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Oxygen isotopes in 3.0 Gyr.cherts: A record of the oceanic temperature?

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A global cooling of the oceans since 3.5 Gyr is inferred from the continuous record of thecoupled $^{18}O/^{16}O$ and $^{30}Si/^{28}Si$ isotope ratios (expressed in $\delta^{18}O$ and $\delta^{30}Si$units) in siliceous seawater sediments (cherts). During the past decade, marked advances in this interpretation were made from in-situ analysis at a micrometric spatial resolution. Among the most remarkable findings of this type of analysis is the discovery of a large internal distribution of $\delta^{18}O$ (up to 8‰) in the microquartz. This mineral stands for the first recrystallization step of amorphous opal CT precipitated from seawater and, in this respect, should exhibit the best preserve disotope compositions. Such internal $\delta^{18}O$ distribution is irreconcilable with a thermal isotope equilibrium between seawater and precipitated silica: large isotope fractionation must have taken place in closed micrometric systems, likely through dissolution-reprecipitation of opal CT during diagenesis. Several petrographical and geochemical criteria were used to reconstruct the original $\delta^{18}O$ of the precipitated silica. These criteria should be regarded as guides to better constrain seawater paleo-temperature reconstructions. Although some Archean microfossil-rich cherts from the Farrel Quartzite (Pilbara Cration/Australia - 3.0 Gyr.) exhibit low $\delta^{18}O$ compatible only with a silica precipitation from hot (80°C) hydrothermal fluids, a warm temperature (≥50°C) for the Archean oceans remains the most plausible conjecture to account for the secular isotope variations in cherts.

Biography

François Robert is an isotope geochemist specialized in Cosmochemistry, Precambrian sediments and organic geochemistry.

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