New Perspetive to SWF and Sinking Well Head Prevention in Deepwater

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ABSTRACT

A new study integrating the seismic velocity profile with a proposed subsurface geopressure partition sheds light on one of the possible main causes of shallow water flow (SWF) and sinking well head in deep water. The Bureau of Ocean Energy Management (BOEM), previously known as MMS, reported 157 cases of SWF in the Gulf of Mexico. Most of these cases occurred in the Mississippi and Green Canyons areas where the late Pleistocene depositional fan was active. Occasionally, surface casings and well heads sink and get lost in these areas as well.

Study the pressure gradients of sand vs. shale in the proposed subsurface zones (A, B, C, and D) points to a possible source of these two events. The fragile nature of the unconsolidated shallow hydrostatic zone A is mostly responsible for the loss of well head. This shallow zone gradually transforms to a compacted hydrodynamic system (zone B), associated with dewatering process that can lead to SWF.

Calculating the linear pressure gradient in the sand beds vs. the feasible formation pressure in the shale layers in zone B is the backbone of this study. The sand rapidly flows upward at a linear gradient ($0.536 \times z - 123$) ranging from 0.53 to .59 psi/ft. On the other hand, slow compaction of shale and dewatering process follow an exponential pressure gradient rate of $1.49 \cdot \mathrm{Ln}(z\text{-MLdepth}) - \alpha$. During drilling, penetrating the interface between the shale and the underlying sand causes water flow that overcomes the mud pressure and SWF takes place.

Mitigating these events should be assigned before drilling any well in the deep water. Seismic velocity, sequence stratigraphy and geopressure modeling can identify these zones so that precautions can be taken to combat and avoid these challenges during operation. Choosing the right depth for surface casing and adjusting the value of the mud up during drilling to avoid SWF are suggested in this paper.