Seawater derived sulfur contributions to the Archean VMS deposits: Multi-sulfur isotope evidences from the Neo-Archean Jaguar Deposits, Western Australia

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The contributions of seawater sulfate to Archean VMS deposits remain equivocal; do they resemble modern seawater in the role of contributing sulfur to modern black smokers? Additionally, in magnitude, how much sulfur seawater can contribute to form an Archean VMS deposit?

Seawater sulfate plays a key role in modern black smoker systems. Estimations based on MDF $\delta^{34}S$ of sulfur isotope are typically ranging from 10% to 40%, or even up to 80% [1, 2]. While for Archean VMS deposits, which have been widely believed to be the analogous of modern black smokers, the seawater contributions have been under-estimated. One case study in the Kidd Creek shows a small contribution of seawater sulfate down to ~3%, and this value therefore implies a very low seawater sulfur concentration [3]. For further investigation, we report *in situ* SHRIMP SI multi-sulfur isotopic analyses (^{32}S ^{33}S ^{34}S) of pyrites from Jaguar VMS deposits in the Yilgan Craton, Western Australia. Taking MIF $\Delta^{33}S$ features of ore sulfides as the mixing of magmatic sulfur and reduced seawater sulfate, we estimate the quantity of seawater contribution to the sulfur budget of Jaguar VMS deposits. The estimated result is 16%-21%, much higher than 3% in Kidd Creek case. Samples from other reported Archean VMS deposits, including Dresser formation, Agnew-Wiluna belt and Alexo greenstone belt, are also quantitively assessed. The assessment reveals that the magnitude of seawater sulfate contribution to Archean VMS deposits can be as much as that of modern sea-floor hydrothermal systems, while the case of Kidd Creek cannot represent a global-scale event for understanding the seawater derived sulfur contributions to Archean VMS deposits.

[1] Ono et al (2007) *Geochim Cosmochim Ac* **71**, 1170-1182. [2] Peters et al (2010) *Chem Geo* **269**, 180-196. [3] Jamieson et al (2013) *Nat Geosci* **6**, 61-64.

From diagenesis to metagenesis, geochemical changes of the late Paleozoic shale and mudstone, periphery of Songliao basin

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With wide spread area of dark shale and mudstone occurred in the peripheral area of Songliao basin, NE China, the late Paleozoic terrane with abundant organic material has been considered as important target strata to evaluate regional potential of shale gas resources. How about the maturity of this shale and mudstone and what is the main factor to control it is more debatable. The contact metamorphism about the strata associated with the Mesozoic igneous activity is in the focus of this study, funded by China Geological Survey.

The shale and mudstone samples of outcrop and drill from different distance to the belt of contact metamorphism were collected. The intrusive and volcanic samples related to the Mesozoic activity were also collected. Analysis about the shale and mudstone are mainly of R_o, illite crystallinity, TOC and the content of absorbent gas. Analysis about the related Mesozoic igneous bodies includes the mineral manometer and the fluid inclusions.

All evidence indicates that contact metamorphism is an important factor to control the maturity of the shale and mudstone. Statistics of the analysis data of R_o and illite crystallinity indicates that the maturity ranges from diagenesis to metagenesis. The mineral manometer combined with homogenization temperature of fluid inclusions shows that some Mesozoic intrusive bodies characterized as hot sources have high crystallization temperature and great emplacement depth, while the others characterized as warm point have low crystallization temperature and low emplacement depth. The contact belt related to the hot intrusive bodies always presents as large scale and high metamorphism degree, while the belt related to cool intrusive bodies presents as small scale and low degree. The contact belt presents as small scale and low metamorphism degree associated with the Mesozoic volcanic eruption. The late Paleozoic shale and mudstone away from hot intrusive bodies and covered with Mesozoic volcanic rocks always possess catagenesis to diagenesis of maturity and have high TOC and high content of absorbent gas.

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