Origin of Dark Material on Vesta from Dawn FC data: Remnant Carbonaceous Chondrite Impators.

V. Reddy[1,2], L. Le Corre[2], A. Nathues[2], D. W. Mittlefehldt, E. A. Cloutis, D. P. O'Brien, D. D. Durda, W. F. Bottke, D. Buczkowski, J. E. C. Scully, E. M. Palmer, H. Sierks, P. J. Mann, K. J. Becker, A. W. Beck, J-Y. Li, R. Gaskell, C. T. Russell, M. J. Gaffey, H. Y. McSween, T. B. McCord, J.-P. Combe, D. Blewett, [1]Univ. of North Dakota. E-mail: reddy@space.edu. [2]Max Planck Institute for Solar System Research.

Introduction: NASA's Dawn spacecraft entered orbit around asteroid (4) Vesta in July 2011 for a yearlong mapping orbit. The surface of Vesta as imaged by the Dawn Framing Camera (FC) revealed a surface that is unlike any asteroid we have visited so far with a spacecraft. Albedo and color variations on Vesta are the most diverse in the asteroid belt with a majority of these linked to distinct compositional units on the asteroid's surface [1]. FC discovered dark material on Vesta (Reddy et al. 2012a). These low albedo surface features were first observed during Rotational Characterization 3 phase at a resolution of ~487 m/pixel. Here we explore the composition and possible meteoritical analogs for the dark material on Vesta.

Description: Several topographic features have been identified that are associated with dark material. Dark material can be broadly classified into 3 groups: associated with impact craters either in the ejecta material and/or on the crater wall and rims; as dark spots; and as flow-like deposits often associated with topographic highs. The albedo trend between various vestan surface color units appears to form a continuum, with the dark material having the lowest values (0.09-0.15) in 0.75-μm filter. Apart from albedo, the intensity of the 0.9-μm pyroxene absorption feature is also affected by the presence of dark material. The average color spectrum of dark material shows a lower band depth (23%) compared to Vesta's global average (46%).

Compositional Link: Exogenous sources (carbonaceous chondrite impactor) could explain the dark material seen on Vesta. The presence of exogenous carbonaceous chondrite meteorite clasts in howardite, eucrite, and diogenite (HED) meteorites from Vesta is well documented [e.g., 2]. In order to test the possibility of carbonaceous chondrite impactors being the source of dark material, we studied color properties of eucrite (Millbillille) and CM2 carbonaceous chondrite (Murchison) mixtures [3] and Antarctic howardite PRA04401 [4]. Comparison of dark material and eucrite + CM2 intimate mixture color spectra suggests a good match. Band depth vs. albedo trend of dark material is consistent with eucrite and carbonaceous chondrite mixtures. We estimate abundance of carbonaceous chondrite material for the average surface of Vesta to be between 1-6 vol%, consistent with HED meteorites [1,4]. Abundances as high as ~50 vol% are noted in areas rich in dark material, and are inline with the 10-60 vol.% CM material observed in howardites PRA 04401, PRA 04402 and SCO 06040 [4].

References: [1] Reddy et al. 2012. *Science* 336 no. 6082 pp. 700-704. [2] Zolensky et al. 1996. *Meteoritics & Planetary Science* 31:518-537. [3] Le Corre et al. 2011. *Icarus* 216:376-386 [4] Herrin et al. 2011. 42nd Lunar and Planetary Science Conference. Abs. 2806.