Naturally Occurring CO_2

Natural CO_2 reservoirs exist underground in normal circumstances, and these naturally occurring stores of CO_2 have securely held the CO_2 in place for thousands, or even millions of years. These natural CO_2 stores have been extensively studied, and the knowledge gained has been incredibly useful in estimating the storage potential and learning about trapping mechanisms for CO_2 capture and storage (CCS). The knowledge gained from this allows scientists to predict the behaviour of stored CO_2, and gives the ability to perfect monitoring technologies that can then be applied to CCS.

Natural sources

CO_2 is found in two main types of location; sedimentary basins where water containing CO_2 becomes trapped, and in volcanic areas, where CO_2 is released from the magma (molten rock) as the pressure underground changes.

Where naturally occurring CO_2 is found in sedimentary rocks, like those that hold oil and natural gas, these stores are secure, with no pathways or routes for the CO_2 to escape. Such stores have existed, securely holding natural CO_2 for millions of years. One particular example is a geological structure deep underground in Mississippi, USA, which holds an extremely large quantity of CO_2, significantly larger than would ever be considered for a CCS project. This CO_2 entered the geological storage formation 65 million years ago (around the time that dinosaurs roamed the Earth), and has remained there ever since.

Examples such as this are not uncommon, and give clear evidence that appropriate geological structures can contain injected CO_2 for the periods of time required for CCS to effectively mitigate climate change.

Although extremely rare, sometimes naturally occurring CO_2 can leak upwards through the subsurface and release to the atmosphere, usually at a slow rate, with no adverse effects to plants or animals in the area. This is part of the natural CO_2 cycle between land, atmosphere and water. These leaks can teach scientists how CO_2 acts in the subsurface, and allows subsurface monitoring and detection tools to be perfected. It is very important to note that CCS sites would be carefully selected to avoid geology that would be susceptible to leaks and that these natural leaks are used as a positive learning experience.

In low concentrations (typically below 3%) CO_2 is harmless, causing tiredness and an increase in breathing rate, but with no lasting consequences. Above this level however, prolonged CO_2 exposure can lead to unconsciousness and possibly death if the affected person is not moved to a location with clearer air. While this is worrying when taken as a single fact, it should be noted that such high concentrations of CO_2 are rare, and would not remain in open areas as the CO_2 would mix with the surrounding air and disperse.

Natural disasters

There have been isolated instances in the past when a large release of naturally occurring CO_2 has lead to loss of life in natural disasters. While this is extremely rare, and in the following example a specific set of circumstances combined to facilitate the disaster, it is important to highlight the event, recognise the circumstances that occurred which lead to it, and recognise that the situation would not arise in the same manner in a CCS project. CCS sites would be selected in stable areas and safeguards would be in place to alert of any dangers in the unlikely event that something should go wrong.

In 1986, in a place called Lake Nyos in Cameroon, a natural disaster claimed the lives of 1700 people and 3500 animals. Lake Nyos is situated in a volcanic crater, where due to tropical conditions, and stable temperatures, the CO_2 that accumulates in the bottom layers of the lake do not mix and slowly release to the atmosphere. A geological event, possibly a landslide, disturbed the layers of water, releasing the CO_2, which (being heavier than air) flowed down the valleys and into several villages, asphyxiating the locals. Since then, pipelines have been installed to link the lower levels of CO_2 saturated water with the lake surface to prevent reoccurrence.

It is important to note that the incident at Lake Nyos and other similar disasters cannot be used as examples of what could happen with CCS sites; CCS would only be carried out at sites not subject to the kind of geological events that could cause leaks, and monitoring tools would minimise risks of undetected leaks.

Using Natural Sources to Learn

Being able to study and monitor natural sources of CO_2 in the subsurface enables scientists to learn how CO_2 behaves in underground storage formations at depth and pressures similar to those that will be used for CCS.

Studying natural leaks also enables scientists to fine tune monitoring technologies and develop early detection systems that can then be deployed near storage sites.

Summary

A great deal can be learned from natural underground stores of CO_2 and the very fact that these naturally occurring reservoirs have securely held CO_2 for thousands or even millions of years demonstrates the feasibility of CCS.

The situations that led to the few isolated natural disasters would not occur in carefully selected storage formations for CCS. For CCS, sites would be carefully selected in geologically secure areas, with little or no volcanic or tectonic (earthquake) activity, and with thorough and rigorous detection and monitoring systems in place with plans for the remediation of any leaks or releases.