

ISOTOPIC ANALYSIS OF HELIUM WELLS ON FOUR CORNERS INDIAN LAND, SOUTHWESTERN U.S

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ABSTRACT

Helium, the lightest noble gas, is a valuable resource within the Colorado Plateau, in the southwestern United States. Helium has two stable isotopes: ^4He (radiogenic origin) and ^3He (primordial origin). Helium is a very useful noble gas and has many applications in modern technology for its unique chemical, physical and thermodynamic properties. The price of crude helium as of fiscal year 2016 was \$84.40 per Mcf (government user) and \$104.00 per Mcf (non-government user). The current economic grade for recovery is .3% helium for direct and secondary extraction methods and .04% for liquefied natural gas methane operations. In the Four Corners region where the states of Colorado, Utah, Arizona and New Mexico join, economic helium is primarily found in structural traps in Paleozoic intervals on the Four Corners Platform and on the edge of the Defiance Uplift. Although scientists have proposed various models to explain helium's formation, migration and trapping, helium exploration can be greatly improved with proper isotopic analysis for the identification of source rocks and migration pathways. This work will sample existing well-heads from historic helium producing units in Paleozoic formations across a number of fields. The molar percentages of helium will range from .01% to >5% to incorporate a wide spectrum of values associated with a constant set of Paleozoic formations. Approximately 50 natural gas samples will be analyzed for noble gas compositions and isotopes as well as hydrocarbon & non-hydrocarbon compositions and isotopes. The geochemical analyses will put constraints on the source rocks and migrations pathways of the helium system, which is a slight modification of the petroleum system. The helium system consists of source rocks, migration pathways, reservoir rocks, seals and traps. Data interpretation of the helium system incorporating regional geology will follow suit in the production of various isopach maps of basement lithology, potential source rocks, seals, traps and reservoir intervals overlain by significant structural features (i.e. deep basement faults). The improvement of the helium system is critical in the improvement of models for helium explorationists, the helium market and all sectors which depend on it.

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