Origin and Evolution of Salt Structures in the Kwanza Basin, Offshore Angola

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ABSTRACT

Salt tectonics represents a key control on the tectono-stratigraphic development of many basins situated globally. Conventional models of salt tectonics describing simple kinematically-linked zones of extension, translation and compression are often inadequate to explain the complex deformation associated with salt-influenced passive margins. Salt-related structures on passive margins are typically assumed to form perpendicular to the direction of maximum stress, which in gravitationally-driven systems means that they should form perpendicular to the base salt dip direction. 3D seismic data from the Outer Kwanza Basin, offshore Angola, image advanced salt structures and complex patterns of overburden deformation. Salt walls in the Kwanza Basin show three dominant trends which are each characterised by different structural styles: i) salt walls perpendicular to the overall base salt dip direction, ii) salt walls parallel to the overall base salt dip direction, and iii) salt walls oblique to the overall base salt dip direction. Interpreting stratigraphic relationships in the overburden allows the origin and evolution of the salt structures to be reconstructed through time. This analysis suggests that in the Outer Kwanza Basin the structural evolution of the salt and overburden has been predominantly controlled by base salt topography. Changes in the downdip volumetric flux of salt as it thickens and thins over topographic features cause local compression or extension, and local changes in the base salt dip direction can redirect the flow of salt. The salt walls of the Kwanza Basin consequently form at a range of orientations and show a complex evolution, often comprising phases of both extension and compression. We propose two key reasons as to why the link to base salt topography is evident in the Kwanza and yet much less obvious in other salt-influenced passive margin settings such as Brazil: i) the salt is relatively thin; and ii) the salt is primarily composed of homogeneous halite. Both of these factors would help to transmit localised stresses from the base salt to the overburden. It would follow that thicker and/or more heterogeneous salt would act to decouple the base salt relief from the overburden.