# Neoproterozoic carbonate clumped isotope records from the onset of the Sturtian Snowball Earth glaciation

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Carbonate strata from NE Svalbard provide a window into diagenesis and changing depositional environments across climate perturbations of the Neoproterozoic. Stratigraphic sections include diamictites correlated to the Sturtian (~717–659 Ma) and Marinoan (~645-635 Ma) Snowball Earth episodes, as well as pre- and inter-glacial stratigraphy. Carbonate clumped isotope ($\Delta_{47}$) thermometry is a potential tool to explore direct records of temperature surrounding Neoproterozoic climate perturbations. In order to test the source of $\Delta_{47}$ variability in these strata, we examine clumped isotope values of calcite and dolomite in the context of petrographic texture and organic matter preservation. In addition, we explore the integrity of this record through sections on different fault blocks that have experienced different burial and alteration histories. Calcites across sections from the onset of the Cryogenian typically record higher temperatures than co-occurring dolomites, consistent with calcite and dolomite reordering kinetics. In the most extreme cases, both depositional and vein calcites record equilibration above the closure temperature for calcites, but dolomite temperatures calculated from $\Delta_{47}$ values indicate that they have not been fully reordered throughout these sections. For example, in the least altered section, Sturtian glacial dolomites have $\Delta_{47}$ temperatures down to 20-25°C. In addition, clumped isotope temperatures vary by approximately 20°C between the pre-Sturtian Russøya and the Sturtian Petrovbreen members of the Elbobreen Formation. These samples also have mineral $\delta^{18}O$ consistent with precipitation from fluids of different compositions. On different fault blocks in NE Svalbard, variability in clumped isotope temperatures correspond to records of organic matter maturity, following expectations for greater clumped isotope reordering in regions with higher burial temperatures. Together, these data indicate that clumped isotope values preserve distinct differences between pre-glacial and syn-glacial stratigraphy through early diagenesis, but that preservation of this signal is sensitive to the burial history of specific fault blocks.