ECOLE LEMANIQUE DES SCIENCES DE LA TERRE
DES UNIVERSITES DE GENEVE ET DE LAUSANNE

Master ès Sciences in Earth sciences

Understanding how ancient atmospheric O_2 is recorded in barite by SwissSIMS ion probe measurements

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Context

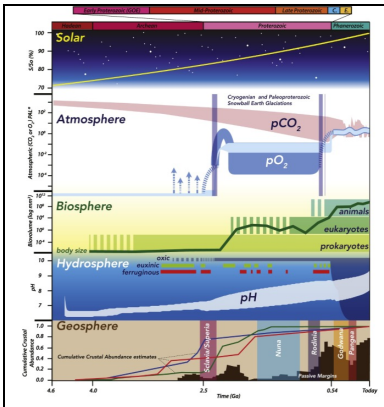
The composition of Precambrian atmosphere is an important topic in Earth Sciences. It is thought that for the most of the Earth's history it was <1 % of modern value. Yet there's evidence for photosynthesis dating to almost 3 billion years ago. A big part of the problem is not being able to determine oxygen content from rocks that are that old. Barite (BaSO4) occurs in a range of conditions from low-temperature sedimentary environments to high-temperature hydrothermal and igneous rocks. However, some barite deposits capture atmospheric O2 through a series of oxidation reactions that involve sulfur. The project will focus on understanding barite forming environments in the deep past when atmospheric oxygen levels were much lower than today. Based on multiple collections of Precambrian formations, we will develop microanalytical methods to measure oxygen isotopes, $^{87}Sr/^{86}Sr$, novel triple oxygen isotopes.

Objectives and Methods

- Developing skills in oxygen isotope geochemistry, modeling fractionations between minerals, fluids and dissolved species (sulfate, O2)
- Measuring chemical composition of barite standards by microsonde
- Determining $\delta^{18}O$ by conventional method (TC/EA + mass spec)
- Preparation of samples for novel in situ isotope measurements using the SwissSIMS ion probe
- Interpreting the data with an eye of statistics-based geochemist
- Plotting the data and thinking about how much oxygen was in the atmosphere, how much of it was in ozone and how many plants were able to process it

Literature

Bao and Zhou 2008 Triple oxygen isotope evidence for elevated CO2 levels after a Neoproterozoic glaciation. Nature 453, 504-506; Crockford et al. 2019 Claypool continued: Extending the isotopic record of sedimentary sulfate. 513, 200-225. Chemical Geology



WEB sites

https://swisssims.com/
https://www.sciencedaily.com/releases/2021/03/210301091139.htm
https://news.uchicago.edu/story/uchicago-scientists-reveal-new-clues-how-earth-got-its-oxygen

Choice of orientation : (supprimer les orientations qui ne conviendraient pas)

1) Sedimentary, Environmental and Reservoir Geology / 2) Geochemistry, Alpine tectonics, Ore Deposits