GRAPHITIC RAMAN SPECTRA IN ANGRITES: A SOURCE OF HIGH-TEMPERATURE CARBON?

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Introduction: Carbon, in varying quantities, has been identified by stepped combustion within many angrites [1]. What is unclear is exactly where this carbon is located within the samples. In terrestrial samples, carbon is usually dissolved within silicate minerals as CO_3^{2-} ions (e.g [2]) and potential indigenous carbonate has been found associated with several of the angrites [3-5]. However while evidence for carbonates is present in our stepped combustion results, its release temperature is too low to account for the high temperature carbon component. Other possibilities for the component are graphite, as hypothesized in Angra dos Reis [6] and found in some Martian meteorites [7-8], or uptake of dissociated C atoms [9]. We have undertaken a systematic study of several samples by Raman spectroscopy to investigate the form of carbon in angrites.

Analytical: 6 Angrite polished mounts were prepared and then characterized in the scanning electron microscope at the Open University, using low vacuum to avoid contamination by carbon coating. Five areas from each sample were chosen and mapped in ~ 100 X 100 μm grids using a 473 nm blue laser with 1-2 mW power. Some depth profiling was also attempted. Separate spectra were taken of the mounting resin and the polishing paste in order to rule out contribution from either of these sources.

Results: 5 of the 6 samples analyzed showed a G band at ~ 1600 cm^{-1}, consistent with the presence of nanocrystalline graphite [10], after correcting for the resin used to mount the samples. Graphitic signatures tend to cluster around the abundant sulfide minerals. The same signatures are found within cracks, possibly representing contaminants, and in grain boundaries.

Discussion: Given the lack of organic signatures, the care taken to avoid graphitic carbon in the preparation process, and the removal of any spectra resembling the mounting resin used, we think it unlikely that these spectra are from contaminants. In addition the peaks are found in specific areas rather than the ubiquitous occurrences in cracks that one would expect from widespread contamination. It therefore seems possible that they are from small pockets of graphitic material exsolved during crystal formation in areas of low fO_2. Further work with TEM wafers of some of these areas and FTIR mapping should serve to confirm or refute the suspected presence of graphite and shed light on the presence of silicate bound CO_3^{2-} ions.

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