Rare earth elements and C-O isotopic geochemistry of calcite in Kangjiawan Pb-Zn deposit, Hunan Province, China

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Abstract: Kangjiawan lead-zinc deposit as an important part of Shuikoushan Pb-Zn orefield, Southern Hunan Province, China, is a deeply-concealed deposit and had not been discovered until the end of 1970s'. The rare earth elements (REE) and C-O isotopic geochemistry of two different kinds of calcite from the deposit is discussed in this study. It is shown that, the lumpy calcite coexisting with pyrite, galena and sphalerite is characterized by low total REE concentrations ($4.11\times10^{-6}\sim38.09\times10^{-6}$) and LREE-enriched REE patterns, but the vein calcite cementing galena and sphalerite share obvious signatures with lower total REE concentrations ($1.52\times10^{-6}\sim5.57\times10^{-6}$) and MREE-enriched REE patterns. Significant differences of two kinds of calcite on total REE contents and REE-normalized distribution patterns indicate that their ore-forming fluids are probably different in origin. The carbon and oxygen isotopic compositions also display a distinct difference between lumpy calcite and vein calcite in the studied deposit. The carbon isotopic compositions in vein calcite are lower than those of lumpy calcite, but its oxygen isotopic compositions are obviously higher than the latter. The theoretical modeling reveals that calcite precipitation was caused by CO_2 degassing together with decreasing temperature. In addition, meteoric water also plays a certain role. For the lumpy calcite, its ore-forming fluid was probably magmatic water mixed with about 45% of meteoric water and characterized by HCO_3^- as dominate dissolved carbon species in hydrothermal solution, and its $\delta^{13}C$ and $\delta^{18}O$ values are deduced to be at −4‰ and +5‰, respectively. For the vein calcite, its ore-forming fluid was also magmatic water only mixed with about 10% meteoric water and characterized by H_2CO_3 as the dominate dissolved carbon species, and its $\delta^{13}C$ and $\delta^{18}O$ values are estimated as −6‰ and +5‰, respectively.

Keywords: rare earth element; carbon-oxygen-isotope; ore-forming fluid; CO_2 degassing modeling; Kangjiawan Pb-Zn deposit