Field-Based Removal of Hydrogen Sulfide from Carbon Dioxide and Natural Gas Sample Streams without Geochemical Alteration

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Abstract

The project goal is to develop a system to remove hydrogen sulfide (H_2S) from gasses without altering the stable isotopic composition of the remaining gas. This will allow robust studies of systems where H_2S has previously prevented geochemical and stable isotopic analysis. There are no commercially available products that can scrub H_2S from carbon dioxide (CO_2) without fractionating the isotopic composition. Our testing using commercially available products designed to scrub H_2S from hydrocarbon gasses showed isotopic changes outside statistically acceptable deviations. We have designed, built, and are extensively testing a proprietary portable scrubber system to remove H_2S from gasses with CO_2, hydrocarbons C_1 through n-C_5, and air without altering $\delta^{13}C$ values of the remaining analytes.

Stable isotopes are important natural tracers and can provide vital information about subsurface systems involving sequestered CO_2, oil and gas, and coal related gasses. Monitoring the isotopic composition of injected CO_2 is becoming more increasingly utilized as a monitoring tool for carbon capture and storage projects. In these systems, H_2S is a common naturally occurring hazard. Currently, high concentrations of H_2S in samples prevent accurate analysis and even sample acceptance at most laboratories. Preliminary data from our scrubber system testing show we have found a novel solution to remove H_2S without affecting stable isotopic composition.

Our scrubber system uses a packed column with a substrate that changes colors when expended. The column is transparent so the substrate remains visible during all stages of operation. The entire scrubber system is made of inert, corrosion resistant materials that are compatible with natural gas, CO_2, and H_2S. Using a Gas Chromatography Combustion Isotope Ratio Mass Spectrometer (GC-C-IRMS) system, we are conducting a series of experiments to verify the efficacy of our scrubber system with gasses containing different combinations and concentrations of CO_2, H_2S, and hydrocarbons C_1 through n-C_5 in conjunction with GC analysis to identify compositional effects.

Testing our system using pure CO_2 has shown we are able to process CO_2 without any statistically significant fractionation or alteration of the $\delta^{13}C$ stable carbon isotope composition. This capability alone is something that is not currently commercially available and is useful in a wide range of applications where stable isotopic analysis provides critical information about the system. Based on preliminary data, this represents a significant improvement in H_2S removal from samples intended for geochemical and isotopic analysis. Additionally, it prevents the hazards of both shipping and handling of samples containing hazardous concentrations of H_2S in the laboratory.

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