

Phanerozoic Evaporites

Website: <https://www.bco-dmo.org/dataset/995188>

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Project

» [Collaborative Research: Development of a novel way for understanding ancient Earth atmospheres and marine sulfate using the stable isotope of Oxygen \(\$^{17}\text{O}\$ \) in marine barite.](#) (Earth atmosphere)

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Table of Contents

- [Coverage](#)
- [Dataset Description](#)
- [Parameters](#)
- [Project Information](#)
- [Funding](#)

Coverage

Spatial Extent: Lat:0 Lon:0

[[table of contents](#) | [back to top](#)]

Parameters

Parameters for this dataset have not yet been identified

[[table of contents](#) | [back to top](#)]

Project Information

Collaborative Research: Development of a novel way for understanding ancient Earth atmospheres and marine sulfate using the stable isotope of Oxygen (^{17}O) in marine barite. (Earth atmosphere)

NSF Award Abstract:

Marine sediments contain a record of climate evolution and how Earth's surface has changed over the last 125 million years. Part of this story is locked up in marine barite (BaSO_4), a mineral that precipitates from seawater and contains sulfur and oxygen. Through studies of the stable isotopes in seawater sulfate (SO_4), changes in biogeochemical processes and variations in other chemical cycles that are important for life on Earth have been determined. However, due to the properties of this sulfate and its ability to incorporate information from processes as diverse as climate, microbial metabolism and weathering, interpretation of traditional oxygen isotope ($^{18}\text{O}/^{16}\text{O}$) and sulfur isotope ($^{34}\text{S}/^{32}\text{S}$) measurements commonly result in interpretations that are not unique. This research explores a new, independent means for unraveling the information stored in marine barite via the addition of a previously difficult-to-measure, and hence generally overlooked, isotope of oxygen: ^{17}O . Only recently, with the development of increasingly sensitive mass spectrometers and new laboratory methodologies, have these measurements become possible. The ^{17}O signal locked inside marine barite has the potential to identify the oxygen/carbon dioxide ratio of the atmosphere as well as the intensity of biospheric

activity and how these parameters have changed over time, important knowledge for understanding present atmospheric compositions and processes related to global warming. This pilot study analyzes barite in the core tops of ten marine cores to quantitatively evaluate whether barite is a faithful recorder of marine sulfate. To further validate whether ^{17}O can provide a reliable proxy for unraveling the influences of various environmental processes, analyses of samples from additional cores and down core of the those analyzed in the core top study will be carried out.

This research further develops and explores the potential of using marine barite to construct a reliable record of the ^{17}O fingerprint of seawater sulfate over the last 125 million years (i.e., from the Cretaceous through the Cenozoic). If successful, the work, in combination with the results of more commonly measured oxygen ($^{18}\text{O}/^{16}\text{O}$) and sulfur ($^{33}\text{S}/^{32}\text{S}$ and $^{34}\text{S}/^{36}\text{S}$) isotope ratios, has the potential to provide insights into the O_2/CO_2 composition of the atmosphere over time and activity of Earth's biosphere. Although previously ^{17}O measurements of marine barite were difficult to make and had high uncertainties, this limitation has now been overcome by advances in mass spectrometry and the development of laboratory procedures that are tuned to increase the analytical precision of ^{17}O . Goals of the research are to measure ^{17}O in carefully selected barite samples from sediment cores collected from the floor of the Pacific Ocean and quantify the offset, if any, between modern core-top barite and contemporaneous water column sulfate. It will also measure down core variations of ^{17}O to examine variations in the isotope signature with time and compare these with the results from co-existing pore waters to examine possible diagenetic effects. The result will be validation of this new proxy in the marine record. Samples of barite will be extracted from sediment from the tops of ten cores, using acid leaching and other separation techniques to remove all oxygen-bearing phases but barite. The resulting barite will be checked for purity using techniques including scanning and analytical electron microscopy. Preparation of samples for isotope work will include fluorination and analysis on a high resolution isotope ratio mass spectrometer.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

[[table of contents](#) | [back to top](#)]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1946137

[[table of contents](#) | [back to top](#)]