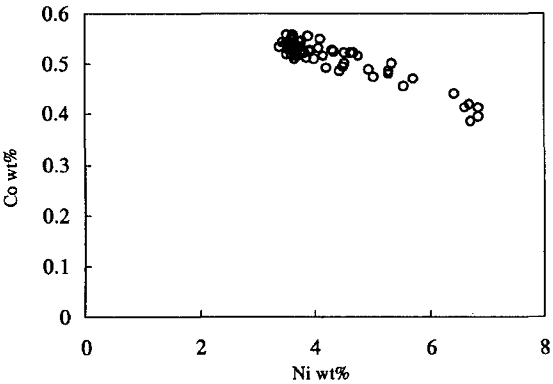

Fig. 1. Cobalt vs. Ni in GRO 95551 kamacite.

small chondrule clasts, Fe,Ni metal, and troilite. Achondritic silicate clasts consist of fine enstatite grains ($Ca_{2-5}Mg_{90-96}Fe_{2-5}$) with a small amount of olivine (Fa_{1-2}), high-Ca pyroxene, and glass. Most chondrules compose of olivine ($Fa_{0.7-0.9}$, $Fa_{1.0-1.5}$), and some chondrules contain enstatite ($Ca_{0.5}Mg_{97-98}Fe_{1.5-2.5}$). The chemical composition of olivines and enstatites is slightly different in individual chondrules. Small chondrule clasts contain Ca-rich pyroxene (Ca_{36} $Mg_{63}Fe_1$). The Fe,Ni metal in GRO 95551 is kamacite. The Si content in kamacite is under the detection limit of electron microprobe analysis. The Co content is 0.4–035 wt%. Kamacite grains show the chemical zonings toward troilite and silicate. Troilite contains 5 wt% Cr.

Discussion: Mason suggested that GRO 95551 resembles Bencubbin-like meteorites because they have both chondritic and achondritic characteristics [1]. We will compare mineralogy of GRO 95551 with Bencubbinlike meteorites, CRs, and CHs to understand the origin of GRO 95551.

Meibom et al. suggested that there are significant differences in the textual occurrences of metal grains in CR-clan chondrites (CRs, CHs, and Bencubbin-like meteorites) [2]. Metal in CRs occurs as rounded chondrules inside chondrites [2]. Metal in Bencubbin-like chondrites occur as large (0.1–10 mm) compositionally uniform clasts welded together with chondrule silicates [2]. Our study suggests that the texture of metal in GRO 95551 resembles that of Bencubbin-like meteorites.

Metal in the CR-clan is generally characterized by a positive Co vs. Ni correlation with a nearly cosmic Co/Ni ratio. This correlation has been interpreted to be either a signature of nebular condensation [3,4] or a result of reduction during chondrule formation [5] or thermal metamorphism [6]. On the other hand, GRO 95551 shows a negative Co vs. Ni correlation (Fig. 1). Our result suggests that the formation process of metal in GRO 95551 is different from CR-clan chondrites.

The Si content in metal of GRO 95551 is also different from that of Bencubbin. Grosvenor Mountains 95551 metal does not contain detectable Si by EPMA although Bencubbin metal contains a significant Si content.

Silicates of GRO 95551 shows different texture from Bencubbin. Although the GRO 95551 silicate part consists mainly of fine enstatite grains, Bencubbin shows a barred-olivine chondrule texture. The size of the silicate part (1 cm in diameter) in GRO 95551 is the same as the Bencubbin silicate part. The model abundance of silicate vs. metal (58:42) in GRO 95551 is almost same as that in Bencubbin (60:40).

Conclusions: Although GRO 95551 resembles Bencubbin in texture, such as a mixture of chondrule, metal, and achondritic clast, our mineralogical study suggested that the formation process of metal and precursor materials of the GRO 95551 silicate part is different from Bencubbin.

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CALCIUM-41, ALUMINUM-26, AND OXYGEN ISOTOPES IN A CIRCUMSTELLAR HIBONITE. B.-G. Choi and G. J. Wasserburg, Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena CA 91125, USA (bchoi@gps.caltech.edu).

We report the discovery of a circumstellar hibonite ($CaAl_{12}O_{19}$) showing clear evidence of ^{41}Ca and ^{26}Al produced in an Asymptotic Giant Branch (AGB) star and O isotopes that were significantly modified by nucleosynthesis in that star. This is the third type of circumstellar oxide discovered from meteorites after corundum and spinel [1–3]. Using an automated SEM scanning procedure [3], among the ~4300 refractory grains from Semarkona (mostly spinel), ~120 corundum, and ~50 hibonite were identified. Among these grains, O isotopes of 73 corundum, 33 hibonite, and 8 spinel were measured using the PANURGE ion microprobe. Among them, six corundum grains and one hibonite were found to have O isotopes that fall in the range of previously identified AGB oxides [1–3]. The hibonite has $^{17}O/^{16}O = 0.00126 \pm 0.00003$ (3.3x solar) and $^{18}O/^{16}O = 0.00152 \pm 0.00006$ (0.76x solar), which fall in the region expected for an AGB star of ~$1.8_{\odot}$ and $Z_{\odot}$ [4]. Silicon and C contents of the grain were low, but the isotopic ratios were measured. The grain has $\delta^{29}Si = 191 \pm 228‰$ and $\delta^{30}Si = 115 \pm 253‰$, which fall in the range of AGB SiC [5,6], but is not resolvable from solar within error. The grain is clearly enriched in ^{13}C ($^{12}C/^{13}C = 51 \pm 20$) that is similar to AGB SiC [5,6]. We cannot rule out a possibility that the Si and C measured were from tiny adhering presolar SiC grains. This hibonite having large Al/Mg and Ca/K ratios allowed us to study the $^{26}Al/^{27}Al$ and $^{41}Ca/^{40}Ca$ of the progenitor AGB star whose initial mass and metallicity are characterized by the O isotopes. Previous efforts to correlate ^{26}Al and ^{41}Ca were made in supernova graphite [7]. Calcium-41 is produced by $^{40}Ca(n,\gamma)^{41}Ca$ in the He shell, while ^{26}Al is mostly produced through $^{25}Mg(p,\gamma)^{26}Al$ in the H shell. It is expected that $^{41}Ca/^{40}Ca = 1 \times 10^{-2}$ in the He shell [8] and $^{26}Al/^{27}Al = 0.8$ in the H shell [9]. The He- and H-shell materials are mixed with the envelope during dredge-ups. With the typical dilution factor of 0.01, $^{41}Ca/^{40}Ca = 1 \times 10^{-4}$ and $^{26}Al/^{27}Al = 8 \times 10^{-3}$ are expected in the stellar outflow. The hibonite shows large excesses in ^{41}K ($^{41}K/^{39}K = 5\times$ solar) and in ^{26}Mg ($^{26}Mg/^{24}Mg = 4\times$ solar), due to *in situ* decay of ^{41}Ca and ^{26}Al respectively. The inferred $(^{41}Ca/^{40}Ca)_o$ is $(1.5 \pm 0.2) \times 10^{-4}$ and the $(^{26}Al/^{27}Al)_o$ is $(4.7 \pm 0.5) \times 10^{-3}$. This is the first measurement of both ^{41}Ca and ^{26}Al produced in an AGB star and the data agree with stellar models within a factor of two. Short-lived radioactive nuclides ^{26}Al and ^{41}Ca were present in the early solar nebula with $(^{26}Al/^{27}Al)_o = 5 \times 10^{-5}$ [10] and $(^{41}Ca/^{40}Ca)_o = 1.4 \times 10^{-8}$ [11] from data on CAIs. Many stellar types including AGB stars have been suggested as sources of these nuclides [9]. If the source of ^{26}Al and ^{41}Ca was an AGB star having similar composition with the one that formed this hibonite, the time interval between the ejection of fresh synthesized material and the formation of CAIs would be 0.75 m.y. with a dilution factor of 0.02. Such a mixture would have increased $^{17}O/^{16}O$ of solar nebula by 6.6% and decreased $^{18}O/^{16}O$ by 1.5%.

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NEW INSIGHTS INTO THE CHEMISTRY OF THE MURCHISON MACROMOLECULE. G. D. Cody III[1], C. M. O'D. Alexander[2], and F. Tera[2], [1]Geophysical Laboratory, Carnegie Institution of Washington, 5251 Broad Branch Road NW, Washington DC 20015, USA, [2]Department