The Noble gas fingerprints of the CO_2 produced at the first French Pilot (Lacq Pilot, Total SA company)

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Geochemical monitoring results of gas characterization combined with CO_2-carbon isotopes and noble gas analyses are presented. This work marks a novel approach to the CO_2 monitoring strategy envisaged in a CCS project. This methodology and results obtained attempt to better understand the dynamic between the gas field, the aquifer, the surface and the atmosphere, in order to detect any eventual leakage of the injected CO_2 from the reservoir to the near surface [1].

Results show that the bulk gas compositions of the Rousse gas are comparable to the Lacq fuel gas with methane as the main compound with residual C_2-C_5 and CO_2. Soil gases are typical mixtures of air with biogenic CO_2 (up to 9-10%), while the monitoring well gases display typical air compositions with no excess CO_2. The Rousse gas and the Lacq fuel gas have $\delta^{13}C_{CH4}$ values of -41‰ and -43‰ respectively. The injected CO_2 out of the oxycombustion chamber has a $\delta^{13}C_{CO2}$ of -40‰ whereas $\delta\ ^{13}C_{CO2}$ value for soils samples is comprised between -15 and -25‰. The Rousse natural gas and the Lacq fuel gas are both characterized by a high He enrichment, and depletion in Ne, Ar and Kr compared to the air values. The oxyfuel combustion process provides a CO_2 with the He enrichment of the Lacq fuel gas, and a Ne, Ar and Kr composition reflecting that of the oxygen produced at the Air separation Unit (ASU). Indeed, Ne is depleted relatively to the air, while Kr is enriched up to tenfold, which results from the cryogenic separation of the air noble gases within the ASU. Soil samples are equivalent to that of the air.

In the light of these results, the composition of the various end-members involved in this CO_2 storage pilot suggest that noble gas compositions produced by oxyfuel process are sufficiently exotic to be directly used as tracers of the injected CO2, in order to detect and quantify any potential leak at soil and aquifer levels.

[1] B. Garcia *et al* (2012) *OGST*, **67**, 341-353