Application of Image Analysis to Reservoir Quality Estimation in Core and Drill Cuttings

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ABSTRACT

Porosity image analysis (PIA) of backscattered electron images acquired from polished thin sections or blocks provides a method for the reliable, quantitative estimation of key reservoir quality parameters. Important information that may be estimated includes permeability, total and effective porosity, irreducible water saturation, detailed pore size distribution, pore diameter to pore throat size ratio, and simulated mercury injection pressure curves. The cost of image analysis is considerably less than mercury injection testing.

PIA is based on the quantitative measurement of the pore size distribution from backscattered electron images. Pore system statistics, such as total and effective porosity, and pore size distribution, are thus directly extracted from the measured dataset. Other parameters, such as permeability, irreducible water saturation, pore diameter to pore throat size ratio, and simulated mercury injection pressure curves must be empirically calibrated against suitable core samples for which measured data are available.

In order for image analysis to yield reliable results, it is imperative that the analyzed images sharply delineate porosity from the solid components of the rock in 2-dimensional section. For this reason, analysis of backscattered electron images is much preferred to similar analyses performed on transmitted light images of thin sections, which are not 2-dimensional in the strict sense. An exception to this general rule may be found in samples that contain little microporosity, and in which the smallest pores are large relative to the thickness of a petrographic thin section. It is also imperative that polished thin sections be of the highest quality, as a poorly polished surface will not yield backscattered electron images that accurately represent the pore system, leading to erroneous image analysis results.

Within certain limits, PIA can be used as a reliable predictor of permeability and other significant parameters in drill cuttings. The results of PIA conducted on simulated drill cuttings compares favorably with the results from the core samples used to produce the simulated cuttings. When analyzing drill cuttings, ample allowance must be made to account for edge porosity. The method is not suitable for use on drill cuttings that do not adequately represent the pore system of the rock, such as carbonate rocks with a substantial component of vuggy porosity, or sections with a large component of fracture porosity.