Geophysical Research Abstracts
Vol. 21, EGU2019-10128, 2019
EGU General Assembly 2019

Putting the Pieces Back Together: Landslide Reconstruction of MTD Mega-blocks, Offshore NW Greenland

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On the NW Greenland shelf, a gas charged sandy mass transport deposit (MTD) reservoir has been identified that covers an area of 420 km2 above the Melville Bay Ridge rift. The MTD displays landslide characteristics with distinct jigsaw-like mega-blocks that geometrically fit back together. These blocks show clear direct hydrocarbon indicators (DHIs) such as bright ‘soft’ amplitudes at the top reservoir and velocity push down, suggesting a reservoir composed of gas charged porous sands. Much of this reservoir, however, now exists as distributed reservoir blocks up to 1000 m wide and 80 m thick.

The reconstruction of 499 MTD blocks has been completed using a combination of seismic geomorphology and GIS techniques. This process highlighted depositional features such as areas of non-deposition and thicker units containing clinoforms as well as deformation kinematics in the form of block transport paths. The result suggests that primary deposition likely occurred within a shallow marine spit complex that developed along the submarine extension of an emergent ridge axis during the Eocene. Reservoir remobilisation was triggered shortly after original deposition by rejuvenation and a southward tilt of the Melville Bay Ridge, leading to bi-directional sliding and emplacement of reservoir blocks. Sliding occurred slowly, along a low angled (<0.5°) decollement surface with block coherency maintained by intra-formational shales and possibly by early-stage diagenesis. In areas of higher dip such as on the ridge flanks, the sand rich blocks disaggregated and sand was shed down slope into deeper waters and now exist as either canyon fill or basin floor fans in the deeper graben.

This MTD provides a high-quality analogue for post-depositional sliding of reservoir facies along decollement surfaces whilst the use of landslide reconstruction provides evidence for the timing and style of basin development, including post-rift tectonic adjustments leading to multi-directional slide emplacement.