

SOLUTION MINING RESEARCH INSTITUTE

679 Plank Road
Clifton Park, NY 12065, USA

Telephone: +1 518-579-6587
www.solutionmining.org

**Technical
Conference
Paper**



**Parametric Study on the Effect of a
Cavern's Aspect Ratio on
Working Gas Capacity**

**Matt Jones, Maggie Sebert, and Josh Rath,
RESPEC, Rapid City, South Dakota, United States**

**SMRI Fall 2025 Technical Conference
29-30 September 2025
Wichita, Kansas, United States**

PARAMETRIC STUDY ON THE EFFECT OF A CAVERN'S ASPECT RATIO ON WORKING GAS CAPACITY

Matt Jones, Maggie Sebert, and Josh Rath
RESPEC, Rapid City, South Dakota, United States

Abstract

When developing new caverns for gas storage, the design must be based on the available space and planned operation requirements. Cavern size is determined by the desired storage volume, which is often constrained by surface area at a facility and geomechanical considerations. A cavern design with a high aspect ratio (i.e., high cavern height-to-diameter ratio) maximizes the volume for gas storage within a given facility property. The operational envelope of tall gas storage caverns, however, is often limited by the minimum gas pressure required to maintain cavern stability. Tall caverns also experience higher creep closure rates compared to shorter caverns of equivalent volume. These effects are often caused by increasing in situ temperatures and stresses with depth. Increased shear stresses around caverns at deeper depths are caused by the pressure differences within the cavern and the surrounding salt. Increased temperature at deeper depths increases the creep rate of the salt, as the salt creep rate is highly temperature dependent. These factors lead to increased minimum pressures required to mitigate closure and maintain the integrity of the salt on the cavern surfaces for taller, deeper caverns.

This parametric study sought to investigate the effect of a cavern's aspect ratio on its working gas capacity during the cavern's operational service life. Numerical models were used to simulate the solution mining, dewatering, and annual gas storage operations of hypothetical cavern designs with various aspect ratios to estimate the working gas capacity over time. The findings from this parametric study can be used to inform gas storage cavern designs and maximize the working gas capacity for the desired operational service life.

Key words: Caverns for Gas Storage, Cavern Design, Computer Modeling, Storage Capacity, Cavern Design Parameters, Aspect Ratio, Cavern Height, Cavern Radius, Cavern Diameter