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Sulfur isotope systematics decipher the metal source and cycling of the world's largest Xikuangshan antimony deposit

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The Xikuangshan antimony (Sb) deposit in China is the world's largest Sb deposit. However, the metal source and cycling, the key issues to understanding deposit genesis, remain equivocal. In this contribution, we investigate the sulfur isotope composition of stibnite from orebodies with varying elevations in Xikuangshan to distinguish the source signal and superimposed imprint from externally-derived sulfur mixing or isotopic fractionation. The deep orebodies show limited δ34S variation from +6.8 to +8.4‰, representing the initial sulfur isotopic composition of ore-forming fluids. In contrast, the significant sulfur isotopic variation in shallow orebodies (+3.5 to +16.3‰) can be explained through the Rayleigh fractionation model that suggests significant isotope fractionation during ore precipitation. Alternatively, the input of pyrite from the wall rocks is a candidate for an externally derived heavy sulfur source. Accordingly, we conclude that the Neoproterozoic basements served as the metal source. We propose a holistic genetic model, where we envisage that Sb and S were leached from the basement rocks and the ore-bearing fluids ascended along the deep fault and eventually precipitated beneath the Devonian shale cap. Sulfur isotope is representative of a means of fingerprinting different sources in a hydrothermal Sb deposit.