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Pennsylvanian Organic Mudstone Reservoir Characteristics from the Paradox Basin, Southeastern Utah

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The organic-rich “black shales” of the Pennsylvanian Paradox Basin cycles are historically well known as the source for hydrocarbons in stratigraphically proximal carbonate reservoirs. Recent vertical and horizontal drilling has successfully produced natural gas emanating from the shales themselves. Extensive examination of numerous conventional cores has revealed several important parameters about the shales: (1) most shales are organic mudstones containing significant amounts of silt, pyrite, and calcareous (and some phosphatic) fossil debris; (2) TOC values are comparatively modest (1-5%) compared to other Paleozoic shales elsewhere; (3) all maturity values obtained from these southeastern Utah cores fall within the oil (or oil-gas) window; and (4) core-measured porosity (2-3%), and permeability values are also low compared to other Paleozoic mudrocks.

The bounding and interbedded carbonate units are silty or muddy dolostones, in many cases possessing modest amounts of conventional intercrystalline and microvugular pore space. This porosity has largely been unrecognized or minimized because most open hole density logs are run on a 2.71 g/cm^3 matrix density. These dolostones, as well as some shales, are also beset by numerous subvertical fractures, both filled and partially filled, mainly by calcite. Therefore, it is highly probable that this gas production is derived not only from the shales themselves, but also from the associated carbonates and from the natural fractures. Thus, this shale play is likely an intermixed series of reservoir types, all of which could produce upon successful stimulation.

Triaxial compression laboratory data were used to assess the potential for storing energy and the manner in which energy is released on failure. These data are indications of the potential for brittle reservoir behavior and suggest opportunities for defining sweet spots with fracturing. Energy-based inferences of preferentially fractured zones could be useful in designing directional drilling and optimized stimulation programs.