

USE CASE



# NO LOGS NO PROBLEM!

Using the Advanced Property Estimator to Interpolate Well Log Data

## USE CASE – USING THE ADVANCED PROPERTY ESTIMATOR

One of the biggest challenges in extrapolating and interpolating well log data today is the lack of well control and limited well log information. Many horizontal wells often come with scarce data due to the costs of running full suites of well logs, leading to time-consuming and expensive interpretation where often the only option is a full 3D geocellular model.

No longer! In this article, we look at how Enverus' new Advanced Property Estimator (APE) increases data coverage quickly and accurately. This is achieved through incorporating the rich information from vertical well logs when analyzing horizontal development, directly estimating values at the horizontal wells, and providing the perfect platform for multivariate predictive models that optimize engineering attributes in horizontals, such as lateral length, resistivity, proppant, and fluid — all without building a full 3D property model. The result is a new level of granularity and finely sampled logs, the calculation of estimates on-the-fly, and real-time accurate extrapolating and interpolating of well log data.

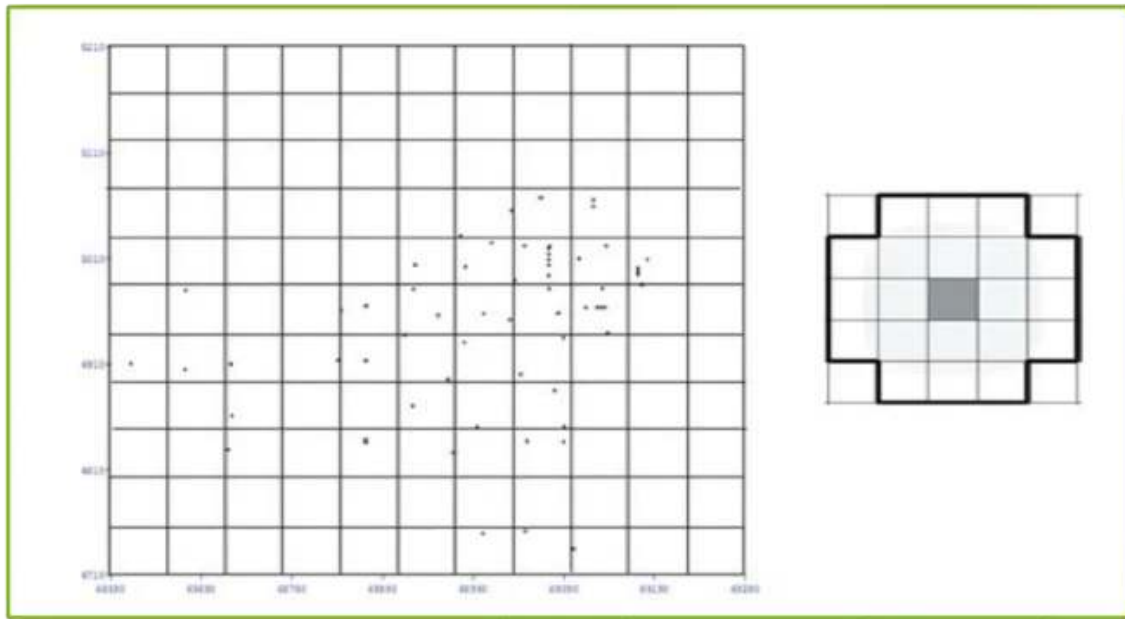
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# HOW THE APE WORKS...

Enverus' Advanced Property Estimator (APE) creates synthetic well logs to accurately predict log properties and quantify depositional environments away from well control and ahead of the drillbit. The APE is lightning fast, dramatically cutting down on calculation time without the need to build a full 3D geocellular model.

So how does it work? In order to interpolate a well log in the center of the square (see figure 1), the APE interpolates from each of the individual blocks and the pre-existing wells (outlined on the left-hand side of figure 1) to the block in the central section, thereby deriving a pseudo log and ultimately a well log suite across the horizontal portion of the well. This is achieved via three possible algorithms — inverse distance (used in this article), kriging, or co kriging.



Lyster and Deutsch, 2008

Figure 1

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# PUTTING THE APE INTO ACTION

In this example of the APE in action, we look at North Western Pecos County in the Delaware basin, focusing primarily on the horizontals in this area and on the Wolfcamp B and C (blue and magenta in figure 2). As figure 2 shows, there is limited well control immediately adjacent to the targeted position with the red question mark representing the main area of interest and the white dots representing the vertical wells of around 4,000 feet measured depth and that have a minimum of a gamma ray associated with them.

We need to know what the log run over the horizontal portion of the well would look like and how we can increase our coverage quickly and accurately and make it more meaningful — answering questions such as ‘What intervals of the Wolfcamp B and C are being targeted in this area?’

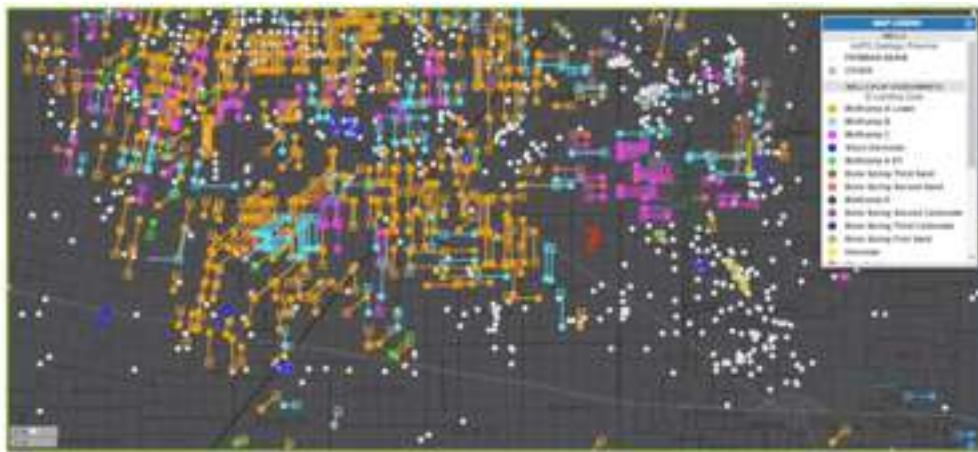


Figure 2

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# NARROWING DOWN THE AREA OF INTEREST

Using the APE, the first step is to narrow down the well list in the area of interest using 68 wells and the existing structural model (the better the structural model, the better the interpretation). In this case, the focus is on one of the more difficult wells to get information for and interpolate — neutron porosity (although you can focus on any log suite you want to interpolate).

The next step is to quality control the grid to be used as seen in figure 3. As the user drags around the map, the right-hand side shows the actual wells used in the interpolation with a 70 percent to 85 percent correlation between what the APE generates and what the actual log looks like. The logs are also highly detailed.

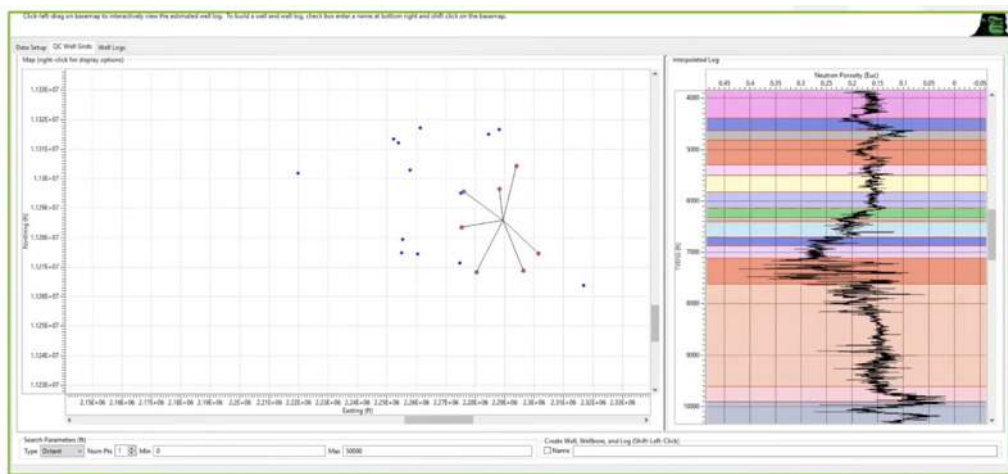


Figure 3

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# WORKING WITH REAL LOGS — FOCUSING ON THE VERTICAL PORTION

The user can now take the logs and information derived from figure 3 and save them as real logs in their database to be used in any application — water saturation applications, for example. Figure 4 shows the well logs that are representative of the pre-existing vertical wells — all detailed logs that can be used in the interpolation. The gray wells are the ones that did not have neutron porosity logs running across them.

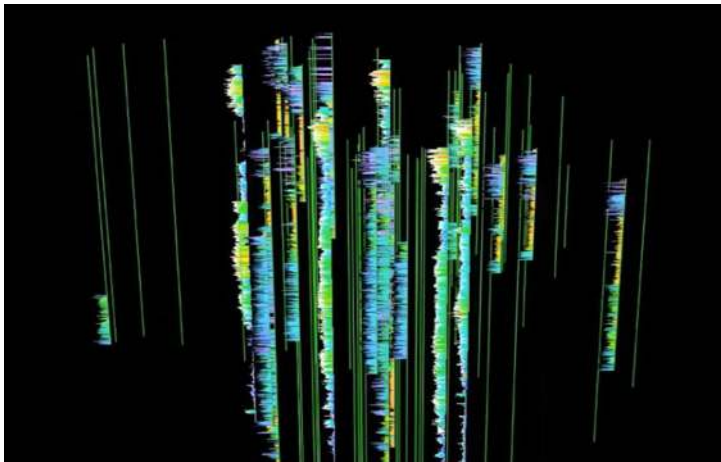


Figure 4

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# HORIZONTAL AND WELL LOG EXTRAPOLATION AND INTERPOLATION

The user can now overlay the interpolative logs over the horizontal portion of the well as illustrated in figure 5, with figure 6 showing the detailed intervals.

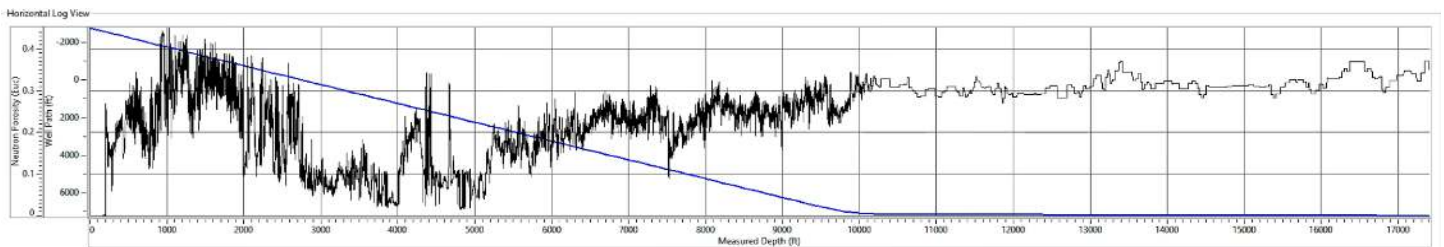


Figure 5

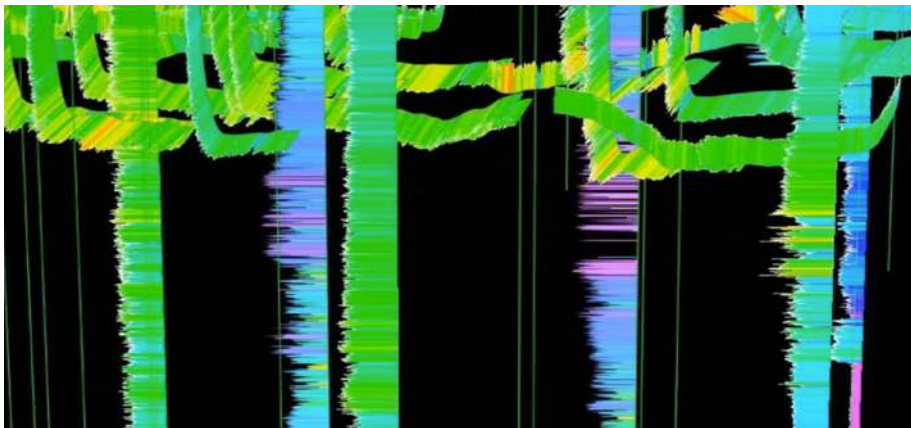


Figure 6

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## USE CASE – USING THE ADVANCED PROPERTY ESTIMATOR

By interpolating vertical well to the horizontal portion of the wellbore, the solution allows the user to extract over the horizontal a single value rather than going through a number of averaging, smoothing, and gridding phases that might affect the estimate. The result (figure 7) is an APE-derived neutron porosity map for Wolfcamp B and C where the user interpolates, averages, and then creates a grid — a much quicker and more seamless process. The result is a finely sampled log that honors both the surrounding vertical well logs and the stratigraphic layering scheme from the input geologic model.

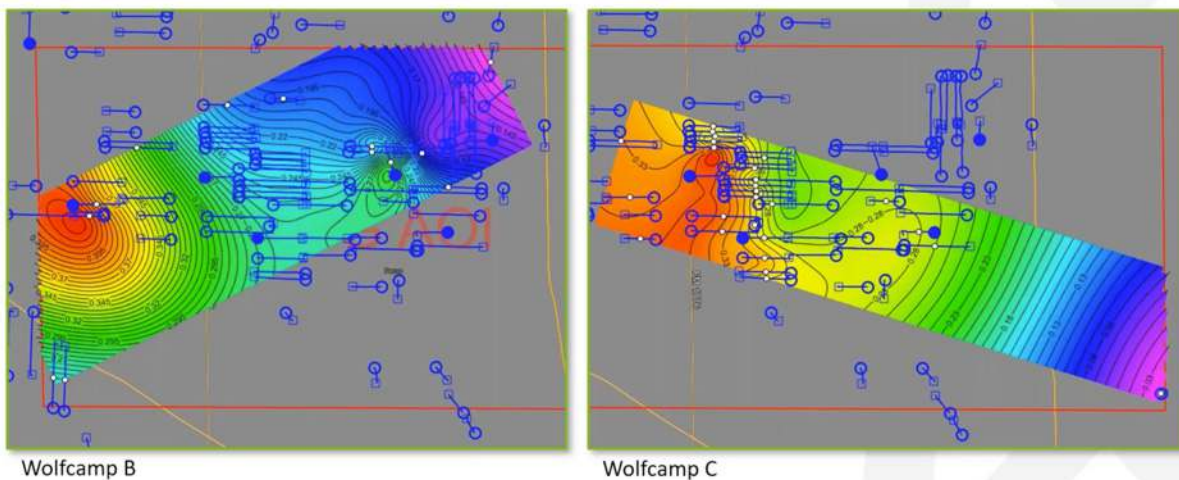


Figure 7

## GENERATING A MULTIVARIABLE STATISTICAL MODEL

It's through the APE that the user can now ultimately create robust and accurate multivariate predictive models that help predict production and optimize engineering attributes in horizontals, such as lateral length, resistivity, azimuth, proppant, and fluids.

Figure 8 shows a multivariable statistical model outside the APE that is trying to predict Wolfcamp B oil production for the first six months. Values include proppant per foot, resistivity, and gamma rays, with the correlation coefficient of .558.

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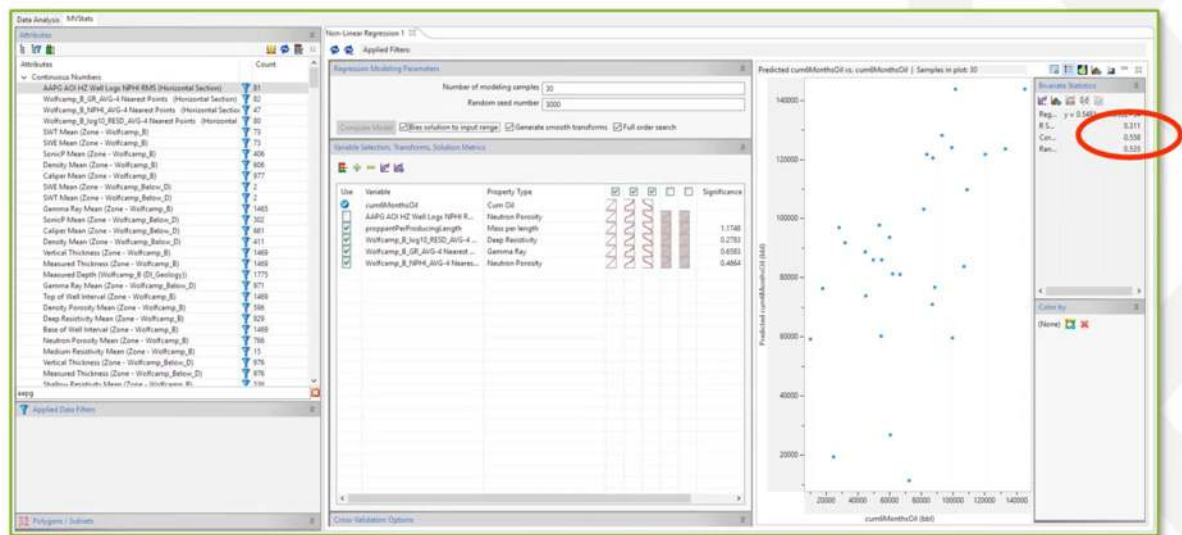


Figure 8

This can be compared with an APE-derived multivariate predictive model (figure 9) where the correlation coefficient goes up to 0.693.

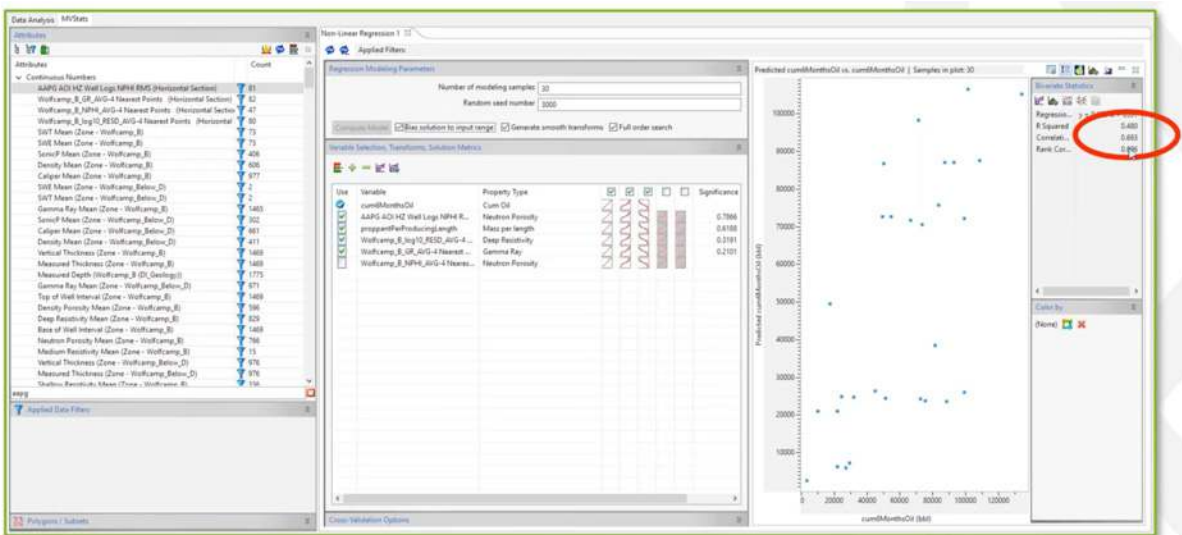


Figure 9

Compared to the more simplistic 2D method, the results derived from the APE lead to more accurate multivariable statistics models, often but not always better correlation coefficients, and the increased significance of geologic variables in the model. With APE, users can build a better map with more data and less smoothing.

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# THE APE — PROVIDING THE ANSWERS

How do you increase your data coverage quickly and accurately without a huge amount of well information?

Enverus' Advanced Property Estimator (APE) addresses this crucial question, creating accurate well logs on-the-fly and with enhanced levels of granularity, improving multivariate analysis, and providing the perfect platform for the incorporation of other data, such as drilling time and water saturation curves.

Whether it be gamma ray, resistivity, or a full triple combo log across the horizontal portion of the wellbore, the APE provides the answers while reducing calculation time and avoiding the creation of a 3D geocellular model and the smoothing, gridding, and averaging that come with it.

### For Further Reading:

Machine Learning for Rapid Lithotype Classification from Multi-Log Suites to Assist Interpretation and Property Modeling, Drillinginfo, AAPG, May 2019  
<https://www.abstractsonline.com/pp8/#!/6795/presentation/5101>

Release the APE: A Novel Approach to Produce Estimated Well Logs on Horizontal Wells and Improve Multivariate Predictive Models, Drillinginfo, AAPG, May 2019  
<https://www.abstractsonline.com/pp8/#!/6795/presentation/3434>

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