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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 field acquisitions performed at a gas seep in the French Alps where thermogenic, CH₄-dominated (up to 85% vol.) and CO₂-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 CO₂ enrichments as well as O₂ 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 CO₂ 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 CO₂, O₂ 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 CO₂ fluxes and more distal areas are only characterized by a CO₂ flux. 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 CO₂ and reduction-oxidation processes assessed through correlation with O₂. Other vents in similar geological positions in the French subalpine chains on a vast transect from the Swiss border to the Provence were identified, based on historical records, and some of them rediscovered and measured.

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