

Triple silicon isotope insight to the formation of Precambrian cherts

HAOXUAN SUN¹, MARC CHAUSSIDON¹, FRANÇOIS ROBERT², SHENGYU TIAN¹, ZHENGBIN DENG³ AND FRÉDÉRIC MOYNIER⁴

¹Université Paris Cité, Institut de physique du globe de Paris, CNRS

²CNRS/Museum National Histoire Naturelle

³University of Science and Technology of China

⁴Université Paris Cité, Institut de Physique du Globe de Paris, CNRS UMR 7154

Presenting Author: sun@ipgp.fr

Cherts are sedimentary rocks composed of various phases of silica and play a crucial role in the silicon cycle of the ocean prior to the emergence of silica-secreting organism [1]. The O and Si isotopic composition of cherts are widely used proxies to reconstruct the evolution of seawater paleo-temperature, suggesting Precambrian oceans warmer than today [2, 3]. However, many Precambrian and Archean chert have triple O isotopic composition plotting to the left of equilibrium fractionation curve from ice-free seawater [4]. This might suggest that these cherts underwent strong isotopic changes during diagenesis or metamorphism [5-7]. Here, we investigate whether triple Si isotope composition of cherts could serve as a robust proxy to better understand the formation and isotopic transformations of Precambrian cherts.

In this study, we report the high precision triple silicon isotopic composition of Precambrian chert spanning 1.3-3.5 Ga. Our findings indicate that Jixian chert (1.3-1.5 Ga) from one single unmetamorphosed basin are mixtures of three endmembers: amorphous silica equilibrated with seawater, hydrothermal quartz kinetically precipitated from the fluids and detrital quartz from the continents. However, Archean chert, with triple Si isotopic composition that deviates beyond any single mass-dependent fractionation line, show evidence of significant secondary processes. For the Gunflint, Overwacht and Warrawoona chert we observe a combined fractionation of 1/3 kinetic and 2/3 equilibrium, indicating a dissolution and reprecipitation of silica in open system. This trend would also be consistent with the systematic shift to the left of the equilibrium curve in triple O isotope diagram and could also introduce a bias in paleo-seawater temperature reconstructions that rely solely on oxygen isotopes. Therefore, triple silicon isotopes can serve as a robust proxy for understanding the formation of Precambrian chert and provide an additional criterion for selecting appropriate samples for paleo-temperature reconstructions.

Reference: [1] Siever (1992), *GCA* 56, 3265-3272; [2] Knauth and Lowe (1978), *EPSL* 41, 209-222; [3] Robert and Chaussidon (2006), *Nature* 443, 969-972; [4] Sharp et al. (2018), *GCA* 186, 105-119. [5] Liljeström et al. (2020), *EPSL* 537, 116167; [6] Sengupta et al. (2020) *CG*, 554, 119789; [7] Zakahrov et al. (2021), *Rev. Mineral. Geochem.*, 86, 365.