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Quantification and assessment of quartz-particle 2D size and shape using digital image analysis.

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The size and shape of rock constituent particles can provide substantial information about the environment in which rocks are formed and also about their evolution during their geological history. There are several geological processes that generate specific particle shapes. We focus on three processes and their effects on particles as end members: sediment transport in water producing sub-rounded particles, tectonic fracturing producing angular fragments and chemical corrosion at grain boundaries increasing their rugosity. In this work we test several shape morphological parameters in natural rock specimens with the ultimate goal of quantifying the proportion of different typologies of particles in a rock, all of which can be related to specific geological processes. The main aim of this work is to distinguish different typologies of quartz particles according to the quantitative and qualitative evaluation of shape parameters by using several shape parameters in grains and/or particles.

The procedure followed includes: i) the petrographic characterization of rock specimens in thin section, visually establishing the different typologies of quartz grains present, ii) the acquisition and segmentation of outlines of quartz particles and iii) the quantification of size and shape parameters such as area (A), perimeter (P), fractal dimension (FD), solidity (So), normalized perimeter-area (PoA), Wadell roundness (Rw), Drevin roundness (RD), Pg/Pe roundness (RP), sphericity (S) and a regularity indicator (RBC). A total of 293 particles were studied by means of ImagePro-Plus, ImageJ and Roussillon Toolbox software.

We have used two rock specimens from the base of the Esla nappe, a thrust sheet emplaced in the foreland fold and thrust belt of the Variscan orogen in NW Iberia (Cantabrian Zone). The first phase of this work was to identify the petrographic characteristics of the samples. One specimen was sampled from a quartz sand injection at the base of the thrust sheet. The other is from a sandstone in the footwall, the likely source for the quartz grains injected in the hanging wall. There are some evidence of fracturing and corrosion of the injected quartz grains during the injection process at the base of the Esla nappe. In summary, the first sample contains quartz grains with distinctive shapes that can be directly related to very specific geological processes affecting particle shape in a rock.

The result of the analysis completed allowed the definition of: i) the parameters that best represent the grain shape variations and ii) the range of values for each parameter that are characteristic of each process, thus allowing the classification of the grain shapes. Furthermore, the analysis allowed distinguishing sub-rounded quartz grains of detrital sedimentary origin from grains that have been partially or totally fractured. However, the used shape parameters do not allow a univocal identification of grains corroded by fluids.

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