Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12837

Significance of carbon and oxygen isotope ratios of hydrothermal calcite: Re-recognition of calcite for the interpretation of fluid-rock interaction processes during ore mineralization

YUICHI MORISHITA

Shizuoka University

Presenting Author: morishita.yuichi@shizuoka.ac.jp

Fluid-rock reactions play a key role in the carbon and oxygen isotope budgets of geologic settings from ore-forming hydrothermal systems in the Earth's crust. Although many studies on isotopes in calcites have been conducted, few researchers have shown interest in using isotope data of hydrothermal calcite. This is because calcite often occurs in the last stage of a hydrothermal mineralization; therefore, a calcite vein is sometimes regarded as a barren vein in mining districts. However, fertile calcite vein may also exist in the same location as barren calcite vein; thus, this study proposes the use of isotope data from hydrothermal calcite. Calcite from fertile vein is distinguished from that from barren vein by using carbon and oxygen isotope ratios of calcite.

The carbon isotope ratios in the fluid for the Noya and Kushikino gold deposits in Kyushu, Japan were estimated to be -6.5 permil and -10.8 permil, respectively (Fig. 1). The carbon isotope ratio of -6.5 permil is regarded as average crustal carbon. Although the host rocks of the deposits are both andesitic rocks, the basement rocks are mostly granitic rocks for the Noya deposit and Cretaceous accretionary sedimentary rocks for the Kushikino deposit; the carbon isotope ratio in the Kushikino fluid might be modified by reactions with organic carbon from the basement sedimentary rocks. The estimated carbon isotope ratio in the fluid for the Hishikari gold deposit, which has the same basement sedimentary rocks as the Kushikino deposit, is similar to that of the Kushikino fluid. The strontium isotope ratios of the Kushikino and Hishikari veins are both high; this is attributed to reactions with basement Cretaceous sedimentary rocks that have high strontium isotope ratios. However, in the Noya deposit that has no basement sedimentary rocks, the strontium isotope ratio remains the same, comparable to that in the surrounding igneous rocks (Fig. 2).

The presentation shows that the carbon and oxygen isotopic microanalyses of fertile vein calcite from the high grade Hishikari deposit, and indicates a relationship between the evolution of hydrothermal fluid and the gold mineralization.

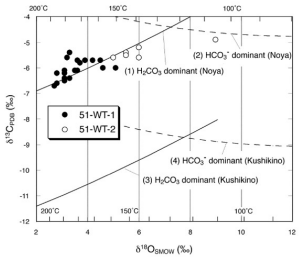

Fig. 1. Curves (1) and (2) are equilibrium fractionation trends for calcite from the Noya veins that were calculated by assuming that H_2CO_3 and HCO_3^- are the dominant carbon species in the fluid for curves (1) and (2), respectively. The $\delta^{13}C$ and $\delta^{18}O$ values of the Noya fluid are taken to be –6.5‰ and –7.5‰, respectively, for both curves. The upper *x*-axis represents isotopic equilibrium temperatures. Curves (3) and (4) are equilibrium fractionation trends for calcite from the Kushikino deposit. The $\delta^{13}C$ and $\delta^{18}O$ values of the Kushikino fluid are taken to be –10.8‰ and –7.0‰, respectively for both curves. The oxygen isotopic equilibrium temperatures for the Kushikino hydrothermal fluid are marked on the lower *x*-axis.

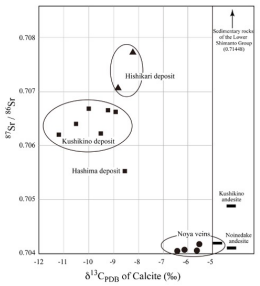

Fig. 2. Comparison of strontium and carbon isotope ratios in vein calcite from the Noya veins and from the Hishikari and Kushikino deposits. The $^{87}Sr/^{86}Sr$ ratio for the Noinedake andesite is relevant to the Noya veins. The average $^{87}Sr/^{86}Sr$ ratio of the Cretaceous accretionary sedimentary basement rocks for the Hishikari and Kushikino deposits is plotted above the frame.