CHROMITE AND PLAGIOCLASE EXSOLUTION FROM PIGEONITE IN ANOMALOUS PYROXENE-PHYRIC EUCRITE NORTHWEST AFRICA 13355: IMPLICATIONS FOR HIGH TEMPERATURE/ PRESSURE CRYSTALLIZATION ON ONE OF THE MANY EUCRITE PARENT BODIES.

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Northwest Africa 13355 is a eucritic achondrite with an unbrecciated igneous texture, but is unique among eucrites in containing relatively large (up to 4 mm) subhedral phenocrysts (or megacrysts) of exsolved pigeonite. The prismatic phenocrysts consist of host low-Ca pyroxene ($Fs_{49.6-53.2}Wo_{1.8-3.0}$, FeO/MnO = 31-32) with augite exsolution lamellae ($Fs_{23.1-25.0}Wo_{39.6-42.7}$, FeO/MnO = 29-31, but they also contain abundant thin (1-2 microns) exsolution lamellae of chromite and arrays of blebby plagioclase distributed along both rational and irrational crystallographic planes. The groundmass is composed of parallel-intergrown pigeonite and calcic plagioclase ($An_{79.2-85.5}Or_{6.5-0.6}$) together with accessory silica polymorph, Ti-chromite, ilmenite, merrillite, troilite and baddeleyite.

Analyses of acid-washed bulk subsamples for oxygen isotopes by laser fluorination gave, respectively, $\delta^{17}O$ 1.665, 1.895, 1.871; $\delta^{18}O$ 3.693, 4.157, 4.105; $\Delta^{17}O$ -0.285, -0.300, -0.296 per mil. These results plot beyond the field for most eucrites to more negative $\Delta^{17}O$ values.

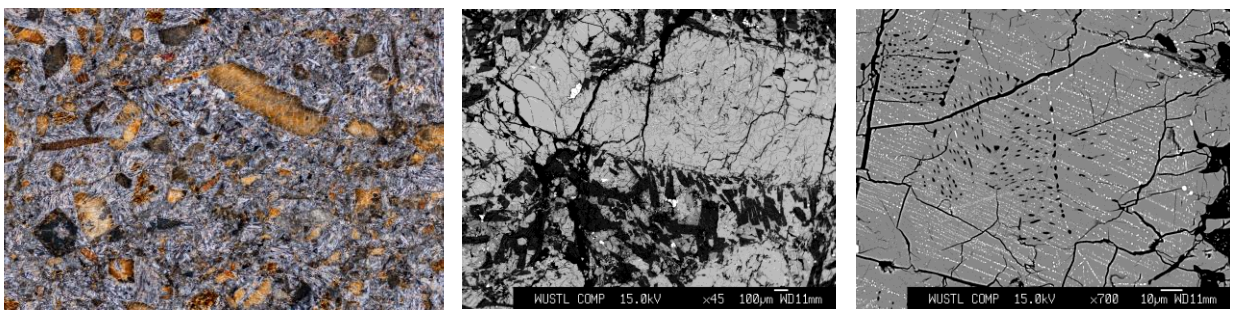

Figure 1. A (left). *Cross-polarized optical thin section image showing pigeonite phenocrysts or megacrysts (orange) within a groundmass of intergrown plagioclase and pigeonite.* ***B (center).*** *BSE image of pigeonite megacryst (top) and groundmass.* ***C. (right)*** *BSE image of exsolution lamellae of chromite (bright) and exsolved blebs of plagioclase (dark) in pigeonite..*

Discussion: Apart from its porphyritic texture and distinctive oxygen isotopic composition, perhaps the most anomalous features of NWA 13355 are the exsolution lamellae within pigeonite. Chromite, plagioclase and spinel have been reported as exsolution lamellae in pyroxene in some terrestrial mafic to ultramafic plutonic rocks [1], and experimental phase equilibria studies establish that the incorporation of Al and Cr into pre-exsolution, high temperature low-Ca pyroxene may require elevated temperatures and pressures [e.g., 2]. Thus, we conclude that some or all the pyroxene phenocrysts in NWA 13355 had to form at higher temperatures and probably greater depths within its parent body than is typical for eucritic magmas, which in turn implies that some or all of these phenocrysts (or cognate xenocrysts) may be products of igneous crystallization on an ancient body of considerable (i.e., “planetary”) size.

It is becoming inceasingly evident that achondrites composed predominantly of pigeonite and calcic plagioclase, and which fall under the broad umbrella term ***eucrites,*** cannot all derive from a common parent body. The wide differences in oxygen isotopic compositions among such specimens [3, 4, 5, 6, 7, 8] now suggest that there may be (or may have been) at least ***7 or 8*** distinct differentiated parent bodies with broadly eucritic crusts. Needless to say, all of these bodies (or their disaggregated remnants) would yield essentially the same reflectance spectra for low-Ca pyroxene as measured for 4Vesta; yet without a *bona fide* returned sample it is impossible to know which (if any) of the eucrite meteorites actually come from there.

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