GENERAL PETROGRAPHY AND BULK COMPOSITION OF LUNAR METEORITE MAC88105. B. L. Jolliff, Dept. of Earth & Planetary Sciences and the McDonnell Center for the Space Sciences, Washington University, St. Louis, MO, 63130

MAC88105 is a 662g meteorite, collected near the MacAlpine Hills, Antarctica, that appears to be of lunar origin. Based upon our preliminary petrographic examination of thin sections MAC88105,80 and MAC88105,97, this meteorite is an anorthositic, glassy matrix, clast-rich breccia. The general texture resembles Apollo 16 feldspathic glassy matrix breccias, e.g., 60019 [1] and several of the other lunar meteorites, Y791197, ALHA81005, Y82192/3 [2,3,4].

Broad-beam analyses of the glassy matrix and of the most common fine-grained lithic clasts indicates the following feldspathic bulk composition (wt.%): SiO_2: 45.2, TiO_2: 0.32, Al_2O_3: 28.3, Cr_2O_3: 0.11, FeO: 5.11, MnO: 0.08, MgO: 3.92, CaO: 16.6, and Na_2O: 0.35. The average molar Mg/(Mg+Fe) is 0.57, and FeO/MnO is ~60. Bulk analyses of matrix and clast materials by INAA are reported in a companion abstract [5].

Thin section MAC88105,80 contains a 6 mm dark brown, glassy matrix breccia within a generally lighter, glassy matrix, but the lighter matrix contains numerous patches or clasts of the darker matrix material, up to 2 mm in size. This thin section contains spherical to sub-rounded lithic clasts, and rare glass clasts, indicating that it is a regolith breccia (cf ALHA81005, Y791197, 82192/3 [3,4]). There are also glassy veinlets that transect portions of the breccia. Areas of dark and light glassy matrix have very similar major element compositions (Fig. 1). Clasts of feldspathic melt rocks have bulk compositions that are very similar to the glassy matrix (Fig. 1). A mafic melt-rock clast type that appears to be a fairly common lithology in this section has a bulk composition approximately that of the peritectic in the Fo-An-Si pseudoternary system. Based on these preliminary data, bulk major element compositions of clasts and matrix cover a similar range as those of other lunar meteorites (e.g., [6], their Fig. 4). However, the bulk Mg/(Mg+Fe) appears to be lower in this meteorite (0.57) than in any other lunar meteorite (cf. [7], their Fig. 5), but is most similar to Y82192/3.

Monomineralic clasts are dominantly anorthitic plagioclase (Fig.2a) showing a range of shock features from weakly shocked (undulatory extinction) to complete isotropization, and ranging in size from <10 μm to 800 μm. Olivine and pyroxene clasts are rare. Lithic clasts are dominated by subophitic feldspathic melt rocks and mafic melt breccias or dark-matrix, glassy breccias. These thin sections do not appear to contain any lithic clasts of mare basalt. Rare lithic clasts include feldspathic granulite or granulitic breccia, and several igneous lithologies that have ferroan mineral compositions, including noritic and troctolitic anorthosites and anorthositic norite. The troctolitic anorthosite clast (W2 in JSC documentation) is described in detail elsewhere [8]. Two of the igneous clasts are described below.

Gabbroic Norite. This clast is about 300 x 400 μm across and occurs in MAC88105,97. It consists of about 52 vol.% anorthite, 34% low-Ca pyroxene, 8% augite, 5% olivine, and 1% ilmenite. Several augite crystals contain thin exsolution lamellae of orthopyroxene. Pyroxene grains range up to 100 μm in size and olivine, 50 μm. Plagioclase is ~An_{95-96} (Fig. 2a), olivine, Fo_{40}, orthopyroxene, $Wo_3En_{52}Fs_{45}$, and augite, $Wo_{42}En_{38}Fs_{20}$ (Fig.2b). This clast is only moderately shocked, and some of the anorthite is crystalline. Although the minerals are not very coarse grained, the uniformity of mineral compositions and pyroxene exsolution reflect a plutonic origin.

Noritic Anorthosite. This clast occurs in thin section MAC88105,80 and is about 600 x 600 μm. It consists of 69% anorthite, 25% low-Ca pyroxene, 2.5% augite and 3% olivine, plus a trace amount of ilmenite. Anorthite grains range up to 300 μm grain size, hypersthene, 200 μm, and olivine, 100 μm. Preliminary electron microprobe analyses indicate plagioclase of An_{97}, olivine, Fo_{52}, orthopyroxene, $Wo_4En_{57}Fs_{39}$, and augite, $Wo_{40}En_{40}Fs_{20}$ (Fig. 2).

These two clasts are similar to several clasts found in Y791197, ALHA81005, and Y82192 [4,9]. Both clasts plot within the ferroan anorthosite field in Fig. 3. If these small clasts can be taken as representative of the modes of their parent lithologies, then they may stem from a source region relatively rich in mafic silicates. However, these clasts make up only a small percentage of the lithic clasts in MAC88105,80 and do not appear to be a dominant compositional component of the polymict materials. Based on broad-beam analyses and on INAA [5], bulk FeO is less and Al_2O_3 is greater than the other lunar meteorites [10], thus MAC88105 on average is more anorthositic.

This meteorite has the characteristics of a feldspathic, vitric matrix, regolith breccia. Matrix and clasts alike have compositions that may indicate a source region distinct from the other lunar meteorites and Apollo samples, most notably their low molar Mg/(Mg+Fe) coupled with high Ca/Na. However, many more analyses of the clasts are needed for verification.

Acknowledgements. This work was funded by NASA grant NAG-956.

References
[1] Ryder, G. and Norman M.D. (1980) Catalog of Apollo 16 rocks, 34-37. [2] Lindstrom M.M., Lindstrom D.J., Korotev R.L., and Haskin L.A. (1986) Mem. Natl Inst. Polar Res., Spec. Issue, 41, 58-75. [3] Bischoff A., Palme H., Weber H.W., Stöffler D., Braun O., Spettel B., Begemann F., Wänke H., and Ostertag R. (1987) Mem. Natl Inst. Polar Res., Spec. Issue, 46, 21-42. [4] Takeda H., Mori H., and Tagai T. (1987) Mem. Natl Inst. Polar Res., Spec. Issue, 46, 43-55. [5] Korotev R.L. et al. (1990) Lunar meteorites.., this volume. [6] Takeda H., Kojima H., Nishio F., Yanai K., Lindstrom M.M., & YLMCG (1989) Proc. NIPR Symp. Antarct. Meteorites 2, 3-14. [7] Warren P.H. and Kallemeyn G.W. (1987) Mem. Natl Inst. Polar Res., Spec. Issue, 46, 3-20. [8] Jolliff B.L. et al. (1990) Troctolitic anorthosite.., this volume. [9] Goodrich C.A. and Keil K. (1987) Mem. Natl Inst. Polar Res., Spec. Issue, 46, 57-70. [10] Koeberl C., Warren P.H., Lindstrom M.M., Spettel B., and Fukuoka T. (1989) Proc. NIPR Symp. Antarct. Meteorites 2, 15-24.

Figure 1.

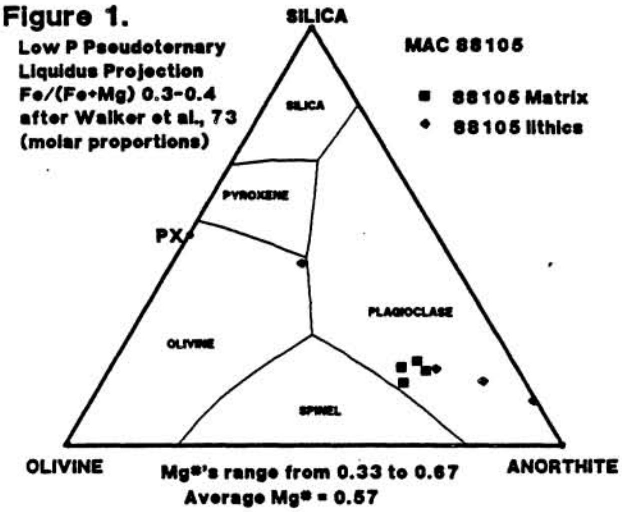

Figure 2. MAC88105,97 & ,80
Mineral Compositions

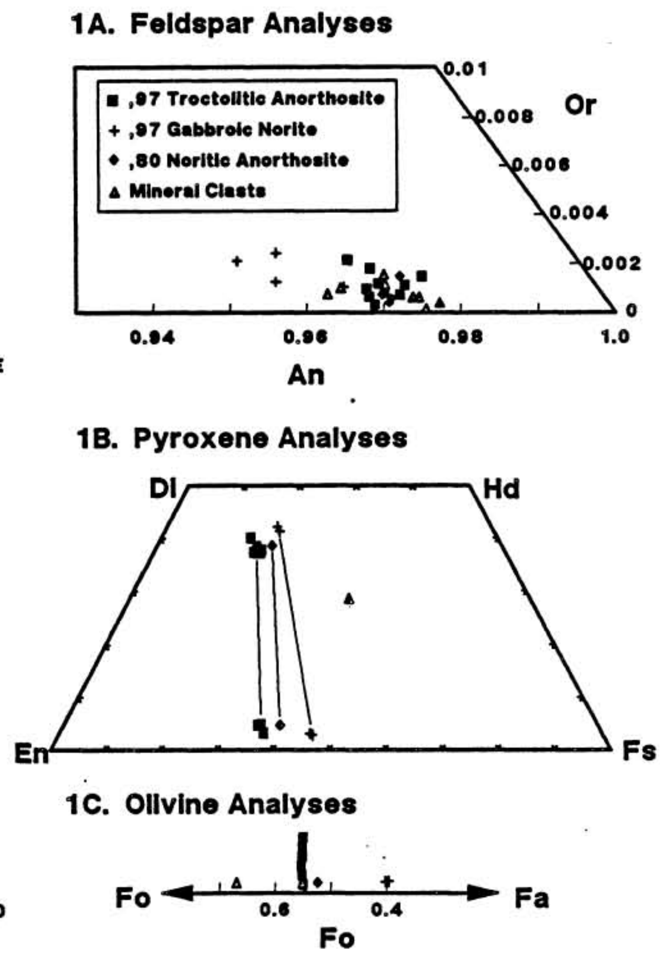

Figure 3.