

## Automated Search for SiC Grains in Meteorite Cross Sections by SEM/EDS

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SiC grains in carbonaceous meteorites are interesting because they may be of presolar origin. SiC grains may be isolated from meteorites by digesting a meteorite in acid such that the remaining material consists of SiC grains [1]. Searching for SiC by SEM/EDS has the advantage of being non-destructive (though it does require sectioning and polishing), and SEM/EDS analysis provides the context of the composition of the surrounding material for each grain.

The method used here is to collect a Spectral Imaging x-ray map which stores an x-ray spectrum at each node in the map, then process that map with COMPASS (multivariate spectral analysis) to parse the map, and XPhase to sort this result into regions of similar composition. Finally, Match is used to identify SiC spectra without the need for quantification.

Match compares unknown spectra to stored, known spectra, producing a chi-square value to measure similarity to the known spectra. A lower chi-square value indicates a better match. This technique can be more robust than quantification as it finds all spectra similar to the known spectra without relying on peak identification or quantification of trace elements which may be present.

COMPASS processes map data sets with relatively few counts which speeds up the search. Combining Match with XPhase should more reliably find areas possibly composed of SiC than by conducting data reduction with XPhase alone.

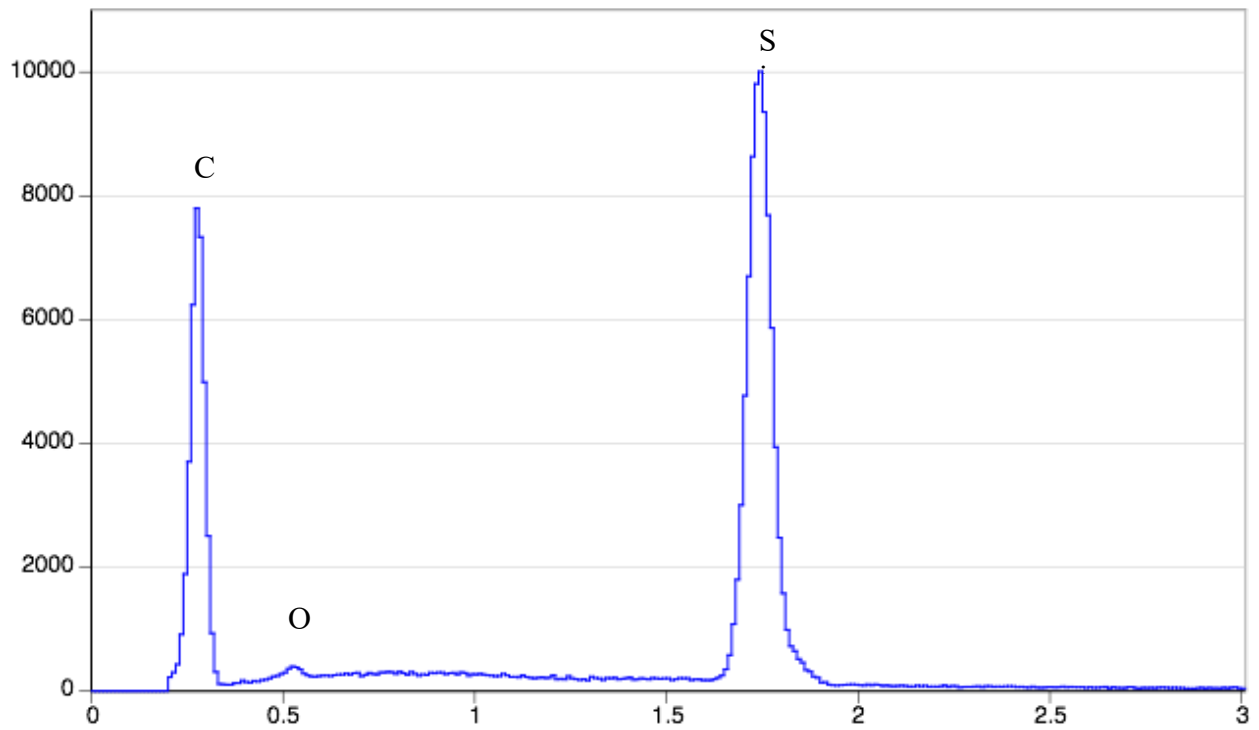
Match standards were acquired from a sample of SiC. A CO3 type meteorite was mapped in 6 locations with submicron precision at 5kV. The analysis was performed with a Thermo Scientific Q250 SEM equipped with a Thermo Scientific NSS EDS system and a 10mm<sup>2</sup> UltraDry silicon drift detector. All samples were coated with about 5nm of carbon.

Many carbon rich areas were found, but SiC was not detected. Figure 1 shows a spectrum of SiC used for Match. Figure 2 shows a set of maps from one field of view of the CO3 type meteorite analyzed.

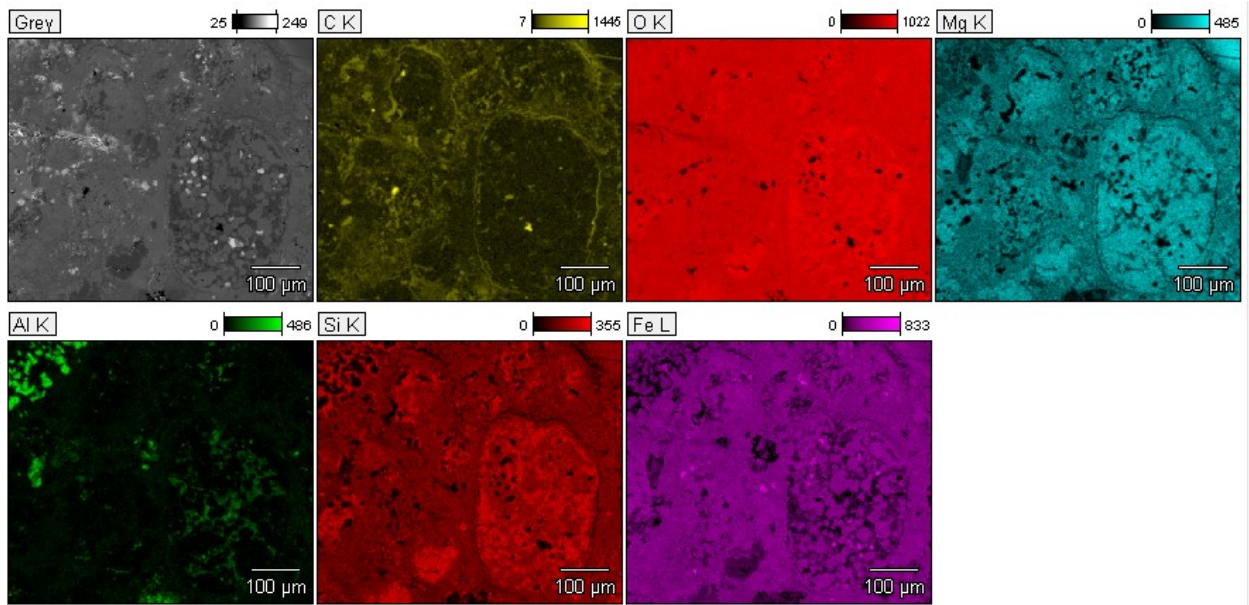
The resolution used and the amount of data collected should have made detection of SiC straightforward. It may be that this particular cross section did not contain any SiC. Perhaps the map resolution was too coarse. To proceed with this investigation other meteorite samples have been acquired including types CM and CV. These will be analyzed in the near future.

### References:

[1] R. M. Stroud, *et. al.*, Microsc. Microanal. **23** (Suppl 1), 2017 p. 2134.



**Figure 1.** Spectrum of SiC. 5kV



**Figure 2.** Net counts map from CO3 type meteorite. 5kV, 512 x 442 resolution.