

# The relation between $\delta^{33}\text{S}$ values of Archean sedimentary sulfide and contemporaneous volcanic activities

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The photolysis experiments of sulfur dioxide undertaken with 193 nm radiation exhibit a large sulfur mass independent isotope fractionation effects, product elemental sulfur with large positive  $\Delta^{33}\text{S}$  values and product sulfate with negative  $\Delta^{33}\text{S}$  values. The characteristics are similar to sulfur multiple-isotope data for sulfide and sulfate documented for terrestrial sedimentary rock samples older than 2.3Ga. Recent investigation discovered that some sulfides or sulfates have positive  $\Delta^{33}\text{S}$  values, and others have negative.

We have measured sulfur multiple-isotope compositions of 2.3 Ga~3.5Ga Archean bedded sulfide deposits and banded iron formations (BIFs) from Hebei, Liaoning, Shanxi and Shandong Province, China. The mass independent sulfur isotope effects were discovered in many volcanic association. The  $\Delta^{33}\text{S}$  values of volcanic sulfide ores and Algoma-type BIFs were negative, but those of Superior-type BIFs were positive. Algoma-type BIFs were generally associated with contemporaneous volcanic suites; Superior-type BIFs were generally in a shelf environment with a lower input from volcanic component and a higher contribution from other sources.

The atmospheric photochemical reactions of  $\text{SO}_2$  following volcanic eruptions produced dissolvable sulfuric acid aerosols which soon fall with rain from the atmosphere on to the ground surface and deposited near the center of volcanic activity. Then sulfates were reduced by microbe in the ocean and deposited as the sulfide. So the volcanic sulfide ores and Algoma-type BIFs have negative  $\Delta^{33}\text{S}$  values. The elemental sulfur produced in atmospheric photochemical reactions of volcanic  $\text{SO}_2$  is unsolvable in water and stayed in the atmosphere until the sulfur aerosol grain grew enough great. The resided time of  $\text{S}^0$  in the atmosphere is longer than those of  $\text{SO}_4^{2-}$ . The precipitation place of elemental sulfur is away from the center of volcanic activity. So the Superior-type BIFs have the positive  $\Delta^{33}\text{S}$  values. If elemental sulfur was oxidized to sulfates, which would have positive  $\Delta^{33}\text{S}$  values, such as 1991 Pinatubo volcanic sulfates preserved in South Pole ice cores.

## References

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