Mineralogical and structural properties of Saharan dust single particles

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Global mineral dust affects Earth climate and ecosystem via physical interaction with electromagnetic radiation, chemical reaction with acidic gases, becoming ice condensation nuclei, and delivering micronutrients to remote ocean. In order to understand physicochemical interaction of dust with environments, enormous works have been done to characterize physical and chemical properties of bulk dust and single dust particles. Of these dust properties, internal properties of single dust particles are much uncertain. Combination of focused ion beam technique and transmission electron microscopy is best to probe thees properties. Saharan desert emits a large volume of mineral dust transported across Atlantic Ocean and Mediterranean Sea. Although the physical, chemical, and mineralogical properties were investigated for Saharan dust, the mineralogical makeup and internal structures of single dust particles were not explored in detail. TEM analysis of cross sections of Saharan dust particles were performed in this study. Clayey particles were most common, and dominated by illite-smectite series clay minerals which were aggregates of nanothin illite, smectite, and their mixed layers, commonly associated with kaolinite. Submicron grains of iron oxides were commonly dispersed through the clay-rich particles. Iron oxides based on electron diffraction and lattice fringes were goethite and hematite. Grain size ranged from a few hundred to several tenth nanometer. Titanium oxide grains were also dispersed through clay matrix usually together with iron oxides grains. Coarse mineral grains several μm in size were usually coated with the aggregates of nano-sized grains of clay and other minerals. Intergrade dust particles composed of roughly equal quantities of clays and coarser mineral grains are present between clay particles and coarse minerals with thin clay coatings. Intergrade dust particles were composed of clays and large inclusions of quartz, K-feldspar, plagioclase, and calcite. The mineralogical and structural properties of the Saharan-dust single particles would be helpful to model dust optical properties and micronutrient carrier to remote ocean.