P-509

3D Crossplot: A Petrel plug-in to draw three dimensional crossplots from well and seismic data.

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Summary

We present a unique plug-in in Petrel capable of visualizing 3 well or seismic attributes in three dimensions. Analyzing a crossplot gives the correlation between 3 parameters that may be useful to characterize the lithology or to study the reservoir characteristics. To supplement wells, it has the ability to include zones as well as multiple wells and plot the selected ones through user defined color coding. To correlate the same with a 2D crossplot there is an option to generate the 2D plots on the fly from any 2 axes of the 3D crossplot. The plug in is capable of displaying the crossplot in Petrel's own 3D window using OpenInventor API.

Keywords: Petrel, Visualization, Three Dimensional Crossplot

Introduction

Correlation between well parameters is of great importance to interpreters. Lithology as well as reservoir properties may be deciphered seeing the visual correlation of well parameters. For example, the neutron-density cross plot is used in log analysis for determination of porosity and lithology from neutron porosity and bulk density. A cross-plot of sonic travel time and formation Density can be used to identify lithology. Thus we see that how correlation between 2 well parameters is useful for deriving additional parameters from well data. A three dimensional crossplot can provide extra information because it shows the visual correlation between 3 variables. Chopra et al (2003) showed that many reservoir parameters can be deduced by studying the individual clusters formed due to plotting 3 parameters in a cube

Theory

The theory of 3D crossplot is pretty simple. Taking a common depth we plot the co-ordinate as per three parameter values at that depth. The clusters are created from several co-ordinates computed from different depths.

The algorithm for drawing the crossplot is outlined as follows:

- Take 3 well parameters A, B and C.

- Find out the depth range where data for A, B and C exists.

- For each depth value containing samples from A, B and C assign a set of co-ordinates where sample A becomes the x co-ordinate sample from B becomes the y co-ordinate and sample from C becomes the z co-ordinate.

- Plot the co-ordinates in a 3D cube.

In addition to just plotting a single well we implemented zone based and well based plots. Multiple wells can be plotted as per different zones derived from WellTop information. There is also a provision for well based coloring and Zone based coloring. In Well based coloring the points are colored differently for different wells whereas for Zone based coloring different zones are shown in different colors in the crossplot.

The crossplot plug in is not only limited to well parameters. It also has the capability to plot three seismic attributes in three dimensions. Seismic attribute crossplots for example a plot of seismic amplitude, instantaneous phase and instantaneous frequency gives much information about reservoir properties.

Another novel feature is the ability to generate on the fly 2D crossplots at the click of a button. The user can select X and Y, Y and Z and X and Z axes to plot the 2D crossplot in a new Function Window.

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User Interface

The UI of the plug in takes a Borehole Collection and Well Top as inputs and lists all the wells and zones in separate list boxes (Figure 1).
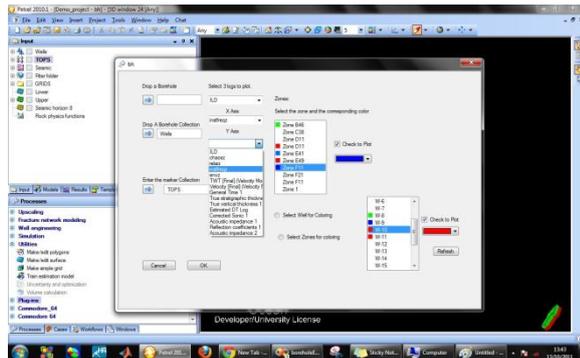

Figure 1: The UI of the Crossplot Plug-in.

After selecting the required Zones and Wells the user selects if he wants to color as per wells or zones.

The different colors corresponding to the wells and zones are selected and after clicking on the "3D Plot" button a 3D crossplot is generated (Figure 2).
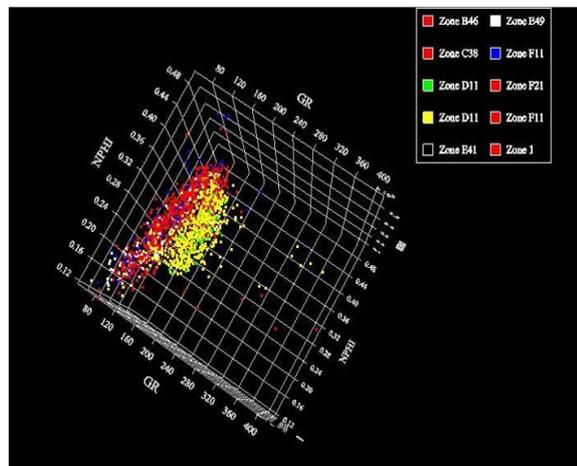

Figure 2: The 3D crossplot generated from well data(NPHI vs GR vs RHOB)

By clicking on any of the 2D plots button he can generate a

2D plot in the function window. The 2D plots from the crossplot is compared with existing Petrel crossplot in figure 3. The new crossplot extends Petrel crossplot by including zone information.
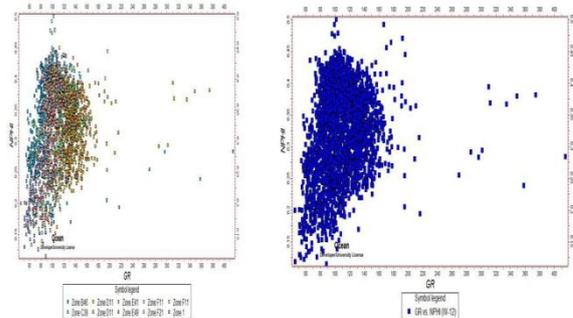

Figure 3: A 2D crossplot generated from a 3D crossplot compared with Petrel's native 2D crossplot

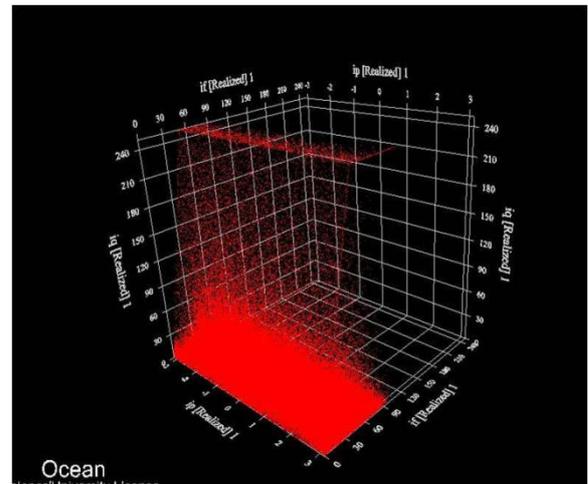A crossplot between seismic attributes is shown in figure 4 generated by placing 3 attribute cubes as input.

Figure 4: A 3D crossplot generated between 3 seismic attributes (IQ vs IF vs IP).

Conclusions and future work

We have presented a Petrel plug-in to draw all types of crossplots in Petrel software from well as well as seismic data. The plug in introduces newer visualization features to the Petrel software as well as correlates the newer

visualization technique with existing visualization techniques. In the future versions of the plug in we would be adding features of cluster selection directly from the crossplot and display it on the well section window. This will provide the interpreter with a clear and precise idea as to which part of the well he is looking into. The seismic crossplot section would also be extended to include horizon and well correlated plots.

Table1: Tables should be properly annotated with each column head giving units of measurement.

References

Chopra S., Alexeev V, and Xu Y,., 1995, 3D AVO crossplotting—An effective visualization technique

Acknowledgments