Geological Applications of the Electrical Borehole Imaging

Karol Komosa
Institute of Geological Sciences, Jagellonian University, Kraków, Poland
Faculty of Geology, Geophysics and Environmental Protection AGH University of Science and Technology, Kraków Poland

Electrical imaging log is an excellent tool in geological interpretations of well data. It can be used to identify natural fractures, faults, unconformities, bedding dip angle, dip azimuth, grain size and shape which allow analysis of sequence stratigraphy and facies reconstruction. Due to high vertical resolution this tool is particularly helpful in the thinly laminated sediments e.g. shale rocks. This method is becoming increasingly important in interpreting the subsurface structures and helps to reducing costs for oil and gas exploration.

The electrical borehole imager is a wireline tool with six independent arms which 25 electrodes per 1 pad, it gives 150 measurement points (XRMI™ Tool http://www.halliburton.com/public/lp/contents/Data_Sheets/web/H/H03629.pdf). The effect of the measurement is a resistivity image of borehole wall of high vertical resolution (0.5 mm). Resistivity imaging device is measure in fact the resistivity contrast between different features on the borehole wall like beds, matrix-clasts etc.

Examples of the geological features from a single well in the Ventura basin, California, contain excellent models of sedimentary features such as groove casts, lenticular bedding, scours graded beds, and rip-up clasts (Amer et. al., 2011). These examples (Fig. 2.) allow interpreting geological facies such as turbidities and channels of the continental slope.

Electrical imaging tools were developed as advancement on dipmeter devices where each arm records microresistivities of the formation in the borehole wall, it provides data used to compute formation dip The results of computer processing are most frequently presented as a vector plot (Fig. 1. track 2.). This application is included in electrical borehole imaging tool as well. As an example the combination of elecrical imaging and vector analysis of which geologists are enable to interpret e.g. eolian facies (Fig. 1.).

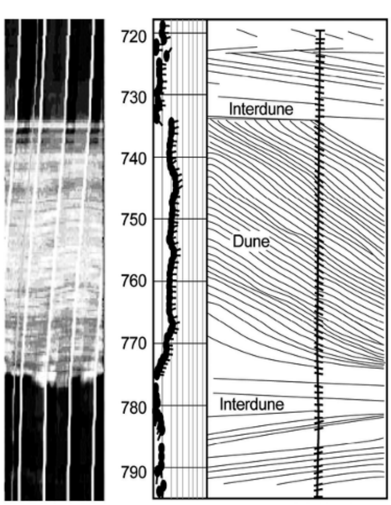

Figure 1.: Track 1: example of an electrical microimage, track 2: vector plot and a scheme of layer dip shows inner geometry of the eolian and interdune sands (source: petrowiki.org/File%3AVol5_Page_0404_Image_0001.png)

Further source of information, while considering this group of tools, is the possibility for estimates of borehole diameter. All arms of the tool are pressed to the wall of the borehole creating signal that represents the changing shape of the borehole. The change of the diameter can indicate the change of the lithology (e.g. washout over the evaporate layer), evaluate and orient borehole breakouts and man-made caverns caused by drilling process.

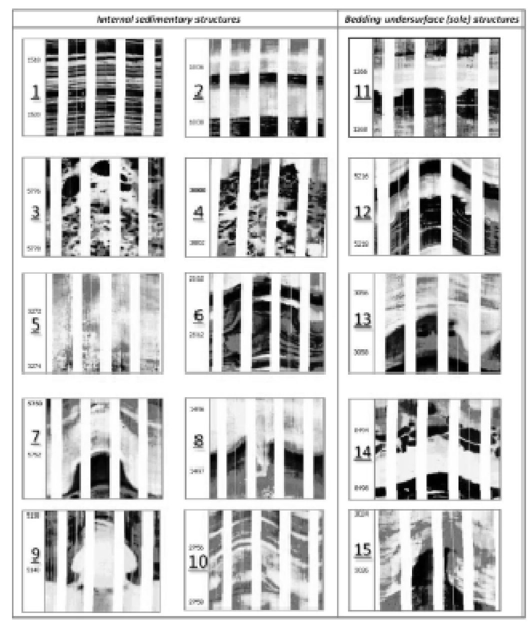

Fig.2.: Sedimentary structures observed on the high-resolution borehole image logs. (depth in feet): 1,lamination; 2,bedding; 3, inverse/reverse grading; 4, conglomerate; 5,massive bed; 6, convolute bedding (slump); 7, sediment deformation; 8, water escape structure; 9, sand injection; 10, cross-bedding; 11, groove cast; 12, load cast; 13, small-scale scour surface; 14, erosional channel base with lag; 15 ,flame structure (Amer *et al*., 2011)

The electrical borehole imager is a great source of geological information, no previous well logging tool could offer such various set of geological data. Borehole image data are used for the identification of lithology, depositional environment, paleocurrent direction, giving great value in interpretation model of the reservoir.

Amer, A., Glascock, M., Schwalbach, J., Khan, M. (2011): Ann Techn Conf Exhib, Soc Petrol Eng, Colorado, USA

Kiełt, M. (2009): Strukturalne i Sedymentologiczne Zastosowanie Otworowych Profilowań Geofizycznych. 1-2.

Lovell, M. A., Williamson, G., Harvey, P.K. (1999): Geol Soc Spec Publ, 159: 1- 60

Poppelreiter, M., Garcia-Carballido, C., Kraaijveld, M. (2010): AAPG, ch: 1, 2, 5.

Courtesy of Schlumberger (FMI™ http://www.slb.com/~/media/Files/evaluation/brochures/wireline_open_hole/geology/fmi-hd_br.pdf)