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Gas analysis and microthermometry of modern halite: the viability of methods

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Over the last century, atmospheric modelling has produced many contradicting opinions regarding the evolution of Earth's atmospheric oxygen. Accurately quantifying these changes throughout geological history is exceedingly difficult [1] [2]. The lack of consensus is in part due to a reliance on proxy data and a lack of cross-temporal comparisons between direct calibrations of ancient redox environments and modern counterparts [1]. The evaluation of modern samples produces a more comprehensive understanding of Earth's atmospheric evolution and allows the viability of analytical techniques used for atmospheric modelling to be tested [3].

The objective of this study is to verify that atmospheric gas ratios and temperatures measured from primary fluid inclusions in modern salt traps reflect modern atmospheric conditions. As well, we will evaluate additional factors affecting and/or altering gas ratios after their entrapment. Gas measurements and microthermometry data were collected from multiple modern halite samples from the Bahamas, Bonaire, South Africa, Australia, New Mexico, and Searles Lake (California, USA) to determine the viability of using primary fluid inclusions in halite for modelling atmospheric conditions through deep time.

Results for this research show that generally, fluid inclusions in halite reflect atmospheric gas compositions, but may become modified by trapped microorganisms, as seen in Searles Lake. Multiple samples exhibited entrapment of two or more phases (i.e., heterogeneous fluid inclusion trapping) with large gas bubbles. Gas measurements for pN2, pO2, and pAr conducted by mass spectrometry of these trapped gases match modern air measurements [4]. Notably, microthermometry of modern Bahamian halite matches ambient temperatures from the time of sample collection. Thus, are likely to accurately record temperatures at times of formation. This suggests that gas analysis and microthermometry are reliable analytic techniques for quantifying paleo-environmental conditions from the time of halite precipitation.

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[3] Blamey, 2012. Journal of geochemical exploration, 116–117, 17–27.

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