

Analysis of organic carbon isotope composition: contamination issues and new decarbonation process

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One of the most serious issues with investigating early traces of life in the ancient rock record is the difficulty in obtaining well-preserved samples. Although not much can be done to avoid diagenetic and metamorphic alterations, oxidative weathering can be avoided by working on drill core samples. This implies a restricted number of possible chemical and isotopic analyses due to the limited amount of sample available. Moreover, even in this case, possible issues of contamination by modern organic matter can remain.

We tested on various Archean rocks different cleaning methods commonly used before decarbonation to avoid contamination with modern organic carbon. In addition, we applied for the first time the chemical protocol for sulfur sulfide extraction, which uses an acidic chromium solution, for decarbonation of sample powders (for later organic carbon isotope analyses). Both sulfur sulfide extraction and decarbonation are time consuming and require important and independent quantities of sample so that coupling them may save a significant amount of both sample and time. Most importantly, it allows both organic carbon (TOC and $\delta^{13}\text{C}$) and inorganic sulfur isotope composition measurements to be performed on the exact same powder.

Our results show that no significant carbon isotope fractionation is caused by this new decarbonation protocol, even for the samples with low organic carbon content. The acidic chromium solution seems to be perfectly adapted for the carbon isotope analysis of organic matter in the ancient rock record, at least when the rock samples have experienced low greenschist facies metamorphism. In addition, our results show that some solvent such as hexane or dichloromethane (DCM) could be responsible for contaminations on TOC and $\delta^{13}\text{C}$, when alcohol and acid don't.