

Tracing ore forming fluids of gold deposits hosted in Kangding complex in Sichuan province, China

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Daduhe River ore belt in Sichuan province is an important gold belt in China. Most gold deposits in this belt locates in Kangding complex, which mainly consists of dioritoids, granitoids and amphibolites. Three gold deposits of Sijiazhai hosted in amphibolite, Guitaizi in Granite, and Taogou in the contact belt of Granite and amphibolite were selected to trace ore forming fluids. Because the altered host rocks of ore body resulted from the interaction between host rocks and ore forming fluids, we compared the REEs and $\delta^{34}\text{S}$ data (Table 1) in host rocks and altered host rocks to trace ore forming fluids.

Deposits	Host Rock	δEu		$\delta^{34}\text{S}$
		HR	AHR	Py (Cpy)
Sijiazhai	Amphibolite	1.17	0.66	0.1 (2.3)
Guitaizi	Granite	0.73	0.52	3.5
Taogou	Granite	0.57	0.30	5.7

Table 1: δEu and $\delta^{34}\text{S}$ in gold deposits.

HR: Host Rock, AHR: Altered Host Rock, Py: Pyrite, Cpy: Chalcopyrite; $\delta\text{Eu}=\text{Eu}_\text{N}/(\text{Sm}_\text{N}\cdot\text{Gd}_\text{N})^{1/2}$ and normalized by chondrite from Boynton (1984).

REE patterns normalized by chondrite are similar in shape except δEu in each pair rocks listed in Table 1. δEu values in altered rocks were lower than those in unaltered rocks manifestily. $\delta^{34}\text{S}$ values of sulfides in each deposits were near those in the magmatic sulphur isotope reservoir. These indicated that ore forming fluids maybe resulted from felsic magmatic fluids in deep source.

The increasing trend of $\delta^{34}\text{S}$ from Sijiazhai, Guitaizi to Taogou gold deposits with the decreasing trend of δEu in Table 1 indicated deep source ore forming fluids were mixed with crust matters.

MIRA: A new high sensitivity, multicollector mass spectrometer for isotopologue and ultra-small sample stable isotope analysis

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The recent development of isotopologue (isotopic cluster) measurements in natural materials is pushing against the performance envelope of current instruments in terms of sensitivity, stability and high vacuum performance. For example, the most common of the rare isotopologues of the CO_2 molecule at $m/z = 47$ ($^{13}\text{C}^{18}\text{O}^{16}\text{O}$) has a natural abundance of just 44ppm and for useful palaeotemperature estimates it's relative concentration needs to be measured to a precision of 0.005%, or better.

MIRA is a new stable isotope ratio mass spectrometer designed specifically for measurements of isotopologue species of the CO_2 molecule. It is based on a 25cm, 120° magnetic sector, with a symmetric extended geometry, stigmatic focussing and a dispersion of 50cm. The analyser is differentially pumped using drag stage turbopumps backed by diaphragm roughing pumps to ensure a completely hydrocarbon free vacuum. The detector array consists of 6 individual, deep faradays aligned with $m/z = 44, 45, 46, 47, 48$ and 49 and operating with a mass resolution of 250. The gain for each channel is 10^7 ($m/z = 44$), 10^9 ($m/z = 45, 46$), 10^{11} ($m/z = 47$) and 10^{12} ($m/z = 48, 49$). The ion source, based on the Nier electron impact design, operates at 10keV ion energy, has two-stage ion extraction, and an overall sensitivity of better than 1 ion per 200 CO_2 molecules.

This increased sensitivity coupled with a novel gas dual-inlet system with a constant pressure variable micro-volume on the sample side allows high sensitivity analysis of ultra-small samples (<0.5 bar μL of CO_2) for $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$.

In testing we have run the instrument with a major beam signal of $5 \times 10^{-7}\text{A}$ and a $m/z = 47$ signal of $2 \times 10^{-11}\text{A}$ ($=1.25 \times 10^8$ ions. s^{-1}). Using 50 sample-reference gas comparisons with a total run time of 30 minutes the standard error of the 47/44 ratio is better than 0.005%. These results were obtained with 500 bar μL of cylinder CO_2 , equivalent to a 2.5mg carbonate sample.

We are currently assessing the effect of source tuning, notably the source pressure, ionisation energy, and extraction geometry on the measured 47/44 ratio, and beginning to make measurements on CO_2 derived from carbonate mineral samples.