Characterization Of Rayoso Formation for Underground Natural Gas Storage in Cupen, Neuquen Basin*

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Abstract

Objective: The underground natural gas storage (UNGS) in this project involves a conversion of a depleted gas field from production to storage, taking advantage of existing wells, gathering systems, pipeline connections and its location close to consumption centers. Depleted oil and natural gas reservoirs are the most commonly used underground storage sites because of their wide availability. This underground facility will allow us to balance a variable gas demand, storing gas in low demand periods (summer) and producing it in peak demand periods (winter) maintaining almost constant supply. The reservoir to be used for the UNGS consists of sandstones from Rayoso Formation that have produced all their economically recoverable gas, located at 500 meters depth, close to Cupén Mahuida area. Each storage type has its own physical characteristics (porosity, permeability, retention capability) and economics (site preparation and maintenance costs, deliverability rates, and cycling capability) which govern its feasibility. To evaluate if the depleted reservoir formation is readily capable of holding injected natural gas, a technical and economic pre-feasibility analysis was carried out. It is crucial to determine the capacity of the reservoir to hold natural gas for future use and the rate at which gas can be withdrawn (deliverability rate). Physical characteristics of the reservoir, seal and trap are equally important to define the aptness of the reservoir for UNGS. Procedures: A static model of Rayoso Formation was built for reservoir characterization. The geological model includes regional studies, outcrop observations, seismic interpretation (structural and stratigraphic), petrophysical analysis and production / pressures of the wells. Results: With this model, different scenarios are being simulated for volume rate injection / production in the area, also considering the existing infrastructure (existing wells, gathering systems, and pipeline connections. Conclusions: The physical characteristics of the reservoir became optimal for UNGS, as well as the structure and the seal. Two different levels had been identified as potential storage due to their wide extension and connectivity. The volume calculated with the static model agrees with the volume made through the material balance. In addition, the volume needed to inject/produce is appropriate to balance the demand of the field.
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CHARACTERIZATION OF RAYOSO FORMATION FOR UNDERGROUND GAS STORAGE IN CUPEN, NEUQUEN BASIN

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Underground Natural Gas Storage

Objectives

- Increase gas sales covering peak demand periods
- Rework depleted gas field from production to storage, taking advantage of existing wells
- Modulate pressure to keep production levels constant supply.

Technical evaluation

- Horiz. DORSAL Toledo Integral (ATI) & Meseta Buena Esperanza
- Gas complexes in Cretaceous Rayoso Formation
- Potential for underground storage: 10-20% Net Pay

Capitol Field

The underground gas storage (UGS) in this project includes a reservoir of sandstones from the Cretaceous Rayoso Formation. The project aims to increase gas sales, particularly in low demand periods (summer) and by producing it in peak demand periods (winter). The reworked depleted gas field will benefit from existing wells and facilities. Increased pressure will sustain production levels and prevent field depletion.

Production and pressure history

The Rayoso Formation, which includes the three producing layers, provides the main source of gas for underground storage. Production and pressure history demonstrate optimal reservoir conditions and significant gas storage potential.

Conclusions

- The dynamic model successfully integrates geological, geophysical, and petrophysical data for accurate predictions.
- The Petrophysical model incorporates sand/shale distribution and porosity variability, enabling efficient reservoir management.
- Future steps include further evaluations and optimizations, as well as potential for gas injection/production combinations.

Dynamic model - Initial conditions

- Stress inversion and 3D geomechanical model
- Initial reservoir and well conditions
- Stress and hydraulic-fracturing models

Next steps

- Establish a historical study on the reservoir's performance, static and dynamic parameters
- Detailed analysis of injection/production ratios
- Evaluate potential for gas injection into the reservoir

Acknowledgments

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Conferences

- Proceeding of the XVII Argentine Oil and Gas Congress. EPI, 2015
- Proceeding of the XVIII Argentine Oil and Gas Congress. EPI, 2016
- Proceeding of the XVIII Argentine Oil and Gas Congress. EPI, 2016

Repository

- Rayoso anticline: Bodies (sand and clastics) of the deposits drilled by RDM wells and RDM.a with different objectives.
- Seismic surveys: Negative amplitude anomalies -26 RDM.a, E.P.V. vs. 2 Cross section.
- Fault plane distribution intersecting of 6 Km, 15 Km, 6 Km, and 15 Km. Near the surface representing the base of the Triassic deposits.
- Pressure depletion: The Pressure depletion is calculated for the Rayoso anticline, which also shows the higher depletion as can be seen in the Pressure depletion figure. There are three producing layers in the Rayoso Formation.

Scenarios

- Upscaling porosity and SW to wells: Upscaling porosity and SW to wells for a more detailed understanding of the reservoir's properties.
- Static Modelling of the Gas Storage Zone: Static modelling provides insights into the potential for underground storage and supporting the decision-making process.

Caveats

- The Patagonian basin offers unique geological complexities, with sand and shales interbedded in various formations.
- The integration of diverse data sets helps to refine predictions and optimize storage strategies.

Techniques

- Map and Seismic - Reservoir properties and fracture characteristics
- Cross section - Fault plane distribution and permeability analysis
- Petrophysical model - Sand/shale distribution and porosity variability
- Dynamic model - Initial conditions and stress inversion

Techniques

- Geophysical and geological surveys: Integrating various datasets for a comprehensive reservoir characterization.
- Petrophysical and dynamic modeling: Simulating injection/production scenarios to evaluate storage potential.

Scenarios

- New insights into the Cretaceous Rayoso Formation: A regional overview of a large accumulation of natural gas.
- Production and pressure history: Understanding past performance to inform future strategies.

Graphical representations

- Production and injection rates: Visualizing gas production and injection trends over time.
- Reservoir management: Monitoring well performance and reservoir health.
- Fault plane distribution: Identifying potential fracture zones and permeable pathways.