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Rock Properties from 2D Images: Computer Assisted Petrography

Historical applications of petrographic image analysis have focused on image segmentation and applications of porosity analysis (flow unit definition, permeability estimation). These techniques have largely overlooked the solid phases and how they contact one another. The nature of grain contacts directly influences acoustic and physical rock properties (e.g. velocity, compressibility). In order to quantify properties of both the pore and solid phase systems of sandstone reservoirs a new type of image analysis tool, Computer Assisted Petrography (CAP), has been developed. Following segmentation of the image for total visible porosity identification, the solid phases are manually "cut" apart at points of contact and classified in terms of mineralogy, and primary detrital or authigenic origin. For each identified solid particle the total perimeter and area, long and short axes lengths (particle size, sorting), number of flat segments and corners, and the relative sharpness of corners along the external perimeter (particle shape), particle orientation, load-bearing contact length, number of grain contacts and the mineralogy of contact partners are identified. Results of CAP analysis compared with rock physical measurements made on full diameter core plugs show strong relationships between contact statistics, grain shape, and pore volume compressibility. The depletion-stress dependent compaction of a reservoir can be predicted from CAP data. Contact statistics can also be used to predict velocity changes with production for unconsolidated sand reservoirs. Once CAP has been calibrated in an area with full diameter core data, CAP analysis can be used to estimate rock properties when sample quality precludes direct measurement.