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Discovery and geological significance of the Magma-hydrothermal micro-jets at the bottom of a lake: A case from the Chang 7 section of the Yanchang Formation of the Triassic in the Ordos Basin, China

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The "black chimney" type of hydrothermal vents in the modern deep sea have become a popular research topic in many disciplines. Due to the actual conditions, the research on palaeo-thermal vents in geological history is relatively low. Fortunately, the discovery of hydrothermal vents and bio-fossils from the Chang 7 source rocks of the Yanchang Formation of the Triassic in the Ordos Basin, China, provides the best evidence for deciphering hydrothermal activity during geological history. Here, we report a case study. Through ordinary sheet observation, scanning electron microscopy and electron probe observation, layered grained siliceous rocks, dolomites, and hydrothermal mineral combinations, such as pyrite + dolomite + gypsum and calcite + barite, are found. Their unique petrological characteristics, mineral composition, and structure confirm the existence of palaeo-thermal fluid vents. We further analysed the geochemical characteristics and in situ isotope characteristics. The study found that Cs, U, Th, Pb, Ba and other trace elements of the sample showed positive abnormalities, in which values of U/Th were high; in addition, the enrichment of major elements such as Sr, Mn, and the in situ sulphur isotopes of pyrite reached 7.89%-10.88%. This study of hydrothermal vents over geological history is expected to provide new insights on the life forms of various extreme microorganisms in hydrothermal environments and on their formation of high-quality source rocks.