NORTHWEST AFRICA 8535: SAMPLING A NEW PORTION OF THE ANGRITE PARENT BODY. A. R. Santos[1], C. B. Agee[1], C. K. Shearer[1], A. S. Bell[1], P. V. Burger[1], F. M. McCubbin[2], [1]Institute of Meteoritics, 1 University of New Mexico, MSC03-2050, Albuquerque, NM 87131, [2]NASA Johnson Space Center, Mail Code XI2, 2101 NASA Parkway, Houston TX 77058, (asantos5@unm.edu).

Introduction: The Angrite Parent Body (APB) remains somewhat mysterious, as no present day Solar System body has been confirmed as the source for the angrites. Possible characteristics of this body, as indicated from study of the angrite meteorites, include early differentiation [1] and relatively oxidized conditions for planetary "basalt" formation [2]. While the angrites have provided information regarding their formation, these insights are somewhat limited in that the majority of angrites seem to show evidence of the same processes (i.e., melting and eruption of a basalt-like melt; slow cooling of such a melt), with Angra dos Reis being the exception as the only clinopyroxenite of the angrite group [2]. The new angrite, Northwest Africa (NWA) 8535, is a dunite from the APB, and thus samples a different process operating on that parent body. Examination of this sample suggests that while it may represent a different magmatic process on the APB, it shares many similarities with other angrites, and thus can provide a unique look into angrite magmatism.

Methods: One thin section and two thick sections of NWA 8535 were examined from the IOM meteorite collection. The thin section was examined with optical microscopy for textural assessment. Electron microprobe analysis was used on all samples for quantitative measurement of mineral compositions. XANES measurements following the procedures of [3] were conducted to determine Cr valence ratios in olivine.

Results: NWA 8535 is a spinel-bearing dunite (96% olivine, 2% Al-rich spinel, 1% Cr-rich spinel, 1% pyroxene, minor amounts of phosphate, metal, and sulfide). Olivine compositions are $Fo_{84}Fa_{16}Lrn_{0.2}$ at their cores with rims of $Fo_{75}Fa_{25}Lrn_{1}$ (Figure 1). Pyroxene is typical of angrites in Ca content, with an average composition of $En_{41}Fs_{14}Wo_{45}$. Variations in pyroxene composition are seen, although they do not correspond with zoning patterns expected from crystal growth. Spinel is strongly zoned in Al and Cr, although zoning does not correspond with crystal growth zoning patterns. Small phosphates, both merrillite and apatite-like compositions, are present. Metal grains (both kamacite and taenite) are present throughout the sample, as well as sulfides of an Fe-rich pyrrhotite composition.

XANES measurements show $Cr^{2+}/\Sigma Cr$ ratios of 0.14 to 0.62 for all olivine grains measured, and a traverse measured across a single large olivine grain shows a shift in $Cr^{2+}/\Sigma Cr$ ratios from 0.52 in the core to 0.30 in the rim.

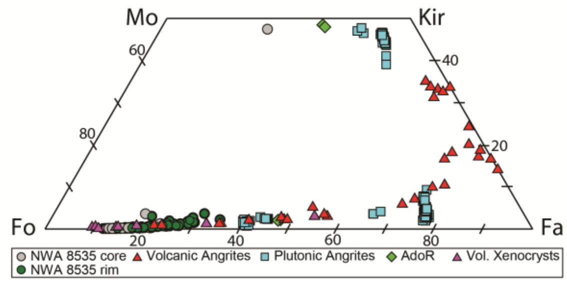

Figure 1: Quadrilateral showing compositions of olivine from NWA 8535 (gray and green dots) and olivine from other angrites, including that described as possible xenocrysts in volcanic angrites (purple triangles). Fo-forsterite, Fa-fayalite, Kir-kirschsteinite ($FeCaSiO_4$), Mo-monticellite ($MgCaSiO_4$). Literature data from [4-19].

Other notable features found in this sample include numerous small inclusions within olivine that appear to contain a fluid. These inclusions are present as both intact inclusions and as open, empty holes within large olivine grains at the surface of prepared samples. Multiple symplectites composed of sulfide and pyroxene are also present; the pyroxene within these symplectites is compositionally distinct from that in the rest of the dunite as it contains less Fe and essentially no Al, suggesting it was formed from a different process.

Discussion: The mineral compositions within this sample (e.g., Mg-rich, Ca-poor olivine, Mg-rich pyroxene, Cr-rich spinel cores) suggest it either represents early crystallized igneous materials, or a residue, possibly from the APB mantle. Several textures of these minerals also suggest that at least one (possibly more) secondary process likely influenced this dunite while on the APB. An example of this textural evidence is found in the mismatch between chemical zones and grain morphology in spinel grains (Fig. 2). Determination of possible secondary processes is underway, however it is possible fluids were involved based on the presence of S- and Cl-bearing phosphates in the sample, small inclusions likely containing fluid, and the sulfide-pyroxene symplectites (Fig. 3). Similar sulfide-silicate symplectites have been observed in lunar breccias and other meteorite samples (e.g., Budulan, Lodran) and were interpreted as having formed from a S-bearing vapor [20-23].

Although NWA 8535 represents a new rock type from the APB, it contains several chemical features linking it to other angrite samples, suggesting the processes and conditions responsible for forming this dunite are not far removed from those that formed the other angrites. For example, olivine in NWA 8535 is

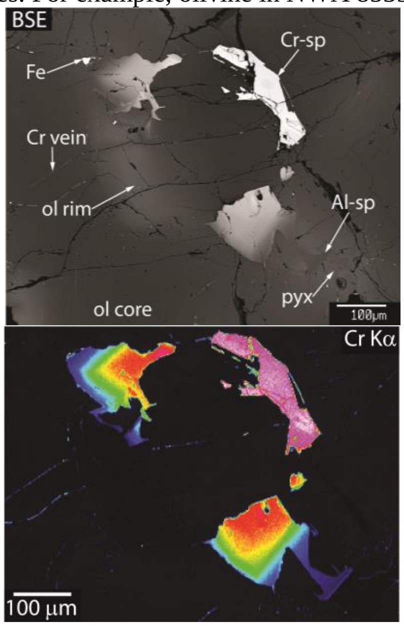

Figure 2: BSE image of spinel grains and a Cr X-ray map of the same assemblage. Note that the Cr zoning does not follow the entire grain shape, and that Cr abundance appears to be highest in what was likely once the center of a larger grain.

similar in composition to olivine interpreted as xenocrysts in several volcanic angrites (Fig. 1). Pyroxene compositions seem to form a continuous trend with pyroxene compositions in other angrites. Both olivine and pyroxene in NWA 8535 also form a continuous trend with the other angrites in Fe vs. Mn space. Cr valence measurements in NWA 8535 olivine could not be directly converted to f_{O2} as the orientation of the olivine has not yet been determined and the relationship between $Cr^{2+}/\Sigma Cr$ in olivine and angritic melt has not yet been parameterized. However, the $Cr^{2+}/\Sigma Cr$ ratios measured here are within the same range as those seen in a xenocrystic olivine within angrite Lewis Cliff 87051 [24]. Additionally, the same trend of decreasing Cr^{2+} from core to rim was also observed. The presence of Ni-rich metal in NWA 8535 is consistent with a relatively high f_{O2} due to the dilution of Fe activity by Ni in the metal.

Although there is a small chance that NWA 8535 is directly related to another angrite sample already in our collections, it seems highly likely that this dunite is sampling the early stages of a common APB magmatic process based on the numerous features that are common between this sample and many other angrites. These similarities highlight the importance of understanding all processes involved in the formation of this dunite, and indicates it can provide important information regarding the APB.

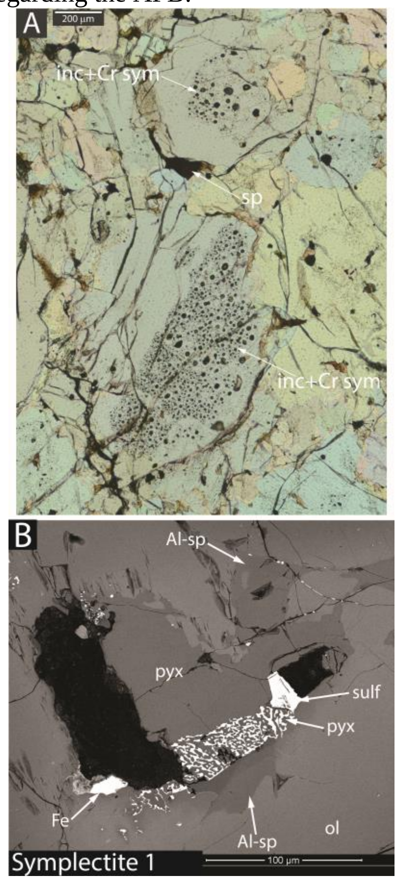

Figure 3: A: Plane polarized light image of olivine containing fluid inclusions (inc) and small Cr-bearing symplectite features (Cr sym). B: BSE image of a sulfide-pyroxene symplectite assemblage.

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