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Integrated Salt Basin Evaluation

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Salt tectonics plays a major role in the development of many sedimentary basins. Basins containing salt thus frequently display a complex geodynamic evolution characterized by several phases of halokinesis and associated sedimentation. One classic area of salt tectonics is the Central European Basin System (CEBS). Here, the mobile Permian Zechstein salt formed a large number of salt structures such as anticlines, diapirs, pillows, sheets, stocks, and walls during an extended period of salt tectonic activity in Mesozoic and Cenozoic times. Major changes in sedimentation patterns and structural regimes are associated and common in this setting. Increasingly complex subsurface evaluation therefore requires an approach to study salt basins including analogue and numerical models, field studies and laboratory studies which combine seismic, structural and sedimentary studies with analysis of rheological properties, and geomechanic modelling.

This concept can be demonstrated using case studies from Permian Salt Basins in Europe and the Late Neoproterozoic to Early Cambrian South Oman Salt Basin. There salt-influenced sedimentary responses to renewed phases of tectonism can be clearly discerned from detailed sequence analysis based on seismic and log data combined with retrodeformation modelling studies. High quality 3-D seismic data integrated with structural modelling improves the definition of the internal dynamics of salt structures and associated sediment architecture in salt-controlled sequences. Paleo-caprocks inside the diapirs point to long phases of dissolution. Salt wedges formed by extrusion and lateral flow of salt glaciers during periods of diapir emergence and reduced sediment accumulation can be accurately modelled. Although salt is widely regarded as a perfect seal, it can become permeable for one- or two-phase fluids under certain conditions of fluid pressure, temperature and deviatoric stress. The fluid pathways can be either along zones of diffuse grain boundary dilatancy, or along open fractures, depending on the fluid overpressure and deviatoric stress.