# Structural and Stratigraphic Dip Computation and Analysis Helps Characterize Geologic Features

## OVERVIEW

Halliburton AutoDip™ and TrendSetter™ services automate dip and dip trend analysis of electrical micro-imaging borehole data. These two services save you time and produce high-quality data that can help you spot "hidden features" in sedimentary beds and laminates.

AutoDip automates high-resolution dip detection, a vast improvement on tedious manual dip picking. Unlike traditional dip computation methods, AutoDip does not simply correlate raw resistivity data. This method operates independently of often inappropriate correlation parameters, such as correlation length, step length, and search angle.

TrendSetter augments AutoDip functionality by taking dip data and automatically sorting it into categories of:

- Constant dip with depth
- Increasing dip with depth
- Decreasing dip with depth

TrendSetter thereby helps you characterize geologic features based on dip trends.

## AUTODIP

AutoDip uses data from all imaging buttons to accurately determine dips. By using more data, you get more accurate dip readings.

AutoDip translates the human visual experience of event correlation into an equation that quantifies visual recognition to obtain the optimal dip. The self-optimizing algorithmic process1 operates without the need to adjust correlation parameters, which can introduce bias into dips or even hide dips when using traditional methods.

AutoDip works equally well in simple bedding or in more complex bedding environments.

Figure 1 shows how AutoDip spots dip reversal (1). The computed dip trend for decreasing dip with depth under the slump (2) is followed by the structural dip (3).

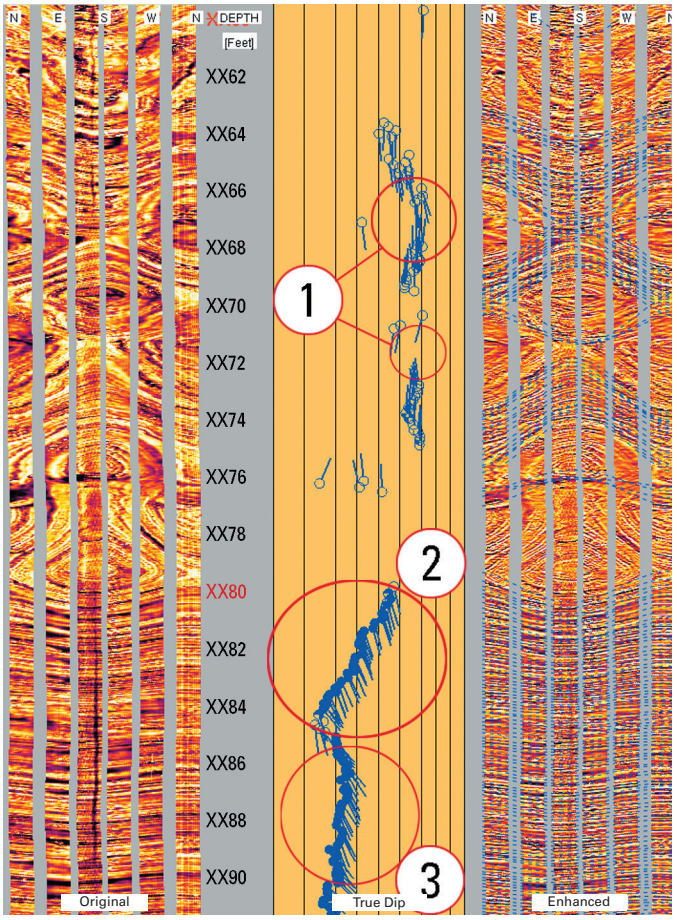


*Figure 1 – Automatic dip computation showing dip reversals due to slumping.*

## AUTODIP BENEFITS

- High quality and greater data confidence
- Improved dip statistics
- Reduced time to pick dips
- Production of five dip qualities
- Consistent picks independent of interpreter bias
- Output curves that indicate degree of laminations
- Output curves that indicate degree of bed contrast
- Independence from search angle, correlation length, and step length

## HIGH QUALITY OF DATA INCREASES CONFIDENCE IN INTERPRETATION

Figure 2 shows the large number of dips that AutoDip can locate within a given range of borehole image data. The software computes over 200 dip picks in 30 ft of data. This high level of detail can increase your confidence in the quality of your interpretation.

A byproduct of the AutoDip process is the generation of Contrast Index and Lamination Index curves that help describe the reservoir. Figure 3 shows two sands with similar GR response. The upper sand contains beds of high contrast, while the lower sand is more massive.

The Contrast Index curve on the right side of the figure, derived from AutoDip, can be a useful tool for providing information about horizontal permeability barriers, reservoir texture, and changing reservoir composition.

GR response. The upper sand contains beds of high contrast, while the lower sand is more massive.

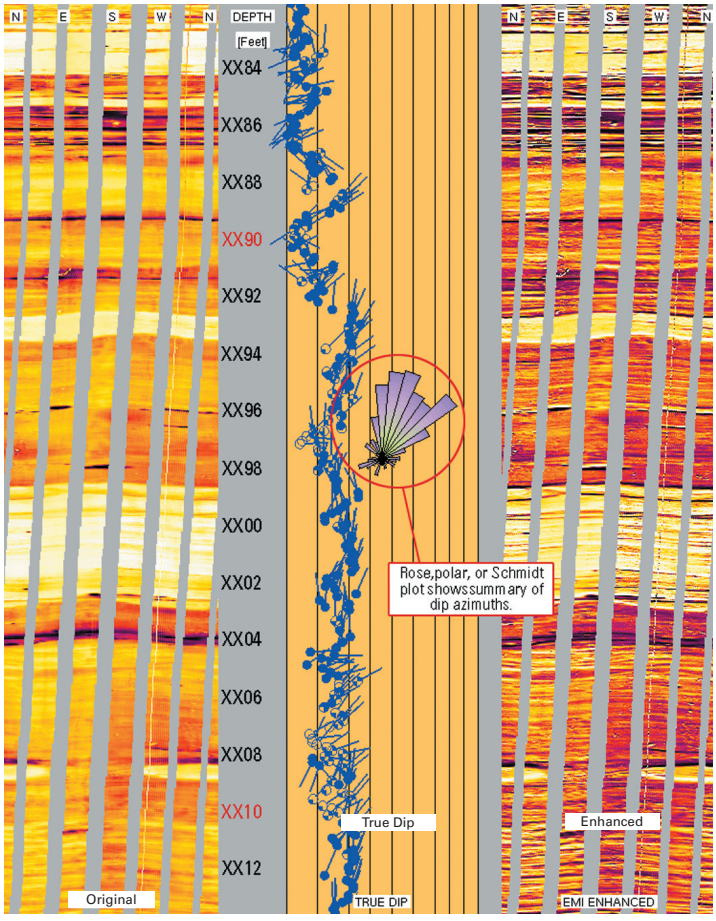


*Figure 2 – High level of detail makes for improved stratigraphic analysis.*

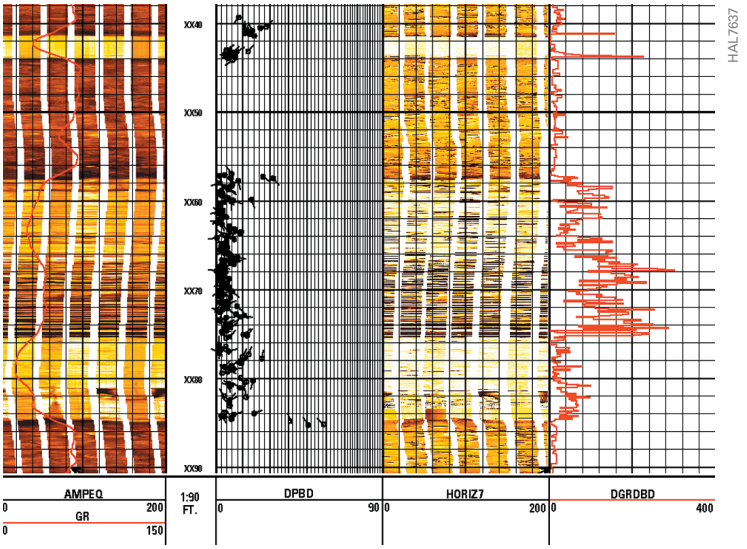


*Figure 3 – AutoDip Contrast Index can provide information about the changing composition of the sand.*

A similar index indicating laminations is presented in Figure 4. The upper sand is more massive and contains fewer laminations than the sand below. This can also be clearly seen in the image and from the frequency of the computed tadpoles.

The shale separating the sands also has a high Lamination Index, which can be compared with the more massive shale below both sands. This Lamination Index would also be very useful in recognizing thin laminated sands that can mask low-contrast pay.

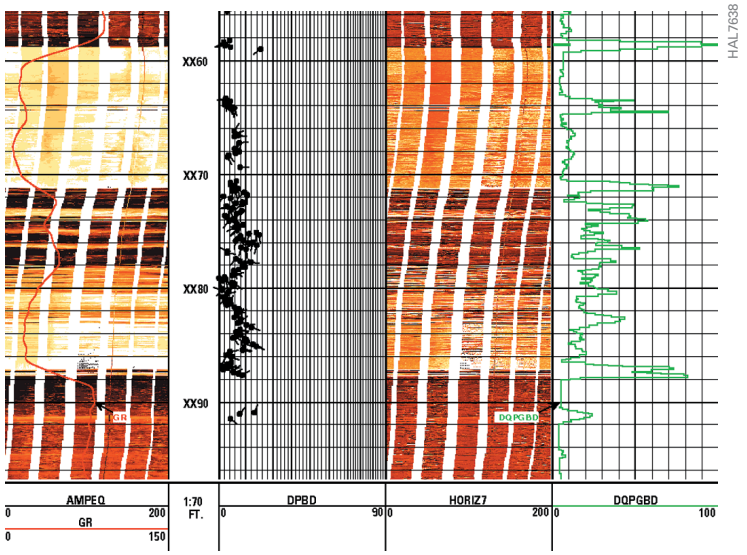


*Figure 4– AutoDip shows laminations unseen by gamma ray.*

## AUTODIP HELPS CHARACTERIZE STRUCTURE OF COMPLEX ENVIRONMENTS

AutoDip has the ability to compute dip trends that may be overlooked if dips are handpicked or computed by conventional methods. Figure 5 shows an increasing dip with depth pattern at XX22 feet and another, subtle pattern at XX02 feet.

The details of these features are expanded to the right. It would be arduous to handpick dips at all the bedding events in the "channel-like feature," and the subtle current bedding feature could easily be missed using conventional dip computational techniques.

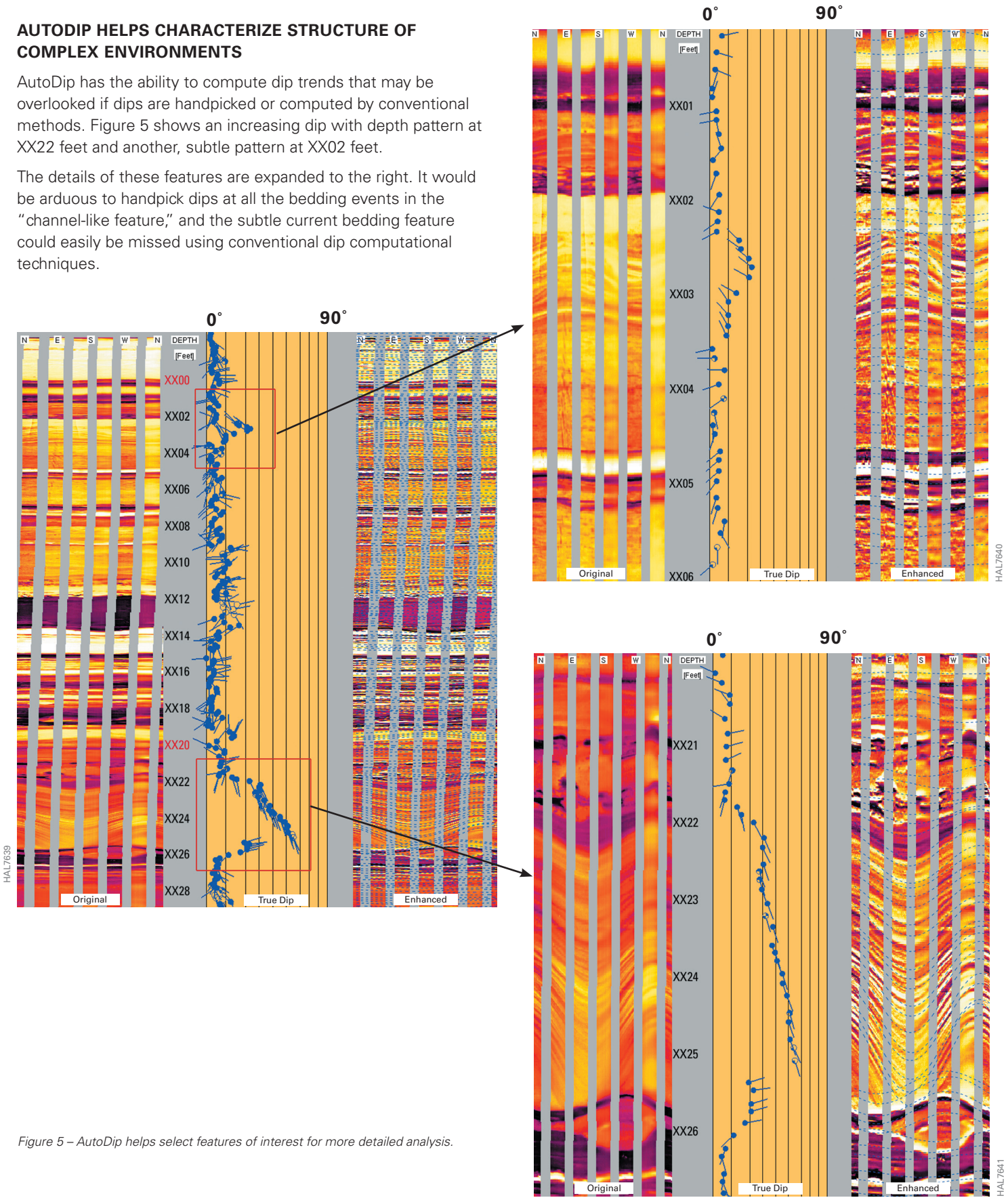


*Figure 5 – AutoDip helps select features of interest for more detailed analysis.*

## TRENDSETTER: AUTOMATIC IDENTIFICATION OF DIP TRENDS

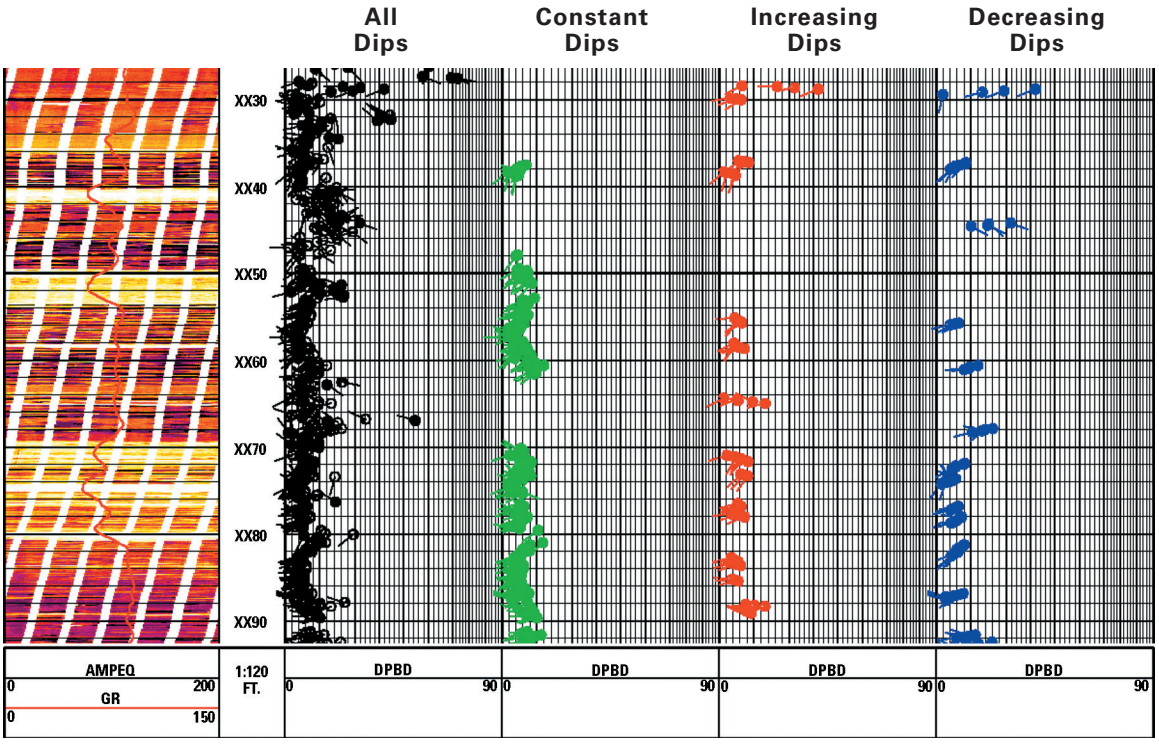


*Figure 6 – TrendSetter eliminates need for hand-selecting dip trends.*

### TRENDSETTER

The AutoDip program can generate many dips. The number of dips is partially determined by dip quality filters. During the analysis process, it is prudent to look for patterns to help recognize trends that can impact mapping, offset wells, and describe depositional environments and structural changes. TrendSetter automatically separates dips into constant, increasing, and decreasing categories, making it easier to visualize changes and trends.

TrendSetter separates the dips from stratigraphic events, such as current bedding, slumps, and drapes, from the more constant structural dips, which allows better estimates of local structural dip.

### TRENDSETTER BENEFITS

- Identification of dip trends
- Removal of random scatter and stratigraphic dips for structural dip analysis
- Identification of other stratigraphic or structural events when used with other geologic data
- A user interface that provides flexibility and quality control

[1] *"Automatic High Resolution Sedimentary Dip Detection on Borehole Imagery," Shin-Ju Ye, Philippe Rabiller, and Noomane Keskes, SPWLA 38th Annual Logging Symposium, June 15-18, 1997.*

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