Carbon dioxide and methane in karst systems

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The role of CO_2 in soil-karst-cave systems is well known but less is known about the actual sources of CO_2 in cave air which accumulates via contributions from degassing dripwater and from advection of CO_2–rich ground air out of the porous karst. The geochemistry of CO_2 and CH_4 are interlinked in the carbon cycle and very little is known about the behavior of methane in karst systems. Methane is an interesting tracer on account of large isotopic fractionations that result from biogenic processes and new carbon isotopic evidence for oxidation of atmospheric methane in a dynamically ventilated cave by methanotrophic bacteria suggest that natural karst ventilation could be a significant terrestrial sink for atmospheric methane in global models. There are many unknowns regarding the magnitude of gas exchange between the atmosphere and porous karst but since 20% of Europe and 13% of the ice-free land surface of the world is limestone the potential impact of CO_2 and CH_4 exchange between karst and the atmospheric greenhouse gas budget warrants more detailed investigation.

This project will use isotope tracing to generation and dispersal of CO_2 and CH_4 in karst systems and will build on ongoing monitoring projects in cave systems in Gibraltar, France. A novel aspect of this project will be to investigate the dynamics of CO_2 and CH_4 fluxes into karst from the soil zone, and between caves and exterior atmosphere using real-time monitoring. The objective of this work will be to quantify the role of karst in as terrestrial sinks and sources of the two most important greenhouse gases by the action of natural ventilation of caves.

Training will be given in environmental monitoring techniques in cave systems, stable isotope analysis of CO_2 and CH_4 in soil and cave air and development and testing of sensor and new sampling systems. The project would suit applicants with an interest in geochemistry, climate science and numerical modeling and will involve fieldwork above and below ground.