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SIMULATING SULFUR LOSS FROM ASTEROID SURFACES AS A RESULT OF SPACE WEATHERING

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The NEAR Shoemaker spacecraft has found a lower than expected S/Si ratio on the surface of asteroid 433 Eros. Given that other element ratios are approximately chondritic, and that all known chondrite groups have S/Si ratio at least 3-10x higher than the NEAR data, it is unlikely that the low S abundance is a bulk property of Eros. Thus sulfur has apparently been lost from at least the top layer of the regolith. Possible sources for the energy required to either remove sulfur or transport it to deeper levels of the regolith are meteorite impact or solar wind exposure, or both. These phenomena are known to cause physical and chemical changes to lunar surface materials and are thought by some researchers to also occur on asteroids and to be responsible for the changes in asteroid spectra. The process is referred to as "space weathering". The effects of space weathering have been successfully simulated by exposure of regolith simulants to laser irradiation (simulating impacts) and ion beams (for solar wind). These experiments demonstrated the formation of submicroscopic Fe metal due to decomposition of Fe-bearing silicates. However, simulants used to date did not contain sulfide, an important constituent of chondrite meteorites and presumably asteroids. In sulfide-bearing regoliths decomposition of FeS as well as FeO would be expected. Experiments with sulfide-bearing simulants could shed light on the processes responsible for the low S/Si ratio on the surface of Eros. However, simulations of sulfur loss require more than simply performing the same experiments with a different simulant. The conditions of energy deposition have to be carefully adjusted so that they are a realistic proxy for the actual processes on asteroid surfaces. Also, the effects of regolith reworking need to be taken into account, since larger impacts can excavate deeper layers of regolith that were previously shielded from the effects of space

weathering. Thus realistic simulations need to be carried out in three-dimensions in an environmental chamber rather than the bench-top experiments of earlier simulations. Our plans and strategies for performing these measurements in the Anromeda planetary environmental chamber will be described.