DIFFERENTIATION OF MARS INVESTIGATED USING HIGH FIELD STRENGTH (HFS) AND PLATINUM GROUP ELEMENTS (PGEs). C. R. Neal (neal.1@nd.edu), James C. Ely, Jinesh C. Jain, Amy Sedlar, Dept. Civil Eng. & Geological Sciences, University of Notre Dame, Notre Dame, Indiana 46556.

Introduction: The geologic history of Mars is investigated through the detailed analyses of three Martian meteorites: EETA79001 (lithology B) - a ~0.18 Ga basalt [1-3]; Nahkla - a ~ 1.3 Ga clinopyroxenite [4-6]; ALH84001 – an ~4 Ga orthopyroxenite [7-9]. A full suite of trace element data was produced using ICP-MS and this included the platinum group elements (PGEs: Ru, Rh, Pd, Ir and Pt) following the method of Ely et al. [10]. Full and detailed analyses of these precious samples have not been carried out until now. Using the new data, reservoirs are defined using PGE and high field strength elements (HFSEs).

Discussion: The new data compare very well with that previously reported for ppm level trace elements (e.g., Fig. 1 and [11]). The results suggest that some of the HFSE ratios are around those of chondrites for the older two meteorites studied (ALH84001 and Nahkla), but depart from chondritic values for the youngest meteorite (EETA79001 lithology B) (Fig. 2).

Ratios of Zr/Hf, Nb/Ta, Hf/Th, Hf/Ta and Zr/Y follow this trend. These ratios should not be affected by crystal fractionation so even though these three samples represent two pyroxenites and a basalt. Therefore, the HFSE ratios should be indicative of source region. The ratio Zr/Nb is different than chondritic for all samples, mirroring the terrestrial N-MORB (ETA79001B), E-MORB (ALH84001), and OIB (Nahkla). This suggests Mars was differentiated early on this basis, whereas other HFSE ratios suggest no major differentiation until after 1.3 Ga.

The PGE ratios (Fig. 2) indicate that differentiation was active early in the history of mars, but in comparison with the HFSE ratios, this was primarily the formation of a metallic core. The ratios of Pd/Pt and Pd/Ir are chosen because of the relative compatibility of Pt and...
Ir in minerals such as olivine and chromite (and possibly pyroxene) relative to Pd [12]. However, the magnitude of these differences is greater than can be generated by silicate differentiation [12].

The PGE profiles (Fig. 3) demonstrate that ALH84001 is depleted in PGE, consistent with [13].

The profiles for EETA79001B and Nahkla are sub-parallel. The profiles flatten out at Rh, Pd and Pt and these elements are elevated above Ir and Ru. The profile for ALH84001 is flatter, with Ir, Ru and Pt having similar chondrite normalized values, with Rh and Pd being elevated (Fig. 3). The PGEs are arranged in order of decreasing melting point. There is a general increase in PGE abundance with decreasing age. These data generally supports the hypothesis of Warren et al. [13] whereby ALH84001 was formed before any late accretion (veneer) of siderophile element rich meteorites, but after the segregation of a metal-rich core.

The initial interpretation of the data presented here is that Mars underwent an early metal-rich core formation, but substantial silicate differentiation did not occur until much later.