Evaluating CO_2 Leakage Around CO_2 Injection Wells and Abandoned Wells

Critical to the success of geologic sequestration is the need to ensure underground storage sinks do not leak to pose a threat to human health and the environment. While leakage can occur via faults and natural fractures, the most likely conduits are CO_2 injection wells, plugged and abandoned (P&A'd) wells, and orphaned wells. Some of the most common reasons for leakage are:

• poor cement jobs resulting in CO_2 leakage in the near wellbore region,

• degradation of cement over long periods of time,

• casing leaks caused by leaking threads, corrosion, pressure, or wear from drilling,

• overpressure causing failure conditions in wells, and

• improper plugging which can limit a well's integrity.

Wells that penetrate the sequestration reservoir create a potential conduit for buoyant CO_2 to migrate to the surface. While the majority of these wells are properly P&A'd, there are still potential risks associated with orphaned and abandoned wells (S. Taku Ide, et. al.).

Amplified Geochemical Imaging's (AGI's) proprietary passive surface CO_2 detection provides a unique ability to detect CO_2 and CO_2 impurities at ppm levels, which is 10,000 times more sensitive than seismic methods.

The AGI passive sampler (**Figure 1**) contains a specially engineered polymeric adsorbent encased in a microporous membrane. Membrane pores are small enough to prevent soil particles and water from entering, and yet allow vapor molecules, such as CO_2, to pass through and concentrate on the adsorbents. Samplers are deployed for 10 days to allow for equilibrium between CO_2 molecules on the sampler and in the soil matrix around the well bore. Since sample concentrations are time integrated, the results are more stable, more accurate and more reproducible than measurements taken at a single moment in time.

For module installation, a 1 in (~2.5 cm) diameter hole is

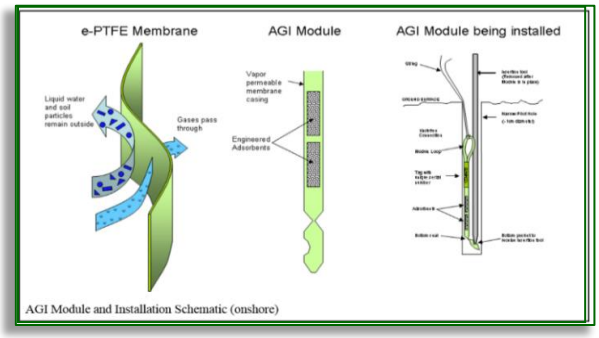

Figure 1.

drilled to a depth of ~2 – 3 ft (~0.6 – 1.0 m) for each sample. Fifteen modules are placed in a circle around each well (**Figure 2**), with a radius of ~10 ft (~3 m). The 10 ft radius is intended to avoid adsorption of contaminants present at the well, which may mask the CO_2. 15 modules are used to ensure the well is adequately encircled to detect leakage up the well bore.

Five samples are placed ~50 ft (~15 m) away from the well of interest **(Figure 3)** to define the baseline or background signature.

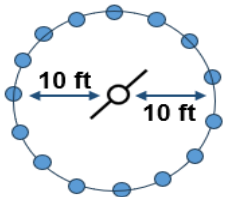

Figure 2

Figure 3

After the 10 day deployment, the samples are collected and shipped to AGI's laboratory in the U.S., to be analyzed by Thermal Desorption GC/MS. Data from the background samples are averaged and data from the 15 well samples are averaged. The two data sets are then compared to determine if CO_2 concentrations around the well are statistically different from background samples. The analytical method also detects trace levels of CO_2 impurities, such as amines and hydrocarbons. The presence of these constituents validates that CO_2 measured around the well bore is subsurface and not ambient.

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