METASOMATIC FEATURES IN EUCRITES. R. L. Funderburg[1], R. G. Mayne, N. G. Lunning[2], and S. Singletary[3], [1]Monnig Meteorite Collection, 2950 West Bowie Street, SWR 244, Texas Christian University, Fort Worth, TX 76109. (r.funderburg@tcu.edu), [2]Department of Mineral Sciences, Smithsonian Institution, National Museum of Natural History, 10th and Constitution NW, Washington, DC 20560-0119. [3]Robeson Community College, 5160 Fayetteville Road, Lumberton, NC 28360.

Introduction: The breakdown of pyroxene to silica and troilite was first identified as an alteration process in eucrites by Duke and Silver [1]; however, metasomatism was not identified as a potential cause of these features until the 1990s [2] and has been increasingly identified in the last 10 years [3, 4, 5, 6, 7]. Many eucrite studies were conducted prior to this time and, while metasomatic features may have been identified, they were not attributed to this process.

Barrat et al. [4] proposed a three-stage alteration process to explain the products of metasomatic alteration found in eucrites:

(1) Fe-enrichments along cracks in pyroxenes
(2) Fe-rich olivine deposits in cracks and troilite
(3) Al-depletion coincident with Fe-enrichment of pyroxene

While metasomatism within eucrites is now commonly identified within the literature, the mechanism for this alteration is not well understood. Possible mechanisms proposed involve hydrous fluid alteration [4] or sulfurization from a S-rich vapor [6, 7]. The addition of sulfur is required to produce troilite from the breakdown of pyroxene, which has been observed in several eucrites [3, 4, 5, 6, 7]. Zhang et al. [5] suggested that the sulfur may have been present in the form of a dry S-O-P vapor, formed by the volatilization of pre-existing S- and P-rich material as a result of impacts. Additional petrological studies are needed to test if metasomatism was consistently driven by S-O-P vapors or if some metasomatism lacks the P-component expected for impact derived vapor.

Metasomatism has been directly investigated for only a handful of eucrites. This study will investigate metasomatism in both Stannern and Main-Group-Nuevo-Laredo (MGNL) eucrites to investigate the com-position of the altering fluid/vapor and overarching processes that drive metasomatism on the eucrite parent body. Our preliminary work is focused on the Stannern-trend eucrites Bouvante and LEW 88010, the main group eucrite Béréba, and the polymict eucrite NWA 4834.

Methods: The samples from this study are on loan from the following: Béréba (USNM 5745-2, USNM 6003-2; National Meteorite Collection, Smithsonian Institution), Lewis Hills 88010 (LEW 88010) (LEW 88010,4; Meteorite Working Group), Bouvante and Northwest Africa 4834 (NWA 4834) (M1224.3, M1224.5, and M2049.2; Monnig Meteorite Collection).

Petrographic analysis was conducted via optical microscopy with an Olympus BX51 polarizing light microscope at the Oscar Monnig Meteorite Collection at Texas Christian University. Backscatter electron (BSE) maps and major element data for pyroxenes in Bouvante, LEW 88010, and NWA 4834 were measured by a JEOL JXA-8530F HyperProbe electron microprobe analyzer (EMPA) at Fayetteville State University's Southeastern North Carolina Regional Microanalytical and Imaging Consortium. Backscatter maps were generated for each thin section and energy dispersive x-ray spectrometry (EDS) point analyses were performed.

Results and Discussion: Of the four samples selected for this study so far, one is unbrecciated (LEW 88010), two are monomict (Béréba and Bouvante), and one is polymict (NWA 4834). These samples were selected as they were observed to contain possible metasomatic features during our petrographic survey, but have not been included in the current literature regarding metasomatism. They include members of both the Stannern- and MGNL- trends (S: Bouvante and LEW 88010; MGNL: Béréba). All samples are either falls or were observed to show little to no terrestrial alteration. Mineralogically, they are typical eucrites, being dominated by pyroxene and plagioclase, with lesser phases including troilite, chromite, ilmenite, Fe-rich olivine, and silica.

Preliminary results suggest that Fe-enrichment of pyroxene rims, along with an associated Al-depletion, is occurring due to metasomatism in the three samples examined using EMPA (Figure 1). Fe-rich olivine was observed in NWA 4834 (Figure 2). Petrographic analysis identified the breakdown of pyroxene into troilite and silica in all four samples (Figure 3).

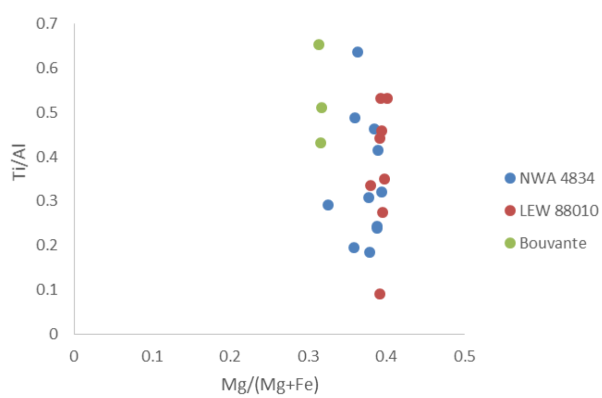

Figure 1: Ti/Al vs. Mg/(Mg+Fe) for pyroxenes in all three eucrites currently analyzed by EMPA. These eucrites show increasing Ti/Al towards pyroxene rims and cracks as a result of Al-depletion, which correlates with Fe-enrichment during proposed metasomatic alteration [4].

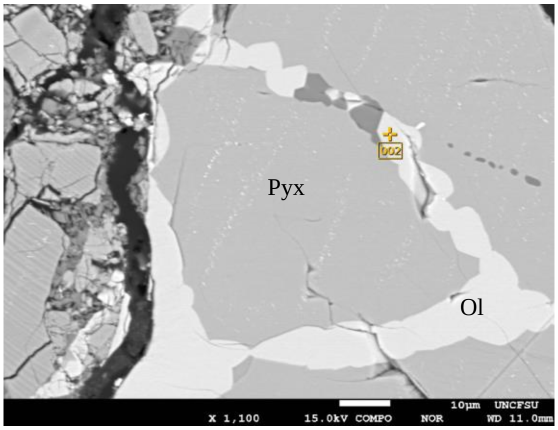

Figure 2: BSE image showing Fe-rich olivine surrounding a pyroxene grain in NWA 4834. The pyroxene also contains abundant troilite.

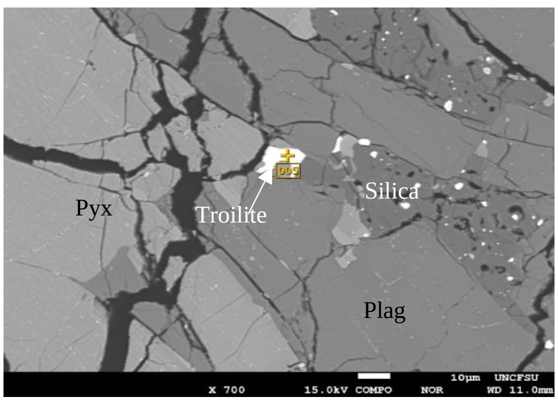

Figure 3: Troilite and silica replacing pyroxene in Bouvante.

Future Work: Quantitative pyroxene and plagioclase data for all four samples will be collected prior to the conference. This will allow for further assessment of the Al-depletion along with Fe-enrichment in pyroxenes. We will also investigate the presence of phosphates in these samples to investigate the P-component that would be present in an impact derived vapor.

We will assess if there are any differences in metasomatism between MGNL and Stannern-trend eucrites. A survey of previously identified residual eucrites for metasomatic features will also be conducted, so that all three geochemical groupings are represented, if possible.

References: [1] Duke M.B. and Silver L.T. (1967) *GCA, 31,* 1637-1665. [2] Takeda H., et al. (1994) *Earth & Planet. Sci. Letters, 122,* 183-194. [3] Rosjzar H. et al. (2011) *Meteoritics & Planet. Sci. 46,* 1754-1773. [4] Barrat J.A. et al., (2011) *GCA, 75*, 3839-3852. [5] Zhang A.-C. et al., (2013) *GCA 109,* 1-13 [6] Mayne R.G. et al., (2016) *Meteoritics & Planet. Sci. 51,* 2387-2402. [7] Chen, H. Y. et al., (2016) *78th MetSoc,* Abstract #1856.