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Medical Geology in the Middle East: Potential Health Risks from Mineralized Dust Exposure

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Abstract. In the Middle East, dust and sand storms are a persistent problem delivering significant amounts of mineralized particulates via inhalation into the mouth, nasal pharynx, and lungs. The health risks of this dust inhalation are presently being studied but accurate characterization as to the potential health effects is still lacking. Experiments were designed to study the chemical composition, mineral content, and microbial flora of Kuwaiti and Iraqi dust particles for the potential to cause adverse human health effects both acute and chronic. Multiple site samples were collected and chemical and physical characterization including particle size distribution and inorganic analysis was conducted, followed by analysis and identification of biologic flora to include bacteria, fungi and viruses. Additionally, PM10 exposure data was collected hourly over a 12 day period (>10,000 ug/m3). Data indicates that the mineralized dust is composed of calcium carbonate and magnesium sulfate coating over a precipitated matrix of metallic silicate nanocrystals of various forms containing a variety of trace and heavy metals constituting $\sim$3 % of the particles by weight. This includes $\sim$ 1% by weight bioaccessible aluminum and reactive iron with the remaining 1% a mixture of bioaccessible trace and heavy metals. Microbial analysis reveals a significant biodiversity of bacteria of which $\sim$25 % are known pathogens. Of the microbes identified, several have hemolytic properties and most have significant antibiotic resistance. Viral analysis indicates a tremendous amount of virons with a large percent of RNA viruses. The level of total suspended particle mass at PM10 constitutes an excessive exposure micro-particulates including PM 2.5 ($\sim$1,0000 ug/m3). Reported data on cell culture and animal studies have indicated a high level of toxicity to these dust particles. Taken together, these data suggest that at the level of dust exposure commonly found in the Middle East (i.e. Iraq, Kuwait, and Afghanistan), in addition to the microbial and metal content, mineralized dust constitutes a significant health risk, both acute and chronic, to deployed troops and native inhabitants.