Text S1: Processing of raw FMI and UBI data

Raw FMI data is processed using Techlog® software following a series of steps: inclinometry quality control (QC), speed corrections, pad image creation, image based speed corrections, button harmonization, pad concatenation and orientation and histogram equalization. Inclinometry QC method allows doing a quality check and repairing magnetometer and accelerometer channels and is designed to use the BGS Global Geomagnetic model to calculate the magnetic field parameters. Speed corrections are applied to avoid incorrect computation of measured variables due to temporary stuck-up of the tool while logging. The pad image creation method converts differing input formats into a single Techlog format by ordering all pads and buttons clockwise around the borehole when looking down the borehole. It also corrects all button and pad measurements for any depth offsets during acquisition. Image based speed corrections are used to minimise the remaining uncorrected effect of irregular tool movement after speed correction as irregular tool movement could create a saw tooth effect due to depth offsets between the button rows in the tool. It can also produce offsets between pads (flaps) with an alternating up and down between successive pads around the borehole. Image-based speed correction uses a correlation algorithm to minimize these offsets. Button harmonization corrects the effects of different responses between buttons. Response of buttons not only depends on the problems of tool but also results from borehole conditions such as poor pad contact or mud cake smeared on the pads. Button harmonization corrects the response of each button so that it matches a global response of all buttons taken together. Pad concatenation and orientation is used to create an oriented array in which each pad is in its correct position around the borehole and gaps between the pads reflect the borehole size. Finally, image is normalised in the histogram equalization step. Two types of normalization are performed on the image:(i) static normalization, where each value mapped on a scale is normalised for the entire intervals, and (ii) dynamic normalization which maps each value to a scale defined by the data range in a sliding window. It enhances localised features present in the image in contrast to the static image.

Raw UBI data are processed in order to generate an oriented image of the borehole wall by using tool azimuth and relative bearing, deviation and azimuth of the borehole for calculating true dip from the apparent dip picked on the image, average caliper for dip picking, amplitude array and travel time array from the ultrasonic imaging tool. Finally, image normalisation similar to that used in the case of FMI data is applied to produce static and dynamic amplitude images of the borehole wall.