

A potential major source rock for helium – bauxite

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Helium (He) has huge applications in medicine, electronics and scientific research, making it a critical strategic resource. Currently, economically available helium is mainly derived from natural gas production. However, due to limited discovery of He-rich natural gas reservoirs, and challenges in gas separation and transport, availability of He has become an increasing issue. Therefore, exploration of new sources of He is essential to secure its future supply.

⁴He, the main stable isotope of helium, is derived from α decay of the isotopes ²³⁸U, ²³⁵U, and ²³²Th. The decay rate depends on the absolute amount of the isotope and its half-life of radioactivity. Therefore, the higher the isotopic content of uranium and thorium, the more helium is produced. Granites are often considered to be source rocks for helium, because they are very old and often rich in uranium-thorium elements. While other types of rocks, such as hydrocarbon source rocks, also contain high levels of uranium and thorium, they are not efficient helium sources, because helium is greatly diluted.

Bauxite contains almost no hydrocarbons but has a high uranium-thorium content. To determine the potential of bauxite as a source rock for helium, we conducted a study in the Jinzhong Basin, China. Particularly, we focused on the Benxi Formation in the basin, which was extensively developed at the base, with iron-aluminium rock sections more than 10m thick.

We collected gamma logging curve data in an exploration well from the bauxite sections in the Jinzhong Basin, which showed high levels of radioactive elements. Borehole samples from the Benxi Formation had U and Th contents ranging $(32.9-58.28) \times 10^{-6}$ and $(58.4-66.76) \times 10^{-6}$, respectively, with a cumulative helium production of 3.69 L/m³. This is higher than the production of He from granite. We present 20 gas samples from the Jinzhong Basin, which had helium contents ranging from 8.50% to 18.86% (v/v), with an average of 13.40%. The discovery of high levels of helium in the bauxite system confirms it as a high-quality source rock for helium. It suggests that exploration of He can be extended to the areas where large deposition of bauxite is present.