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Characterisation of the aquifer in Straumsvik with respect to the saline-fresh groundwater interface

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Abstract

Climate change is an undeniable reality, posing a significant threat to islands worldwide. While transitioning to cleaner energy sources and reducing emissions are crucial steps, mitigating climate change also requires the permanent removal of CO_2 from the atmosphere. Carbfix represents one such method, developed to sequester CO_2 underground with mineralisation, mimicking natural processes at an accelerated pace. Initially designed to reduce greenhouse gas emissions from geothermal power plants, Carbfix has been developed for broader applications, including the initiative outlined here. In this case, CO_2 will be shipped in containers from hard to abate industries in Europe to Straumsvík harbour just outside Reykjavík, Iceland. Straumsvík area is located at the Reykjanes peninsula which is known for its very recent volcanic eruptions. Although the surface in Straumsvík is covered by Holocene lavas the area is outside the most volcanic and tectonic activity. Nearby there are glacially eroded older lavas and inland, hyalaclastite forms mountain ridges. A powerful groundwater current originating from mountain precipitation, emerges at Straumsvík bay's beach.

While the Carbfix method has been previously applied in freshwater environments, studies indicate that seawater can be used for dissolving CO_2 before injection and mineralisation. However, mineralisation kinetics and potential vary based on different properties like fluid type, amount of dissolved CO_2, and rock composition. Understanding the aquifer's properties, is thus crucial for optimizing the planned CO_2 injection in Straumsvík. Previous studies have revealed a freshwater lens on top of a saline aquifer in the region but the depth of the interface between them varies.

Prior to this project the data on the subsurface was scarce, with the deepest wells about 100 m deep. A variety of studies have been conducted to characterize the subsurface formations and the aquifer, and ÍSOR has been involved in many of them. Three deep wells have been drilled and studied in detail, including wireline logging and analysis and cutting analysis to determine the stratigraphy. TEM surveys were conducted and interpretated to try determining the depth to boundary between the saline and freshwater. Utilizing data from the deep wells and surface mapping, a 3D geological model has been developed, revealing the heterogeneous nature of rock formations. Although accurately predicting the freshwater/saline interface remains challenging, ongoing surveys and logging efforts, both surface and subsurface, offer promising approximations. Continued exploration drilling will play a vital role in refining our understanding of this interface.

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