GEOCHEMISTRY OF VESTA. T.H. Prettyman,[1] A. Beck,[2] W.C. Feldman,[1] O. Forni,[3] S.P. Joy,[4] D.J. Lawrence,[5] T.J. McCoy,[2] L.A. McFadden,[6] H.Y. McSween,[7] D.W. Mittlefehldt,[8] H. Mizzon,[3] P.N. Peplowski,[5] C.A. Polanskey,[9] M.D. Rayman,[9] C.A. Raymond,[9] R.C. Reedy,[1] C.T. Russell,[4] T.N. Titus,[10] M.J. Toplis,[3] N. Yamashita,[1] [1]Planetary Science Institute (1700 East Fort Lowell, Suite 106, Tucson, AZ 85719-2395, prettyman@psi.edu), [2]Smithsonian Institution, [3]University of Toulouse, [4]University of California, Los Angeles, [5]Johns Hopkins University Applied Physics Laboratory, [6]NASA Goddard Space Flight Center, [7]University of Tennessee, [8]NASA Johnson Space Center, [9]JPL, Caltech, Pasadena, CA, [10]USGS Astrogeology Science Center.

Introduction: By the end of March 2012, the Dawn spacecraft will have completed low altitude mapping of 4 Vesta (264-km mean radius). Dawn's roughly circular, polar, low altitude mapping orbit (LAMO) has a mean radius of 470 km, placing the spacecraft within about 210 km of Vesta's surface. At these altitudes, Dawn's Gamma Ray and Neutron Detector (GRaND) is sensitive to Vesta's elemental composition. The duration of LAMO (16 weeks) was sufficient to map the elemental composition of the entire surface of Vesta. We present our initial analyses of geochemical data acquired by GRaND.

Chemical data. The design of the GRaND instrument, science objectives and prospective results are presented in [1]. At low altitudes, GRaND is sensitive to gamma rays and neutrons produced by cosmogenic nuclear reactions and radioactive decay occurring within the top few decimeters of the surface and on a spatial scale of a few hundred kilometers. From these nuclear emissions, the abundance of major- and minor-elements, such as Fe, Mg, Si, K, and Th can be determined, provided they are present in quantities detectable by GRaND in LAMO. Measurements of atomic mass and neutron absorption by neutron spectroscopy yield additional constraints on elemental composition. Neutron spectroscopy also provides constraints on the abundance and layering of H.

Geochemistry. Vesta's crust is thought to be represented by the howardite, eucrite, and diogenite (HED) meteorites [2]. If so, then GRaND will be able to determine the proportions of diogenite and eucrite below the optical surface. GRaND can also distinguish sublithologies of these end members, including cumulate eucrites and harzburgitic diogenites [1,3,4]. The latter may be found in mantle outcrops or igneous intrusions in major impact basins. GRaND will also search for evolved lithologies (e.g., K-rich regions [5]) and the mesosiderite source region. GRaND will globally map the abundance of H, providing constraints on the delivery of H by solar wind and the infall of carbonaceous chondrite materials.

The chemical data acquired by GRaND will be analyzed within the broader context of the Dawn mission, and will be compared to and integrated with maps of mafic mineral abundances, geologic provinces, gravity, shape and topography. The compositional data acquired by Dawn will provide a more complete picture of Vesta's thermal history and evolution, supplementing geochemical data from HED meteorite studies. GRaND's elemental specificity and depth sensitivity provides a unique view of a compositionally-diverse protoplanet, complementing data acquired by Dawn's Visible-Infrared (VIR) spectrometer and framing camera (FC).

Preliminary observations: GRaND has had sufficient accumulation time and spatial coverage at high altitude and in LAMO to map strong thermal and epithermal neutron emissions, with full global coverage, and to investigate how counting rates for Fe (7.6 MeV) and fast neutrons vary with latitude. Corrections for cosmic ray production and solid angle have been applied, revealing significant compositional variations over the surface of Vesta; however, the global variation in mapped counting rates is much lower than that measured by Lunar Prospector at the Moon, consistent with the geologic evolution of Vesta inferred from the HED meteorites.

Some of the variability in the neutron signal, however, may be due to H. The output of Vesta in the epithermal energy range is significantly higher than measured by GRaND at Mars. This result supports Vesta having a much lower abundance of hydrogen than Mars. Our analysis of H will be presented along with implications for the delivery of H to Vesta's surface.

The detection of the Fe 7.6 MeV gamma ray at low altitudes was accompanied by increases in other gamma-ray energy ranges, which have contributions from O, Si, and Mg. Th and K have not yet been detected on a global scale, consistent with very low concentrations of these elements in the HED meteorites. Preliminary results for Mg and Si will be presented. Detection limits will be determined for elements that cannot be analyzed.

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