AN UNUSUAL MAGNESIAN TROCTOLITIC GABBRO IN LUNAR METEORITE MAC 88105: AN EXAMPLE OF NEW ROCK TYPES FOUND IN LUNAR METEORITES.

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Introduction: MacAlpine Hills (MAC) 88105 is a feldspathic lunar regolith breccia meteorite. The stone contains a range of ferroan anorthositic igneous and granulitic lithologies, feldspathic low-ITE impact melts and melt breccias and rare very low-Ti and low-Ti basaltic fragments. Here we report an enigmatic magnesian troctolitic gabbro found in section MAC 88105,159.

Clast petrography and mineral chemistry: The crystalline fragment is small (300 × 400 μm) and divided by an 80 μm fracture propagating through the surrounding meteorite matrix. It includes ~29 % forsteritic olivine (Fo_{83-93}), ~42 % plagioclase (An_{67-83}), ~17 % clinopyroxene (En_{45-62} Fs_{8-12} Wo_{26-45}), ~11 % K-rich glass mesostasis and accessory (~0.5 %) Ti-rich phases (ilmenite?). A plagioclase grain analyzed by LA-ICP-MS has a positive Eu-anomaly (Eu/Eu* = 6.5) with trivalent REE at ×2-×24 CI abundances; similar to plagioclases of the lunar Mg-Suite. However, when plagioclase An# (Av. An_{77}) is compared to olivine Mg# (Av. $Fo_{88.5}$), the clast plagioclases are too sodic to be part of the Mg-Suite. Pyroxenes notably have higher Na and Ti concentrations, and olivines higher Ti and Cr concentrations than Mg-Suite troctolites, norites and gabbros. The clast therefore appears to be unique within the lunar sample collection.

A non-lunar origin?: Intriguingly FeO/MnO ratios in both the olivine (40-71) and pyroxene (20-29) phases are lower than typical Apollo mafic minerals and in the rest of MAC 88015,159, and are not consistent with the lunar trends defined by Papike et al. [1]. We therefore considered that the fragment could have a meteoritic origin and we performed in situ oxygen isotope Cameca IMS 1280 ion microprobe analysis at the University of Hawaii. Results of this study suggest that clast minerals (plag. and olivine) have oxygen isotopes that are (i) statistically indistinguishable from the Terrestrial Fractionation Line and surrounding MAC 88105,129 lunar phases; (ii) are statistically (2σ error) different from the HED meteorite trend; (iii) but are just within 2σ error of the Martian oxygen isotope trend.

We discount a terrestrial origin for the fragment as clast olivine Ni contents are lower and Ti and V contents are higher than terrestrial material [2]. We are also doubtful that the clast is of Martian origin as mineral compositions are distinct from those reported in Martian meteorites [1-3].

We acknowledge that the clast could represent a fragment of an unknown differentiated achondritic parent body, although a lunar origin also satisfies most of our observations. The fragment likely represents an unusual KREEP-rich lunar Mg-Suite rock with mineral phases enriched in moderately volatile elements compared with typical Mg-Suite samples.

References: [1] Papike J. J. et al. (2003) *American Mineralogist,* 88:469-472. [2] Karner J. et al. (2003) *American Mineralogist.* 88:806–816 [3] Karner J. et al. (2006) *American Mineralogist.* 91:1574-1582.