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Subsurface fluid data from Longyearbyen CO_2 storage site: Basin history and compartmentalization

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The Longyearbyen CO_2 storage site, located on the main island of Svalbard at the northwestern margin of the Barents Sea Shelf, is a demonstration project for a "green showcase", which aims to make a full value chain of power generation, CO_2 capture and storage by achieving a net zero carbon footprint. The key objective of this study was to assess the local geological conditions for CO_2 storage by defining a seal sequence stratigraphy above and within the reservoir from gas and fluid geochemical data. Seven wells were drilled at two sites to collect core material and gas samples at various defined depths. Gas composition (C1-5, CO_2) and stable isotope (δ13C) analyses were performed on gas samples obtained from both core material and well heads. In addition, Sr isotope data from residual salts extracted from core material were used to look at compartmentalization.
The combined analysis of trends in isotope and gas composition data as a function of depth revealed three major breaks and permitted the identification of three major fluid compartments. These compartments are suggested to be associated with impervious caprock and reservoir barriers. The first break in the data trends occurs at approximately 250-300 m depth, which is interpreted as the depth limit of the meteoric water system. A second hydrologic barrier, most likely produced by reservoir uplift was identified. Finally, a very distinct change in trend around 800 m depth may be associated with an observed significant change in reservoir pressure. Three clear breaks in the geochemical data as a function of depth all point towards an efficient seal sequence and demonstrate the potential for CO_2 storage at the Longyearbyen site.