

The Volcanic Carbonatite Origin of Phosphorite Host Dolostone in Yongwen Phosphorite Deposit: Geological and Chronological Evidence

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The dolostone, which has been referred to as typical marine sedimentary rock, comprises the main ore-hosting rock for the phosphorite deposits worldwide. Based on petrological and chronological results, this paper discusses the origin of the phosphorite host dolostone in the Yongwen Phosphorite Deposit, Guizhou, China. Tectonically, the Yongwen Phosphorite Deposit is situated on the western margin of the Yangtze Craton. The phosphorite mineralization is constrained to Ediacaran-Cambrian dolostone. Our results show that geodes and microcavities are very common in the dolostone. These geodes typically display a progression from oriented micro-crystalline dolomite margins inward through fine-crystalline dolomite and coarse-crystalline dolomite, culminating in coarse-crystalline quartz. The minerals within the geode exhibit distinct concentric zoning characteristics. In the fine-grained dolomite matrix surrounding the geode, dendritic quartz commonly occurs. Moreover, the siliceous interbeds within dolostone layers exhibit abundant quartz spherulites with sharply defined boundaries. These features collectively indicate that the diagenetic processes underwent intense rapid cooling. The U-Pb dating of coarse-crystalline dolomite within the geodes yields a formation age of 511 ± 18 Ma, consistent with the diagenesis age range (551.1–538.8 Ma), suggesting that the widely developed geodes are syngenetic with diagenesis rather than products of post-depositional hydrothermal infilling. Additionally, the ore-hosting dolomite consists of dolomite, quartz, barite, fluorite, apatite, calcite, and magnesian muscovite. This mineral assemblage closely resembles that of REE-rich igneous carbonatites. Therefore, we propose that the formation of the host dolomite in the Yongwen phosphate deposit may be associated with a submarine carbonatite volcanic event. This event likely occurred during the breakup of the Rodinia supercontinent, which triggered subduction and melting of carbonate-rich sedimentary marine plates, leading to the eruption and formation of dolostone. During the eruption, substantial CO₂ released triggered global warming while shifting seawater pH towards neutrality, thereby creating favorable conditions for the Cambrian Explosion.