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"ISOTOPIC ANALYSES OF HELIUM FROM WELLS LOCATED IN THE FOUR CORNERS AREA, SOUTHWESTERN, US"

Abstract

Helium is a valuable resource located on the Colorado Plateau, southwestern US. Helium, a proven, useful noble gas, has many applications in modern technology for its chemical, physical, and thermodynamic properties. As of this writing, the price of crude helium is ~40% greater than CH4, rendering the economic grade for direct and secondary extraction at 0.3% helium. The helium systems in the Four Corners area (i.e., the study area) are characterized utilizing geochemistry of noble gases, hydrocarbons, and non-hydrocarbons (compositional and isotopic), as well as geologic mapping. The geochemistry delineates sources of gases, migration pathways, and potential trapping/sealing mechanisms of the helium system, which is a deviation from the petroleum system.

Economic helium (>0.3%) is primarily found in Paleozoic intervals structurally trapped on the Four Corners Platform, the edge of the Defiance Uplift, and the edge of the Holbrook Basin. Thirty-one gas samples, isotopically analyzed, are from actively producing Paleozoic formations within five fields: Tocito Dome, Dineh-Bi-Keyah, Ratherford, Pinta Dome, and Navajo Springs. Helium concentrations range from 0.01% to >6.0% and incorporate a spectrum of other gas values associated with relatively similar Paleozoic formations.

Noble gases along with hydrocarbon and non-hydrocarbon gas geochemistry are successfully used in genetically fingerprinting gas families. The source of helium is determined to be from the shallow crust, i.e., Precambrian granitic basement. Noted faults and attendant fracture systems serve as primary migration conduits (via fluid flow from advection). Observed gas-water reactions indicate groundwater involvement in the concentration of helium and in extreme solubility fractionation (i.e., long secondary migration pathways). By investigating migration pathways, N2 and CO2 are recognized as major, helium carrier gases, whereas CH4 is a helium dilutant. Geologic mapping illustrates dominant structural, stratigraphic, and combination structural-stratigraphic traps. The helium system definition is updated, as well as criteria developed to successfully explore for helium. Proper isotopic and geological analyses can improve helium system models that involve generation, migration, and trapping/sealing mechanisms. Improvements in the understanding of the helium system model are critical for more effective helium exploration. Native Americans Tribes of the Southwest and other economic sectors stand to benefit (economically and socially) from a more enhanced scientific knowledge of the helium system in the study area.

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