Efficient Data Integration, Visualization and Mapping in a Mature Basin Lead to Interpretation of New Prospects

aspentech | Case Study

> "Combining the flexibility and automation of SKUA-GOCAD™ helped us identify exploration opportunities missed by previous operators in record time."

Damien Thenin, CEO, PetroPhoenix Resources Corp.

CHALLENGE

In a mature onshore North American basin with a wealth of information, PetroPhoenix Resources Corp., a Canadian oil and gas E&P company, needed to streamline data integration and interpretation in order to enable efficient prospecting.

SOLUTION

Aspen SKUA-GOCAD software was used to develop multiple custom-made macros, and to create a new mapping workflow that was able to accommodate variable data density over large areas of interest while perfectly honoring every well.

VALUE CREATED

- Repetitive and time-consuming tasks were automated.
- Aspen SKUA-GOCAD integration capabilities enabled the customer to efficiently create prospecting maps to assist in the strategic acquisition of oil and gas leases.
- Unstructured gridding reduced modeling time for each realization from many hours to minutes, allowing the team to quickly explore multiple scenarios.

Overview

Mature basins usually contain a wealth of information. In addition to the efforts required to access this large amount of data, geoscientists face the daunting task of integrating everything, to turn the results into a useful solution that will help improve their prospecting efforts. Given the tens of thousands of wells, decades of production data, and the large number of seismic surveys available in the onshore US basin explored by the customer, streamlining data integration and interpretation has become imperative for efficient prospecting.

A crucial aspect of interpreting the subsurface in a data-rich basin is the ability to customize displays to suit specific data types and interpretation needs. Traditional geomodeling workflows work well in mature basins but can quickly become cumbersome when dealing with tens of thousands of wells over very large areas: the model resolution required to accommodate wells that are sometimes spaced less than one hundred feet apart quickly becomes difficult to maintain when the area of interest exceeds several thousand square miles.

A compromise is usually to upscale the data spatially into a grid coarser than the minimum well spacing. This is reasonable when the objective of the model is to understand large-scale regional features. However, it is not recommended when the short-scale lateral heterogeneities of the formations of interest need to be preserved.

Another common problem in mature basins is the inconsistency of the stratigraphic nomenclature used by operators when reporting production data: generations of geologists and exploration companies named formations differently, resulting in large inconsistent databases.

Custom-made Macros Save Time and Help Avoid Human Error

The customer used the Aspen SKUA-GOCAD software development kit to develop multiple custom-made macros. The macros made it possible to automate repetitive tasks, to save time and avoid potential human errors when importing data in different formats from different databases.

A new mapping workflow was developed using Aspen SKUA-GOCAD's macro capabilities to identify subtle short scale anomalies and their relationship over long distances (Figure 1). This automated workflow builds unstructured grids with local grid refinement to accommodate the variable data density over large areas of interest while perfectly honoring every single well (Figure 2). This was done using the gridless geostatistics available on unstructured grids and meshless objects.

A macro was also developed to quickly assign production data stratigraphically based on the depth of perforation.

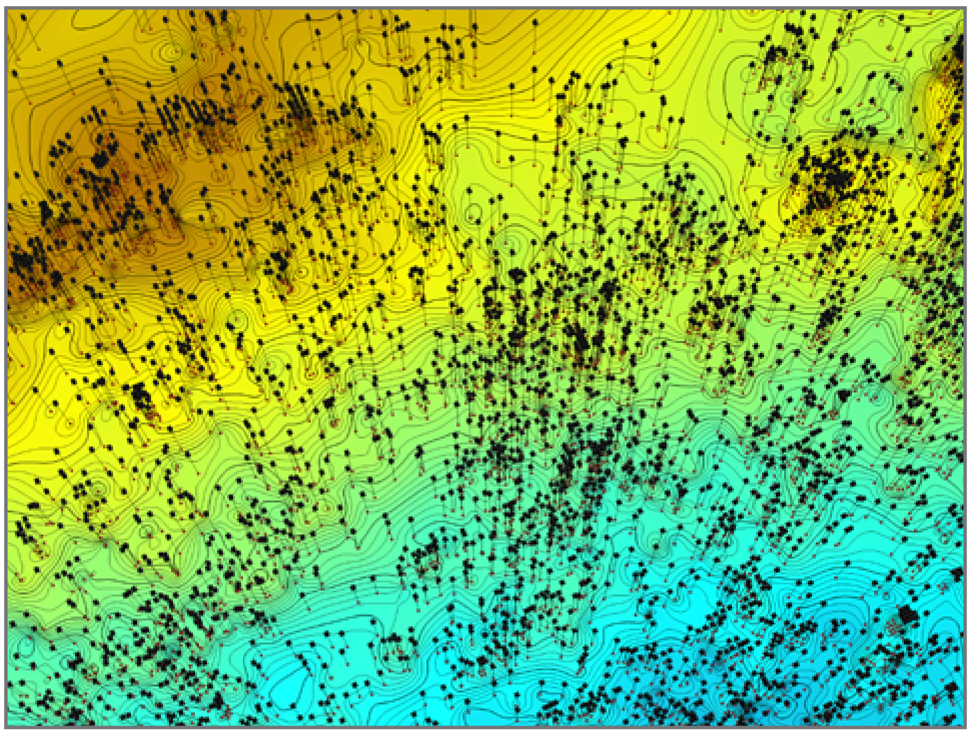

Figure 1. Subset of a high-resolution regional structure map from tens of thousands of wells computed with gridless geostatistics.

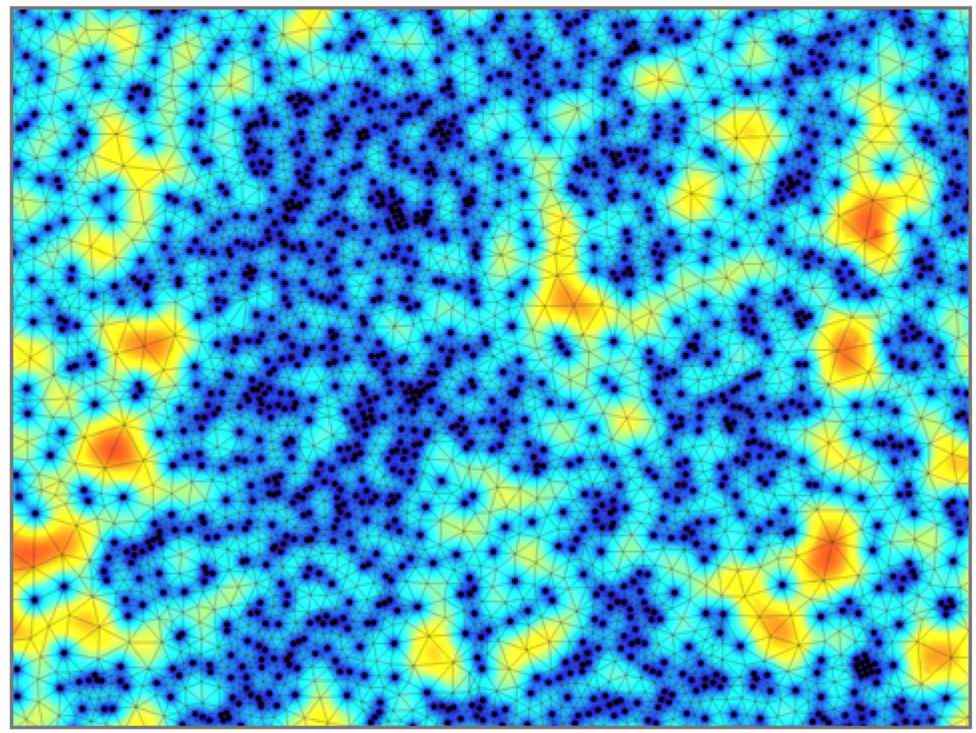

Figure 2. Unstructured grid with Local Grid Refinement to accommodate variable well density over large areas (wells represented as black dots).

Results

A huge amount of data was integrated into the project to help interpret the subsurface: well surveys, logs, markers, drill stem tests, completions, production, seismic surveys, culture data, aeromag and gravity surveys, georeferenced historical maps from the literature, historical earthquakes, USGS basin models and satellite images. This enabled a high level of quality check to identify and fix database issues. In particular, the location and KB of historical wells, sometimes older than fifty years, could be corrected when needed.

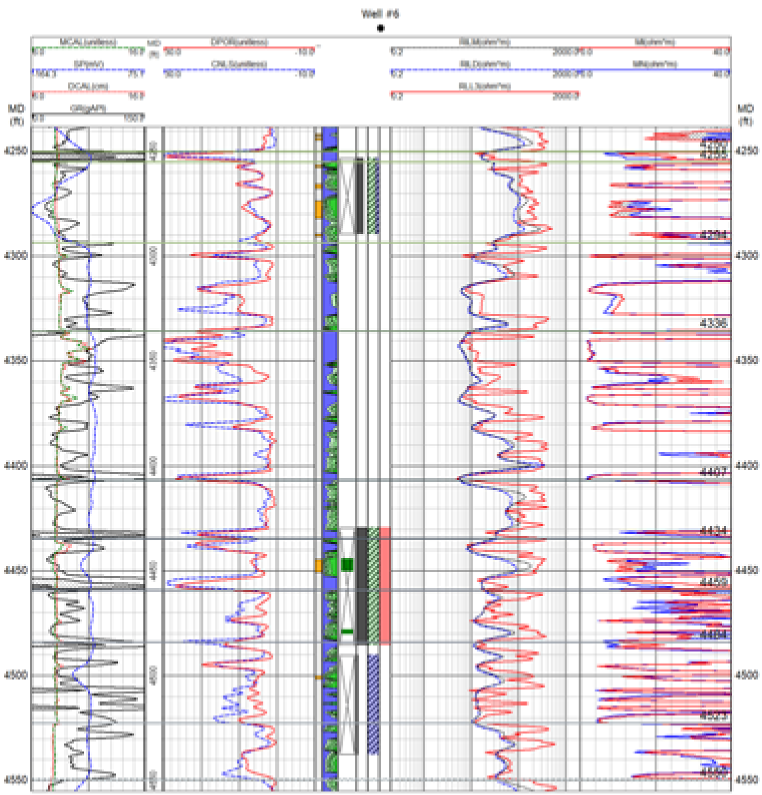

Figure 3. Custom well template displaying key data (full log suite, permeability flags, oil saturation scenarios, perforations, drill stem test intervals and results) enabling a quick interpretation of wells.

The customized macros helped free valuable time to focus the team's efforts on prospecting, and to quickly update the interpretation every time new wells were added or when the area of investigation was extended.

Given the large amount of well data available, particular attention was paid to designing a useful well visualization template mixing what well logs traditionally look like on paper, with the results of automated interpretation, such as permeability flags and oil saturation estimates. The template also included key Drill Stem Test information such as depth interval, estimated fluid flow rate and saturation, and the amount of gas in pipe (Figure 3). The templates enabled the exploration team to quickly interpret the results of individual wells.

The new unstructured gridding method reduced the modeling time needed for each realization from many hours to minutes, allowing the team to quickly explore multiple scenarios and perform sensitivity analysis to find the most suitable parameters for the models. The high-resolution maps helped with the interpretation of structural flexures on key stratigraphic horizons and their relationship over long distances, resulting in the identification of multiple prospective corridors on a very low angle carbonate platform in a strike-slip stress regime. This new method was also implemented to quickly generate fit-for-purpose property maps (gamma ray, porosity) required for the team's regional prospecting efforts, for example to help in identifying potential stratigraphic traps.

Finally, the production data was automatically assigned stratigraphically to generate consistent regional production maps; it enabled the interpretation of key production trends for each stratigraphic zone (Figure 4).

Benefits

- Customized macro scripting helped free valuable time to focus the team's efforts on prospecting.
- The client was able to view and validate all available data to ensure maximum accuracy and optimal reservoir characterization.
- Efficient visualization: 1D, 2D and 3D display customization allowed the team to quickly develop shared visualization templates to fast track the prospecting efforts.
- Unstructured gridding reduced modeling time for each realization from many hours to minutes, allowing the team to quickly explore multiple scenarios and perform sensitivity analysis to find the most suitable parameters.

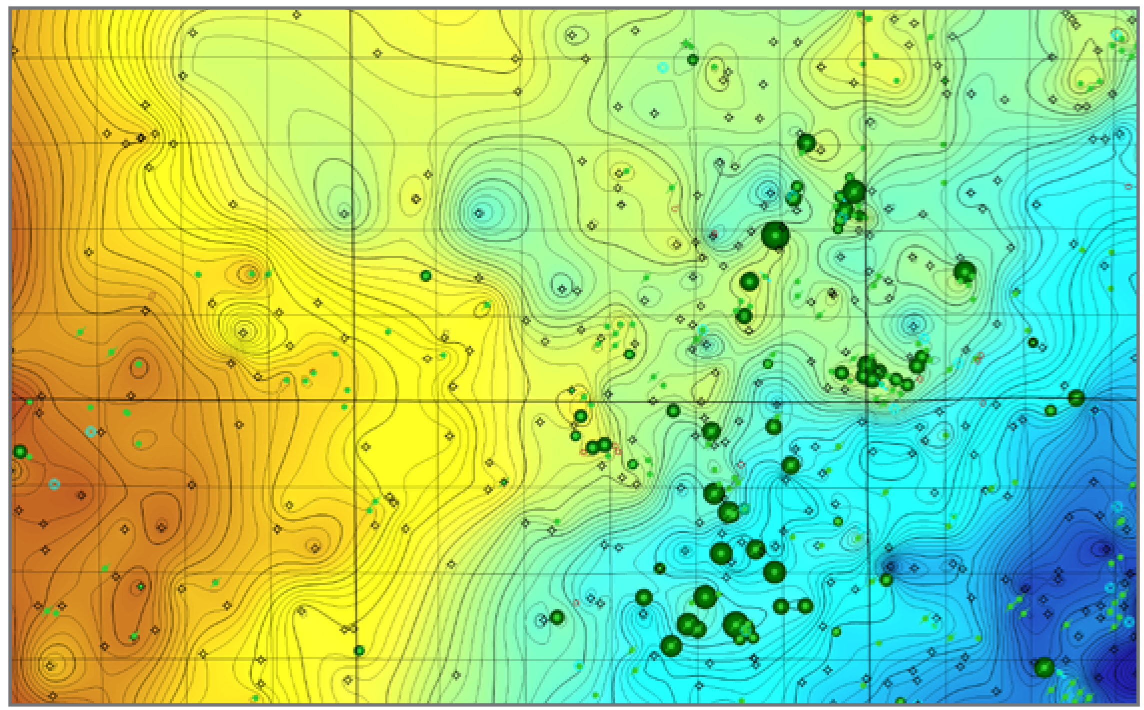

Figure 4. Structure map from wells with initial oil production assigned to a specific stratigraphic formation (bubble size proportional to production).

About AspenTech

Aspen Technology, Inc. (NASDAQ: AZPN) is a global software leader helping industries at the forefront of the world's dual challenge meet the increasing demand for resources from a rapidly growing population in a profitable and sustainable manner. AspenTech solutions address complex environments where it is critical to optimize the asset design, operation and maintenance lifecycle. Through our unique combination of deep domain expertise and innovation, customers in capital-intensive industries can run their assets safer, greener, longer and faster to improve their operational excellence.

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