PETROLOGY AND MINERALOGY OF THE NORTHWEST AFRICA 13943 (CK4/5) CHONDRITE.

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Introduction: CK (Karoonda-like) carbonaceous chondrites (CCs) are highly oxidized meteorites, with metal/magnetite ratios close to zero [1]. Unlike other CCs (petrologic type: 1 – 3), most CK chondrites have suffered intense thermal processes on their parent body with a petrologic type 4 or above (550 – 1270 K) [2]. Lines of evidence indicate that CK chondrites could be genetically related to CV (Vigarano-like) chondrites which are mostly type 3 meteorites [3]. Here, we report the petrology, mineralogy as well as bulk O isotopes and nucleosynthetic anomalies in Cr (ε^{54}Cr) of another newly collected CK chondrite Northwest Africa (NWA) 13943 in Algeria. This study would shed light on the genetic relationship between CK and CV chondrites.

Results and Discussion: NWA 13943 is a single cone-shaped stone with an intact fusion crust and weighs 93.6 g. It is composed of olivine (~78 vol.%), pyroxene (~9 vol.%), plagioclase (~5 vol.%), and abundant Cr-bearing magnetite (~7 vol.%) with minor Ca, Mg carbonates (mainly occurring along the cracks). A small number (~7 vol.%) of chondrules (with diameters of 0.6 ± 0.4 mm) are set in a fine-grained recrystallized matrix dominated by olivine. Chondrules are mainly composed of porphyritic olivine (PO) and olivine-pyroxene (POP). The size range of the secondary plagioclase grains (D = 16.9 ± 6.7 μm, n = 206) in NWA 13943 is consistent with that in typical CK5 chondrites (CK3: no plagioclase; CK4: D < 4 μm; CK5: 4 μm < D < 50 μm; CK6: D > 50 μm) [1].

The Fa values of olivine grains within chondrules (28.3 ± 0.5) and matrix (30.2 ± 1.3) fall into the ranges previously reported for CK4 – 6 (chondrule olivine: Fa_{31-32}; matrix olivine: $Fa_{28.8-33.3}$) [4]. But pyroxenes show relatively large chemical variation (low-Ca pyroxene: $Fs_{27\pm6.3}Wo_{1.9\pm3.8}$, FeO/MnO = 52 – 76, n = 79; and high-Ca pyroxene: $Fs_{16.4\pm4.5}Wo_{29.9\pm1.8}$, FeO/MnO = 37.4, n = 3). Both Na-rich plagioclase ($An_{23.5\pm11.1}Ab_{74.0\pm10.7}$, n = 22) and Ca-rich plagioclase ($An_{82.6\pm12.8}Ab_{17.4\pm12.8}$, n = 10) are present. The chemical compositions (Cr_2O_3: 1.9 – 5.9 wt.%, TiO_2: 0.05 – 0.45 wt.%, Al_2O_3: 0.24 – 2.11 wt.%, MgO: 0.03 – 0.29 wt.%, Fe_2O_3: 61.3 – 66.4 wt.%) of magnetite in NWA 13943 also falls within the range of CK4 – 6 [5], except for a few extremely Cr-rich magnetites (up to 11.4 wt.%). Fe_2O_3 were calculated from stoichiometry [6].

The oxygen isotope of CK chondrites ($\delta^{17}O$ = -5.91 – -2.53‰, $\delta^{18}O$ = -2.24 – 1.76 ‰) fall near the carbonaceous chondrite anhydrous mineral (CCAM) line overlapping with the CVs ($\delta^{17}O$ = -5.81 – -1.77‰, $\delta^{18}O$ = -1.67 – 2.95 ‰) [3]. The bulk oxygen isotope compositions of NWA 13943 ($\delta^{17}O$ = -3.13 ± 0.02‰, $\delta^{18}O$ = 1.35 ± 0.01 ‰, $\Delta^{17}O$ = -3.85 ± 0.01) are close to that of previously reported CK chondrites. On the other hand, $\Delta^{17}O$-ε^{54}Cr plot shows that ε^{54}Cr of NWA 13943 (0.68 ± 0.09) falls between the CK and CV chondrites [7]. The slightly higher $\Delta^{17}O$ for NWA 13943 may be attributed to aqueous alteration [8] and/or terrestrial weathering [9].

Collectively (chondrule diameter and proportion, magnetite abundance, grain size of secondary plagioclase, Fa contents of olivine in chondrule and matrix as well as chemical composition of magnetite), it is clear that NWA 139435 is a CK4/5 chondrite. Integrating mass independent Cr (ε^{54}Cr) and O isotopes ($\Delta^{17}O$), it is legitimated to infer that CK and CV chondrites may derive from a similar isotopic reservoir in the protoplanetary disk.

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