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Crustal xenoliths: evidence of volcanic gas fluxing by textural and geochemical analysis

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Volcanic xenoliths generally provide direct information on the lithology of a volcano basement. At Mount Etna xenoliths are quite rare and have sedimentary origin, being mostly quartzarenites. Recently, xenoliths have been ejected together with the scoriae during the short and violent paroxysms associated to the South East Crater (SEC) from 2011 to 2016. Besides the information about the volcano basement, xenoliths are used to investigate the processes occurring during magma ascent, including host-rock assimilation. In this work we have sampled 7 quartzarenitic xenoliths erupted by the recent paroxysms of the SEC. Samples were analyzed through XRF to obtain a whole rock chemical composition and SEM EDS to perform spot chemical analyses along traverses. The study of the porosity has been performed on 3D images by Synchrotron X-ray microtomography. Results indicate that the composition of the interstitial glass between quartz grains is definitively less silica rich (SiO_2 50-57 wt.%), approaching well to the composition of the clays (except for higher Na and K contents), usually found within the Numidian Flysch constituting Mount Etna basement and indicating that the clay levels within the quartzarenitic beds undergo melting. This process could have been driven by both the high temperature that flysch underwent when in contact with magma (ca. 1200°C) and by the flux of magmatic gases, much more efficient in carrying the heat. The large number of vesicles within the glass can only be caused by the expansion of a gas phase constituted by volcanic gasses fluxing the magma and therefore fluxing the xenoliths embedded in it. Such hypothesis is supported by the composition of the glass phase, which is similar to the average composition of the clay of Numidian Flisch except for the anomalous enrichment in Na and K. These two elements are scarcer in the clay compositions, but their amount in the xenoliths grows in accordance with the total volume of vesicles. The largely vesicled xenoliths are therefore the evidence that the gas flux within the plumbing system is extremely high thus posing the problem of the nature of the relationship of this gas with the magma.