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# THE REGOLITH OF 4 VESTA: PERSPECTIVES FROM HOWARDITE METEORITES AND DAWN MISSION OBSERVATIONS

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4 Vesta is the largest asteroid with a basaltic surface, the only surviving differentiated asteroid recording igneous processes from the earliest phase of solar system history. The Dawn spacecraft is in orbit about Vesta pursuing a campaign of high resolution imaging and visible and infrared spectrometry of the surface; compositional mapping by gamma-ray and neutron spectrometry will follow. Vesta is heavily cratered with a surface covered by impact debris, a regolith. One important goal of the Dawn mission is to develop an understanding of regolith processes that are affecting this surface debris. Regolith characteristics are a record of interaction with the environment (e.g., impactors, dust, solar wind, galactic cosmic-rays) and give evidence of surface processes (down-gravity movement, etc.). Regolith mineralogy and composition reflect the local bedrock, with influences from regional and global mixing. Understanding regolith processes will aid in determining the lithology of underlying crust.

Vesta is most likely the parent asteroid of the howardite, eucrite and diogenite meteorites. Eucrites are intrusive and extrusive mafic rocks composed mostly of ferroan low-Ca clinopyroxene and calcic plagioclase, while diogenites are cumulate magnesian orthopyroxenites. Magmatism occurred within a few million years of the formation of the solar system and then ceased. Impacts into the igneous crust produced the howardites - polymict breccias composed of mineral and lithic debris derived mostly from eucrites and diogenites. Some howardites are true regolith breccias formed by lithification of extensively impact-gardened surface debris. However, howardites have a number of significant petrologic and compositional differences from mature lunar regolith breccias and soils reflecting the different environment around Vesta compared to that at 1 AU. The most significant differences are the higher impactor flux with a lower mean impact velocity and the lower gravity. As a result, regolith processes on Vesta differ in detail from those on the Moon.

Laboratory study of howardites and orbital investigation of Vesta will allow for development of robust models of regolith formation on hand sample to multi-kilometer scales.

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