CHEMICAL CLASSIFICATION OF ASTEROIDAL MATERIAL: IMPLICATIONS FROM CHONDRITE CHEMICAL DIVERSITY.

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Introduction: In summer 2005, the Hayabusa (MUSES-C) robotic explorer is due to arrive at asteroid 25143 Itokawa (1998 SF36) for extended observations and samples are due to be returned in summer 2007 [1]. These invaluable samples will be used to establish a concrete physical connection between the ordinary chondrites, their generally accepted S-class asteroid source [3] and the evolutionary processes affecting both. Individual Hayabusa researchers will likely have access to only small amounts (<< 100 mg) of material sampled from the outermost surface of 600m 300m Itokawa rather than more representative (interior) material [1]. To investigate the effect of (surface) sampling and chondrite heterogeneity on the classification of and conclusions drawn from returned asteroidal material, we have compared several suites of H chondrites and H chondrite-derived material.

Methods: We used compiled H chondrite data from [4]. This includes 470 H chondrite chemical analyses including Mg (for normalization). We divided these into collections of likely surface material (solar gas rich, regolith breccias, chondrites with surface-process derived light/dark structures, and combinations of the above) and less processed "normal" material. Data used for statistical comparisons of differently processed H material was in some cases limited to that produced by [5] to eliminate possible analytical bias.

Results and Discussion:

Comparisons using common classification metrics. Major element comparison of our H chondrite suites show that the surface suite is slightly (>3%) enriched in Mg, Ca, Cr, Co, Ni and slightly (>2%) depleted in K and Mn. Other major elements are nearly identical. These differences are likely the result of brecciation processes. When comparing the same suites using common elemental classification ratios, (e.g. Mg/Si vs. Fe/Si) occasional separate compositional domains emerge, but overlap is either complete or total: as might be guessed, chemical classification should be possible using ratio-type classification metrics.

Statistical comparisons. We initially compare the major element composition of equilibrated and unequilibrated H chondrites to examine the univariate statistical significance of H chondrite chemical ranges. In this case, significant (>95% CL) differences emerge in C, Cr_2O_3, H_2O+/-, Fe_{metal}, Fe_{total}, Ni. Similar significant differences (CaO replaces Cr_2O_3) exist with comparisons of Si normalized major elements. These differences seem likely due to metamorphic redox conditions and Fe_{total} content.

Our work is beginning to establish the diversity of material recognized as H chondrites. Additional methodical comparisons of H chondrites and other chemical groups will clarify sampling issues associated with asteroid sample return.

References: [1] Fujuwara A. et al. 2004 Abstract #1521, 35th Lunar and Planetary Science Conference. [3] Gaffey M. J. et al. 1993 *Meteoritics* 28: 161-187. [4] Koblitz J. 2003 METBASE ver. 6.0 CDROM. [5] Jarosewich E. 1990 *Meteoritics* 25: 323-337.