# Mineral Associations in Enstatite Chondrites: A Window into Mercury's Present

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Sierra V. Kaufman[1,2], Catherine M. Corrigan[1], Timothy J. McCoy[1], Emma S. Bullock[3]

[1]Smithsonian National Museum of Natural History, Mineral Sciences Department [2]Fredonia State University of New York, Geosciences Department [3]Carnegie Institution of Washington

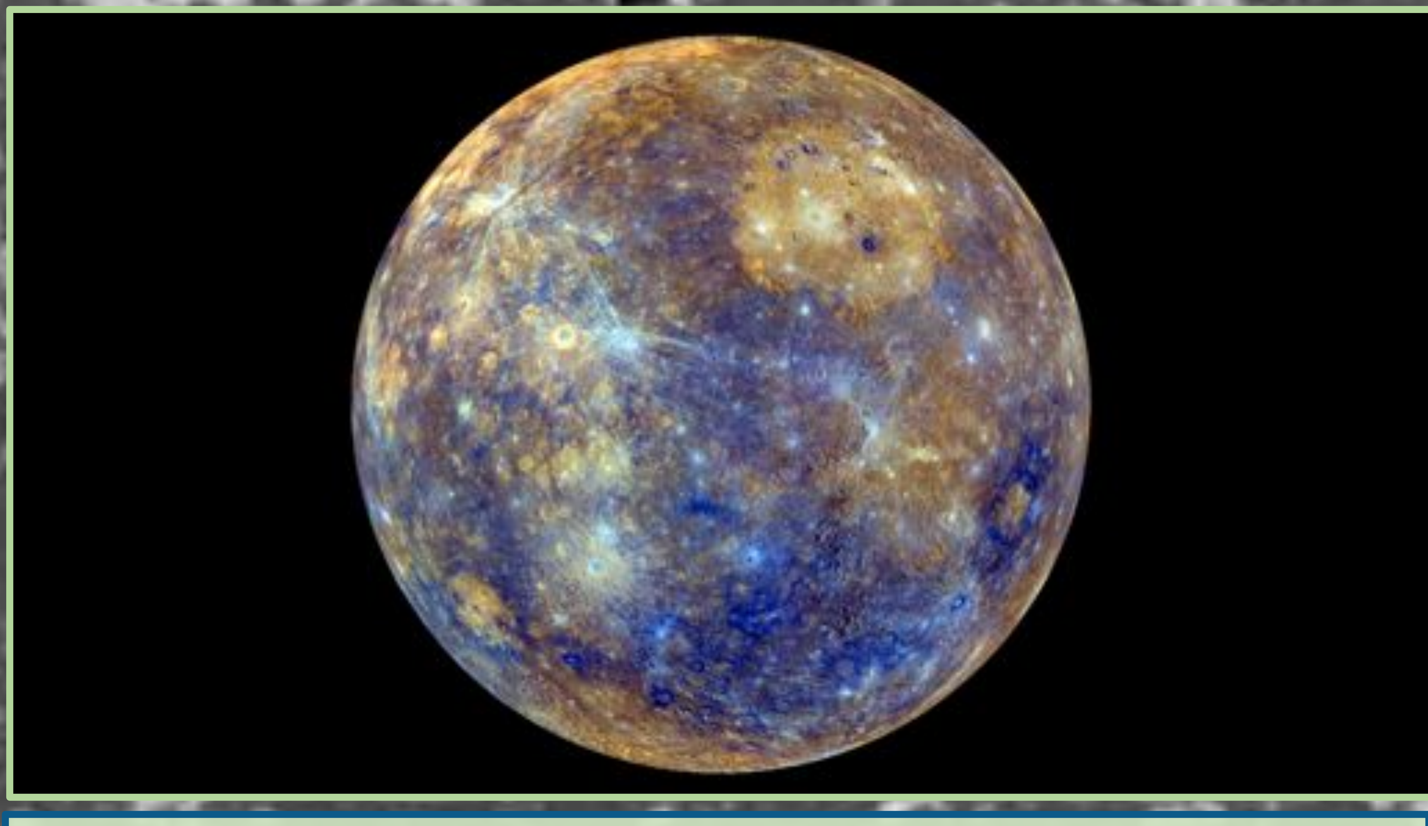

**Fig. 1:** False color image of Mercury. Photo credit: NASA

## Introduction and Background

Enstatite chondrite meteorites share many elemental characteristics with the planet Mercury as discovered by the MESSENGER mission. Both E chondrites and Mercury's surface contain volatile elements such as sodium, potassium, sulfur and chlorine and have high magnesium contents[1]. Due to technological and monetary constraints, obtaining samples directly from Mercury is not feasible. However, because of their similarities, enstatite chondrites are a viable proxy for determining the mineral phases that may host the elements on Mercury[2].

Djerfisherite, a potassium sulfide with the formula[3] $K_6(Fe, Cu, Ni)_{25}S_{26}Cl$, is thought to be the phase which houses the chlorine content on Mercury and is hypothesized to be formed through the sulfidization of roedderite[4], a potassium silicate with the formula[3] $(Na, K)_2(Mg, Fe)_2[(Mg, Fe)_3Si_{12}O_{30}]$. Both minerals are thought to form in highly reducing environments such as those thought to be present during the formation of E chondrites and Mercury. A detailed study to prove their common occurrence and examine their relationship needed to be undertaken before asserting the presence of roedderite on Mercury.

**Fig. 2**: Sierra Kaufman and Cari Corrigan working on the SEM. This is how the majority of the data was collected. Photo credit: Jim Di Loreto.

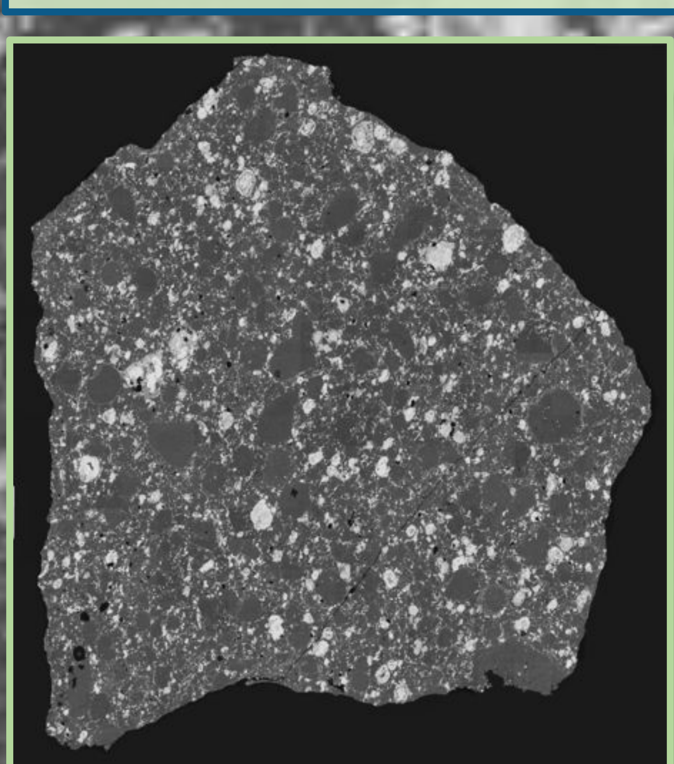

**Fig. 3:** Backscattered electron (BSE) image of meteorite ALH 84250, named for Allan Hills, the locality it was found in Antarctica. Height: 1.21 cm

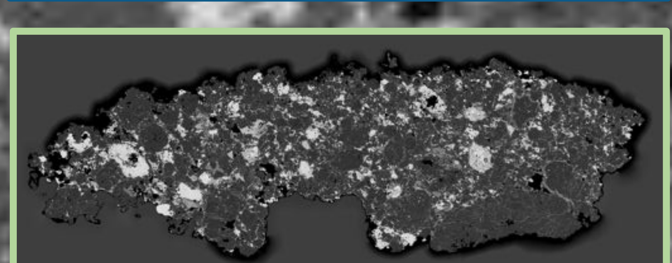

**Fig. 4**: BSE image of meteorite ALHA 77156. Height: 0.72 cm.

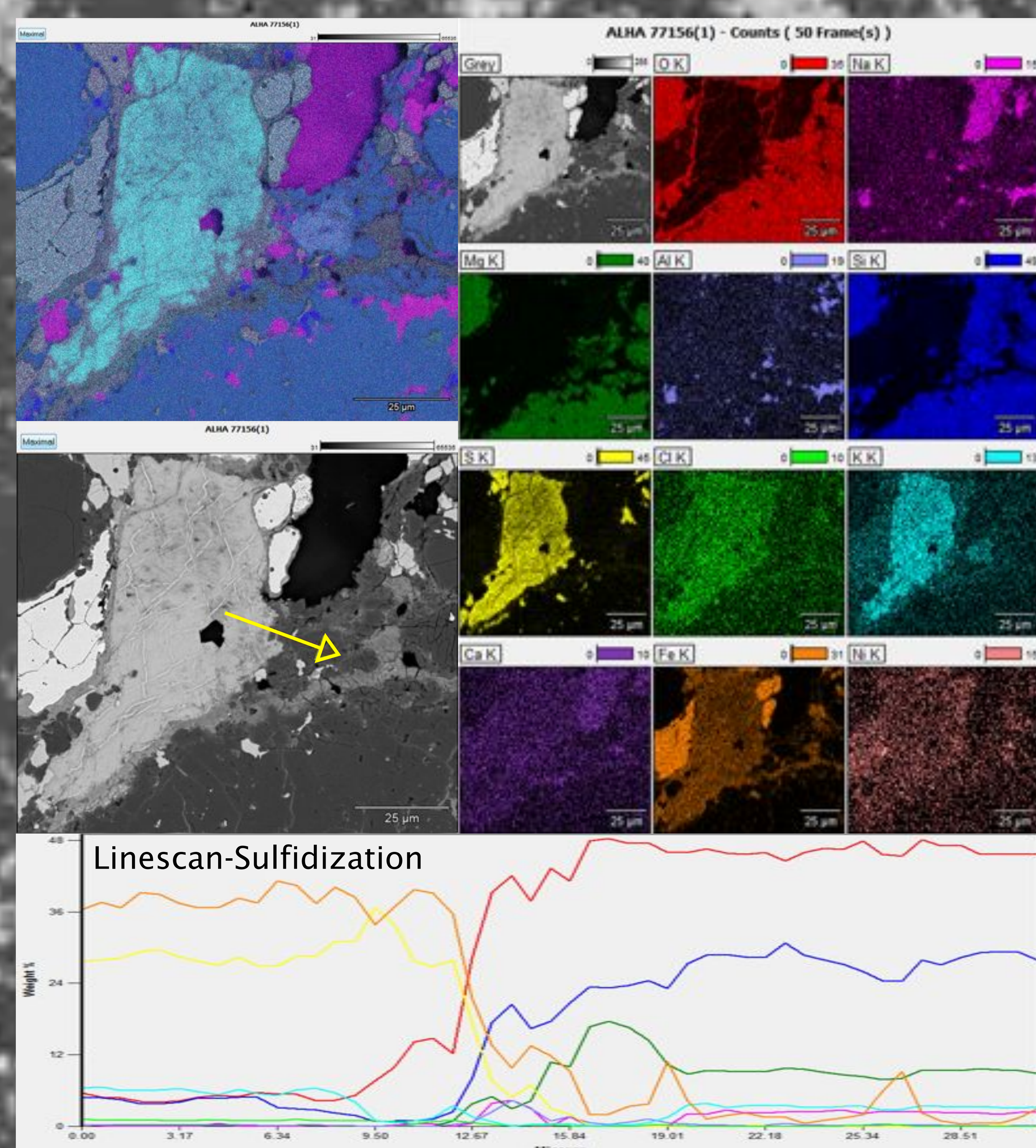



**Fig. 5:** Roedderite and djerfisherite separated by sodic feldspar and enstatite show a reaction texture interpreted as sulfidization.

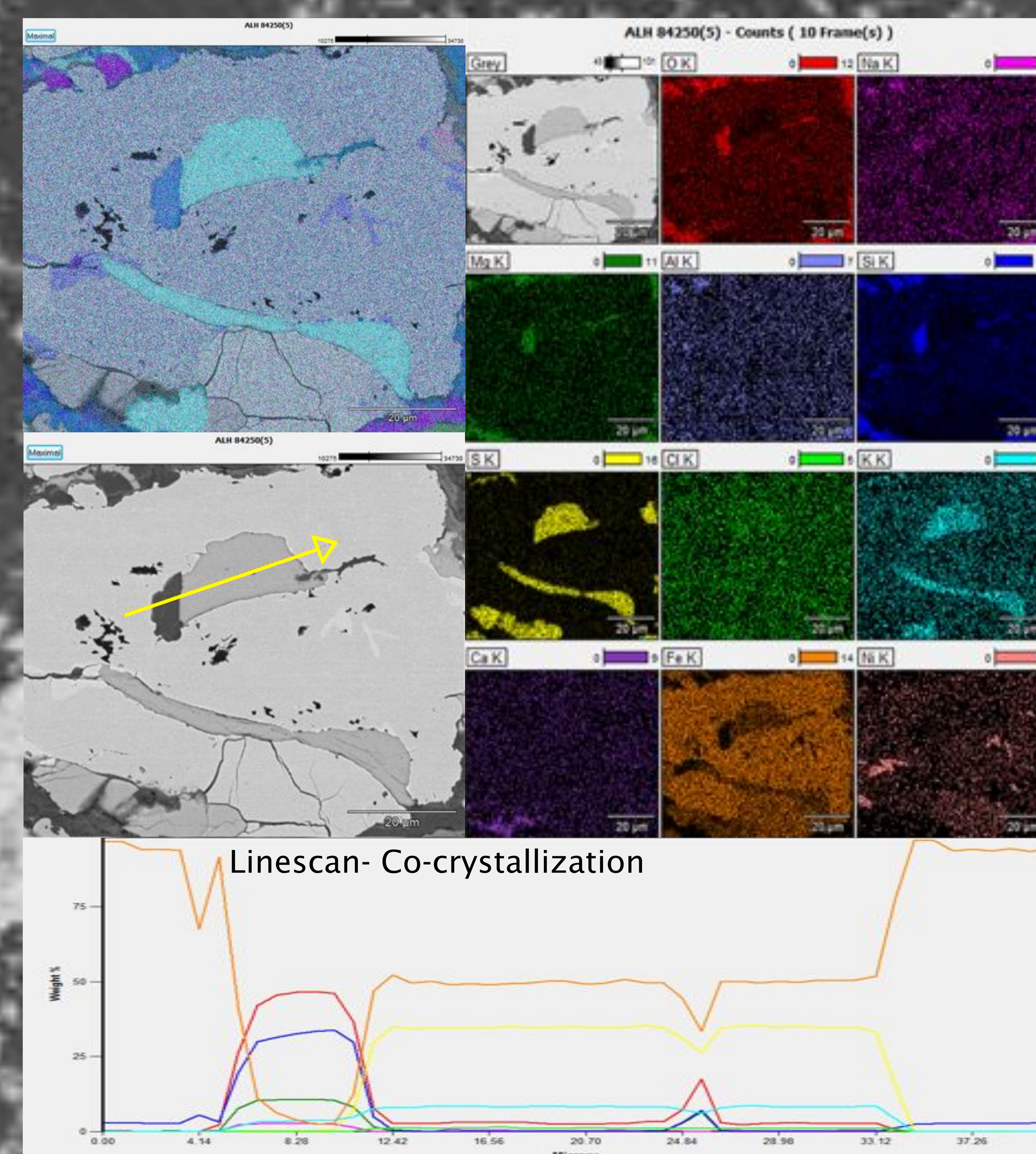



**Fig. 6:** Roedderite and djerfisherite surrounded by iron metal show a co-crystallization relationship with a straight border and definite linescan.

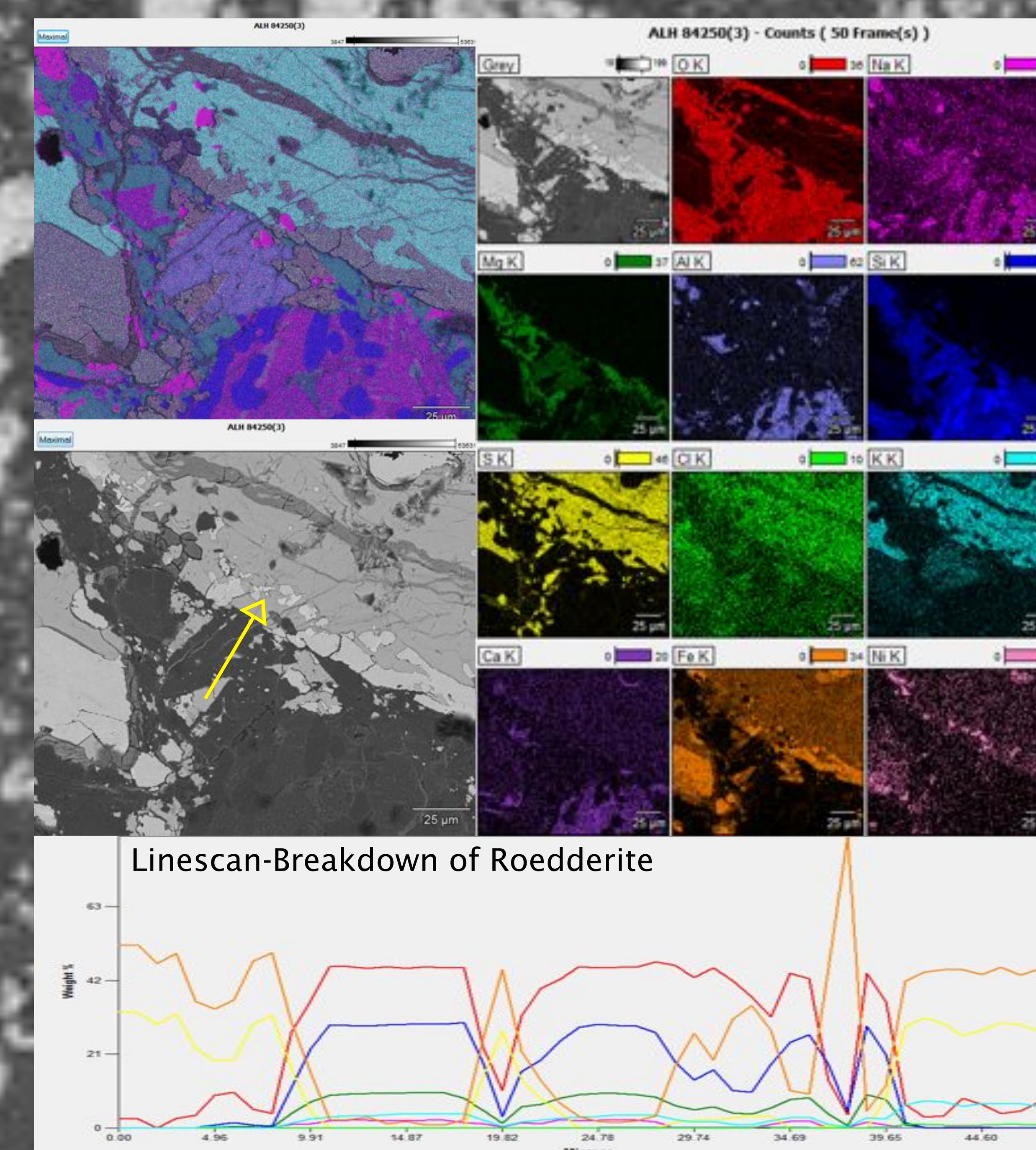



**Fig. 7:** Roedderite breaking down into enstatite, sodic feldspar, and djerfisherite. Higher concentration of sodium in feldspars closer to the roedderite.

## Legend



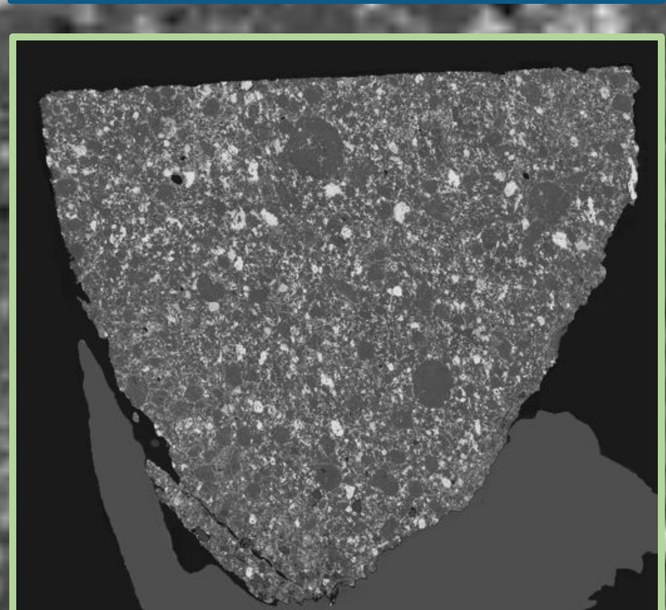

**Fig. 8**: BSE image of meteorite MIL 07139. Height: 1.10 cm.



**Fig. 9**: Enstatite chondrite MIL 07139, one of the meteorites associations were found in, named after Miller Range the locality in Antarctica were it was found.

## Results and Further Work

38 samples were analyzed optically, 7 contained djerfisherite. The SEM showed that 5 of these contained roedderite, 3 with obvious associations between the two minerals. Within these three samples, ten contact associations were found. For several of these associations, the relationship between the roedderite and djerfisherite was unclear. However, within those that were discernable, both co-crystallization and reaction textures were observed. The most common reaction texture indicated a sulfidization reaction. Both the co-crystallization and sulfidization reactions suggest increased sulfur fugacity during formation. It is also possible that the melt composition changed from peralkaline to metaluminous causing roedderite to break down.

The exact composition of the roedderite will need to be determined via electron microprobe in order to calculate the temperature of formation and determine formation conditions. With these conditions, melting experiments will be performed. From the results we can make assertions about the phases that host elements on Mercury's surface.

## Acknowledgements and References

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