

Preliminary Assessment of the Helium Resources Potential in Central Kentucky

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Helium (He) is a rare element essential to medical procedures, such as magnetic resonance imaging, and low temperature physics research. However, the decision to sell Federal helium supplies through the Helium Privatization Act of 1996 may make the United States dependent on foreign sources for its He supply. He is produced in the Earth's crust by radioactive alpha decay of uranium (U) and thorium (Th) isotopes in minerals. Radioactive decay of potassium (K) isotopes, common in crustal rocks, is by gamma decay and does not produce He.

He migrates and accumulates in porous rocks much like oil and natural gas. He concentrations exceeding 1.6 vol.%—three times the minimum concentration required for commercial development in western U.S. helium fields—have been found in oil and gas exploration wells drilled to the Rome Formation, at an average depths > 4500 ft, adjacent to the Kentucky River fault in the Rome Trough, Garrard and Clark Counties, Kentucky. There are, however, no data on He occurrences in the 20-mi gap between those locations.

He generation potential can be estimated by calibration of conventional gamma ray logs (GR) to U and Th concentrations measured by X-ray fluorescence (XRF) analyses of cuttings and core samples from wells in the areas of known He accumulation. These data can then be used as a guide for predicting commercial He accumulations. A spectral gamma ray log (SGR), a logging tool that measures U, Th, and K concentrations in formations penetrated in a wellbore, was run in the Kentucky Geological Survey 1 Hanson Aggregates well, Carter County, Kentucky, and XRF analyses of cuttings from the Conasauga shale and Grenville basement were performed for calibration of SGR and GR log data. SGR log values were a poor match to XRF data, with SGR values of U much lower and Th values higher XRF values in the Conasauga and SGR measured U values much higher and Th values much lower than XRF values in the Grenville. By calibrating SGR values to XRF measurements, however, calibration of GR log values to U and Th concentrations was possible. Net potential He source rock in the Rome Formation shales was determined using a 108 API units (APIu) cutoff. Average GR values in Rome Formation shales in the Rome Trough at the API unit cutoff increase from about 125 APIu in central Garrard County to more than 200 APIu in southern Clark County. This suggests that the Garrard-Clark counties region has a high likelihood for He generation. Additional XRF analyses of cuttings from the Rome Formation shales will be necessary to confirm this.

If the Garrard-Clark counties region is rich in He, central Kentucky may have a valuable commercial resource. The cost of drilling deep wells to assess the He distribution, however, has discouraged exploration in the region.