SEACHING FOR POTASSIUM HOST PHASES IN PREPARATION FOR AR-AR ANALYSIS OF BRACHINITE AND BRACHINITE-LIKE ACHONDRITES.

S. P. Beard[1], T. D. Swindle[1,2], K. J. Domanik[1].
[1]Lunar and Planetary Laboratory, University of Arizona, Tucson AZ 85721 (spbeard@lpl.arizona.edu),
[2]Department of Geosciences, University of Arizona.

Introduction:

Brachinites are a poorly understood group of achondrites composed predominantly of olivine [1]. There are approximately 30 meteorites in this enigmatic group, with several classifications not in agreement, leading to what have been called 'brachinite-like' ungrouped achondrites [2]. Looking at the chronology of these samples should provide clues to whether or not there is a genetic relationship among these samples, or if instead their similarities are due to common geophysical conditions. Ar-Ar techniques will be used to obtain the thermal history, but it is first important to have an idea of what mineral phases are present, specifically, where potassium is located, if it is present at all. Samples studied for this purpose include the brachinites NWA 595, NWA 1500, NWA 7297, RaS 309, and brachinite-like NWA 6077 and the ungrouped achondrite Tafassasset. More samples of each type are currently in the process of being obtained to add to this study. In addition, we will determine cosmic-ray exposure (CRE) ages for all samples.

Approach:

Samples were analyzed with CAMECA SX50 and SX100 electron microprobes for mineral identification and characterization, specifically using backscattered electron (BSE) imaging in conjunction with element mapping to look for potassium. Analysis conditions were 15 kV, 20 nA for olivine and pyroxene and a defocused 5um beam with 10nA (Na, K), 20nA (remaining elements) was used for plagioclase. Element maps (Mg, Fe, Si, Ca, Na, Al, K, S, Cr, and Ni) of each sample were made (at 15KV, 40nA) to aid in identifying plagioclase and other minerals containing potassium.

Results:

As characteristic of brachinites, all samples studied were predominantly composed of olivine (70-96% among these brachinites [3,4]. NWA 6077 has a subhedral, granular-textured olivine, clino- and orthopyroxene, chromite, and apatite. Pyroxene (~1mm) often has metal inclusions, as well as large metal veins linking across grains. Irregular melt inclusions of merrillite were located between some clinopyroxene and apatite grains.

NWA 1500 shows subhedral olivine with interstitial, equigranular diopside and chromite. Metal and pyroxene-rich melt veins and pockets run throughout the sample. Unlike the work by [3], no plagioclase was detected in our sample.

NWA 7297 exhibits 200 micron orthopyroxene and clinopyroxene interstially in olivine.

NWA 595 has equigranular olivine (100-400 microns) with interstitial chromite and pyroxenes. Pyroxenes tend to group together, forming a series of equigranular regions that are up to 4 mm across.

RaS 309 also has an equigranular texture with metal along the grain boundaries of olivine, and pyroxene grains, which are up to 1mm across.

None of the above five samples had either any measurable potassium content or observable plagioclase.

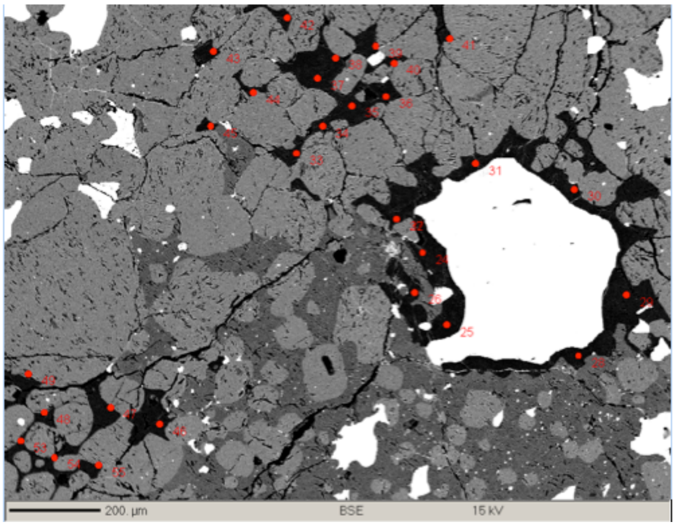
Tafassasset is subhedral with interstitial plagioclase, troilite, and pyroxene (Figs 1-2). Olivine grains are 200-300 microns, while plagioclase grains are 50-150 microns. Analysis of plagioclase sites shows 0.4-1.4 wt% potassium. Using the range of modal abundances from [5], this corresponds to 100-600 ppm bulk potassium, similar to their ICMPS estimate of ~250 ppm. This agrees with element maps that only show potassium associated with plagioclase. However, plagioclase in Tafassasset was found to behave differently if it was interstitial in olivine than if it was located in grain boundaries around metal. Plagioclase along metal boundaries is Ab 63±3, An 32±4, Or 4.5±1 (1σ, n=58), and interstitial plagioclase in olivine is Ab 55.5 ±3, An 41±3, Or 3±0.7 (1σ, n= 60).

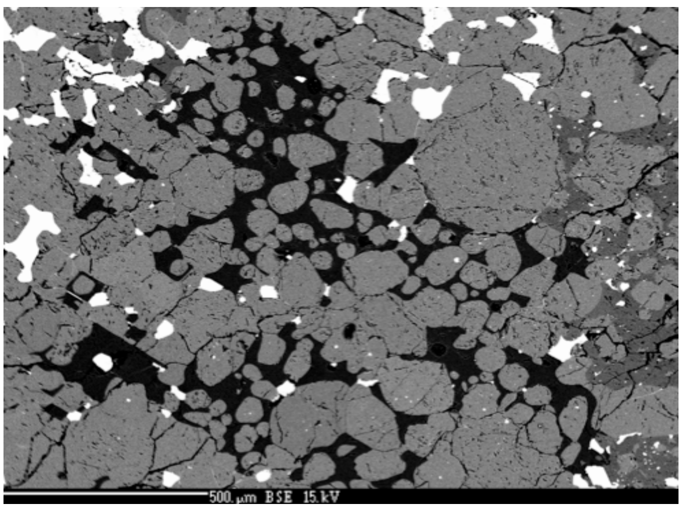
Conclusions and Future (Ar-Ar) Work:

Brachinites are a complex and poorly understood group of achondrites that need to be further studied. Classification has become complicated and now includes brachinite-like achondrites and anomalous brachinites. By combining mineralogy, cosmic ray exposure ages, oxygen isotopes, and argon-argon thermochronology, it may be possible to definitively combine or separate this perplexing group.

Tafassasset has proven to be the only sample thus far to contain potassium, which is at ~100ppm level. Whether or not the other samples have enough potassium for successful Ar-Ar dating, remains to be seen. Future work includes at least ten other brachinite/brachinite-like samples that will include the samples described here for Ar-Ar dating and CRE dating. More detailed mineralogy and oxygen isotope measurements will be performed on those samples that have not already been well measured.

Acknowledgements:
Special thanks to Rainer Bartoschewitz, Beda Hoffman, Cyril Lorenz, Marina Ivanova, Fredric Stephan, and Twink Monrad for supplying samples and making this work possible.





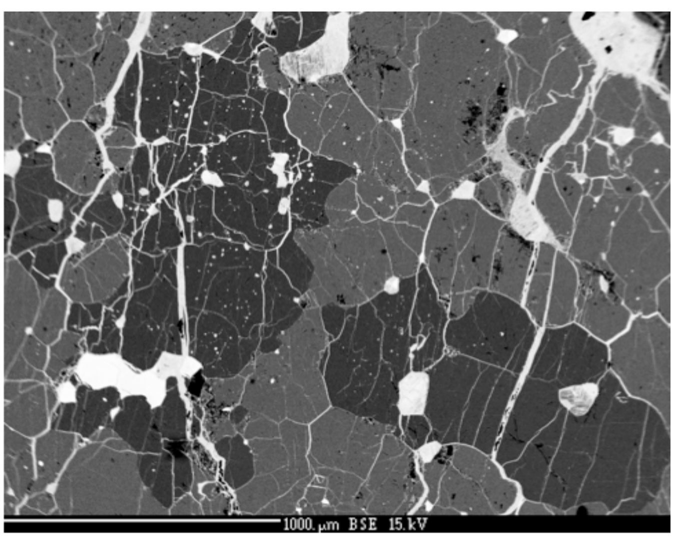


Figure 1 (top): Plagioclase (black) associated with metal (white) in Tafassasset. Scale bar is 200 μm. Small dots represent location of spot analysis. All figures are backscattered electron (BSE) images.

Figure 2 (middle): Plagioclase (black) from Tafassasset, located within olivine, and not associated with metal as in figure 1. This plagioclase is more anorthitic. Scale bar is 500 μm.

Figure 3 (bottom): RaS 309's large granular pyroxene grains (dark) with large interstitial metal grains and veins. Scale bar is 1000 μm. Note absence of plagioclase, which would be black.

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