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Soil gas flux measurements as part of environmental baseline assessment

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Natural gas seeps provide a unique opportunity for testing techniques and strategies of environmental baseline assessment (EBA) for exploration or exploitation activities of conventional and unconventional methane. We report new field acquisitions performed at a gas seep in the French Alps where thermogenic, CH4-dominated (up to 85% vol.) and CO_2-rich (up to 11.5 % vol.) gas emanates over a localized 8x4 m emission area with complex geometry (Gal et al., 2016) that characterizes many naturally occurring gas vents (e.g. Etiope et al., 2010).
We tested a portable system of in-situ soil gas flux measurements, combining an accumulation chamber and a monitoring system, recording CH4 and CO_2 enrichments as well as O_2 depletion over 3 minutes, the typical duration of soil flux measurements. Methane fluxes have been quantified on 70 monitoring points emplaced along a 2x1 m mesh grid. The potential time evolution of the CH4 and CO_2 emission has been assessed through complementary soil gas concentration measurements at 1 m depth. Only minor changes of the location of the emitting points with respect to previous measurements have been observed.
Correlations of CO_2, O_2 and CH4 indicate distinct processes of CH4-oxidation in the area surrounding the main CH4-vent and in the vent itself. The most active part of the gas vent only exhibits high CH4 fluxes whereas adjacent areas show moderate to high CH4 and CO_2 fluxes and more distal areas are only characterized by a CO_2 flux. The main flux occurs through the vent (piped) with daily CH4 and CO_2 emissions of respectively 130 kg and 40 kg. Cumulated fluxes in the adjacent area are estimated at 0.82 kg of CH4 and 1.66 kg of CO_2 per day. Multi-gas flux measurements in the vicinity of a seep or supposed leak is an efficient and straightforward onsite method to be integrated in EBA, but spatial extension and resolution of survey grids will depend much on the expected scale of impact of industrial point sources (exploration/exploitation wells). Natural fluxes can be addressed both for methane and CO_2 and reduction-oxydation processes assessed through correlation with O_2 .

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Etiope G., Zwahlen C., Anselmetti F. S., Kipfer R., Schubert C. J. (2010) Origin and flux of a gas seep in the Northern Alps (Giswil, Switzerland). Geofluids, 10, 476-485.
Gal F., Kloppmann W., Proust E., Bentivegna G., Defossez P., Mayer B., Gaucher E. (2016) Natural CH4 gas seeps in the French Alps: characteristics, typology and contribution to CH4 natural emissions to the atmosphere. In: 13th International Conference on Greenhouse Gas Control Technologies, GHGT-13, J. O. G. Tande, T. Kvamsdal, & M. Muskulus (Eds.), Energy Procedia.