Tracing the evolution of biogenic opal to porcellanite and chert with $\delta^{18}O$ in deep sea sediments

Anastasia G. Yanchilina[1], Ruth Yam[1], Aldo Shemesh[1],
[1]Department of Earth and Planetary Sciences, Weizmann Institute of Sciences

Deep sea cherts exhibit a wide range of oxygen isotope compositions, indicating that the transition from opal-A to opal-CT to chert in deep sea sediments is not yet isotopically constrained and necessitates more study. Interpreting the $\delta^{18}O$ signature of marine cherts has substantial potential for reconstructing ocean temperature and sea water $\delta^{18}O$ composition. We use $\delta^{18}O$ isotopes of opal-A, opal-CT, and chert to diagnose the pathway of formation of marine cherts using sedimentary records of Miocene to modern age from ODP sites 795 and 799 retrieved from the Sea of Japan. The sediment is first processed with a robust cleaning procedure to isolate the opal-A and opal-CT fractions of the sediment, followed by XRD and SEM/EDS to diagnose the mineralogical phases present within the isolated silica. We observe that the $\delta^{18}O$ composition of the diagenetic product of opal-A to opal-CT and chert is dependent on the sedimentary environment. That opal-A that is deposited in a clay dominant lithology, is likely to react with the clays, leading to locking in a depleted $\delta^{18}O$ composition, close to that of the clays themselves of approximately 20 ‰. On the other hand, opal-A that is deposited in an opal-A / diatom dominant lithology, is likely to instead react with the co-depositional silica, leading to locking in an enriched $\delta^{18}O$ of 30 to 40 ‰, a measurement that perhaps provides an opportunity to diagnose the original depositional environment.