LUNAR METEORITES NWA 2700, NWA 2727 AND NWA 2977: MARE BASALT/GABBRO BRECCIAS WITH AFFINITIES TO NWA 773. T. E. Bunch[1], J. H. Wittke[1], R. L. Korotev[2] and A. J. Irving[3], [1]Dept. of Geology, Northern Arizona University, Flagstaff, AZ 86011 (tbear1@cableone.net), [2]Dept. of Earth & Planetary Sciences, Washington University, St. Louis, MO 63130, [3]Dept. of Earth & Space Sciences, University of Washington, Seattle, WA 98195.

NWA 2700 and NWA 2977 - Paired With NWA 773: NWA 2700 is a 31.7 gram stone consisting of small gabbro clasts plus regolith breccia matrix (see Figure 1). The olivine gabbro contains ~50 vol.% olivine ($Fa_{29.3-34.7}$; FeO/MnO = 94), pigeonite ($Fs_{22-28.3}Wo_{5.6-10}$; FeO/MnO = 52), augite ($Fs_{13.2}Wo_{38.5}$), plagioclase and minor maskelynite (An_{89}), Ba-rich alkali feldspar ($Or_{92}An_4$, BaO up to 8.9 wt.%), Cr-spinel, ilmenite, phosphate, and troilite. The breccia contains abundant small olivine gabbro clasts and sparse clasts of fine-grained basalt (containing pyroxenes zoned from $Fs_{44}Wo_{29}$ to $Fs_{58}Wo_{23}$ (FeO/MnO = 57), plagioclase (An_{90}), ilmenite and ferropigeonite ($Fs_{80.8}Wo_{14}$). Other components are fayalite (Fa_{91}) + hedenbergite ($Fs_{60.3}Wo_{32.7}$) + silica symplectites, clear to yellow glass spherules, agglutinates, fayalite ($Fa_{95.6}$)+silica, ulvöspinel, K-Si-rich glass (8.8 wt.% K_2O) and a silica polymorph.

Figure 1a, b. NWA 2700 breccia and gabbro; slice (above) is 23 mm across, and cross-polarized thin section image of gabbro (below) is 7 mm wide.

NWA 2977 is another 233 gram stone composed entirely of olivine gabbro identical to that occurring as clasts in NWA 773 [1] and NWA 2700, and thus appears to be paired with those breccia specimens.

Figure 2. Interior of NWA 2977 showing black, glassy shock veinlets. Image © M. Farmer.

This very fresh, crusted specimen (see Figures 2 and 3) is an olivine-rich, two-pyroxene cumulate gabbro composed of olivine (51%, $Fa_{31.7}$, FeO/MnO = 96), pigeonite (23%, $Fs_{26.6}Wo_{6.7}$), augite (9%, $Fs_{16.2}Wo_{29}$), and plagioclase (14%, An_{92}) with minor amounts of Ba-K-feldspar, chromite, ilmenite, and merrillite. Larger pigeonite grains commonly enclose equant olivine grains, which contain abundant melt inclusions (0.025 to 0.125 mm). Plagioclase is partially converted to maskelynite, and pyroxenes and olivine exhibit shock lamellae and undulatory extinction. Trace element analyses are in progress.

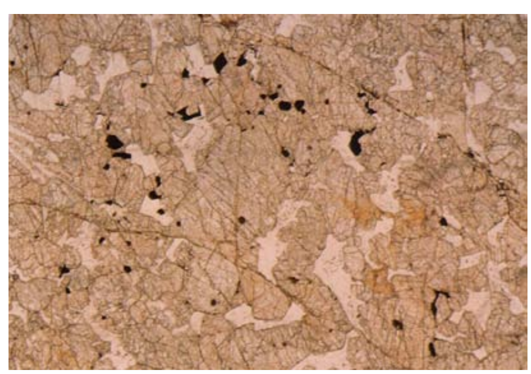

Figure 3. Plane-polarized thin section image of NWA 2977. Width of field = 13 mm.

Mare Basalt/Gabbro Breccia NWA 2727 - Not Paired With NWA 773, But Possibly Related: A total of 191.2 grams of material comprising at least four stones (several partly crusted) was classified as NWA 2727. Further material from the same coarse breccia, which is distinctive because of very large clasts of mare basalt and gabbro (see Figure 4), has been classified as NWA 3160 [2] and other numbers.

Figure 4. NWA 2727 slice with large olivine-phyric basalt clast (right), olivine gabbro clast (upper left) and coarse grained ferrogabbro clast within interstitial breccia matrix. Image © S. Turecki.

NWA 2727 is a clast-dominated polymict breccia composed of >80 vol.% olivine-phyric basalt and gabbroic/diabasic clasts (0.2 cm to several cm across) within a finer breccia matrix. The basalt clasts show a wide range in mineral compositions, but all contain phenocrysts of olivine (Fa_{28-99}, FeO/MnO = 98.9), and some also have phenocrysts of pyroxferroite or chromite, all in a rapidly quenched, fine-grained matrix consisting of intergrown pigeonite, pyroxferroite, K-Ba-feldspar, ilmenite, merrillite, baddeleyite, troilite, silica and glass. Further detailed information on one large basalt clast is given by [2].

The plutonic clasts range in texture from coarser grained (>3mm) hypidiomorphic gabbro to finer grained (~1 mm) diabasic examples. Both consist mainly of pigeonite ($Fs_{23.3-31.3}Wo_{8.7-11.5}$, FeO/MnO = 60-69) and subhedral to anhedral olivine ($Fa_{34.1-41}$; FeO/MnO = 85-99), with less abundant augite ($Fs_{24.1-47.5}Wo_{24.4-32.1}$) and partly maskelynitized, blocky to tabular plagioclase (An_{81-94}). The breccia consists mainly of gabbroic debris with fragments of basalt, silica polymorph, symplectites, subparallel ("striped") intergrowths of anorthite+pyroxferroite+ilmenite and shock-melted material.

Subsamples of NWA 2727 (N=11) vary considerably in bulk composition, with the most Fe-rich subsample nearly indistinguishable from NWA 3160 basalt [2]. All other subsamples are compositionally equivalent to mixtures of NWA 3160 basalt and the regolith breccia lithology of NWA 773 [3], but with slightly lower concentrations of incompatible elements. Samples of a rind on the NWA 3160 basalt clast are compositionally anomalous in being mafic (20% FeO) but highly enriched in incompatible elements (22 µg/g Sm in most extreme subsample), and may represent a residual mesostasis component.

Although there are broad similarities between NWA 2727 and NWA 773, there are enough differences for us to conclude that they are not paired meteorites. Both are relatively fresh and relatively unshocked breccias containing large clasts of mare lithologies in a matrix of the same material. However, very little basalt has been found in NWA 773 or NWA 2700, either as larger clasts or within the breccia matrix, whereas basalt is the dominant component of NWA 2727. The olivine gabbro occurring as clasts in NWA 773 and NWA 2700 (and constituting all of NWA 2977) is texturally and mineralogically different from the olivine gabbro clasts in NWA 2727; for example, the former contains accessory Ba-rich K-feldspar, which we have not found in the latter. More definitive evidence for this distinction may come from U-Pb age determinations on the baddeleyite present in both the basalt and gabbro lithologies of NWA 2727 and pairings, in comparison with the Sm-Nd and Ar-Ar ages of 2.87 - 2.91 Ga obtained for NWA 773 [4, 5].

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References: [1] Fagan T. J. et al. (2003) *MAPS, 38*, 529-554 [2] Zeigler R. A. et al. (2006) *LPS XXXVII*, this volume [3] Jolliff B. L. et al. (2003) *GCA, 67*, 4857–4879; Korotev R. L. (2005) *Chemie Erde, 65*, 297-346 [4] Fernandes V. et al. (2003) *MAPS, 38*, 555-564 [5] Borg L. et al. (2004) *Nature, 432*, 209-211.