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Textural and compositional features of ash erupted between 18 and 22 May 2010 from Eyjafjallajökull

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The April-May 2010 Eyjafjallajökull eruption (Iceland) was characterized by prolonged explosive phases of different styles (magmatic to phreatomagmatic), which produced km-high eruption columns above the ice-capped volcano. For several days, a great amount of ash was almost continuously injected into the atmosphere and widely dispersed from tens to thousands of kilometers away from the volcano, causing severe damage and inconveniences in Iceland and, remarkably, important air traffic disruption all over the world. We report the last days of the 2010 Eyjafjallajökull eruption by direct sampling of ash-sized products around the volcano. We collected 15 ash samples from the ongoing volcanic activity and simultaneously measured PM10 concentrations at the ground using a TSI DUSTTRAKTM aerosol monitor just below the eruption cloud.
Grain-size, density, componentry, morphological and compositional analyses were performed on ash samples after oven-drying at 105 °C. Grain-size analysis was carried out at 1 phi interval by hand-sieving. Material smaller than 0.063 mm has been further analyzed by Beckmann Coulter LS230 laser analyzer. Density of the solid fraction of the ash particles was measured through Helium Pycnometer (AccuPyc II 1340) on total sample and each 1 phi grain-size classes. Componentry analysis was performed over the selected grain-sized class of 0.125-0.250 mm on 8 representative samples by counting 500 particles for each sample under the stereo-microscope; components were detected based on the morphological features of the ash particles. High magnification morphological observations were made under Field Emission-Scanning Electron Microscopy (FE-SEM). FE-SEM was also used to carry out semi-quantitative chemical compositional and mineralogical analyses of ash particles selected among different components forming the fallout deposit.
Results of laboratory analysis show that collected samples span from fine lapilli to very fine ash between the summit of the volcano and a few km from the eruptive vents. Nonetheless, aggregation of ash particles was clearly perceived in the field and revealed by the analyzed samples, composed of a high percentage of particles stuck together in the range 0.063-0.125 mm, probably unable to easily separate from each other by mechanic sieving but detectable under laser analysis. Simultaneous measurements of PM10 during the ash fallout also confirmed the high percentage of <0.001 mm-sized particles. Ash componentry reveals that vesicular particles constitute more than 70 % of the deposit, with a decrease in abundance with time with respect to denser particles. Compositional data indicate a marked evolution and spreading of the magma composition during the last days of the eruption. All these data provided useful information on physical and chemical aspects of the erupted ash, which may be crucial for the assessment of magmatic processes and eruption dynamics occurring during the Eyjafjallajökull eruption.