SALT BASIN EVALUATION: AN INTEGRATED, MULTI-SCALE APPROACH

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ABSTRACT: Basins containing salt frequently display a complex geodynamic evolution characterized by several phases of halokinesis and associated sedimentation. Successful salt basin evaluation therefore combines seismic, structural and sedimentary studies with the analysis of rheological properties, and geomechanic modelling. This approach will be demonstrated with case studies from Permian Salt Basins in Europe and Precambrian to Paleozoic Salt Basins from the Middle East.

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. 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 now allows detection and visualization of salt-internal structures (stringers, floaters) and improves the overall definition of salt structure and associated sediment architecture in salt-controlled sequences.

Paleo-cap rocks inside salt 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. The fluid can form halite veins or networks of brine-filled grain boundaries which conduct fluid from primary inclusions during recrystallization. The main criterion for this to occur is the presence of near-lithostatic fluid pressures, which allow dilatancy and a dramatic increase in permeability.