Maturation pathways of amorphous opal in clay and carbonate rich environments in deep sea sediments indicated by silica $\delta^{18}O$.

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In deep sea sediments, biogenic amorphous opal (opal-A) in the form of diatoms, radiolaria, and sponge spicules transforms to opal-CT and microquartz chert via different pathways according to the lithology in which the opal maturation takes place. Given that $\delta^{18}O$ of silica reflects local porewater $\delta^{18}O$ and temperature of formation, $\delta^{18}O$ of opal-A, opal-CT, and microquartz chert can be used to identify pathways of maturation of opal-CT and microquartz chert. We have identified two sets of deep sea cores in which the maturation of opal-A takes place in both clay and carbonate rich sediments. ODP cores 795 and 799 retrieved from the Sea of Japan have clay dominant lithologies and ODP cores 1049-1053 retrieved from the North Atlantic have carbonate dominant lithologies. The sediment is first processed with a robust cleaning and separation procedure to isolate opal-A and opal-CT components of the sediment, followed by characterisation with XRD, XPS, and SEM/EDS. In ODP cores 795 and 799, the $\delta^{18}O$ of opal-CT is ~25 ‰ and the $\delta^{18}O$ of microquartz chert is ~20 ‰, interpreted to reflect local temperature of 40°C and 60°C and porewater $\delta^{18}O$. This suggests that the original biogenic opal dissolves and reprecipitates as a more thermodynamically stable form of silica. In ODP cores 1049-1053, the $\delta^{18}O$ of opal-CT ranges from 37.5 to 44.5 ‰. Opal-CT with these high values contains little to none additional impurities of Al, Mg, and Fe which is almost identical to those values measured in biogenic opal-A of similar age. Taking into consideration that these high values cannot be explained by affects of local temperature or porewater $\delta^{18}O$, opal-CT that forms in carbonate rich environments is interpreted to instead follow a different pathway (solid state transformation) of maturation but further study is needed to investigate this conclusion.