

S-isotope study of Archean shallow-crust recycling in the Earth's mantle

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Archean supracrustal rocks (i.e. chemical sediments and metavolcanics) preserve sulfur Mass Independent Fractionations (MIF) that originate from photochemical reactions occurring in atmosphere before the great oxygenation event, 2.45 Ga. Reduced and oxidized aerosols were produced by photochemistry and respectively carry ³³S enrichment ($\Delta^{33}\text{S} > 0\%$) and depletion ($\Delta^{33}\text{S} < 0\%$). The relative abundance of the minor isotope of sulfur (³⁶S) was also affected by MIF in such a way that compact negative correlation exists between $\Delta^{33}\text{S}$ and $\Delta^{36}\text{S}$. For much of Archean sediments, $\Delta^{36}\text{S} / \Delta^{33}\text{S} \approx -1$, while slight variation of this slope have been attributed to minor change in the chemical composition of the atmosphere affecting global MIF source mechanism. On another hand, ³⁶S abundance is also affected by microbial cycling and in this specific case, $\Delta^{36}\text{S} / \Delta^{33}\text{S} \approx -7$. Accordingly, $\Delta^{33}\text{S}$ - $\Delta^{36}\text{S}$ co-variations can be used to discriminate distinct sedimentary pool.

This contribution aims to test the robustness of MIF array of specific exospheric sulfur pools along their journey from the surface to the mantle. We examine the $\Delta^{36}\text{S}$ in addition to $\delta^{34}\text{S}$ and $\Delta^{33}\text{S}$ signatures measured in-situ with secondary ion mass spectrometer, in sub lithospheric peridotitic and eclogitic sulfides from Kaapvaal (Jwaneng and Kimberley Pool) and Siberian craton (Mir and Udachnaya).

Unlike peridotitic sulfides, eclogitic sulfides from both localities display significant MIF attesting from the presence of surficial sulfur in their source. More interestingly, the magnitude of the anomalies as well as $\Delta^{36}\text{S} / \Delta^{33}\text{S}$ ratio, differ from one locality to the other. Siberian eclogites match the composition of Eoarchean sulfate ($\Delta^{36}\text{S} / \Delta^{33}\text{S} = -3$ and $\Delta^{33}\text{S} < 0\%$). Sample from Jwaneng follow the MIF array previously reported in Archean chemical sediment ($\Delta^{36}\text{S} / \Delta^{33}\text{S} = -1$) while sulfide from Kimberley pool match the composition of some meso-Archean sediments in good agreement with isochron age reported in the literature for the sulfide from this locality.

This study confirms that surficial sulfur has been efficiently transferred to the lithospheric mantle. More interestingly, it shows that peculiar sedimentary pools are still preserved in the cratonic keels.