

UNGROUPED CHONDRITE CHUG CHUG 086.

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Introduction: The ungrouped chondrites have attracted a lot of attention recently. This group includes highly reduced chondrites such as Acfer 370 [1] and even more reduced ungrouped chondrite El Médano 301 (EM 301) [2]. Acfer 370, an ungrouped chondrite of petrologic type 3 [1] and NWA 7135, an ungrouped chondrite of petrologic type 3/4 [3], that show affinities with dark chondritic clasts in the Cumberland Falls aubrite (CFC) [4]. Other chondrites, defined as low-FeO ordinary chondrites, have OC whole-rock chemical composition but olivine and pyroxene richer in Mg than OCs [5]. It was suggested that these clasts are the fragments of an otherwise unsampled “F chondrite” (F for “Forsterite”) parent body which upon a collision with the aubrite parent body led to the formation of Cumberland Falls polymict breccia [5]. Chondritic clasts inside IIE iron meteorites (also reduced), defined as HH chondrites, with reduced olivine and pyroxene compositions and higher concentration of siderophile elements than OCs, are thought to be fragments of a different parent body than H chondrites [6-8]. Here we report results on investigation of a new ungrouped chondrite from Chile, Chug Chug 086 (CC 086), and discuss its affinities with other reduced ungrouped chondrites.

Results: One piece of the meteorite was found in the desert of Chile by Mr. T. V. Kryachko. A sample of the meteorite has a brown fusion crust. Meteorite consists of well-defined chondrules (~90%) and matrix (~10%), average size of chondrules is 283 ± 270 μm , however, several chondrules, up to 4 mm, also occur. POP, OP and PP chondrules are abundant, BO and PR chondrules are rare. One Al-rich chondrule occurs in the section. CAIs are absent. Main minerals in the meteorite are olivine, pyroxene, Fe,Ni-metal, troilite, glass and products of terrestrial weathering. Silica, schreibersite, and chromite are secondary minerals. Modal abundance of weathering products, Fe,Ni-metal and troilite – 19 vol.%. Glass of plagioclase composition occurs in chondrules. Shock features are minimal and correspond to stage S1, weathering grade is W3. Average olivine composition is Fa 2.13 \pm 0.08, and average orthopyroxene composition is Fs 12.3 \pm 5.00, Wo 1.21 \pm 1.20, Fe/Mn = 21.2 ± 8.7 , clinopyroxene is represented by pigeonite (Fs 10.5-27.5, Wo 6.6-14.8), augite (Fs 2.6-22.4, Wo 30.3-43.7) and diopside (Fs 1.0-9.2, Wo 46.0-49.6). Plagioclase glass in chondrule has variable composition: Ab 9.7-83.4, Or 0.13-17.4. Fe,Ni-metal contains 6.37 wt% of Ni, 0.46 wt% of Co, and sulfide is represented by troilite.

Oxygen isotopic compositions of CC 086 are: $\delta^{17}\text{O}$ 2.923, 2.949; $\delta^{18}\text{O}$ 4.312, 4.464; $\Delta^{17}\text{O}$ 0.715, 0.628 (‰).

Discussion: Olivine and pyroxene in CC 086 are very reduced than those in OCs. Olivine is homogeneous and orthopyroxene has variable composition like those in very reduced ungrouped meteorite, EM 301, with average olivine and low-Ca pyroxene of Fa 3.9 \pm 0.3 and Fs 12.8 \pm 4.9, respectively. These values are far lower than the values for OCs and even for chondrites designed as “reduced” chondrites. Olivine and low-Ca pyroxene are the dominant mineral phases, and low-Ca pyroxene shows zoning with higher MgO contents along the crystal rims (reverse zoning). The Co content of kamacite is in the range of that observed in H-chondrites (0.46 wt%). Oxygen isotopic compositions are $\Delta^{17}\text{O} = +0.72, +0.63$ ‰, are similar to that of H-chondrites, and closed to that of the reduced chondrite Acfer 370. CC 086 shows some similarities with EM 301, CFC, NWA 7135 and Acfer 370 ungrouped chondrites. However, unlike NWA 7135 and the clasts, it does not contain highly reduced mineral phases like dauberelite. Thus, this meteorite is an ungrouped forsterite-rich chondrite although its oxygen isotopic composition, average chondrule size and Co content in kamacite are in the range of H chondrite. The CC 086 olivine composition probably does not correspond to the Prior’s law – the more abundant metal, the less reduced olivine and low-Ca pyroxene in chondrites – like for all ordinary chondrites. Modal abundance of weathering products, Fe,Ni-metal and sulfide in CC 086 is much lower than that of EM 301 (31 vol.%), but it is difficult to value a precise real content of the Fe,Ni-metal phase.

Homogeneous olivine, very well-delineated chondrules and presence of glass in chondrules make difficult also to determine petrological type of this chondrite. Since olivine is homogeneous and chondrules are well delineated, the petrological type should be 4, however glass in some chondrules may indicate petrological type close to 3.

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