Investigating the chemical composition and morphology of natural mineral dust samples

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Mineral dust is an important component of tropospheric aerosols representing the largest mass emission rate of particles at a global scale (Andreae and Rosenfeld, 2008). Although the primary sources are arid regions, because of global air circulation, mineral particles undergo long-range transportation to remote areas. Dust particles have a direct effect on the radiation budget of the atmosphere, thus they impact Earth climate. Besides, they also act as efficient platforms for the scavenging or conversion of gases.

For these reasons, the heterogeneous processes of mineral dusts with atmospheric trace gases have generated a great deal of interest. Particularly, the literature studies report the kinetics and products of dust interaction/reaction with gas pollutants under various environmental conditions. In many cases, the authors attempt to interpret or compare their results with others reported on different samples, without considering the physicochemical properties of each dust. Even for Arizona Test Dust (ATD), used as a "reference" material in many studies due to its commercial availability and not its standard properties, limited information comes from the supplier. Therefore, it is necessary to initially investigate the chemical composition and morphology of particles in order to better comprehend the observed kinetics and mechanisms of degradation of pollutants.

Mineral dust samples that originate from different arid regions, in particular natural ones collected from Saharan, Gobi and Saudi Arabia deserts, and two samples of commercially available ATD, were characterized using the less-than-100-µm sieved fraction (corresponding to the one that can be suspended in air). N_2 sorption measurements and granulometric analysis were performed to determine the specific surface area and the particle size distributions, respectively. The chemical properties of dusts were examined employing both X-Ray Fluorescence (XRF) and Diffraction (XRD). The complementary use of the X-ray techniques allowed the determination of the chemical composition of the bulk samples. Besides XRF and XRD, dust could also be characterized by means of Raman spectroscopy for surface analysis and/or employing a Diffuse Reflectance UV-Vis Spectrometer for UV absorption properties.

Figure 1 presents results obtained with a first group of samples collected from six different regions along the Sahara desert, extending from Tunisia to the western Atlantic coastal areas of Morocco. It was observed that the relative abundance of Si decreases moving from the East part of Sahara to the West (Romanias *et al*, 2016). The SiO_2 fraction in the samples from mid-eastern Sahara desert is around 82%. On the contrary samples collected on the western coastal areas of Morocco contain only ~50% of SiO_2. This observation is of significant importance since up to now it has been considered that the relative abundance of SiO_2 is around 50% (Hanisch and Crowley, 2003).

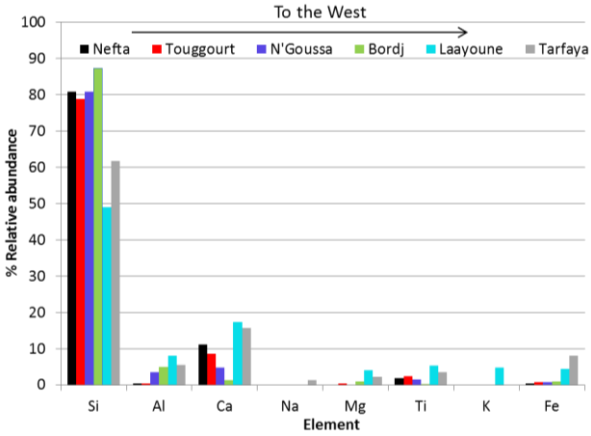

Figure 1. Elemental bulk composition (%) of Saharan mineral dust measured with XRF and XRD.

The complete characterization of the samples will provide further information that could be later used to interpret the observed reactivity on these samples. Furthermore, their large diversity will allow us to highlight and assess the differences on the properties of the natural samples and to examine whether ATD could be considered as a "reference dust".

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