

The Characteristics of a Helium-Rich Natural Gas Reservoir in the Guanzhong Basin, China

Min Dong¹, Zongxiu Wang¹, Hui Dong², Licheng Ma¹, Linyan Zhang¹

¹Institute of Geomechanics, Chinese Academy of Geological Sciences, China Geological Survey, Ministry of Natural Resources;
²Xi'an Center, China Geological Survey, Ministry of Natural Resources

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Abstract

Helium is a rare stockpiled resource exhibiting strategic importance. The presence of helium reserves has been proved during borehole gas logging in the Guanzhong, Songliao, Sichuan, and Qaidam basins in China. The Weiyuan gas field in the Sichuan province, China, harbors helium-rich gas pools on a scale suitable for ensuring industrial helium recovery. The helium in the Guanzhong basin is typically crust-derived even though modest amounts of mantle-sourced gas have been obtained from the helium near deep and large faults along the southern margin of the basin. The uranium-rich granite in the Guanzhong basin is the main source rock of the crust-derived helium found there. The helium generated from the α -decay of radioactive elements in the crust of the Earth, especially uranium and thorium, is often confined by the same features that trap natural gas, resulting in helium-rich natural gas pools. Further, we examined the inclusion compositions of quartz fissures in the uranium-rich granite mass samples using microscopic laser Raman spectroscopy and measured the homogenization temperature of the inclusions based on the field surface tectonics survey. The results revealed two distinguishable gas pooling stages. Based on the thermochronological constraints obtained from the apatite fission-track data and the detrital zircon U-Pb dating, the helium-rich natural gas in the Guanzhong basin can be observed to have pooled in a late stage. The local burial history suggests that the main pooling period of the helium-rich natural gas in the Guanzhong basin began during the Miocene. Within this basin, helium has been detected in deep layers of boreholes and helium-rich natural gas has recently been obtained as a component dissolved in geothermal water. Unlike conventional helium-

rich natural gas, this new type is soluble in water. Therefore, it is crucial to consider the helium pooling characteristics and enrichment patterns in the Guanzhong basin for understanding the surface tectonics, deep textures, and geochemical proxies. A complete understanding of this system will provide necessary clues for the exploration and development of the helium resources in the area.