SIDEROPHILE ELEMENTS IN PRISTINE AND ALTERED CLASTS IN NWA 7533.

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Introduction: Based on siderophile element abundances, the igneous-textured noritic clasts examined in Martian breccia NWA 7533 were impact melts [1]. This raises the question if any components in this meteorite were derived from pristine igneous rocks excavated by impacts. NWA 7533 contains mm-sized crystal clasts of plagioclase or pyroxene, many of which exhibit exsolution lamellae indicating a plutonic origin. There are also mm-sized lithic clasts with an unknown relationship to crystal clasts. Hewins et al. [2] reported Ni in pyroxenes from NWA 7533 by EMP and found that most pyroxenes in crystal clasts had Ni contents <20 ppm, implying derivation from pristine crustal rocks. They reported higher Ni contents (100-800 ppm) in pyroxenes from lithic clasts implying an impact melt origin. If this is correct, then crystal clasts are not merely fragments of lithic clasts but represent distinct crustal lithologies. To better understand the origin of mm-size clasts in NWA 7533 and assess the abundance of pristine (non-impact melt) materials in this breccia we studied a set of 3 lithic clasts and 4 crystal clasts in section SP7. We determined 73 elements by laser ablation ICP-MS (LA-ICP-MS) following the methodology of [1]. We also include data obtained on individual minerals in shergottites [3].

Results: We used Ni or Ir vs. Mg [1] and Ge vs. SiO_2 as discrimination plots. The Ni contents of plagioclase grains from 2 lithic clasts (#5-6) and from an antiperthite (#7) were found to be <10 ppm, consistent with a pristine origin. The abundance of Ge in these feldspars is comparable to that of shergottite plagioclases, while the bulk breccia has twice the Ge content compared with shergottites [1]. Two pyroxene crystal clasts (#1, and an $En_{73}Wo_3$ orthopyroxene) are pristine in terms of Ni, Ge and Ir abundances. A zoned pigeonite (#2) from a lithic clast plotted along the Ni-Mg and Ir-Mg relations defined by SNC meteorites [1], but had higher (1.5x) Ge than shergottite pyroxenes and Ni-pyrite, and is potentially of impact origin. An inverted pigeonite ($En_{64-42}Wo_3$) with lamellar augite bands exhibited the highest Ni>400 ppm, and Ge (4 ppm), but no Ir (<1 ppb). This clast had abundant healed fractures, high S, and correlated Ni and S contents. Original igneous zoning was preserved in Li, Sc, Ti, V, REE, etc. Fe-oxide grains laced the rim of the pyroxene. Iron loss to healed fractures indicated that this grain must have been weathered or hydrothermally altered forming secondary Ni-pyrite [4] and Fe-oxides within it.

Discussion: Siderophile element abundances of mm-sized crystal (n=3) and lithic (n=3) clasts indicate that those studied had compositions consistent with an origin from either ALH 84001-like orthopyroxenite or from shergottite-like sources, with one possibly from an impact melt. A patchily zoned pyroxene clast with high Ni and Ge was likely altered on Mars. Future studies of altered pyroxenes could help elucidate conditions of chemical weathering on Mars.

References:

[1] Humayun M. et al. 2013. *Nature* 503:513–517. [2] Hewins R. H. et al. 2014. *LPSC XLV*: abstr#1416. [3] Yang S. et al. 2015. *MaPS* 50:691-714. [4] Lorand J.-P. et al. (*MaPS* submitted).