Salt Shoulders

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ABSTRACT

A salt shoulder forms a zone at the margin of a salt diapir where the margin steps relatively abruptly inward. Strata above the shoulder may host hydrocarbon accumulations, especially when associated with salt dissolution-related anticlinal folds and normal faults. Utilizing outcrop and seismic data from salt shoulders formed on both salt walls and allochthonous salt sheets we summarize some basic characteristics of salt shoulders and relate them to processes associated with shoulder development. Salt shoulder strata display parallel to onlapping geometries and often overlie regional subaerial or submarine unconformities that truncated the crest of the diapir. The shoulder strata may be progressively rotated and upturned by drape folding as the inboard part of the diapir continues to rise. As this happens topography on the rising part of the diapir may confine sand-prone channel facies to the shoulder area resulting in stacked sand-prone reservoir facies in the onlapping shoulder strata. In subaerial settings or if exposed with the lowering of base level the salt in the shoulder area may undergo dissolution, resulting in collapse folding and/or faulting of the overlying strata and concomitant caprock and/or karst collapse breccia development. In this scenario, the pre-shoulder outer edge of the diapir forms a pivot point (hinge) for collapse rotation of supra-shoulder strata down in-toward the new inboard diapir margin forming an anticline and tight syncline. The pivot point defines the outboard extent of potential down-toward-the diapir collapse faulting of supra-shoulder strata. The caprock and collapse breccia may provide substantial additional reservoir in shoulder traps. Shoulder formation is controlled by the interplay of lateral variations, from the diapir center to its margin, in salt-supply rate, salt-dissolution rate, and sedimentary roof and/or caprock thickness. Shoulders form when the salt rise rate near the margin of the diapir substantially decreases or stops relative the salt rise rate in the inboard central part of the diapir. This may be caused by differential salt dissolution and caprock formation from center to edge (i.e. higher dissolution & thicker caprock near the margin), differential erosion of roof strata from the center to the margin (i.e more erosion or complete removal of the roof in the center while significant roof remains near the margin), or fault-related weakening of the roof in more central positions.