INVESTIGATING THE COMPOSITIONAL DIVERSITY OF DIFFERENTIATED PLANETESIMALS: A SPECTROSCOPIC STUDY OF NON-VESTA BASALTIC ASTEROIDS.

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Introduction: Compositional and isotopic analyses [1,2] suggest that at least 50 distinct differentiated parent bodies are represented in meteorite collections. Finding an equal number of differentiated parent bodies amongst Main Belt asteroids (the ultimate source of all meteorites) has proven challenging. The asteroid 4 Vesta and its collisional family of Vestoids are associated with basaltic crustal compositions [3,4] and serve as some of the best known examples of differentiated asteroids. Only recently have basaltic asteroids unrelated to Vesta been found [e.g. 5-9]. Dynamical models have been the predominant method for discriminating whether a basaltic asteroid is related to Vesta [10,11]. In general, basaltic asteroids with semi-major axes beyond 2.5 AU are dynamically unlikely to be related to Vesta and thus must represent relic crustal material from other differentiated parent bodies (Fig. 1). We will present a comprehensive compositional analysis of a sample of middle (2.5-2.8 AU) and outer (2.8-3.25 AU) Main Belt basaltic asteroids in order to better understand the origin of these objects and to place constraints on the diversity of compositions associated with the differentiation of planetesimals.

Observations: Near-infrared (0.9-2.5 μm) reflectance spectra were obtained using the instruments FIRE at the Magellan Baade 6.5m telescope and SpeX at NASA's Infrared Telescope Facility (Fig. 2). Targets were selected based on visible wavelength broadband photometry following [7].

Analysis: Compositional analysis is performed using band analysis techinques [12,13] and Hapke modeling [14]. For comparison purposes we apply these techniques to spectra of basaltic meteorites with well known compositions, with the ultimate goal of a better understanding the geochemical provenance of these unusual asteroids.

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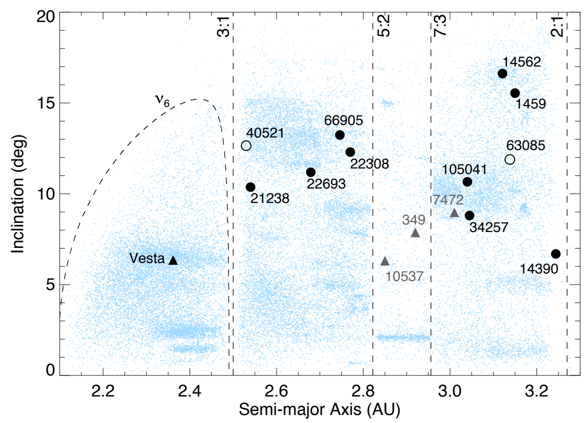

Figure 1: Proper orbital element distribution of outer Main Belt basaltic asteroids (filled circles). The orbital separation of these objects from Vesta by prominent mean motion resonances (dashed lines) indicates that they are fragments of basaltic crust originally from non-Vestan differentiated parent bodies. The underlying blue dots represent all Main Belt asteroids. The grey triangles are objects thought to be broadly related to basaltic compositions. The open circles represent candidate basaltic asteroids; near-IR spectra are not yet available to make this compositional assignment.

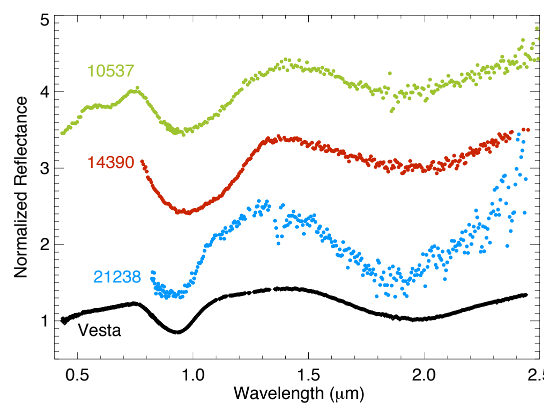

Figure 2: Representative sample of reflectance spectra of basaltic asteroids. Though all of these objects can broadly be classified as igneous, the shapes of their respective absorption bands vary considerably. Compositional analyses will reveal the mineralogical causes of this spectral diversity.