THE DETECTION OF SIC *IN SITU* IN CM METEORITES: A PROGRESS REPORT.

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The presence of SiC, that is probably interstellar in origin, in CM and some ordinary chondrites is now well established[1,2]. However, all evidence for SiC has been obtained from highly concentrated acid residues. Almost nothing is known of the petrologic context in which the SiC grains are situated in the meteorites. Nor is certain what effect the acid treatments have on the SiC grains themselves. For these reasons Swan *et al.* (1989) proposed a method by which SiC grains could be detected *in situ*.

This method utilizes the differences in Si X-ray production rates between SiC and silicate material. From X-ray maps, SiC grains of sufficient size can be detected, even when embedded in a silicate matrix, by selecting only those pixels that have Si X-ray intensities above a chosen threshold. Using this principle we have undertaken a extensive *in situ* search using a Jeol 840 SEM with a Tracor Northern ultrathin/Be window Si-Li Micro ZII detector and 5400 Series II image processor. Under a standard set of operating conditions an effectively infinite SiC grain gives on average 75 Si counts/pixel which compares with 20 to 40 counts/pixel for most silicates. Because the vast majority of SiC grains are small, less than 1-2μm, a threshold of 50 counts/pixel was set. Statistical fluctuations in X-ray production occasionally results in silicates, particularly olivine and pyroxene, giving pixel intensities of this order. These can be effectively removed by adding a second Mg threshold criterion.

Since the aim of this search was not simply to find SiC grains, but to be able to estimate their concentration, the efficiency of detection must also be known. The efficiency is a function of the size of the SiC grains, the stepping distance of the beam during X-ray mapping, the X-ray production rate per unit volume of SiC and silicates, and the interaction volume of the electron beam within the specimen. Fig. 1 shows the results of a simple geometric model used to estimate the detection efficiency. Since the interaction volumes and production rates are not known with great accuracy the model was fitted to a series of experimentally determined efficiencies. These experimental efficiencies were found, at 800 times magnification, by repeated mapping of *in situ* SiC grains of known size.

The single greatest obstacle in this search has been sample preparation. SiC is one of the most commonly used abrasives. It has been our experience that the use of SiC at any stage of sample preparation leads to levels of contamination that far exceed the concentration of indigenous material. Our current search has been conducted on a thin section of Cold Bokkeveld (CM) provided by R. Hutchison (BMNH) that was prepared without the use of SiC. An

additional problem that has yet to be addressed is the possibility that the very hard SiC grains are plucked from the sample leading to erroneously low estimates of the SiC concentration.

Despite efforts to minimize the possibility of contamination, additional proof of the indigenous nature of any SiC grains found would seem imperative. The only unambiguous test is isotopic analysis in the ion probe since most, but not all, SiC grains have anomalous C and/or Si isotopic compositions. Ion probe analysis requires grains at least 1-2μm across and conditions were chosen that optimize the probability of finding grains in this range or larger.

To date a total of 16 SiC grains, ranging from 0.6-2.4μm in diameter, have been found after analysis of an area of 0.169 cm^2 using magnifications ranging from 400 to 800 times. All occur as single grains in the matrix of Cold Bokkeveld. None of them appear to be associated either with any other identifiable minerals or unique clasts. Two of the 'grains' appear to be composites of at least two subgrains. All grains have smooth surface morphologies and there is no evidence for the 'fluffy' morphologies observed for some SiC grains recovered from acid residues. When corrected for detection efficiency the concentration of SiC grains in this size range is estimated to be approximately 3ppm in agreement with previous estimates from acid residues of Murchison[4]. The estimated concentration of SiC in conjunction with stereoscopic examinations strongly suggest these grains are, indeed, *in situ*. To confirm this identification ion probe measurements are currently in progress. (1) Bernatowitz *et al.* Nature (1987) 330, 728-730; (2) Alexander *et al.* (1989) Meteoritics, in press; (3) Swan *et al.* (1989) L. P. S. C. XX, 1093; (4) Zinner *et al.* (1989) G.C.A. 53, 3273-3290.

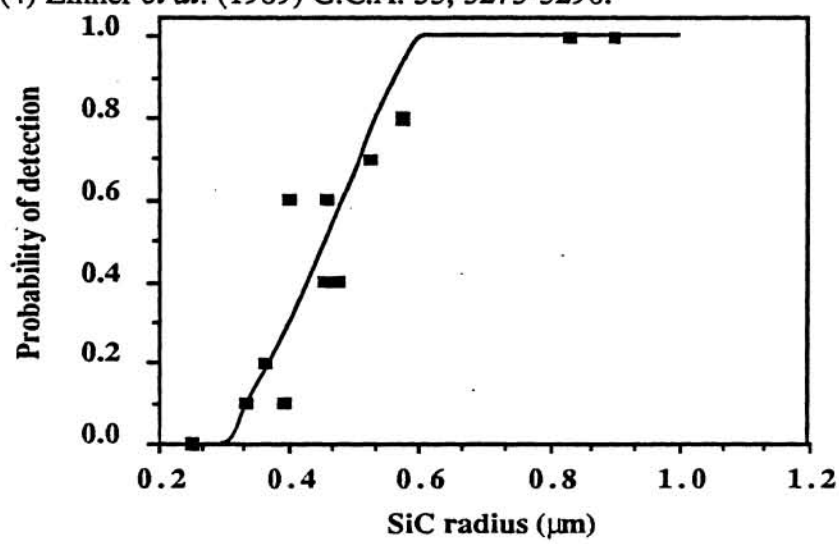

Fig. 1. The detection efficiency as a function of SiC grain radius at 800 times magnification. The solid line is a theoretical curve based on an assumed radius for the interaction volume of 0.45μm. The squares indicate measured efficiencies from ten runs on each grain.