Quantification of Net-to-Gross and Oil Impregnation in Bioturbated Heterolithic Clastic Reservoirs using Core Photographs

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Abstract

Bioturbated heterolithic clastic reservoirs are often characterized by clean sandstones forming thin levels, small patches, and burrow infills. This scenario makes precise estimation of percentage of sandstone (net-to-gross) a very difficult task. At present, there are no tools available that allows a straightforward quantification of the sand content using core pictures. In this work, a novel technique that uses core photographs is presented. Using computer vision processing software it is possible to determine the composition of the analyzed cores. The method is based on an automatic segmentation of contrasted core photographs and the subsequent analysis through image processing. This methodology allows precise estimation of the sandstone percentage (ISA, image sandstone analysis) at a variable and fully customized sample rate. The results are continuous logs that can be fully integrated with other conventional core and well logs. A similar procedure was applied to the analysis and quantification of oil impregnation (IFA, image fluorescence analysis) through the processing of UV core photographs. The results were highly satisfactory. IFA was able to appropriately distinguish between impregnated and unimpregnated areas. Additionally, it was possible to successfully determine the degree of impregnation. This technique was successfully applied to the analysis of the Lower Cretaceous Leushinskaya and Vikulovo reservoirs in Western Siberia Basin, Russia. Three different logs were computed with sample rates of 1, 10 and 50 cm. In the case of ISA, the obtained logs proved to be useful tools for evaluating the location of sandier intervals, the precise calculation of net-to-gross for a desired interval, and the analysis of the internal cyclicity at different scales. IFA results were compared with other sophisticated well tools. The IFA log shows an excellent match with the oil saturation curve and provides a precise location of HC contacts. Both ISA and IFA logs also contribute to the precise estimation of core shift.