

MINERALOGY OF MICROMETEORITES FROM GREENLAND AND ANTARCTICA: INDICATIONS FOR THEIR ASTEROIDAL ORIGIN. W. Beckerling and A. Bischoff, Institut für Planetologie, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany

One of the major questions concerning the origin of cosmic dust particles, including tiny interplanetary dust particles (IDPs) collected in the stratosphere, deep sea particles (DSPs) collected with a magnetic rake from deep sea sediments, and micrometeorites mostly collected in Antarctica and Greenland [1,2], is whether they represent asteroidal or cometary materials. Regarding micrometeorites it is also of significance to find evidence for or against a relationship to known types of meteorites. In order to obtain information about the origin of micrometeorites we have studied the mineralogy and chemical composition of 161 micrometeorites from Greenland (100-200 μm in size) and 66 micrometeorites from Antarctica (50-100 μm in size). The bulk composition of these particles has been published previously [3,4].

Most of the micrometeorites $>100 \mu\text{m}$ showing a spherical shape are melted during atmospheric heating, whereas the major part of the particles $<100 \mu\text{m}$ is unmelted or partly melted. A detailed statistic of the investigated particles is given in Table 1. Please note that an unknown portion of the fine-grained porous particles from Greenland was destroyed during laboratory preparation [1].

Relict minerals which escaped melting during atmospheric heating are the best candidates for a comparable study with other extraterrestrial material. Within 66 of the 227 investigated micrometeorites 140 relict olivines and 84 relict pyroxenes were found. Other relict minerals include perovskite (\pm ilmenite), chromite, Fe,Ni-metal, magnetite, and sulfide.

The Fa-distribution of the relict olivines ($>4\mu\text{m}$) can give a first indication of a relationship to ordinary and carbonaceous chondrites [5]. Olivines from ordinary chondrites do not contain CaO in considerable amounts since only a small number of olivines in micrometeorites containing about 14 to 27 wt.% FeO (FeO concentration of olivine in type 4-6 ordinary chondrites) are poor in CaO (see Fig. 1a), only a very small number of micrometeorites can originate from parent bodies similar to ordinary chondrites. The vast majority of relict olivines shows similarities to olivines occurring in Type I and Type II chondrules from carbonaceous chondrites, to isolated olivines in the matrix of C2 and C3 chondrites and to matrix olivines in type III carbonaceous chondrites [5]. Taking into account the relatively high amount of NiO (0.3 to 0.4 wt.%) in some relict olivines with FeO-contents of 30 to 35 wt.% (Fig. 1b) a relationship to olivines within the metamorphosed carbonaceous chondrites (CK-chondrites; [6]) and to olivines described from the Rumuruti chondrite group (R-chondrites; [7]) is given. Similarities to minerals from achondritic meteorites were not found.

TEM-measurements of 16 fine-grained porous micrometeorites have demonstrated that most have abundant small olivines (typically $<100 \text{ nm}$) with variable Fa-contents of 15 to 68 mol%. Magnetites, pyroxenes, and glass are less abundant [8]. The texture of the matrix of these fine-grained porous particles is similar to that of experimentally heated phyllosilicate-rich materials of the carbonaceous chondrite Orgueil [9]. Phyllosilicates are transformed within a few seconds of heating to a mineral assemblage of olivines, pyroxenes, magnetite, and glass [9]. Thus, the tiny phases of the matrix of fine-grained porous micrometeorites can probably not be considered as relict minerals. According to the well known transformation of phyllosilicates into Fe,Mg-silicates, we assume that phyllosilicate-rich micrometeoroids are most probably common precursors of the fine-grained porous particles consisting of small olivines.

The asteroids regarded as the parent bodies of meteorites can also be considered as the parent bodies of micrometeorites. Based on the study of [10] the majority of asteroids appears to consist of materials related to carbonaceous chondrites (asteroids of types B, C, F, G, D, P). Only a very small number of asteroids exists that may be related to ordinary chondrites [10,11]. This is in good agreement with the results on relict minerals in micrometeorites investigated in this study. It is obvious that statistically micrometeorites with relict minerals much better represent the abundance of distinct types of asteroids than the abundance of distinct groups of meteorites as revealed from the frequency of meteorite falls.

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References: [1] Maurette M. et al. (1990) in *From Mantle to Meteorites*, 87-126. [2] Maurette M. et al. (1992) *LPSC 23*, 859-860. [3] Beckerling W. et al. (1992) *Meteoritics 27*, 200-201. [4] Beckerling W. and Bischoff A. (1993) *Ann. Geophys.* 11 III, C476. [5] Beckerling W. et al. (1993) *Meteoritics 28*, 320-321. [6] Geiger T. and Bischoff A. (1989) *Meteoritics 24*, 268-270. [7] Bischoff A. et al. (1994) *Meteoritics 29*, 264-274. [8] Beckerling W. et al. (1994) *Meteoritics 29*, 442-443. [9] Klöck W. and Stadermann F.J. (1994) *AIP Conf. Proc.* 310, 51-87. [10] Gaffey M.J. et al. (1989) in *Asteroids II*, 98-127. [11] Gaffey M.J. et al. (1993) *Meteoritics 28*, 161-187.

Table 1: Number of micrometeorites collected in Greenland and Antarctica.

| | | Greenland | | Antarctica | | |
|--------------------------|------------------|-------------------------|--------|------------------------|--------|-----|
| size | | 100 - 200 μm | | 50 - 100 μm | | |
| texture | | number | % | number | % | |
| spheres: | glassy | 29 | 18.0 % | - | - | 29 |
| | barred | 58 | 36.0 % | 5 | 7.6 % | 63 |
| | porphyritic | 54 | 33.5 % | 12 | 18.2 % | 66 |
| partly melted particles: | scoriaceous | - | - | 8 | 12.1 % | 8 |
| not melted particles: | kompact | 8 | 5.0 % | 7 | 10.6 % | 15 |
| | poikilitic | 4 | 2.5 % | 2 | 3.0 % | 6 |
| | fine-gr., porous | 8 | 5.0 % | 32 | 48.5 % | 40 |
| Σ | | 161 | | 66 | | 227 |

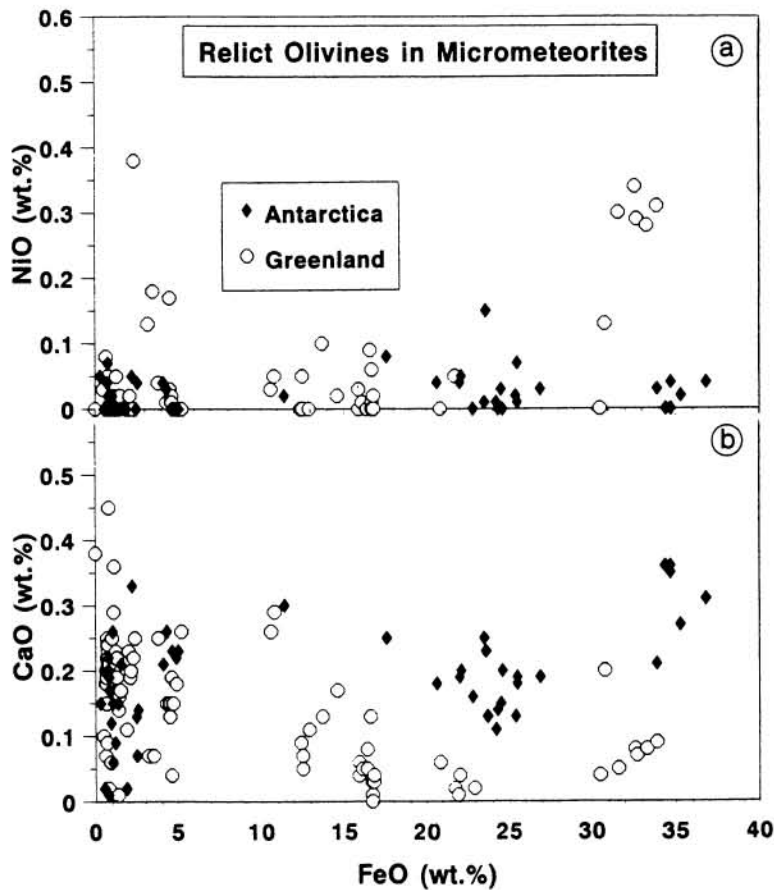


Fig. 1: NiO-, CaO- and FeO-concentrations of relict olivines in micrometeorites from Greenland and Antarctica. All data in wt. %.