SOLUTION MINING RESEARCH INSTITUTE

679 Plank Road

Clifton Park, NY 12065, USA

Telephone: +1 518-579-6587

www.solutionmining.org

Technical Conference Paper

Understanding the regional stress impacts of cavern development combined with brine disposal in the Fort Saskatchewan Region

Dallas Longshore, SubTerra Engineering, Calgary, Canada

Dustin Kinch, SubTerra Engineering, Calgary, Canada

SMRI Fall 2024 Technical Conference

22-25 September 2024

Edmonton, Alberta, Canada

Solution Mining Research Institute Fall 2024 Technical Conference

Edmonton, Alberta, Canada 22-25 September 2024

Understanding the regional stress impacts of cavern development combined with brine disposal in the Fort Saskatchewan Region

Dallas Longshore & Dustin Kinch

SubTerra Engineering, Calgary, Canada

Abstract

The Fort Saskatchewan region in Alberta, Canada, is the country's western region's primary salt cavern storage hub. Of the salt formations present, the Lotsberg salt has been utilized for cavern storage operations since the early 1960s. Hydrocarbons are stored in the caverns as part of the refining process in the local area. One of these facilities' cavern fields has been operating since 1975, and the facility remains in operation to this day.

Over the last five decades, the cavern field operations have grown to a footprint covering 400 acres of mineral land for storage operations. Despite this significant scale, these operations have maintained their reputation as one of the safest, most reliable processes for storing hydrocarbons. They not only minimize the footprint at the surface but also protect the environment from any issues that may occur over the life of the cavern asset, which has a design life of over 75 years.

Recently, wellbore failures have been confirmed in the field, where there is no history of problems in this geological section of the wellbore.

Regional geology and geophysics were mapped and studied at the beginning of the investigation. This geological assessment was combined with an offset operations review to understand what oil and gas activities are occurring in the field. This analysis would confirm if any correlatable data could be identified. Additionally, seismicity in the region was reviewed to ensure no data points were overlooked that could be capable of creating the stress required to cause the wellbore failures observed.

Based on all the details reviewed, the current working hypothesis of the factors that led to and resulted in the wellbore failures have been isolated towards two key technical attributes:

- Primarily, the timing of the wellbore drilling
- Secondly, when combined with the primary attribute, the wellbore trajectory through the upper geologic formations where the wellbore issues occurred.

During the solution mining phase of salt caverns in the region, the brine is disposed into the Nisku formation that overlays the storage zone with ~700m (~2,300 feet) of overburden separating the two formations. When these disposal operations are combined with the regional geology in the area, a high-stress subsurface environment is created. As the in-situ stress fluctuates from the disposal operations, the total stress in the system can potentially build up to a point where it may be released. This observation is confirmed by the emergence of local area seismicity that was not observed before 2020.

Changing geologic forces in the reservoir may be the catalyst for excessive strain on wellbores operating in the area, which could lead to potential wellbore failures, as observed in some of the caverns operating in the area.

The timing of the wellbore's construction correlates with the time when the volumes of fluid injected into the local area disposal formation were at a level not observed before. As the daily, monthly, and yearly volumes of fluid injected remained at a high level, it is believed that had the injection volumes not been reduced or limited, the wellbores may not have experienced failures as the stress in the region would have stayed relatively constant. This point is shared to confirm that change in stress (delta stress) can impact wellbores as the stress increases or dissipates. It is the change in stress that impacts subsurface operations.

The area continues to be monitored for additional wellbore events that may impact the operation of the cavern systems to continue to analyze and correlate if this hypothesis is plausible.

Keywords: Alberta, Canada, Cavern Design, Caverns for Liquid Storage, Disposal Wells, Drilling, Geology, Geophysics, Well Casing, Well Cementing, Well Design, Drilling and Completion