Gas Hydrate as a Geohazard in Deepwater Settings

Shipp, Craig [1]; McConnell, Daniel R.[2] (1) Shell International E&P Inc., Houston, TX. (2) AOA Geophysics Inc., Houston, TX.

Since the first indications that they could affect flow-assurance issues in onshore pipelines in the 1930s, gas hydrate has been a potential safety issue in the energy industry, particularly related to drilling activities. Gas-hydrate dissociation occurs, when hydrate-bearing interval are penetrated and warmed by a rotating drill bit. If high concentration of gas hydrate is encountered, then a substantial amount of free gas may enter the borehole. It is this potential release of free gas, which is the cause for concern. Gas hydrate has been encountered in shallow onshore Arctic environments associated with permafrost, as well as globally in many deepwater basins with water depths over 800 m, which is the focus of this investigation.

Geohazards issues for gas hydrate in the deepwater involve four separate operational scenarios that are characterized by their own unique issues and concerns. The first and most common scenario occurs, when penetrating gas hydrate during conventional exploration and appraisal drilling. This scenario is where most of the drilling experience has been gained to date, with the overall adverse impact being relatively minor. The second scenario occurs during conventional field development. There has been limited documentation on the actual effects of hydrocarbon production over time through shallower gas hydrate-prone intervals. However, there is a possibility that the near-surface-soil stability profile around continuity heated production casing would be adversely affected in a producing field. Dissociation of gas hydrates around casing may fluidize adjacent sediments, which can cause loss of the skin friction, holding up the casing. Note that these first two scenarios occur in the context of targeting deeper hydrocarbons, where the well design can be optimized to avoid the thickest interval of predicted gas hydrate. The third scenario is exploration and appraisal drilling targeted for gas hydrate. For this scenario, the only analogous operations are a number of examples from recent scientific drilling activities targeting gas hydrate, which yielded highly variable results in terms documented geohazard issues. Finally, the fourth scenario involves focused development and production from hydrate-prone intervals. So far, there has been little collective experience with the last scenario, but this operational setting must be better understood for gas hydrate to be considered a viable economic resource.