

Detailed Sub-seismic Resolution in the Eagle Ford Shale and Identification of Under-explored Geobodies

This Application Brief is a companion to a series of four such Briefs. Please see Paradise® Application Brief EF-1 for an introduction to the project.

In **Figure 1a** on the left, a NW-SE seismic section across the location of Well #6 is comprised of a conventional amplitude seismic display with red/white/black 1D color scheme. The Figure shows the Austin Chalk – Eagle Ford Group – Buda stratigraphic interval resolved in roughly 3 peak/trough cycles. This sample was provided by the client. On it, amplitudes appear “boosted”, which in the early days, say prior to the early 1980’s, passed for continuity enhancement. Formations appear “continuous”, yet any details are obscured rather than resolved and occur in the amplitude domain, where tuning, absorption, and other vertical “influence” effects are a legitimate concern.

The graphic on the right displays the results of a Self-Organizing Map (SOM) of multiple Instantaneous attributes colored by neurons of up to 64 classes (see Paradise Application Brief EF-1). A seismic interval from 10ms below the Buda to 100ms above

the Buda or near to the top of the Austin Chalk was chosen for the SOM run. Shown clearly is the resolution improvement provided in Paradise when the interpretation interval is reduced to just the area of interest or to a few depositional sequences.

The results shown in **Figure 1b** reveal non-layer cake facies bands that include details in the Eagle Ford’s basal clay rich shale, High Resistivity and Low Resistivity Eagle Ford shale objectives, the Eagle Ford ash, and the Upper Eagle Ford marl, which are overlain disconformably by the Austin Chalk.

The Basal Clay Shale (BCS) (**Figure 1b**) is distinctly resolved on top of the Buda (whose 10 ms are hidden by the shaded horizon as background) generally by the #1 neuron in dark gray. Its lithologic and neural uniqueness are concomitant with its distal detrital or pelagic emplacement after deposition of the underlying Buda carbonates. The BCS is distinct also from the overlying downlap of two red neurons (black arrow) and subsequent transgressive (white arrow) greyish-gold Eagle Ford High Resistivity organic rich facies.

Figure 1a

Well #6

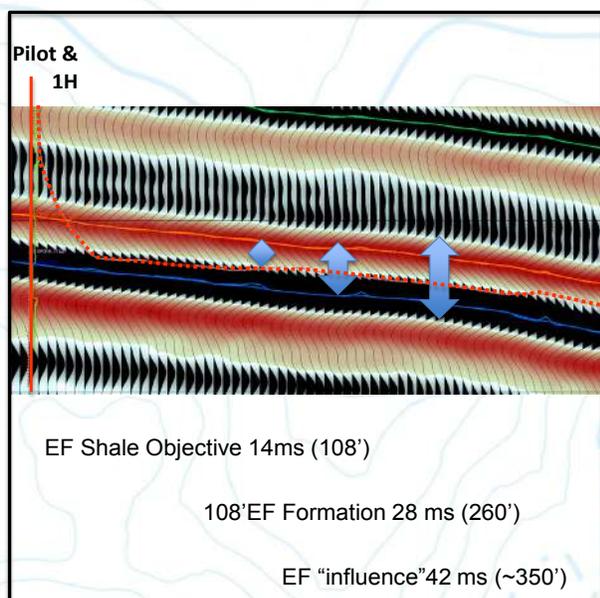
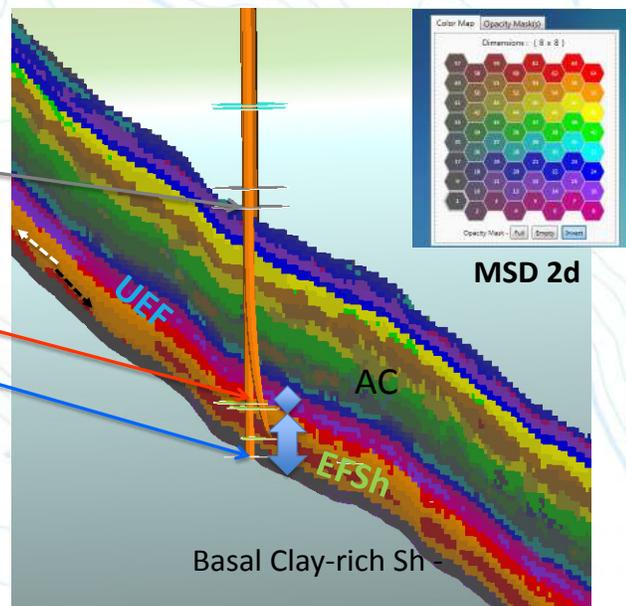


Figure 1b

100ms Stratigraphy above Buda



A previously unknown, encapsulated, discontinuous core of rust-colored facies within the gold section of the Eagle Ford is also well resolved. This zone can be localized and its distribution understood by moving the top Eagle Ford horizon down to intersect the geobody shallow (**Figure 2a**) where its fairway is wide, and (**Figure 2b**) deeper where its fairway is narrower. Note that a change in the 2D ColorMap helped facilitate the geobody's extraction. This geobody can also be discriminated (**Figure 2c**) by selection of only its three neurons in the Paradise

2D Colormap. Calibration of this zone has proven it to be of the High Resistivity reservoir type.

The Eagle Ford Ash (**Figure 1b**) lies above the gold and comprises a different red facies than the downlap; it is resolved as discontinuous and concave or low-seeking fill at the top of the Eagle Ford shale.

Lastly, the Upper Eagle Ford marl, in purple and magenta colors in **Figure 1b**, rather than showing simple layers, exhibits updip and downdip facies changes and features that may signify faults.

Figure 2a

Offset .012ms below Top EF Shale

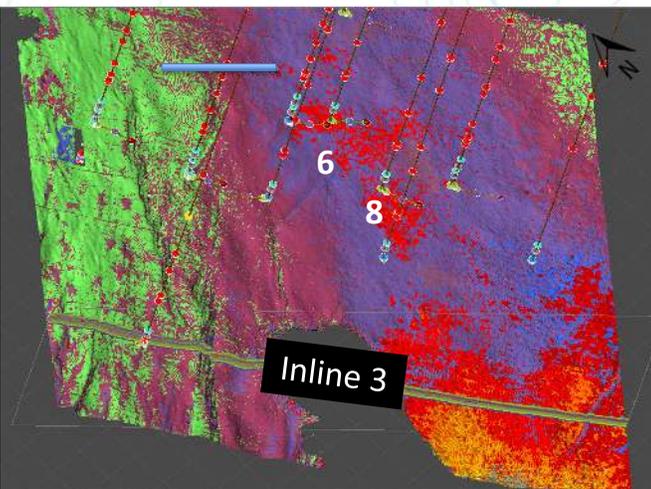


Figure 2b

Offset .016ms below Top EF Shale

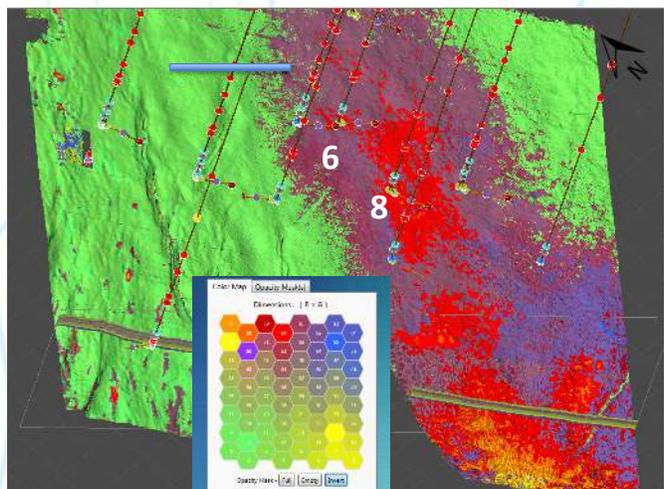
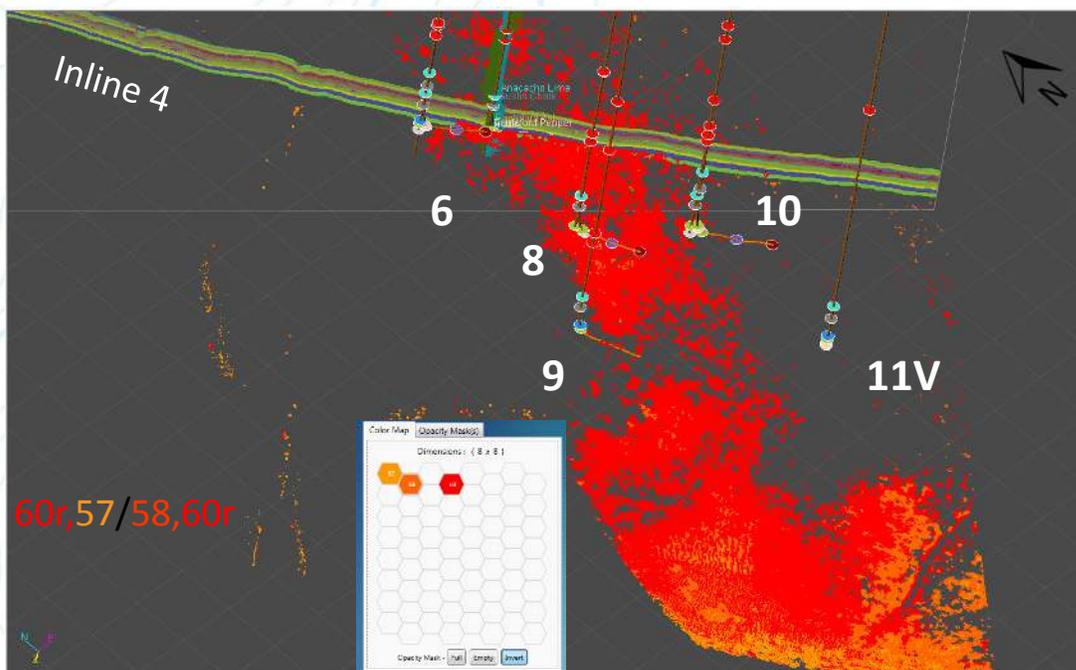


Figure 2c



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Figure 3a

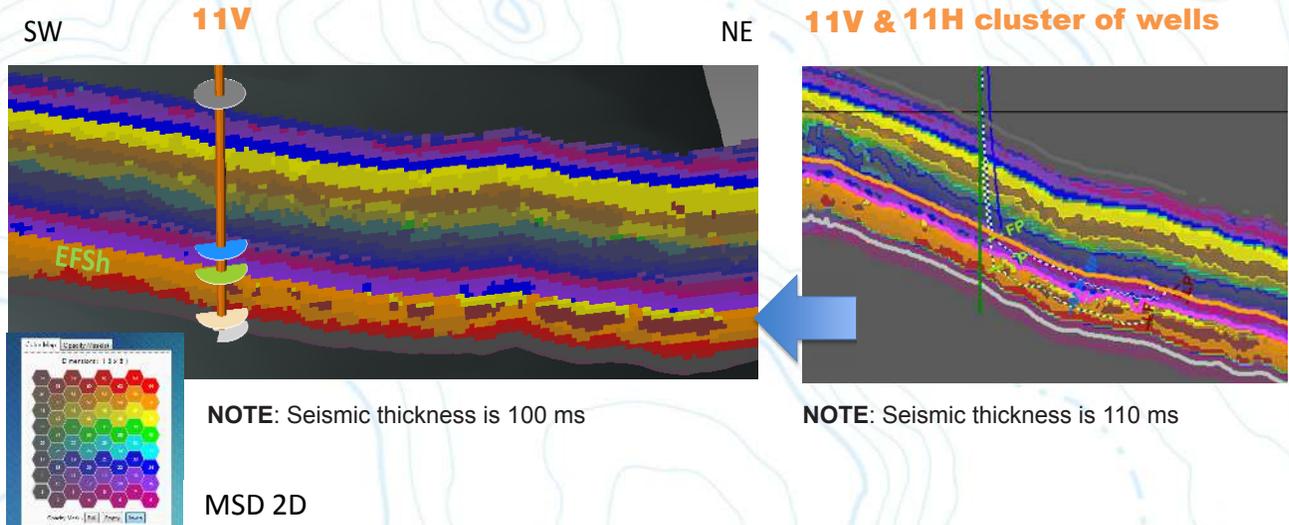
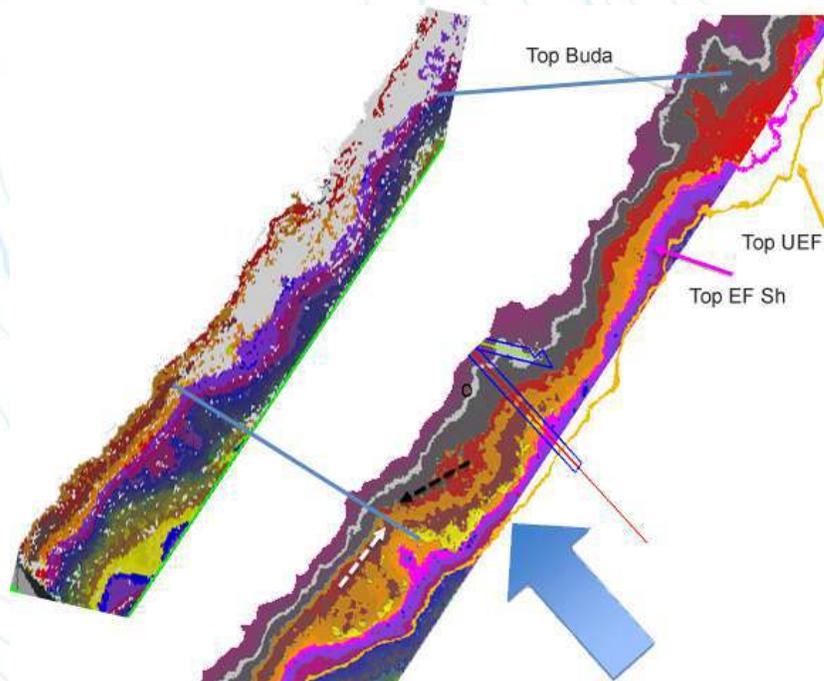


Figure 3a shows another geobody, which is highlighted by brown and yellow neurons, in the vicinity of the 11V calibration well and the cluster of associated horizontal wells. Note the concave upward shapes of the elements of the geobody. This geobody is stratigraphically above the Rust zone. Only one of the lateral boreholes appears to sample it as most of these wells targeted the Upper Eagle Ford marl.

Figure 3b is a time slice taken at 2.722 seconds and on the right is the SOM classification. Stratigraphic “up”, the top of the Eagle Ford Group, is to the right, and “down” to the Buda is to the left. Note that the Red lapout (black arrow) and the Rust geobody onlap (white arrow) both lie below Geobody 2. The left view shows the same slice with the 10% probability filter on. This white overlay indicates that all of the Eagle Ford updip is rare or anomalous and is likely

Figure 3b

Time slice at 2.722s



hydrocarbon rich. Note also the indication of a fault trace highlighted by the probability overlay as well as an offset of the two major pods of this geobody.

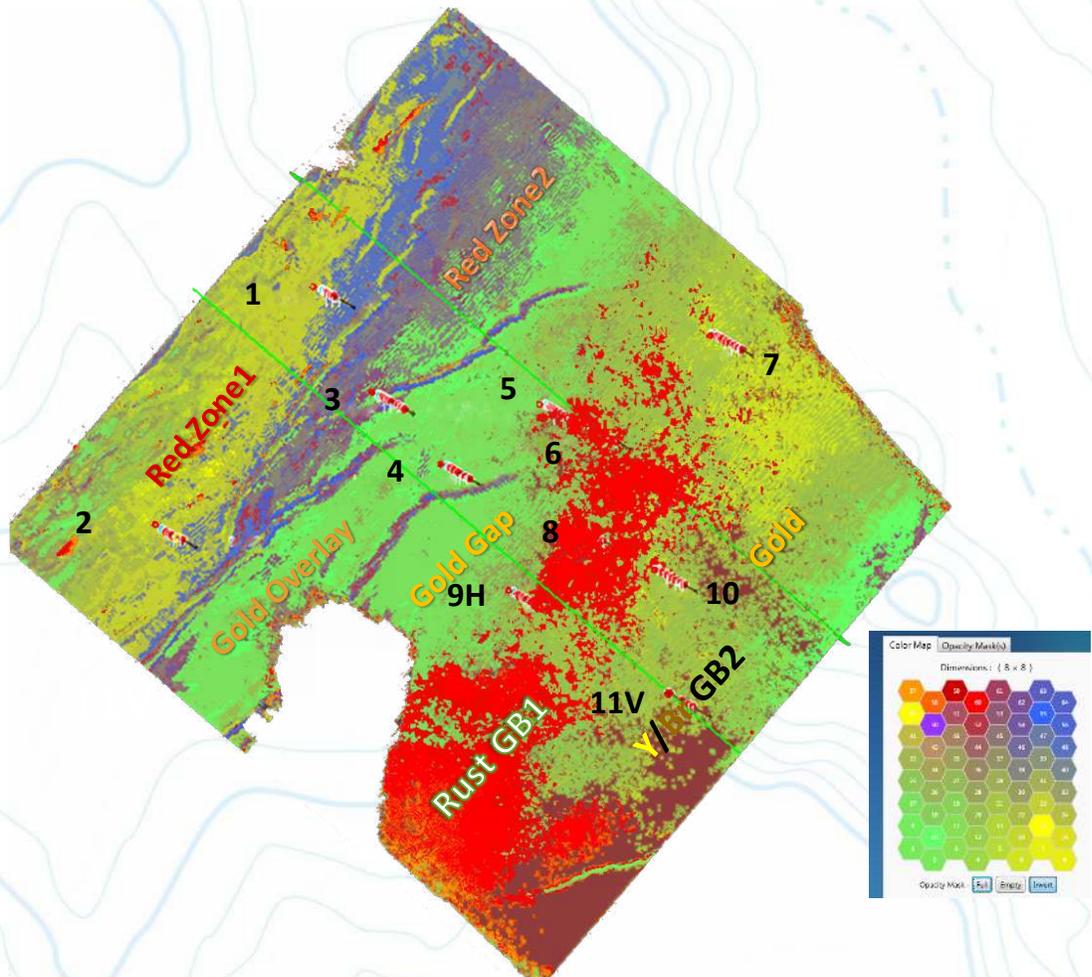
Figure 3c is the extraction of the brown part of the geobody for a view of its distribution. The yellow was not shown as it is non-unique neural facies that

also occurs in the Austin Chalk. A major fault is also clearly shown in this extraction.

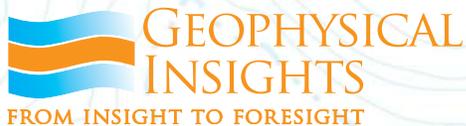
Later studies indicate that this geobody also comprises an unique neuron class #1 when its geological and petrophysical characteristics are classified against other wells in the area.

Figure 3c

11V Wells



All Seismic data owned and provided courtesy of Seitel, Inc.



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