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The nature and formation of aeolian mineral dust material

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Aeolian dust affects climate and records past climates. It has become a much studied material but there has been a certain lack of emphasis on the actual nature of the dust, and an even greater neglect of actual production mechanisms for dust particles. Huge amounts of dust may be raised from the Bodele depression and other parts of North Africa, and much of it may be carried across the North Atlantic to aid in soil formation in Brazil. But what does it consist of? We know that much of the Bodele dust is diatoms from old Lake Chad, but what of the lithological inorganic mineral content?

A very crude division of aeolian dust into large dust(say around 20-50um) and small dust (2-5um)has been proposed. Much of the study of loess has been confused by the failure to make this distinction, and similar problems may arise in the study of the finer fractions of aeolian dust. Much aeolian material is clay-mineral based- formed from clay mineral aggregates(CMA), from lake bottom sediments. This can form large dust particles, as in parna in Australia, but also contributes largely to small long travel aerosolic dust.

Another major contributor is the quartz fragment. The large dust for classic loess deposits is mostly quartz silt- and there is considerable discussion about the controls that affect quartz silt. There are some interesting modalities in the world of quartz particle sedimentology which need to be examined. Quartz sand (say 200-500um) is the key initiating material and the formation processes for quartz sand have a down-the-line effect on the formation of smaller particles. The central observation is the action of two processes- a eutectic-like reaction in the proto-rock granite which defines the essential nature of sand particles, and the high-low displacive crystallographic transformation which introduces tensile stresses into the quartz particle systems. The limited range of eutectic particle size means a limited range of tensile stresses. A neat combination of factors which yields an obvious quartz silt mode.

Small quartz dust is difficult to produce. The high-low stress works again in the surface regions of sand dune particles; a combination of impact stresses and internal stresses yields small dust sized particles. But this stress combination only yields small dust. Large dune areas may produce a considerable amount of small quartz dust- but negligible amounts of large dust. Mineral particles generated by hot deserts and going to make dust clouds can be expected to contain small quartz dust and small CMA dust. Outline mechanisms for the production of these two particle types can now be proposed, and the size controls delineated.
To quote Morales from Saharan Dust 1979; he proposed that we need "comprehensive studies to understand the production of fine particulate material by weathering and disintegration processes as a first and important step in dust production." These are still needed.