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Application of statistical analysis of CBCT images in evaluation of rock heterogeneity of hydrocarbon reservoirs and reservoir studies

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Investigating changes in the reservoir rock's pore system during multiphase flow studies in porous media is crucial, especially for processes like enhanced oil recovery, underground carbon dioxide storage, and wastewater disposal. Ignoring core heterogeneity in laboratory studies can significantly impact the results and their potential for upscaling to the reservoir.

In this study, 31 limestone samples with varying porosity and permeability from the Ilam Formation were scanned using a dental Cone-Beam Computed Tomography (CBCT) scanner. To assess heterogeneity, 9 or 12 cross-sections were selected from each sample. Histograms were plotted for each image based on the CT number of all voxels using image processing software. The standard deviation of each histogram was then calculated. This approach quantified the heterogeneity and classified the samples into five zones based on data dispersion: homogeneous (blue zone), relatively homogeneous (green zone), relatively heterogeneous (yellow zone), heterogeneous (orange zone), and damaged (red zone).

The results showed that out of the 31 samples studied, 14 samples were within the blue zone, 11 in the green zone, 3 in the yellow zone, 1 in the orange zone, and 2 in the red zone. It is recommended to prioritize these samples in that order (1st to 5th) for reservoir rock laboratory studies.

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