

Development of on-site sampling and analysis methods for accurate isotopic underground gas storage monitoring

ZINE EDDINE HAMOUM^{1,2,3}, MARRIE LARREGIEU¹,
PIERRE CHIQUET^{3,4}, HERVÉ CARRIER^{2,3} AND ISABELLE
LE HÉCHO^{1,3}

¹Université de Pau et des Pays de l'Adour, E2S UPPA, CNRS, IPREM, Pau, France

²Université de Pau et des Pays de l'Adour, E2S UPPA, CNRS, LFCR, Pau, France

³Joint laboratory SEnGA, UPPA-E2S-Teréga, Pau, France

⁴Teréga – Geosciences Department

In the context of the energy transition favoring decarbonized gas energies, underground natural gas storage sites are required to receive new effluents known as “renewable gases”, including hydrogen and biomethane. This involves the development of appropriate sampling and analysis methodologies for the effective monitoring of gas storage infrastructures. Such methodologies must be secure, robust, and tailored to the specific application, considering several factors such as ease of use, industrial field conditions, and the long-term sustainability of the analytical chain.

Our aim was to develop robust analytical methods, from sampling to analysis, for monitoring natural gas and other gaseous effluents stored or about to be stored, as well as those likely to be generated in the underground gas storage aquifer ‘UGS – A’. In order to provide tools to ensure the integrity of underground gas storage facilities and highlighting the phenomena occurring there. Several on-site sampling and laboratory isotopic analysis methods have been developed and validated for alkanes and others gaseous chemical compounds.

Two sampling systems have been evaluated. The first system is a direct gas sampler using vacuum-sealed vials, compatible with high- and low-pressure gas sources, including gas from tubing head and annular spaces. The second system involves preconcentration and uses adsorbent tubes to capture specific trace compounds. Both systems have been tested for reproducibility on reference gas standard and actual natural gas samples to verify the accuracy of $\delta^{13}\text{C}$ and $\delta^2\text{H}$ isotopic measurements of alkanes ($\text{C}_1\text{-C}_6$) and to investigate any potential fractionation occurring during the sampling process. The methods developed were applied to samples from multiple gas wells as part of a comprehensive ‘UGS-A’ monitoring study conducted at two gas reservoirs, demonstrating high measurement efficiency.