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Synthetic Diagenetic Variations in Biogenic Opal

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Silicon plays an important role in global biogeochemical cycles and has helped regulate climate change throughout Earth's history. Biogenic silica ($bSiO_2$), formed by biological organisms in the oceans (e.g., sponge spicules and diatoms), is one of the most abundant biogenic materialsDia in marine sediments worldwide. The isotopic composition (i.e., $\delta^{30}Si$) of $bSiO_2$ can be used to reconstruct what the ocean environment was like when the organisms lived. For this reason, $\delta^{30}Si$ in unaltered sedimentary $bSiO_2$ has widely been used as a paleoproxy for primary production in modern marine environments. The $\delta^{30}Si$ signal of amorphous $bSiO_2$(termed opal-A) is generally believed to remain resilient to dissolution or early diagenetic overprinting following burial in the sediments. Surprisingly, it is still largely unknown what happens after early diagenesis and how late diagenetic processes, following initial sedimentation, can affect $\delta^{30}Si$ isotopic values. Throughout the geologic record, marine $bSiO_2$ sediments are preserved in a range of opaline conversion states (i.e., opal-A, opal-CT, and quartz). Despite a recent acceleration in the number of studies surrounding this topic, early diagenetic effects on $\delta^{30}Si$ isotope values, are perhaps one of the most understudied processes affecting global oceanic biogeochemical cycles. We conducted a set of laboratory synthetic ageing experiments designed to track the diagenetic transition of opal-A to opal-CT and examine $\delta^{30}Si$ isotope values throughout the transition period. To better understand the climatic development and geochemical balance in the oceans we must consider how postdepositional changes may alter Si isotopic signatures across the geologic record. The results of this study provide new insights into the mechanism behind late silicate diagenesis, helping to better constrain the reliability of Si isotope as a paleoenvironmental proxy.