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Analysis of SF6 and SF5CF3 by Gas Chromatography to Characterize Groundwater Transport at a CO2 Sequestration Site in Iceland

To mitigate the effects of climate change, carbon dioxide (CO2) emission levels must be greatly reduced. Carbon sequestration is a proposed strategy that entails capturing CO2 as it is produced, or extracting it directly from the atmosphere, and placing it in a long-term storage reservoir. Underground geologic formations are a feasible site for storage, where CO2 dissolved in water can react with basaltic rocks to form precipitates. The Carbfix project is a large-scale, international, proof-of-concept effort to design and implement a carbon sequestration system at a geothermal power plant in Iceland. The initial two stages of the project have sought to characterize the flow patterns of the target aquifer using the tracer dye sodium fluorescein (Na-Flu) as well as the gas sulfur hexaflouride (SF6). The final and third stage of the experiment, scheduled for January 2012, will be to inject CO2 into the groundwater along with a radiocarbon tag (14C) , the tracer dye rhodamine and the gas trifluoromethyl sulfur pentafluoride (SF5CF3). These tracers will be monitored to track the behavior of the CO2 and to determine the degree to which mineral carbonation has occurred. In order to perform the analysis of both the SF6 and the SF5CF3 tracer for the next phase of the study, a gas chromatograph (GC) setup was needed that could measure both components simultaneously. The development of such a setup entailed testing various columns and valve organizations to optimize the chromatograph results. Both SF6 and SF5CF3 were measureable when using a 12-inch molecular sieve precolumn and a 6 foot CarboBlack packed column, but the SF6 results were poorly resolved due to a large O2 contamination peak. Although the machine produces satisfactory results for SF6 and SF5CF3, the results could be improved by eliminating the O2 contamination. Analysis of the SF6 concentrations as part of the second phase tracer study has also been ongoing. The results indicate the presence of a fissure through which water flows quickly in addition to a low-flow path. The low velocity of the groundwater flow suggests that when CO2 is injected into the system there will be sufficient time for the carbonate reactions to take place, and thus the aquifer is a suitable site for carbon sequestration.