

RMAG November Luncheon
November 4, 2026

Subsurface Pressure Trends & Implications for Exploration Across the Rockies, Permian, Mid-Con, & Gulf Coast

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Reservoir pressure is one of the most important controls on well productivity in low-permeability reservoirs, and it is also one of the hardest parameters to find. Direct measurements from DSTs, DFITs, and bottomhole pressure gauges are uncommon, rarely number more than a few dozen in a given area and are almost never made public. This presentation uses a widely available but often overlooked alternative: the drilling mud density recorded on wireline well log headers.

We review 650,000 data points hand-collected from well log headers across every major basin in the Rockies, the Permian, the Mid-Continent, and the Gulf Coast, converted to pressure gradient and overpressure. Mud weight is not a direct measurement of pore pressure, but it reliably shows regional pressure trends. Based on the shape of their mud density vs. depth plots, basins fall into three characteristic profiles:

- "Rulers" have tight vertical distributions with little to no change in mud density with depth. In map view, pressure changes are small and gradual. The Denver, Williston, San Juan, Midland, and Arkoma basins are the clearest examples.
- "Boots" are normally pressured at shallow depths, then show a sharp overpressured "foot" at depth. In map view, these basins show "bullseye" pressure zones, as in the Powder River and Green River basins.
- "Hockey sticks" show a gradual increase in both mud density and variability with depth. Pressure varies widely both vertically and laterally, which makes exploration in basins such as the Delaware, Anadarko, and East Texas basins more nuanced.

Maps and cross sections show where these overpressured zones are located and how they appear in mud logs and drill stem tests. The results show how a simple, low-cost dataset can highlight prospective fairways, flag drilling hazards, and support exploration screening.

Biography

Bryan McDowell is a reservoir engineer and geologist specializing in subsurface data integration and visualization for oil and gas exploration and development. He is the founder of Sabata Energy Consultants in Midland, Texas, one of the largest private holders of geological data, which manages roughly 3 million digital files and 5 million physical documents. Bryan holds a B.S. in Geology from Texas A&M University and an M.S. in Petroleum Engineering from Colorado School of Mines, where he is completing his Ph.D. in Geology. With more than 15 years of experience in unconventional reservoirs, he has worked extensively across the Permian Basin, Rockies, and Mid-Continent.