

U and Th accumulation mechanism in the Precambrian-Lower Paleozoic shales and the source correlation of helium in Sichuan Basin

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Helium, as a by-product of natural gas processing, is widely used in high-tech industries and scientific research. China is now facing a shortage of helium resources, making the exploration of helium resources imminent. Helium-rich natural gas reservoirs have been found in Weiyuan, Sichuan. The uranium(U) and thorium(Th) are often enriched in shales and can produce ⁴He by α -decay. However, there are few studies on the enrichment mechanism of U and Th in the shales. In this study, we confirm the enrichment mechanism of U and Th in the shales and the source of helium in the Sichuan basin based on organic geochemistry and noble gas isotope geochemistry. The results show that the studied area was deposited under a suboxic-anoxic environment, which is suitable to the accumulation of U in shales. The U enrichment in shales is mainly controlled by the combined effects of organic matter, microorganisms, and pyrite. In addition, the enrichment of Th is mainly affected by the input of terrigenous debris. The helium gas in the Sichuan Basin mainly originates from the basement granite and partly from organic-rich shale. This study will provide guidance and promotion for helium exploration and alleviate the shortage of helium resources.