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# Turonian Sill Complexes in the Offshore Morondava Basin, Madagascar: Trap Formation by Compound Forced Folding

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## ABSTRACT

Hundreds of seismically imaged igneous sills were analyzed on modern large 3D seismic data sets in the undrilled deepwater segment of the Morondava Basin, Madagascar. The age of these sills is assumed to be Turonian based on well penetrations on the shelf and in the nearby onshore part of the basin. The sills are typically saucer-shaped, but other types, such tabular and transgressive sills were also documented. Besides the large number of sub-volcanic intrusive complexes, a relatively small number of submarine paleo-volcanoes with associated lava flows and hydrothermal vents were also mapped corresponding to an inferred Turonian unconformity. Like many other volcanic basins, where the geometry of the sills has been analyzed in great detail, the vertical magnitude of the 4-way structural closures observed in the forced folds above the sills is a function of the emplacement depth below the paleo-seafloor. Whereas individual sills may not provide very large forced folds above them, a vertical stacking of several sills clearly provide large, compound structural traps with considerable vertical closure (up to 300 m) and moderately large areal extent (up to 75 $km^2$).

Although the intrusive sills and associated hydrothermal vents may locally compromise the reservoir quality of pre-Turonian reservoirs in the deepwater Morondava Basin, their positive impact for hydrocarbon trapping is far more significant. As the Cretaceous to Cenozoic deepwater strata of the margin has a moderately uniform monoclinal dip to the west, with lots of stratigraphic trapping potential, the numerous complex forced folds above the sills provide almost all the structural traps in this frontier basin. In addition to the 4-way closures within the pre-Turonian strata, differential compaction above the sill-related forced folds influenced the map-view geometry of deepwater sediment dispersal on the margin, including Senonian-Paleocene turbidite fan systems.