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Characterization of volcanic ash emissions: A study of ultrafine particle

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Ultrafine particles (UFPs) are those particles that measure less than 100 nm and are characterized by particular physico-chemical properties. UFPs are present in nature and emitted from different sources, such as forest fire, dust storm, sea salt, and volcanic emissions. Active volcanoes constantly emit toxic gases and particles with different sizes, including UFPs. UFPs are considered a risk to human health, as well as affecting environment and air quality even at great distances from the source. In this study, we report a particle size distribution and characterization of volcanic ash from Popocatépetl volcano, Mexico. The Popocatepetl volcano is one of the most active volcanoes in Latin America and the world, with constant exhalations and medium intensity eruptions. The size distribution, morphology, and a semi-quantitative elemental analysis of volcanic ash particles were obtained using Scanning Electron Microscope - Energy Dispersive X-ray Spectroscopy (SEM-EDS) and a High Resolution - Transmission Electron Microscope (HR-TEM). SEM analyzes show that approximately 63% of the identified particles are PM_1 (i.e. <1 μm, submicrometric), followed by $PM_{2.5}$ (17%), PM_5 (14%), PM_{10} (4%), and PM_{20} (1%). Elements from volcanic emissions such as Al, Fe, Ca, K, Mg, As, S, Ti, etc. were observed in submicrometric and UFPs. Several mineralogical phases were recognized, like andesine, cristobalite, augite, diopside, and magnetite. In addition, we investigated for the first time the behavior of volcanic ash UFPs particle in contact with synthetic lung fluid (SLF), Gamble solution (GS) and Artificial Lysosomal Fluid (ALF) using Dynamic Light Scattering (DLS) techniques. GS represent an external lung conditions with a neutral pH (~7), on the other hand, ALF simulate deep lung conditions, i.e., alveolar macrophage region, with a slightly acidic pH (~4.5). Large variability in the hydrodynamic diameter of volcanic ash particles were detected. The behavior of volcanic ash in contact with different *in vitro* lung fluids is opposite, finding aggregation and disaggregation processes in GS and ALF solutions, respectively. The foregoing analysis reflects the importance of carrying out more studies relating the influence and behavior of ash UFPs in lung fluids.