Geophysical Research Abstracts
Vol. 21, EGU2019-10008, 2019
EGU General Assembly 2019

Salt-like Shale Tectonics Study: Seismic Examples from Ceduna Sub-Basin, Offshore Australia and Outcrop Examples from the Rakhine State, Myanmar

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Scale of observation and distributed deformation define the ductility of rocks, such as; salt and shale. Confinement pressure, temperature, water content and/or speed of loading are the parameters governing the behavior of these rocks. Thanks to the improved seismic imaging and outcrop examples around the world such as the Gulf of Mexico, the Sivas Basin (Turkey) and the Zagros Fold&Thrust Belt (Iran), salt tectonics is a well-understood phenomenon today.

Shale tectonics has been developed as an analogy to salt tectonics to describe and sometimes interpret structures from poorly imaged geometries. Shale diapirism, which is suggested during the 80s but later discarded due to the improvement of seismic imaging, is now being discussed again. Our aim is to investigate shale tectonism and its behavioral similarity with salt tectonics under the light of good quality seismic datasets and outcrop examples. For this purpose, we conducted an interpretation study of a 3D seismic dataset collected from the Ceduna Sub-Basin (Offshore South Australia) as well as a fieldwork in Rakhine State, Myanmar.

Late Cretaceous Age Ceduna Sub-Basin consists of two prograding deltaic systems: White Pointer (Late Albian-Santonian) and Hammerhead (Late Santonian-Maastrichtian) Supersequences. The 3D PSDM seismic dataset displays two different structural domains visible on time-slices and inline-xline views within the White Pointer Delta Interval;

(1) A gravitationally gliding delta domain classically dominated by listric faults in the proximal-to-central part of the basin
(2) A minibasin domain separated from the former at the delta toe within an inflated shale interval

A major thrust, which roots into the lower detachment, duplexes the mobilized shales and minibasins at the distal part of the delta, while the mobilized shales are reactivated as diapirs within the upper thrusted domain. Both of these structurally differentiated domains sole into the Blue Whale Shale main detachment level (Albian Age) underlying the White Pointer Delta. Within this mobilized shale interval minibasins development, we observe numerous striking seismic examples resembling salt tectonics such as; collapsed calderas above the diapiric tops, polygonal cracks and radial fractures roofing the diapiric highs, unconformities and welds bounding the sedimentary wedges, and sedimentary flaps alongside the edges of minibasins to evidence clay-kinetic sequences.

In the case of Rakhine Fold&Thrust Belt, Western Myanmar, the Eocene turbidites show evidence of strong mobilization (mainly as a Mass Transport Complex, MTC) during the Oligocene sand deposition. Oligocene deltaic sequences have been syn-sedimentarily folded forming the minibasins sinking into the major Eocene MTC. In this case, the Eocene shales have been mobilized over a long (i.e. sedimentary time scale) and largely distributed way, similar to salt tectonics again.

Both of these examples point out, as well as several other studies referring to the possibility for shale to become mobile/viscous under unknown controlling conditions, to a real physical analogue for salt tectonics.