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Si isotope thermometry in silicified carbonate

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Cherts are one of the most detailed and alteration resistant archives of surface environments. Yet, the information disclosed in form of isotope ratios of Si and O cannot be confidently translated into conditions prevailing at the Earth surface in deep time.

We investigated carbonate silicification in a Lower Cambrian silicified zebra dolomite that we analyzed for δ^{30}Si by laser ablation MC-ICP-MS and δ^{18}O using SIMS. Successively replaced carbonate layers show systematically decreasing δ^{18}O and δ^{30}Si values. We show that quantitative Si precipitation in a closed system best explains these data, requiring positive ε^{30}Si values. We quantify ε^{30}Si values and use a T-calibration based on an ab-initio model to determine the temperatures of carbonate replacement to be approx. 60°C and calculate the fluid δ^{18}O to have been approx. -11 ‰. This approach opens a new avenue for determining initial fluid δ^{18}O values in deep time and could thus solve long-standing disputes about hot vs. temperate Precambrian oceans.

Cite abstract as:

Tatzel, M., Oelze, M., Liesegang, M., Stuff, M., et al. (2021) Si isotope thermometry in silicified carbonate. DMG Sektionstreffen Petrologie und Geochemie, Online (Germany), abstract URL: http://paneth.eu/PanethKolloquium/DMG2021/0023.pdf (abstract #0023).