

Core to Borehole Image Log Simulation and Transformation Fostering the Core-Log Calibration

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ABSTRACT

Borehole image logs provide high resolution digital data for reservoir formation evaluations. While borehole imaging offers centimeter-scale images of the borehole wall, well core is the actual physical rock extracted from the wellbore. It is the data mirror image of rock left around the perimeter of the wellbore. The acquisition of borehole image logs is, however, costly. Therefore, typically only a small fraction of wells have borehole image logs. Conversely, many wells may have core data but no formation image log. A 360-degree core photo image provides only a visual picture of the core. It does not contain spatial and vertical depth information so can only provide a qualitative reference, not quantitative information. An innovative technique has been developed to color decode the traditional 360-degree core photograph, geospatially anchor, and transform it into the borehole image log. This data transformation empowers the geologist to benefit from borehole imaging digital interpretation functionality. A core is placed on a rotating table with a scanner/camera mounted on top. Through continuous scanning, a 360-degree photo image of the core's outer surface is generated. By decomposing the full color contrast of the unfolded photo image, numerical arrays of red, green, blue, and greyscale color are generated. This is then transformed and re-arranged to a digital log format. By entering the proper top and bottom depth as specified in the core and iteratively adjusting the image orientation to align with the wellbore azimuth, a borehole image log can be simulated. By calibrating the prediction with the actual formation image log at the same well, the correlation and confidence of prediction can be improved. Wells with core data but no corresponding formation image log can use this method to simulate the formation image log through guided training. If the transformation from the 360-degree core photo in the blind test is satisfactory, significant cost savings can be made by opting not to acquire additional costly formation image logs. This technology has been successfully applied in field development. Two different data types, well core and borehole image logs transformed from the 360-degree core enable two different interpretation applications to collaborate, amplify, and yield tremendous reservoir insights. Not only agility and accuracy have been significantly enhanced but also operational cost and turnaround time dramatically reduced.