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 (0.53 x 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∙Ln (z-MLdepth) - α. 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.
A new perspective on shallow water flow (SWF) prediction and the prevention of sinking well-heads in deepwater

Selin Simon Shaker (G.A.S.)

**Aim**
A new study integrating the seismic velocity profile with a proposed subsurface geopressure model. The study involves pre-stressed shale, low velocity tight gas sands and data from the comprehensive reservoir data from shallow water flow (SWF) and existing well control in deep water.

**Methodology**
The study builds upon previous work in the Gulf of Mexico (GoM) and implementation of the geopressure model is proposed. The novel study involves the following steps:

1. **Seismic velocity analysis**
   - Analysis of the seismic velocity profile
   - Integration with proposed subsurface geopressure model
   - Identification of zones A, B, C, and D

2. **Geopressure analysis**
   - Calculation of pressure and feasible formation pressure (FFP)
   - Estimation of the mud-up value at the shale / sand interface
   - Estimation of the depth to zones A and B

3. **Flow analysis**
   - Identification of shallow water flow (SWF) and the breakdown cycle
   - Estimation of the maximum water depth

4. **Prediction**
   - Prediction of the SWF and Flow-Kill-Breakdown cycle
   - Estimation of the depth to zones A and B from seismic velocity

**Results**

- **Aim**: The study aims to identify zones A, B, C, and D using seismic velocity and geopressure modeling.
- **Methodology**: The study integrates seismic velocity analysis with the proposed geopressure model to identify zones and estimate pressure and feasible formation pressure (FFP).
- **Results**: The study predicts the SWF and Flow-Kill-Breakdown cycle and estimates the depth to zones A and B from seismic velocity.

**Conclusions**

- The study provides a new perspective on SWF prediction and the prevention of sinking well-heads in deepwater.
- The proposed geopressure model can be used to identify zones A, B, C, and D and estimate pressure and FFP.
- The study's findings can be used to improve well control and prevent SWF events.

**Acknowledgements**

This study was supported by Geopressure Analysis Services (G.A.S.), a division of Selim Simon Shaker (G.A.S.).