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Deformation of intrasalt competent layers in different modes of salt tectonics

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Layered evaporite sequences (LES) comprise interbedded weak layers (halite and, commonly, bittern salts) and strong layers (anhydrite and often non-evaporite rocks such as carbonates and siliciclastics). This results in a strong rheological stratification, with a range of effective viscosity up to a factor of 105. Here we focus on the deformation of intrasalt competent beds in different modes of salt tectonics using a combination of conceptual models, numerical and analog models, and seismic data. In extension, boudinage of the strong layers forms isolated, ruptured stringers within a halite matrix. In contraction, partly because rocks are stronger under compression, competent layers tend to maintain coherency while forming disharmonic and polyharmonic folds, with the rheological stratification leading to buckling and fold growth by bedding-parallel shear. In differential loading, extension and the resultant stringers dominate beneath suprasalt depocenters while folded competent beds characterize salt pillows. Finally, in tall passive diapirs, both inherited stringers and new stringers generated by ongoing intrasalt extension are rotated to near vertical in tectonic melanges during upward flow of salt. In all cases, strong layers are progressively removed from areas of salt thinning and increasingly disrupted in areas of salt growth as deformation intensifies. The varying style of intrasalt deformation impacts seismic imaging of LES and associated interpretations. Ruptured stringers are often visible where they have low dips, as in slightly extended salt layers or beneath depocenters, but are usually not imaged in tall passive diapirs due to steep dips. In contrast, areas of slightly to moderately shortened salt typically have well imaged, mostly continuous intrasalt reflectors, although seismic coherency decreases as deformation intensifies. Similarly, wells are more likely to penetrate strong layers in contractional structures and somewhat less likely in extended salt and salt pillows, but more rarely encounter the steep stringers of tall passive diapirs. Thus, both seismic and well data may be interpreted to suggest that diapirs and other areas of more intense intrasalt deformation are more halite rich than is actually the case.