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Implications of rock texture characterization on the modelling of volcanic processes

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Volcanic processes are complex phenomena that require a multidisciplinary approach to understand their behaviour and to monitor and forecast volcanic activity. It has long been proved that the nature and physical characteristics of volcanic rocks provide fundamental information about the history and evolution of the volcanic system that has generated them. In the following we report examples of how studies conducted on rocks erupted from Italian volcanoes and other volcanic areas in the world have been integrated with numerical models to understand the physics of volcanoes and the physico-chemical properties of their magmas. High-resolution 2D (via scanning electron microscopy) and, more recently, 3D (via X-ray computed microtomography) imaging on volcanic rocks has led us to 1) to investigate the degassing behaviour of basaltic and trachytic magmas and to provide implications for the eruptive dynamics and style of the related volcanic systems. Permeability measurements and lattice Boltzmann simulations of fluid flow have been also used as tools to constrain magma degassing; 2) to find a relationship between results from geophysical measurements and the distribution of gas vesicles in basaltic scoria; 3) to define the rheological properties of magmas of mafic to felsic composition and use the results in the modelling of magma ascent dynamics during Strombolian, fire-fountain and effusive activity as well as during large Plinian eruptions. The results of these works have strongly pointed out that parameters as vesicularity, vesicle number density, vesicle interconnectivity, permeability, crystallinity, crystal shape etc. need to be included in numerical and theoretical models in order to be able to reproduce accurate conduit flow conditions and forecast reliable eruptive scenarios.