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Field characterizations of oxidizing acids in dust and soils using the Mars Oxidation Instrument

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Results of field experiments performed to further develop and validate the Mars Oxidation Instrument (MOI) and measurement strategies for the in situ characterization of oxidation mechanisms, kinetics, and carbon cycling on Mars will be presented. Using the Chilean Atacama Desert as a test site for the current dry conditions on Mars, we have characterized the chemical reactivity of the surface and near-surface atmosphere in the dry-core of Atacama. MOI is a chemiresistor-based sensor array that measures the reaction rates of chemical films that are sensitive to particular types of oxidants or that emulate prebiotic materials. With these sensors the chemical reactivity of a planetary environment is characterized by monitoring the resistance of the film as a function of time. MOI is included as a component of the Mars Organic Detector which has been selected for inclusion in the ESA ExoMars Pasteur payload. Our instrumental approach correlates reaction rates with dust abundance, UV flux, humidity, and temperature, allowing discrimination between competing hypotheses of oxidant formation and organic decomposition. The sensor responses in the Atacama are consistent with an oxidative attack by strong acids triggered by dust accumulation followed by transient wetting due to an increase in relative humidity during the night. We conclude that in the Atacama Desert and on Mars, extremely low pH resulting from acid accumulation, combined with limited water availability, and high oxidation potential, will result in oxidizing acid reactions on dust and soil surfaces during low-moisture transient wetting events (i.e. thin films of water). These soil acids are expected to play a significant role in the oxidizing nature of the soils, the formation of mineral surface coatings, and the chemical modification of organics in the surface material.