Deepwater Shallow Water Flow (SWF): Causes and Evasion

Selim Simon Shaker [1]

[1]G.A.S.

Abstract

SWF represents a costly drilling challenges in deepwater. This study shows the impact of depth below the mud line (BML) vs. the subsea mud-line depth (WD) on this phenomenon. It calculates the mud-up required to evade SWF occurrences at different WD / BML depths.
The backbone of this study is establishing the differential pressure between the sand vs. the shale beds. This is due to the fact that most of the SWF's take place while penetrating the shale – sand boundaries. Case histories from the Gulf of Mexico, where the upper Pleistocene depositional fan was and is still active, are utilized.

During compaction, sand's formation water rapidly influxes upward whereas shale's dewatering is slow. The differential pressure (Δ P) value ranges from 630 psi (1.2 ppg) to 50 psi (0.2 ppg) at variable depths. All Δ P's show highest values between 1500 and 2500 ft BML which is where most of SWF takes place. Moreover, Δ P noticeably increases near the ML at greater WD and can be the reason for the occasional conductor and well head sinking in the extra WD.

Sand-shale hydrodynamic pressure modeling and high resolution shallow seismic before drilling can mitigate the potentially problematic zones. Choosing correct mud up values (Δ P) at depth is essential to combat SWF and conversely loss of circulation.

This pilot method can also be successfully applicable in other young similar deepwater settings worldwide e.g. the Nile, Niger and Amazon Deltas, and as well as south Asian areas.