PETROLOGY OF ANOMALOUS EUCRITE QUE 94484.

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Introduction: Most mafic achondrites are broadly "eucritic", being composed of ferroan low-Ca clinopyroxene, high-Ca plagioclase, a silica phase, ilmenite and accessory phases [1]. Their characteristics indicate that eucrite-like basalts formed on asteroids of similar composition under similar petrologic conditions (T, P, fO_2). Some eucrite-like basalts have isotopic compositions and petrologic characteristics consistent with formation on different parent asteroids (*e.g.*, Ibitira, NWA 011 [2-4]). Others show small isotopic differences but no distinguishing petrological characteristics (*e.g.*, Caldera, Pasamonte [3, 4, 6-8]). We have begun a study of anomalous eucrite-like achondrites in an effort to seek resolution to the issues: Did the eucrite parent asteroid fail to homogenize via a magma-ocean stage, thus explaining outliers like Pasamonte? How many parent asteroids are represented by these basalts? Here we present preliminary petrologic information on anomalous basaltic eucrite QUE 94484.

Petrology and Discussion: Previous petrologic study showed QUE 94484 is an unbrecciated, unequilibrated basalt containing mesostasis rich in silica and troilite [8]. Its pyroxenes have the unusual characteristic of decreasing Fe/Mn with increasing Fe/Mg [8]. Zoning in pyroxenes consists of relict, isolated cores of Mg-rich pyroxene (mg# 62.1; $Wo_{5.8}$; Fe/Mn 28.6) transected by ferroan pyroxene, plus rims of ferroan pyroxene. The ferroan low-Ca pyroxene composition is mg# 49.0; $Wo_{5.8}$; Fe/Mn 25.5. The most ferroan pyroxene composition is mg# 37.1; $Wo_{11.8}$; Fe/Mn 23.4. Ferroan pyroxene rims poikilitically enclose small, elongate grains of silica, plagioclase and troilite, especially adjacent to mesostasis. We interpret the texture and pyroxene compositions as demonstrating that the QUE 94484 magma was undergoing reduction during crystallization, resulting in its relatively high modal silica content [8] and the decreasing Fe/Mn with increasing Fe/Mg in pyroxene. QUE 94484 is not vesicular, thus there is no evidence for escape of an oxidized volatile phase. The reducing agent may have been S as the mesostasis is rich in troilite [8]. The fO_2, fS_2 and FeO contents of mafic melts are interrelated variables; for a given fO_2, the FeO content of a basalt will be lower at higher fS_2 [9]. Our hypothesis is that as the QUE 94484 basalt crystallized, the fS_2 increased to the point where FeO was reduced from the silicate melt and formed additional sulfide melt. However, the fate of the liberated O is currently unknown.

Key Finding: The unusual petrologic characteristics of anomalous eucrite QUE 94484 were engendered by reduction during crystallization, likely by S.

References: [1] Mittlefehldt D. W. (2015) *Chemie Erde – Geochem.*, in press. [2] Yamaguchi A. *et al.* (2002) *Science* **296,** 334-336. [3] Wiechert U. H. *et al.* (2004) *Earth Planet. Sci. Lett.* **221,** 373-382. [4] Greenwood R. C. *et al.* (2005) *Nature* **435,** 916-918. [5] Mittlefehldt D. W. (2005) *Meteoritics & Planet. Sci.* **40,** 665-677. [6] Lentz R. C. F. *et al.* (2007) *LPS XXXVIII*, Abstract #1968. [7] Scott E. R. D. *et al.* (2009) *Geochim. Cosmochim. Acta* **73,** 5835-5853. [8] Mayne R. G. *et al.* (2009). *Geochim. Cosmochim. Acta* **73,** 794-819. [9] Haughton D. R. *et al.* (1974). *Econ. Geol.* **69,** 451-467.