben-diapir system. A critical factor governing diapir growth is the supply of salt. If during extension the salt supply becomes restricted (for example by flank collapse or 2D/3D starvation) growth of the graben-diapir system can no longer be maintained and fall will occur.

Experiments reveal that salt is very weak when compared to the strength of sedimentary rocks in the upper crust. As such, salt is effective at decoupling the sub-salt basement from its overburden and, when

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thick enough, can buffer deformation below the salt from deformation above the salt.

Contraction can exert an important control on diapir development. Salt diapirs represent weak points within the sedimentary cover they intrude. During contraction, deformation is preferentially partitioned into the diapirs, squeezing the diapir-stems and thus adding "tectonic pressure” to the natural buoyant pressure within the diapirs. The net effect is rejuvenation of the diapirs.

In this paper we test these experimentally-derived concepts and observations against data from salt basins around the world including the Barents Sea, Mid-Norway, the UK and Norwegian Central Graben, the southern North Sea, West Africa, and the S.E. Arabian Gulf. The examples are from a range of tectonic settings including passive margins, active and flexural rift-margins, thrust belts, and foreland basins. The examples illustrate a diversity f structural styles including: low-amplitude, long-wavelength swells; long, high-relief walls; low-relief domes; high-relief piercements; graben-diapir systems; raft-trough systems; and monocline-graben systems. Despite the diversity of structural styles and the range of tectonic settings. The development of the salt-related structures typically follows a common thread and can be explained in terms of a few simple concepts initially derived from experimental data.