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Development and application of a gas membrane sensor for in-situ down hole observation of carbon dioxide during sequestration

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The geological storage of carbon dioxide (CO_2) in deep permeable reservoir rocks is one of the most promising technologies for a considerable reduction of greenhouse gases entering the atmosphere from stationary point sources. However, comprehensive research is essential to better understand the behaviour of CO_2 during storage. Therefore we aim to develop and apply a new, innovative geochemical monitoring tool for the real time and in-situ observation of CO_2 and additional physical parameters during geological sequestration.

The method uses a phase separating membrane, permeable for gases, in order to extract the gases dissolved in borehole fluids, water and brines. The dissolved gases diffuse from the liquid through the membrane wall into its interior. In the membrane's interior, the gases mix in a prevailing argon stream provided from a pressure vessel and conducted via a capillary into the membrane element. Via a second capillary, the argon together with all gathered bore hole gases is led back to the surface. Both capillaries are embedded in an especially developed borehole cable. At the surface, the gas phase can be analyzed directly, e.g. in real-time with a mass spectrometer allowing for the determination of all permanent gases, and/or can be sampled for more detailed investigations in the laboratory.

By considering the permeation rates of the different gases and the Henry-constants on gas solubility, the gas concentration dissolved in the water can be calculated.

A prototype of the proposed technique was recently proved successful during a test in a water well at Ketzin (NE Germany) and at the site of the German Continental Scientific Drilling Program (http://icdp.gfz-potsdam.de/sites/ktb/index/index.html).