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Quantification of particle shape parameters using optical image analysis

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The purpose of this study is the development of a shape indicator that quantifies the regularity of particle outlines observed in thin sections. This shape indicator is estimated from the combination of a set of parameters: fractal dimension, Wadell's roundness, normalized ratio of perimeter-to-area, solidity and sphericity, all of which were obtained through the use of optical image analysis techniques. This work's methodology can be summarized as follows: i) the creation of 18 theoretical type particles with different degrees of roundness (from rounded to angular), roughness (from smooth to rough) and sphericity (from high to low); ii) the quantification of the type-particle's morphometric parameters by Image-Pro Plus, ImageJ and Rousillon Toolbox and the evaluation of their interdependence; and iii) the mathematical development of a particle-outline regularity parameter by means of a multiple linear regression. Thus, image analysis techniques allowed defining a regularity parameter of particle outline as a function of shape parameters, providing values between 0 and 1. In addition, this process allowed a) the correction of deviations or limitations from the individual use of some of the parameters in the study of particle shape; and b) the improvement of the quantitative analysis of the particles according to the shape of their contour. The proposed regularity parameter was applied and validated using a natural case study (quartz particles in sandstones). Overall, this technique provides an important contribution to quantitative petrographic studies, allowing an automatization and optimization of particle-shape characterization, which holds a strong relationship with important reservoir properties such as porosity and permeability.