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Thermodynamic behaviour of CO2 during the injection into low pressure reservoirs

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The reduction of greenhouse gas emissions is one of the most promising targets to counteract global warming. Since CO2 was identified as a mayor greenhouse gas, and its reduction has been addressed by the world leaders at the climate conference in Copenhagen, the Carbon Capture and Storage (CCS) technology plays a mayor role to achieve these goals. CCS targets to reduce CO2 emissions from large scale industrial sources such as fossile fuelled power plants by means of long-term storage into a downhole reservoir. Since regenerative energy sources cannot serve the growing human electricity demand, the base load has to be covered by fossile energy sources which can be equipped with CCS technology.
However, still open questions remain which need to be addressed for a future large scale use of this technology. One of these questions addresses the injection process of CO2 into a reservoir.
The CO2 will be transported in pipelines from the power plant to the storage site. In order to minimize the pipeline costs, the pipeline calibre should be as small as possible. Therefore CO2 will be transported in a dense phase (fluid) under high pressures (>80 bar). Typically storage sites are saline aquifers or depleted gas reservoirs. Latter can be divided into reservoirs with and without water drive. Depleted gas reservoirs without water drive are characterised by low reservoir pressures (e.g. <20 bar) due to production of natural gas. During the injection into such a low pressure reservoir the temperature will cool down due to the Joule-Thompson effect which relates gas expansion to coherent phase change efficiency. Hence, the temperature will drop to negative values. This may cause material damage, icing and the formation of hydrates in the borehole or in the reservoir. However, these effects are not completely understood and need further investigations. In this poster the initial concept of a PhD-thesis about the thermodynamic behaviour of CO2 during the injection will be presented.