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Geochemical monitoring of vadose zone retention ability on induced CO_2 leakage

G. Cohen, C. Loisy, and A. Cerepi
EA 4592 Géoressources et Environnement, University of Bordeaux, ENSEGID, 1, allée F. Daguin, 33607, Pessac, France

CO_2 emissions in the atmosphere are increasing continually, which are mainly originated from burning of fossil fuels. The Intergovernmental Panel of Climate Change Special Report on Carbon Capture and Storage in 2005 identified various knowledge gaps that need to be resolved before the large-scale implementation of CO_2 geological storage is possible. One of them is to determine what would be the impact of a CO_2 leakage from a geological storage on vadose zone and near surface environment.

The CO_2-Vadose Project aims at developing a facility around a room of a former underground limestone quarry in Saint-Emilion (Gironde, France) to perform experimental releases of CO_2 under controlled conditions in order to study CO_2 transport and geochemical reactions along the vadose zone and to test near-surface detection techniques. Experimental site was set up among others with more than forty gas probe in order to follow CO_2 concentrations before and after injection thanks to μGC and infrared analyser. These probes have been set at different depths spatially distributed: in the soil at ten centimetres, at the contact between soil and limestone at about 40 centimetres depth, in limestone at about 90 centimetres depth, and in limestone all around the injection chamber. Micro-climatic parameters were also recorded by a weather station at the site surface (precipitation, barometric pressure, temperature, relative humidity, wind speed, amount of sunshine) and around the injection room (barometric pressure, relative humidity, temperature).

Natural ground and limestone CO_2 concentrations were monitored during almost a year before CO_2 injection. During this period, natural CO_2 concentrations variations were observed in order to plot a natural baseline and so to determine the best period for the injection and to distinguish natural biogenic from injected CO_2. Natural CO_2 concentrations recorded vary between about 400 ppm in deeply limestone to more than 20,000 ppm in the upper part of the soil following cycles. First results show that these cycles are about six weeks. Before the CO_2 injection, argon was used as a tracer to determine experimentally the time needed by an inert gas to spread into limestone. These experimentations are of primary interest to study CO_2 behaviour in the vadose zone.