EXECUTIVE SUMMARY

Offeror: Utah Geological Survey, Salt Lake City, Utah
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Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities

Shale gas reservoirs in Utah have tremendous untapped frontier potential. Paleozoic shales in the Colorado Plateau and eastern Basin and Range Provinces have long been known for their potential as source rocks for hydrocarbons that have migrated into other formations but have not been considered as in-situ gas reservoirs. These include the Mississippian Manning Canyon and Delle Phosphatic shales and the Pennsylvanian Paradox Formation of north-central, western, and southeastern Utah, respectively. Shale beds within these formations are widespread, thick, buried deep enough to generate dry gas, and contain sufficient organic material and fractures to hold significant recoverable gas reserves. Exploratory efforts are just beginning to target these frontier gas shales; many in environmentally sensitive areas.

The Manning Canyon Shale is mainly claystone with interbeds of limestone, sandstone, siltstone, and mudstone, and has a maximum thickness of 2000 ft. Total organic carbon (TOC) varies from 1% to more than 8%. In north-central Utah, the Manning Canyon was deeply buried by sediments in the Pennsylvanian-Permian-aged Oquirrh basin and is likely very thermally mature. The Delle Phosphatic Shale is a member of the Chainman Shale, Deseret Limestone and Little Flat Formation. The Delle Phosphatic Shale Member is composed of interbedded organic-rich phosphatic shale, siltstone and limestone deposited in a starved basin at the foot of the Paleozoic carbonate ramp. The member is typically 100 to 200 ft thick. Cyclic shale units in the Paradox Formation consist of thinly interbedded, black, organic-rich marine shale; dolomitic siltstone; dolomite; and anhydrite. Individual shale units generally range in thickness between 25 and 50 ft; the cumulative shale thickness is typically 100 to 200 ft. These units contain TOC as high as 15%, are naturally fractured (usually on the crest of anticlinal closures), and are often overpressured.

Although the organic content of some of these shales is partially known, the reservoir quality and the basic rock mechanic data so important to successful completions are virtually unknown. In addition, the distribution and thickness of these rocks are poorly mapped and the vertical succession and regional

correlation of the Manning Canyon and Delle Phosphatic has not been interpreted in a sequence stratigraphic framework. The burial history of the Manning Canyon and Delle Phosphatic appears complex and probably varies widely from deep burial in the Permian Oquirrh basin (>10,000 ft of overlying Pennsylvanian and Permian strata) to shallower burial along the Paleozoic shelf of central Utah. There are no published studies of the best completion practices for the Manning Canyon, Delle Phosphatic, and Paradox shales.

The proposed **tasks** include data compilation from existing wells and publications; detailed description and petrophysical, geochemical, and rock mechanical analysis of cores and cuttings from our collection; outcrop examination and sampling; regional mapping including structure, thickness, thermal maturity, and deposition facies maps of key shale gas reservoirs; and design, description, and recommendation of the best completion practices for these frontier Utah shale gas reservoirs based on various parameters defined by our study.

Thus, the overall **objectives and/or benefits** of this study are to (1) identify and map the major trends for target shale intervals and identify areas with the greatest gas potential, (2) characterize the geologic, geochemical, and petrophysical rock properties of those reservoirs, (3) reduce exploration costs and drilling risk especially in environmentally sensitive areas; and (4) recommend the best practices to complete and stimulate these frontier gas shales to reduce development costs and maximize gas recovery. All project maps, data reports, and results will be publicly available and presented to the petroleum industry (both small and large operators) through a proven technology transfer plan. The project will therefore, develop techniques and methods for exploration and production for emerging frontier basins where these operations typically encounter technical, economic, and environmental challenges.