NORTHWEST AFRICA 11118: A UNIQUE ACCRETIONARY AGGREGATE

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Introduction: Accretion is a fundamental process in the Solar System that finally led to the formation of our planets [1]. Rock textures that document these sticking processes of primordial dust-sized material are best preserved in chondritic meteorites. In particular CM-type carbonaceous chondrites often display accretion textures characterized by agglomerated chondrules, Ca,Al-rich inclusions, mineral and chondrule fragments most of which are surrounded by dust rims [2]. Interstitial to these objects is fine-grained matrix that constitutes ~70 vol% of the rock [2]. However, the primary textures have generally been modified by aqueous alteration as well as thermal and impact metamorphism hindering an undisguised view on the primary accretion processes in the early Solar System. In this study, we report on the characterisitcs of the unique accretionary aggregate Northwest Africa (NWA) 11118.

Results: NWA 11118 was found as a black individual of 222 gram partly covered with fusion crust near Dakhla City, Western Sahara. The rock diffuses an organic smell and is unusually light. It has a bulk density of 1.95 g/cm^3 and, depending on the method applied, a porosity between 30% (BSE image analysis) and 38% (CT scanning). The meteorite displays a perfect accretion texture of chondrules, chondrule and mineral fragments and rare CAIs virtually all surrounded by fine-grained dust rims. Matrix-dominated areas are largely missing. The different components stick directly together at their respective dust rims. Often these fine-grained rims are found empty, i.e., the previously enclosed object is no longer preserved. Chondrules and their fragments are the most abundant coarse-grained components (~35 vol%) and mostly of porphyritic-olivine and porphyritic-olivine-pyroxene types. Compositionally, FeO-poor chondrules (olivine Fa0.3-6) are dominant over FeO-rich chondrules (Fa up to 75.8). Chondrule pyroxene is mostly enstatite with Fs1.0-4.3 and Wo0.9-3.8. In several chondrules the mesostasis appears to be at least partly glassy. CAIs constitute about 1-2 vol% of the meteorite and are almost exclusively of spinel-pyroxene-rich types. Opaque phases in NWA 11118 include FeNi-metal, pyrrhotite, high- and low-Ni pentlandite and chromite. Parent body formed alteration products occur subordinate and include sponge-like aggregates, ferrihydrite, phyllosilicates and calcite in the very few “matrix-like” patches. Fine-grained dust rims surround nearly all coarse components and make up ~30 vol% of the meteorite. They are dominantly composed of <1-5 µm sized Fe-Mg-silicates, magnetite, Fe-Ni-sulfides and hydrous phyllosilicates. Fine-grained matrix, a major component in carbonaceous chondrites is almost completely missing in NWA 11118. The oxygen isotopic composition was determined using a representative whole rock sample of NWA 11118 and gives δ^{18}O‰=6.764, δ^{17}O‰=0.670, and Δ^{17}O‰= -2.901.

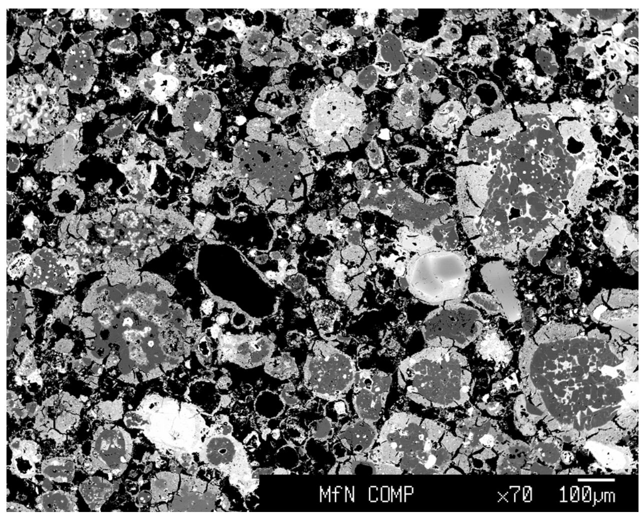

Figure 1. Backscattered electron microscope image of the texture of NWA 11118.

Discussion: According to some textural characteristics but mainly with respect to its oxygen isotopic composition NWA 11118 was classified as a CM2 chondrite [3]. However, the meteorite shows some striking differences to typical CMs, most importantly: the lack of matrix-dominated areas, the absence of major amounts of hydrous phases, “empty” dust rims with so far no hints for the missing material, and a very high porosity that results in a low bulk density. NWA 11118 is, thus, an unique very loosely consolidated highly porous accretionary aggregate that will allow new and largely undisturbed insights into early solar nebula accretion processes.

References: [1] Johansen A. et al. (2015) *Sci. Adv.* 1: id. e1500109. [2] Metzler et al. (1992) *Geochimica et Cosmochimica Acta* 56: 2873-2897. [3] *Meteoritical Bulletin* (2017) 106, in preparation.