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Geothermal Reservoir Characterization and Power Production Modeling of the South Swan Hills Reef Complex, Alberta

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Summary

Wells in the South Swan Hills oil-pool penetrate a Devonian reef build-up. The wells have historically produced hydrocarbons but presently produce over 400,000 m^3 of hot (≥100° Celsius) water monthly. This research applies the same techniques used to characterize hydrocarbon resources to model the production of hot water for geothermal power production. Developing a high resolution 3-D geo-cellular model of the reef complex allows for the identification of the reservoir geometry and subsequent quantification of the reservoir's maximum power potential through flow modeling.

Workflow

The 3-D model is grounded by several long cores tied to petrophysical data, which are used to identify the permeable and porous lithofacies and facies associations. A sequence stratigraphic framework is applied to discern how reservoir units shift as a result of paleobathymetric changes. Cells in the 3-D model are populated by lithofacies linked to poroperm data obtained from core. Cells between wells are interpolated and populated by lithofacies dictated by the facies model. Reservoir cell data, temperature and rock property data are incorporated into flow simulations taking a Monte Carlo approach to predict the power generation potential.

Results

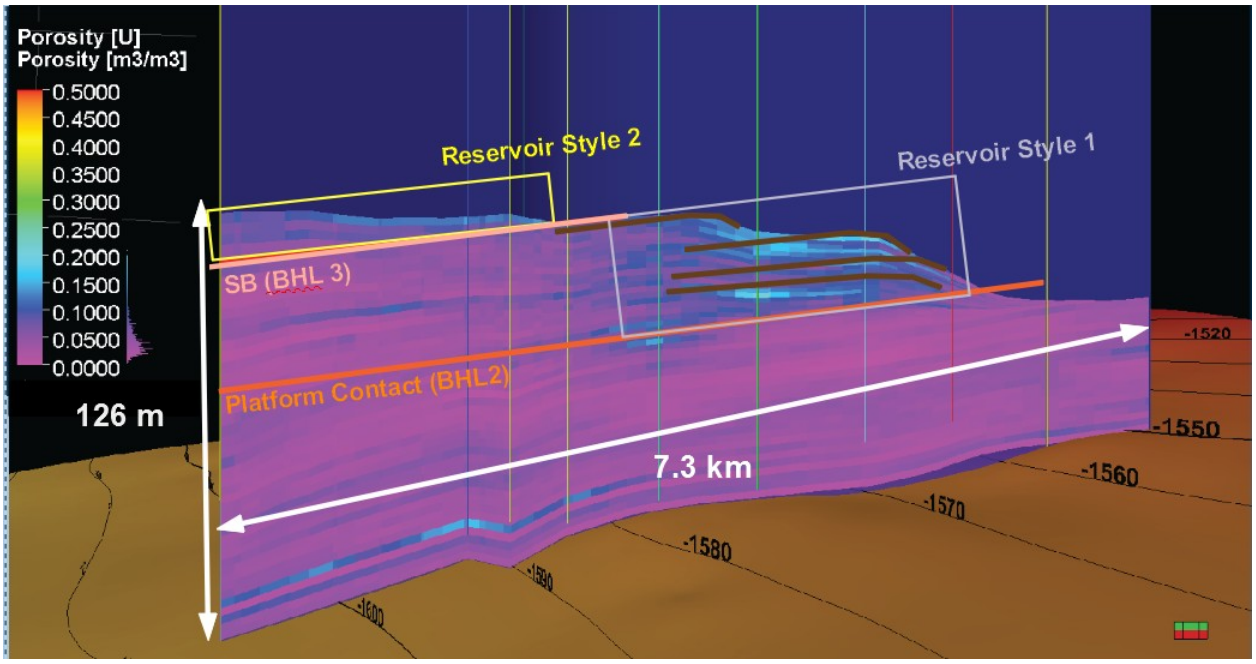

Figure 1. A cross section of the reef build-up where cells represent raw porosity data from core analysis. Reservoir facies have porosity values higher than 10% and permeability values between 10 and 100 mD. Two main reservoir units are observed and can be interpreted in the context of a sequence stratigraphic framework.

Reservoir style 1: An extensive marginal apron which wraps around the atoll for which continuity is locally interrupted by backsteps in reef growth at 4th order sequence boundaries (brown surfaces).

Reservoir Style 2: Uppermost 3rd order sequence cap (BHL3, pink surface) associated with the drowning of the reef build-up and an intense change in deposition style.

Flow simulations suggest that the reservoir volume can produce between 10 and 25 MW over a 50 year lifespan. These simulations will be further refined by combining pressure measurements and production data into the 3-D reservoir model to optimize a production/injection strategy, further enhancing the values of power potential.

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