Earth-Orbit Crossing Asteroids: Testbeds for mechanisms of space weathering. Y. Liu[1] and Kevin G. Thaisen[1], [1]Planetary Geosciences Institute, Department of Earth and Planetary Sciences, University of Tennessee, Knoxville, TN 37996 (yangl@utk.edu).

Earth-orbit crossing asteroids provide a unique opportunity for addressing several important questions in planetary science, as well as a possible source of future resources [1].

Main Scientific question to be answered:

Classification of asteroids is based on the spectral characteristics of the surface of the asteroids [2,3]. However, many asteroid spectra display space weathering effects, which camouflage the true mineralogy exposed at the surface. Seeing through the space weathering effects has been the goal for spectroscopists. Much of our understanding of space weathering has been obtained through the study of returned lunar samples [4,5]. The nanophase iron in the fine fraction of the lunar soil and in the vapor deposited glass coatings of soil particles contributes to the reddening of the spectral continuum of lunar soils. These nanophase iron particles are generated through solar wind sputtering and micrometeorite bombardment [4,5]. However, the mechanisms and timescales of space weathering on asteroids remain controversial [6,7]. Because of the different orbits of asteroids and their distances from the Sun, solar wind and micrometeorite bombardment are expected to contribute in different proportions to space weathering on the surface. Unfortunately, this can only be verified through returned samples from asteroid bodies.

Recent studies have also suggested that the surface of near-Earth asteroids with an orbit within 16 earth radii is reset by the tidal stress generated during their close encounters with Earth [8-9]. If this is true, these asteroids can contribute to understanding the time-scale of space weathering and why near-Earth asteroids of similar compositions can have different spectra. A sample return mission will provide ground-truth to study the effect of these processes and to determine the mechanisms of resetting.

Other Scientific questions to be answered:

The recent findings of surface absorbed water on the Moon [10-12] suggest that space weathering may also impart chemical changes to the surface of airless bodies. Returned samples will also be able to determine whether this chemical alteration also plays a role on asteroid surfaces.

In addition, abundant water and organic materials have recently been identified on main-belt asteroids; these may have been the source of water and life on Earth [13-14]. The isotopic composition of water can be tested through direct sampling of the Earth-orbit crossing asteroids.

Finally, except for the lunar, HED and SNC's, the majority of meteorites still have unknown parent bodies. Samples returned from these asteroids may help to pair these meteorites with their parent bodies.

Advantages: The orbit of near-Earth asteroids are well calibrated, some of which are tracked for possible impact with Earth. Because of the orbital configuration of Earth-crossing asteroids, there are two sampling opportunities. Surface of Earth-crossing asteroids can be well characterized during their approach to Earth. The near-zero gravity of many Earth-crossing asteroids makes them easy sampling targets.

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