WHEN A CM GROUP METEORITE DECOMPOSES AT THE SEA FLOOR - WHAT WILL REMAIN?

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Introduction: Recently our group has successfully recovered relict chromite grains (ca. 63-150 µm) from unmelted meteorites and micrometeorites that have fallen and decomposed on ancient sea floors, up to 470 Myr old, e.g. [1]. We dissolve 30-100 kg of slowly formed (ca. 2 mm per kyr) marine limestone in HCl and HF acid. This can yield an almost clean assemblage of resistant chromite from ordinary chondrites. Noble gas analyses of the chromite grains indicate that they mainly originate from micrometeorites [2]. Because carbonaceous chondritic material, primarily CM-group material, makes up a significant fraction of the micrometeorite flux today, we are testing if there are resistant minerals in this type of meteorite that can be recovered from ancient sediments. For different chondrite groups different oxide minerals have been reported. Chromite dominates the oxide fraction in ordinary chondrites, in enstatite chondrites oxides are rare, chromian spinel dominates in R chondrites, whereas in carbonaceous chondrites a wide range of oxide minerals occur, e.g magnetite, chromite and different spinel group varieties [3, 4]. In CM2 meteorite Murchison spinel is primarily found in CAIs and as inclusions in olivine, chromite grains are found in matrix and in CAIs [5]. Here we further evaluate what is the case for CM meteorites, with focus on large spinel grains.

Methods: Two four-gram samples of CM2 chondrite Acfer 331 were treated in strong HF acid for 24 hours. All spinel grains >63 µm were recovered from the residue under an optical microscope. The grains were mounted in epoxy, polished flat and analysed with SEM-EDS, see [1].

Results: The samples contained 17 and 20 spinel grains >63 µm, respectively. Most grains are 63-150 µm, a few grains reach ca. 250 µm. Pink and colorless grains dominate, but red and blue grains also exist. The grains are all rich in Al and Mg whereas Cr and Fe contents are low: Mg 13.2-14.6 at%, Al 24.8-28.3 at%, Cr up to 3.4 at% and Fe up to 1.2 at%. Ti and V contents are mostly low, but Ti occurs up to 0.1 at% and V up to 0.2 at%. The grains richer in Cr are mostly pink or red, whereas colorless grains generally are poorer in Cr. The grains are often heterogeneous in composition; in backscatter mode they often show patchy or gradational variations, a few grains show zoning. The within-grain variations reach maximum 1.5 at% for Cr and 0.3 at% for Fe.

Conclusions: A CM meteorite of one gram being dissolved on the sea floor may thus leave behind ca. four to five relict spinel grains >63 µm. These grains can be recovered from sediment samples with the same methods we use for recovering ordinary chondritic chromite. As a comparison, chromite makes up 0.25 wt% of ordinary chondrites [6], but this includes chromite grains in all size fractions. Apparently our approach of recovering ancient spinels can be extended to reveal the flux variations through Earth history of several of the meteorite types that fall on Earth today.

References: [1] Cronholm A. & Schmitz B. 2010. *Icarus* 208:36-48. [2] Heck P. R. et al. 2008. *Meteoritics & Planetary Science* 43:517-528. [3] Rubin A. E. 1997. *Meteoritics & Planetary Science* 32:231-247. [4] Simon S.B. et al. 1994. *Geochimica et Cosmochimica Acta* 58:1313-1334. [5] Fuchs L. H. et al. 1973. *Smithsonian Contributions to Earth Sciences* 10:1-39. [6] Keil K. 1962. *Journal of Geophysical Research* 67:4055-4061.