

THE TAFASSASSET PRIMITIVE ACHONDRITE, ITS ORIGIN AND RELATIONSHIP TO CHONDRITES

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Introduction: Discovery of partially melted, equilibrated meteorites possibly related to CR and CV chondrites [1] and recent evidence for an internally-generated magnetic field on the CV parent body [2] suggests the possibility of partially differentiated asteroids having unmelted, chondritic surface materials. Thus, it is important to study the primitive achondrites that are closely linked to chondrites, to understand the chondrite-achondrite transition and the structures of asteroids. Tafassasset (Tafa) is a metal-bearing primitive achondrite, whose classification has been debated, as it contains similarities to both brachinites [3] and CR chondrites [4,5]. Here we revisit the petrology of Tafa to understand its link to brachinites and its chondrite protolith.

Petrography: Tafa is a find consisting of 26 stones with textural/compositional variability [6]. We have studied 3 sections of Tafa from different collections (Paris, Freiburg and M. Kilgore) and find that all show a similar range of textural variability. Tafa consists of both olivine-dominated regions showing equilibrium textures (triple junctures) and coarser grained, pyroxene-rich regions. Olivine-rich regions are marked by higher plagioclase volumes, whereas pyx-rich areas have higher metal. We suspect it is this textural variability that led to misinterpretation of the pyx-rich regions as relict metal-rich CR chondrules [4]. The large pyx grains show augite exsolution and poikilitic olivine. Metal, plag and chromite are nearly always interstitial with the exception of minor (micron-sized) metal blebs enclosed within some silicate grains. Modally, Tafa contains 8-10 vol. % metal, similar to CR chondrites, which have up to about 7.4 vol. % [7]. Silicate abundances, calculated on a metal-free basis, are very similar to Brachina as are Tafa's mineral compositions [3, 8].

Discussion: The metal-rich character of Tafa, compared to brachinites [3], is intriguing, as is its oxygen isotope composition which is similar to CR chondrites and unlike main group brachinites [4,5]. Heterogeneity in the oxygen isotopes among different samples of Tafa [5], attests to its primitive character. Its composition is fractionated from CI with Al/Mg and Mn/Mg similar to Brachina, Lodran and Divnoe [9]. Its O isotopes, although similar to CR, are also similar to the LEW 88763, anomalous brachinite [10]. Tafa is an unusual brachinite that formed by melting, and annealing of a CR-like precursor and is derived from a complex, partially differentiated parent body.

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