Geochemical characteristics of fluid inclusion in Shizishan ore district, Anhui, China

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Shizishan ore district located in Tongling of Anhui Province and in the Middle and Lower Reaches of Yangtze River, China. The ore district developed more than 10 deposits, and is most enriched in copper and gold. The ore-bodies formed in bedded and quasi-bedded and are controlled by strata. The fluid inclusions in garnet, quartz and calcite can be divided into three types, namely, gas-rich, liquid-rich and daughter mineral-bearing polyphase brine inclusion.

Homogeneous temperatures are almost identical in the same mineralization stage, and are respectively 411～600°C, 173～440°C, 117～280°C in three stages of mineralization from earlier to later. Gas component of all deposits are mainly H_2O and CO_2, secondly are reduction gases such as CH_4, C_2H_6, N_2, H_2S, Ar. The anions in liquid are mainly Cl^-, SO_4^{2-} and F^-, and the cations mainly K^+, Na^+, Ca^{2+}, Mg^{2+}. K^+/Na^+, $F^-/C1^-$ and other relative figures show that the mineralizing solution mainly came from the magmatism.

Hydrogen- and oxygen-isotope data suggested that the ore-forming fluids in Shizishan ore district main consisted of magmatic water, gradually mixed in various proportions with meteoric water at later stage of mineralization。The data of $\delta^{13}C_{CO2}$ gave a feasible proof that mineralizing material comes from magmatism, but the stratigraphic component and the meteoric water may add to ore-forming fluids in the later mineralization stages. The values of $\delta^{13}C_{CH4}$ reduced from the deep deposits to the shallow deposits perhaps reveal that CH_4 is the main factor for separating copper and gold in mineralization process.

The REE characteristics with the ∑REE, LREE/HREE, $(La/Sm)_N$ ratios of mineral inclusions in the ore district suggests that ore-forming fluid originated from magma. The characteristics of Eu negative anomaly reflect that the ore-forming fluids of gold deposits originated from the differentiation of magma at low pressure, and the ore-forming fluids of copper deposits originated from the differentiation of magma at high pressure and at the deeply of the earth curst.

Ca isotope constraints on diagenetic alteration of Cenozoic paleo-proxies

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The interpretation of Cenozoic climate records depends, at least in part, on the high fidelity of geochemical proxies. The initial chemical composition of proxy materials, such as marine carbonates, can be preserved over million-year time scales if sediments react to a minor extent or if the geochemical conditions of the sedimentary column are such that exchange between solid and fluid does not alter the chemistry of the solid to any significant degree. A robust method of constraining reaction in the sedimentary section is the combination of reactive transport models and geochemical measurements. This method allows for both the quantification of reaction rates in long-lived geologic systems and the correction of proxy records for diagenetic alteration.

Recent Ca isotope measurements of pore fluids in carbonate-rich marine sediments from various ODP sites (807A, 1170A, and 1171A) suggest that nannofossil oozes recrystallize at rates more rapid than previously assumed from modeling of Sr chemistry. This is not surprising given estimates of the diffusive reaction length in young sediments for Ca (~meters) and Sr (~hundreds of meters). The Ca isotope data are important because they suggest that carbonates and pore fluids exchange mass rapidly, either via dissolution-reprecipitation or solid state diffusion, over time scales less than 1 Ma. For some elements, such as Sr, the time scale (and associated position in the sedimentary column) is critical since this places rapidly reacting sediments in a zone within which Sr in the solid is out of equilibrium with the pore fluid (diffusive boundary layer). Other elements such as Mg, which have low concentrations and large diffusive reaction lengths, are much more susceptible to diagenetic alteration relative to elements such as oxygen and carbon.

The implications of rapid reaction are considerable when it comes to deciphering Cenozoic climate records. The current study analyzes the Ca isotope data in detail using previously-described numerical models. Various hypotheses are posed to explain the Ca isotope pore fluid data, including control via dissolution, recrystallization, and enhanced advection. Additional geochemical data (mainly Sr concentration and isotopic data) help constrain the models. Finally, the implications of so-called rapid recrystallization rates, as they pertain to the alteration of proxies such as Mg/Ca ratios over tens of millions of years, will be discussed from a model perspective.