



Stable oxygen and hydrogen isotopes of brines - comparing isotope ratio mass spectrometry and isotope ratio infrared spectroscopy

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Today's standard analytical methods for high precision stable isotope analysis of fluids are gas-water equilibration and high temperature pyrolysis coupled to isotope ratio mass spectrometers (IRMS). In recent years, relatively new laser-based analytical instruments entered the market that are said to allow high isotope precision data on nearly every media. This optical technique is referred to as isotope ratio infrared spectroscopy (IRIS). The objective of this study is to evaluate the capability of this new instrument type for highly saline solutions and a comparison of the analytical results with traditional IRMS analysis.

It has been shown for the equilibration method that the presence of salts influences the measured isotope values depending on the salt concentration (see Lécuyer et al, 2009; Martineau, 2012). This so-called 'isotope salt effect' depends on the salt type and salt concentration. These factors change the activity in the fluid and therefore shift the isotope ratios measured by the equilibration method. Consequently, correction factors have to be applied to these analytical data. Direct conversion techniques like pyrolysis or the new laser instruments allow the measurement of the water molecule from the sample directly and should therefore not suffer from the salt effect, i.e. no corrections of raw values are necessary. However, due to high salt concentrations this might cause technical problems with the analytical hardware and may require labor-intensive sample preparation (e.g. vacuum distillation).

This study evaluates the salt isotope effect for the IRMS equilibration technique (Thermo Gasbench II coupled to Delta Plus XP) and the laser-based IRIS instruments with liquid injection (Picarro L2120-i). Synthetic salt solutions (NaCl, KCl, CaCl₂, MgCl₂, MgSO₄, CaSO₄) and natural brines collected from the Stassfurt Salt Anticline (Germany; Stadler et al., 2012) were analysed with both techniques. Salt concentrations ranged from seawater salinity up to full saturation.

References

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