

## NWA5298 – 445 grams Enriched Basaltic Shergottite



*Figure 1: Photo of NWA5298 (from Ted Bunch).*

### **Introduction**

NWA5298 was found near Bir Gandouz, northwest Africa in 2008. It has a brown weathered surface without fusion crust (figure 1). It is one of the most oxidized of the Martian meteorites, with magnetite as a primary phase.

### **Petrography**

Irving and Kuehner (2008) described NWA5298 as composed mainly of intergrown prismatic grains of zoned pyroxene up to 1.5 mm and lath-shaped regions of vesicular material of plagioclase composition (figure 2). Accessory minerals are titanomagnetite, ilmenite, silica, merrillite, apatite, pyrrhotite, fayalite and baddeleyite. Irving and Kuehner (2008) and Hui et al. (2009) found that NWA5298 was highly oxidized.

Hui et al. (2009, 2011) reported detailed mineral analyses (figure 4) and used the mineral mode to calculate the bulk rock composition (figure 5).

### **Mineralogy**

***Olivine:*** There is trace fayalite in the mesostasis.

***Pyroxene:*** Figure 3 shows that pyroxenes in NWA5298 are highly zoned (it's a basalt).

### **Mineralogical Mode of NWA5298**

|             | Hui et al. 2011 |
|-------------|-----------------|
| Olivine     | 0               |
| Pyroxene    | 64.5 vo. %      |
| Plagioclase | 29.4            |
| Opaques     | 2               |
| Silica      | 1.3             |
| Phosphates  | 1               |
| Meostasis   | 1               |

***Plagioclase:*** Plagioclase in NWA5298 has partially been converted to maskelynite and partially to plagioclase glass that has partially recrystallized.

***Opaques:*** Titanomagnetite and ilmenite coexist and set a high value on the oxidation state.

***Silica:*** Rather large grains of silica are found in plagioclase glass (Irving and Kuehner).

***Phosphates:*** Both apatite and merrillite are present, but merrillite is the main carrier for REE.

### **Chemistry**

Irving et al. (2011) reported a composition for NWA5298 (table 1).

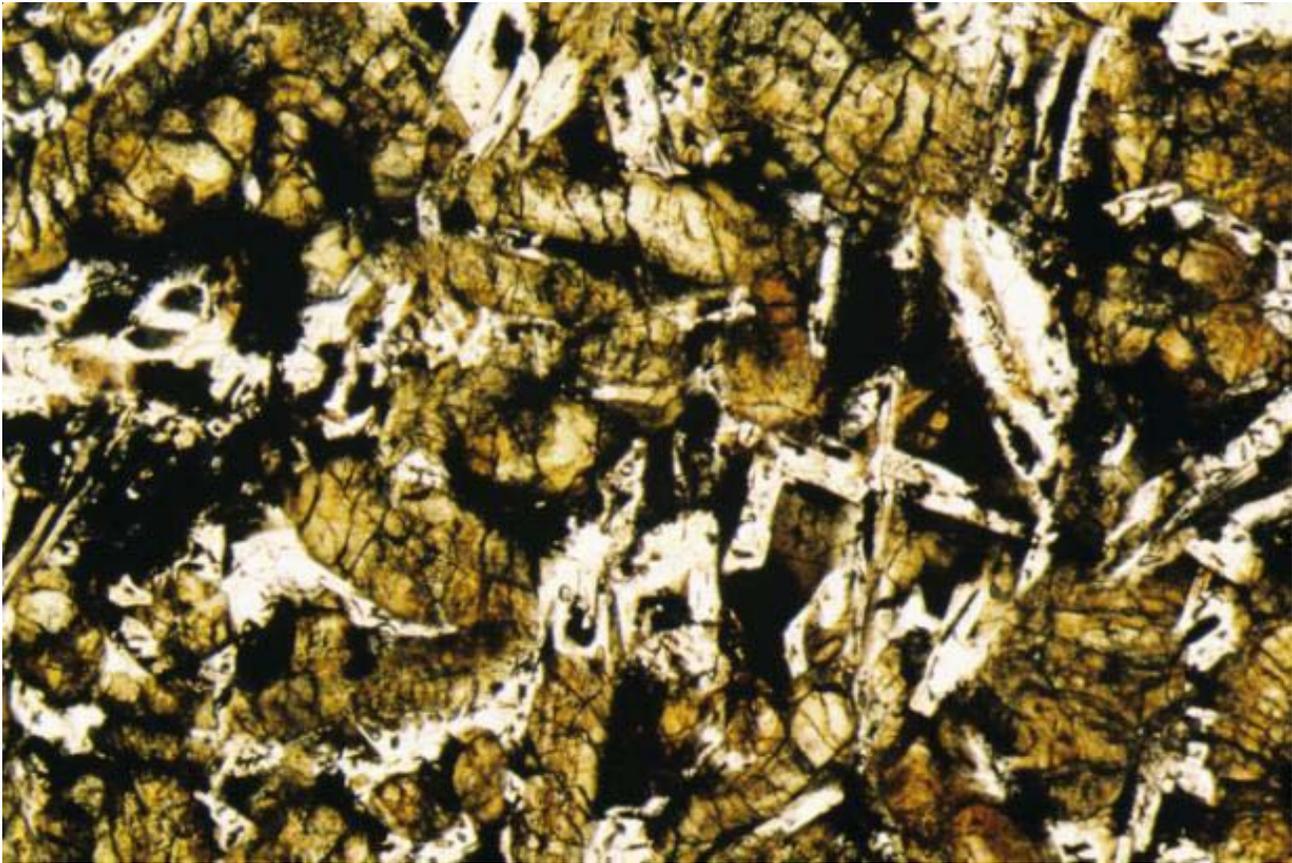


Figure 2: Photo of thin section of NWA 5298 by Ted Bunch (from Hui et al. 2010). Image is 9 mm across.

**Radiogenic age dating**

Moser et al. (2012) dated baddeleyite grains between  $209 \pm 22$  m.y. and  $26 \pm 2$  m.y. in NWA5298 by the U/Pb ion probe method.

**Cosmogenic isotopes and exposure ages**

Not yet

**Other Studies**

Hui et al. (2011) and Rumble and Irving (2009) reported oxygen isotopes ( $\Delta^{17}\text{O} = 0.3$ ).

**Processing**

Unknown

**References for NWA5298**

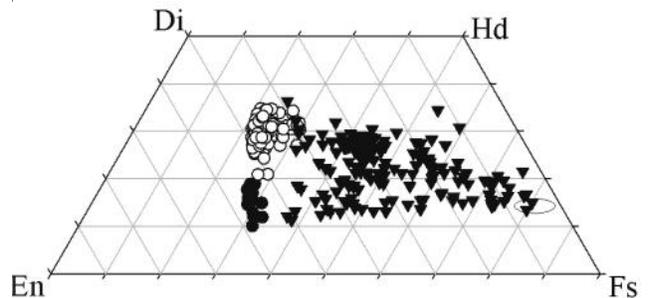


Figure 3: Pyroxene composition in NWA5298 (Hui et al. 2010).

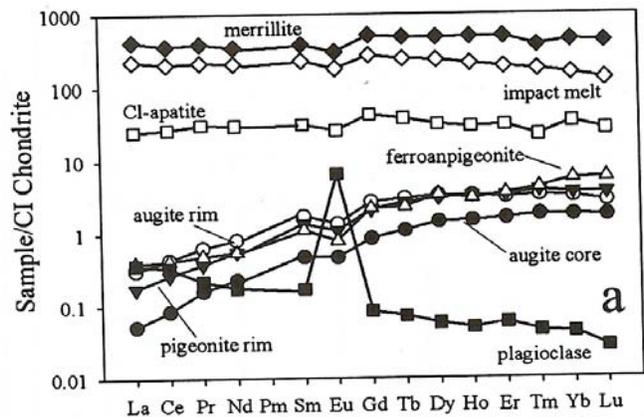
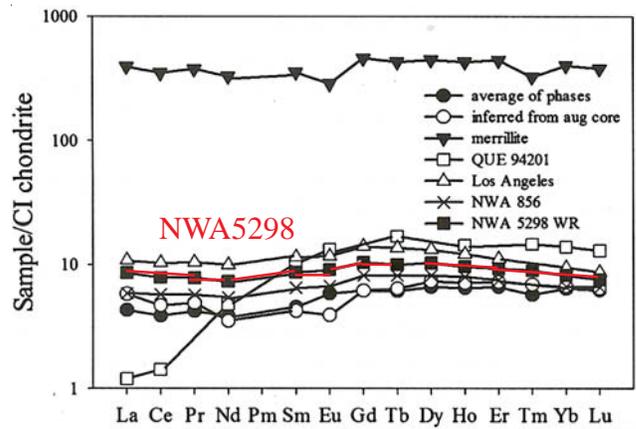


Figure 4: REE content of minerals in NWA5298 (Hui et al. 2011).

**Table 1. Chemical composition of NWA 5298**

| reference                             | Irving11 |     |
|---------------------------------------|----------|-----|
| <i>weight</i>                         |          |     |
| SiO <sub>2</sub> %                    | 48.77    | (a) |
| TiO <sub>2</sub>                      | 1.06     | (a) |
| Al <sub>2</sub> O <sub>3</sub>        | 8.11     | (a) |
| FeO                                   | 19.01    | (a) |
| MnO                                   | 0.48     | (a) |
| MgO                                   | 7.11     | (a) |
| CaO                                   | 10.22    | (a) |
| Na <sub>2</sub> O                     | 1.61     | (a) |
| K <sub>2</sub> O                      | 0.22     | (a) |
| P <sub>2</sub> O <sub>5</sub>         | 0.95     | (a) |
| S %                                   |          |     |
| <i>sum</i>                            |          |     |
| Sc ppm                                |          |     |
| V                                     |          |     |
| Cr                                    | 958      | (a) |
| Co                                    |          |     |
| Ni                                    | 28       | (b) |
| Cu                                    |          |     |
| Zn                                    |          |     |
| Ga                                    |          |     |
| Ge ppb                                |          |     |
| As                                    |          |     |
| Se                                    |          |     |
| Rb                                    |          |     |
| Sr                                    |          |     |
| Y                                     |          |     |
| Zr                                    |          |     |
| Nb                                    |          |     |
| Mo                                    |          |     |
| Ru                                    |          |     |
| Rh                                    |          |     |
| Pd ppb                                |          |     |
| Ag ppb                                |          |     |
| Cd ppb                                |          |     |
| In ppb                                |          |     |
| Sn ppb                                |          |     |
| Sb ppb                                |          |     |
| Te ppb                                |          |     |
| Cs ppm                                |          |     |
| Ba                                    | 90       | (b) |
| La                                    | 3.15     | (b) |
| Ce                                    | 7.52     | (b) |
| Pr                                    | 1.07     | (b) |
| Nd                                    | 5.18     | (b) |
| Sm                                    | 2        | (b) |
| Eu                                    | 0.79     | (b) |
| Gd                                    | 3.19     | (b) |
| Tb                                    | 0.58     | (b) |
| Dy                                    | 3.94     | (b) |
| Ho                                    | 0.82     | (b) |
| Er                                    | 2.32     | (b) |
| Tm                                    | 0.32     | (b) |
| Yb                                    | 2.03     | (b) |
| Lu                                    | 0.29     | (b) |
| Hf                                    | 2.7      | (b) |
| Ta                                    |          |     |
| W ppb                                 |          |     |
| Re ppb                                |          |     |
| Os ppb                                |          |     |
| Ir ppb                                |          |     |
| Pt ppb                                |          |     |
| Au ppb                                |          |     |
| Th ppm                                |          |     |
| U ppm                                 |          |     |
| <i>technique: (a) XRF, (b) ICP-MS</i> |          |     |



**Figure 5:** Normalized rare-earth-element diagram for enriched shergottites with pattern calculated for NWA5298 (Hui et al. 2011).