Combined Hydrocarbon and Nonhydrocarbon Gas for Pore Pressure

Mathew Rowe[1] and Rachael Keller[1]

[1]Halliburton Energy Services, Houston, TX, United States.

ABSTRACT

Pore pressure prediction and monitoring in real time often lacks the high density data necessary for confident results. If higher data resolution is available from alternative or supplemental means than downhole tools, a more complete and repeatable pore pressure prediction can be made. Carbon dioxide, hydrogen, helium, and methane from high speed mass spectrometry provide the data density necessary for confident prediction and monitoring. A process mass spectrometer with high speed scanning (less than 11 seconds) and high sensitivity (one ppm) can provide the needed data resolution. When combined with pore pressure prediction models, the high data resolution increases confidence in the prediction. Carbon dioxide, hydrogen, helium, and methane are used because of their great abundance and their mobility in formations. It was observed in several wells that carbon dioxide, hydrogen, helium, and methane were better indicators of changes in pore pressure than downhole tools. This increased indication can help enable better modeling of pore pressure for more accurate prediction. All four indicators were influenced by the presence of liquid hydrocarbons with hydrogen and methane being the most sensitive in all formation types. In gas reservoirs, hydrogen and carbon dioxide maintained strong correlations to pore pressure trends and enabled continued prediction. In the absence of a reservoir, the four indicators could be used at all times with carbon dioxide and methane being the strongest indicators of trends in pore pressure. If poor drilling practices were encountered and drill bit metamorphism occurred, carbon dioxide, hydrogen, and methane could not be used, and only helium trended with pore pressure. Using carbon dioxide, hydrogen, helium, and methane is a cost effective means to increase data density for pore pressure prediction and monitoring. An additional benefit is the reduction in use of more expensive downhole tools.