

Underpressured Gas Accumulations with Pressure Control at the Outcrop

Philip H. Nelson
US Geological Survey, Denver, CO.

Underpressured gas accumulations, in which the ratio of fluid pressure to depth is less than hydrostatic, are found in areas that have undergone extensive uplift and erosion. Hydrologic conditions can produce an apparent underpressuring of both unconventional and conventional gas accumulations. Hydraulic head is a better parameter than pressure for studying apparent underpressure, and as a consequence, four elevations can be used to parameterize a system: Z_s , the surface elevation of the observation well; Z_o , the surface elevation of an outcrop of the aquifer that contains a gas accumulation at depth; Z_i , the elevation of the interface between the water-bearing aquifer and the gas accumulation; and Z_r , the elevation of the gas reservoir.

Three examples of gas accumulations—the Wasatch G interval of the Piceance Basin (pressure-depth ratio of 0.35 psi/ft), sandstones of the Mesaverde Group (0.24 psi/ft) of the San Juan Basin, and the Hugoton field (0.16 psi/ft) of the Anadarko Basin—show varying relations among Z_s , Z_o , Z_i , and Z_r . Despite differences in geologic age, geologic history, and spatial scale, in all three examples $Z_o - Z_i$ is less than $Z_s - Z_r$, that is, the height of the water column is less than the elevation difference between surface and reservoir. Z_o is the outcrop elevation that controls subsurface pressure; it is the recharge elevation in one example and the discharge elevation in the other two examples. The main features of these underpressured systems are captured by a static perspective which does not require any flow in the aquifer, so that hydrodynamic conditions may or may not be present.