NWA 1586: MACROSMELTING IN A MONOMICT UREILITE. S.J. Singletary and T. L. Grove (Massachusetts Institute of Technology, Dept. of Earth, Atm. And Planet. Science, Cambridge, MA 02139) (jumper@mit.edu, tlgrove@mit.edu)

Introduction: NWA 1586 is a provisional new ureilite obtained by a meteorite dealer in Morocco in the spring of 2001. In thin section, NWA1586 displays the typical monomict ureilite texture with abundant triple junctions, curved intergranular boundaries and coarse grain sizes (1-2 mm average grain size with one or two grains up to 5 mm in length, Figure 1). Modal silicate mineralogy is 75% olivine: 25% pyroxene - determined by image analysis of an electronprobe stage rastered, Mg x-ray map of the entire thin section. The olivine cores are homogeneous and Fo79 (n=61). Olivine displays prominent reduction rims that contain mg-rich olivine (Fo97; n=3) and finely dispersed grains of metal. The pyroxene is dominantly pigeonite of mg# 80 (calculated as Mg/Mg+Fe) and Wo 11 (n=103). Pigeonite rims show no reduction. The intergranular boundaries contain significant amounts of carbon.

Figure 1. Crossed polars photomicrograph of NWA 1586 displaying the typical ureilite texture. Field of view is 4 mm.

Contained within the primary pigeonite grains are wide swaths that consist of a metal + three pyroxene assemblage (Figure 2). The pyroxenes within these regions are augite (mg# 90, Wo 32, n=17), orthopyroxene (mg# 86, Wo 5, n=8), and pigeonite (mg# 86, Wo 9, n=6)(Figure 3). Also contained in these areas are rare silica-rich phases and abundant voids. The swaths display a sharp contact with the host pigeonite and terminate at the grain boundaries. The swaths are not observed in olivine. One grain of highly reduced forsterite is included in and surrounded by the pyroxene-rich swaths (see Figure 2).

A Mass balance calculation using the primary pigeonite composition as the bulk composition indicates that in situ melting of the primary pigeonite could have produced the swaths. The absence of the swaths in the olivine grains indicates that the swaths are not the result of an impact injection process. The restriction of the swaths to the primary pigeonite suggests that they are a reduction product of the pigeonite, and we propose that in situ smelting of the pyroxene has occurred.

The mg#s of the primary silicates indicate that they equilibrated at higher pressures in the ureilite parent body [UPB]. Applying the olivine pigeonite thermometer of [1] we estimate a smelting temperature of ~1220°C, and a smelting pressure of ~90 bars [2]. The pyroxene smelting reaction present in the swaths records a 3-pyroxene temperature of ~1243°C using the QUILF thermometer [3] and a lower pressure of ~70 bars [2].

These features have several implications for the evolution of the UPB. The presence of in situ melting of one phase in a typical monomict ureilite, that is itself interpreted to be a residue of partial melting, indicates that heating and partial melting of the UPB was episodic and occurred under rapid, disequilibrium conditions. The higher mg#s of the silicate phases in the swaths...
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Indicate generation at shallower depth than the host pigeonite. This could have been accomplished by movement of material inside the UPB due to convection, and would be consistent with descriptions of the UPB as a “mush ball”[3]. Another possible scenario is that overlying material was stripped away by impacts, resulting in lower pressures during the smelting process. The presence of these swaths around a grain of highly reduced olivine suggests the in situ smelting of pigeonite occurred after the ubiquitous “late-stage” ureilite reduction event. This scenario is at odds with interpretations of the common reduction observed in ureilites occurring during break up of the UPB. This new ureilite (NWA 1586) provides a rare opportunity to study the ureilite partial smelting process.