

# RECON NEWSLETTER

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AGM



## INTERPRETATION WHILE DRILLING (IWD) WORKFLOWS IN RECON

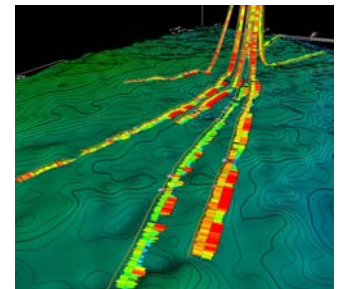
### Problem Definition

Well plans created using static geological interpretation and modeling tools rarely match the real world geology encountered during drilling. Conventional well planning solutions spread the Interpretation While Drilling (IWD) workflows across multiple applications and data management modules, making it difficult and time consuming for asset teams to integrate new data in order to reconstruct the geological interpretation. Increasingly more complex drilling environments call for more accurate predictive well planning, using real time operational decisions to drill more cost-effective wells.

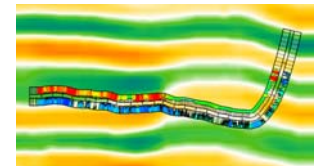
In this Recon newsletter we will describe a project in which Recon was used to change the geological interpretation while a horizontal well was being drilled in an offshore exploration environment. Using Recon to monitor the LWD results enabled the asset team to closely cooperate with the drillers in adjusting the well plan in real time.

### Integrating LWD and MWD Data

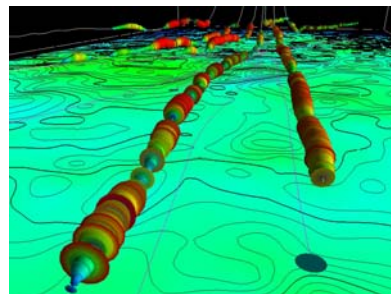
The advantage of Recon's Interpretation While Drilling (IWD) workflows is that they are integrated with Recon's 3-D geological interpretation environment, combining 3-D views with cross-section and basemap views to give the asset team the most comprehensive view of the subsurface situation and enabling the team to change its interpretations on the fly.



Gamma ray and deep resistivity curves shown along horizontal well trajectories



Cross-section along horizontal well showing a seismic backdrop

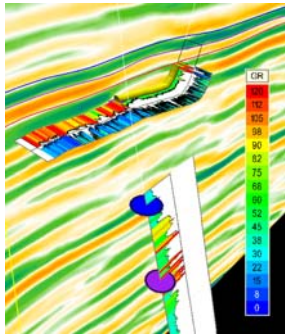


Horizontal well cylinder logs in Recon highlighting payzones

There are several ways to integrate logging while drilling (LWD) data and measurement while drilling (MWD) into Recon during the drilling process. In this example, Recon accessed the Landmark OpenWorks® database to access WITSML (Wellsite Information Transfer Standard Markup Language) data for real time monitoring of the well trajectory and LWD data. WITSML was developed by an industry consortium that

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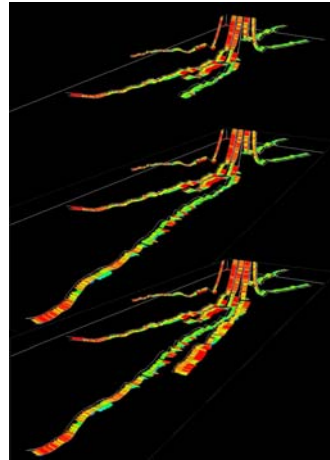
3-D view of a cross-section showing a horizontal well along a seismic cross-section

*“Working with horizontal or highly deviated wells in 2-D is frustrating, if not impossible. Recon is what you need to do it right.”*

includes BP, Statoil, Shell, Halliburton, Landmark, Baker Hughes and Schlumberger. Using Recon’s 3-D interpretation environment, the asset team made real time interpretation adjustments of the subsurface data and actively adjusted the drilling plan in order to ensure the success of the exploration well.

The problem with conventional geological modeling and interpretation software occurs when the asset team compares the predicted subsurface earth model with the actual measurements during drilling. When a deviation between the predicted data and the subsurface reality occurs, there is a need for an adjustment to the geological interpretation, which in turn leads to the possible necessity for an immediate drilling plan adjustment. Recon’s real time interpretation environment, powered by Recon’s Cascade Technology™ is the ideal tool for this challenge.

In this example, Recon was brought in to monitor the

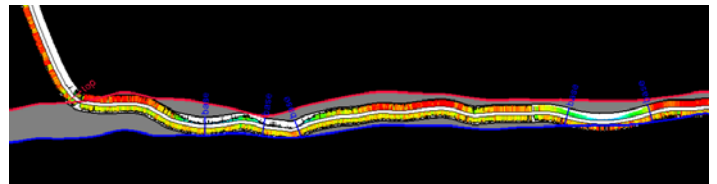


3-D Recon collage of time steps showing LWD data updates accessed from Open-

drilling of several horizontal wells in an offshore exploration environment involving unconsolidated

based on LWD information. Using Recon for the new wells, the well trajectory and real time logging data was loaded into Recon as soon as it became available, and was visualized in 3-D in combination with depth-converted seismic structure horizons. One of the challenges faced by the asset team was the need to design a planned well path that stayed within a thin payzone, bounded by non-hydrocarbon bearing zones.

By analyzing the well log templates combining gamma ray and deep resis-



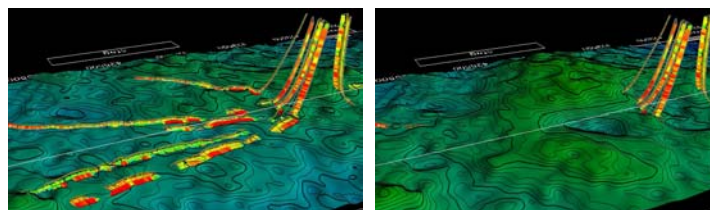
Recon cross-section view along horizontal well trajectory showing top and base seismic horizons tied to the picks.

sandstones. In previously drilled wells in the field, the asset team had executed the drilling plans without having had access to tools enabling them to analyze their data in order to recommend adjusting the well trajectory

tivity in both 3-D and 2-D cross-section, the wells spatial position relative to the hydrocarbon zones was determined clearly, enabling the asset team to steer the well trajectory in order to obtain a more precise well placement designed to achieve maximum production.

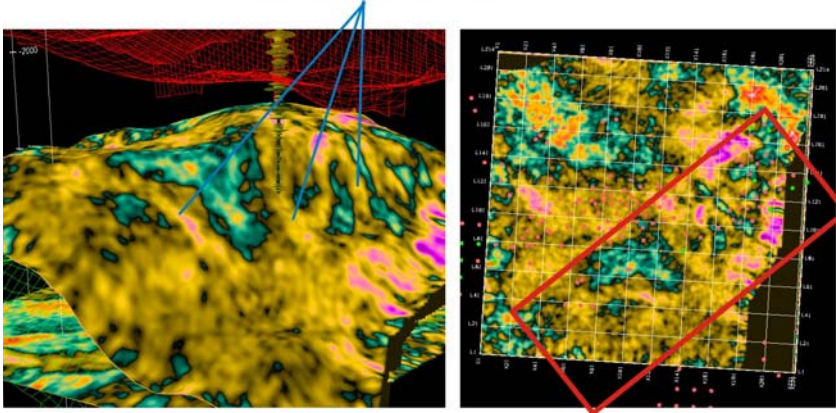
**Recon StrataISlice Examples**

Using a chronostratigraphic framework to slice 3-D seismic reveals important geomorphological information.



Comparison between the original depth-converted top of reservoir seismic horizon (left) and the horizon adjusted after top and base picks had been made in all horizontal wells (right).

## Turbidite flows



The picture on the left shows a stratal slice in Recon with three turbidite flows highlighted. Displaying the stratal slice in 3-D makes identification of debris flows and other slope related facies easier when compared to the same stratal slice displayed in the two-dimensional basemap.

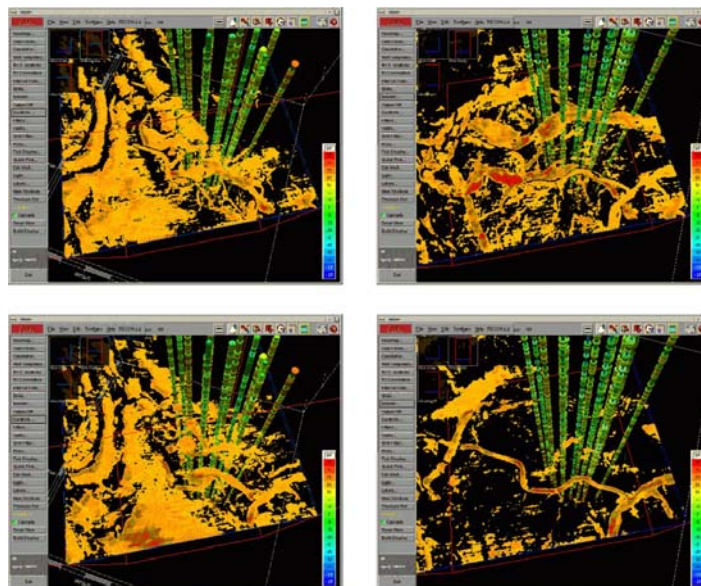
Recon StratalSlice™ is a Recon module which enables you to easily combine seismic structural and stratigraphic horizons with 3-D seismic to create a stratigraphically layered 3-D seismic volume that reveals depositional patterns.

Recon StratalSlice uses sequence stratigraphic principles to improve the quality of your stratigraphic correlations and significantly deepen your understanding of your reservoir's depositional system.

Once the StratalSlice volume has been created, you can access it in Recon's basemap. When you slice through the StratalSlice volume in the basemap, a 3-D StratalSlice indicator horizon will automatically appear in Recon's 3-D window, displaying the geomorphological patterns in their proper 3-D spatial

setting. The example shown in the figure above demonstrates the usefulness of analyzing geomorphological patterns in a 3-D stratigraphic view.

The example in this figure was taken from a West Texas carbonate field, with a shelf margin depositional environment, showing



Comparison between conventional time slices on the left with geomorphological stratal slices on the right for the same volume of interest. Note the clearer identification of fluvial channel distributions resulting from the use of stratal slicing.

grainstone distributions and debris flows along the edge of the slope. Note how much easier it is to identify the turbidite flows when analyzing the StrataSlice in 3-D as opposed to viewing the slice in the basemap.

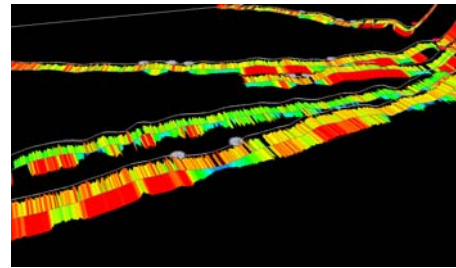
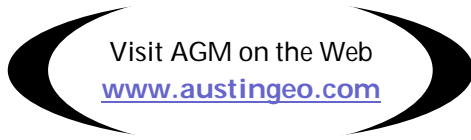
Stratal slicing is just as powerful in fluvial depositional settings, as is shown in the figure below. Here we compare conventional time slicing through a 3-D seismic volume with the results of a Recon StratalSlice volume. Notice the clear definition of meandering channels in the StratalSlices shown on the right.

*“Recon StratalSlice uses sequence stratigraphic principles to improve the quality of your stratigraphic correlations and significantly deepen your understanding of your reservoir's depositional system.”*

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This 3-D Recon image of the deep resistivity curve shown on the right hand side of the horizontal well template indicates when the well trajectory exits and re-enters the target payzone.