ELEMENTAL ABUNDANCES IN THE METAL OF LOS VIENTOS 263 - AN ANOMALOUS PALLASITE FORMED IN A REDUCED ENVIRONMENT.

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Introduction: Metal-rich meteorites bear important information on the diversity of planetesimals in the Early Solar System. Pallasites, olivine-metal bearing meteorites, characterized by their mineralogy, chemistry and oxygen isotopic composition, include the Main Group pallasites (PMG), the Eagle Station pallasites (PES), and many anomalous members [1, 2, 3]. A growing number of anomalous pyroxene-bearing pallasites have been found that are distinct from the PMG and PES - Vermillion, Yamato 8451, Choteau, NWA 10019, Zinder and NWA 1911 [4,5]. Milton is another unique pallasite, which is similar to ES group in its Fa content with a distinct oxygen isotopic signature [6]. Here, we investigate the origin of a new pallasite – Los Vientos 263 (LoV 263), an orthopyroxene-olivine-kamacite pallasite with many distinctive attributes.

Samples and Analytical Methods: Two samples of LoV 263 were analyzed: a small polished chip that was silicate-dominated with small, isolated grains of metal, and a 2 cm x 4 cm polished slab that ranged from metal-dominated at one end to silicate-dominated at the other end. Laser ablation ICP-MS analysis was performed with a Thermo Element XR™ coupled with a New Wave™ UP193FX excimer laser system at the Plasma Analytical Facility, Florida State University. Elemental abundances across large areas of metal were determined by taking line scans with a 50 µm beam spot scanned at 10 µm/s at 50 Hz repetition rate. Smaller metal grains embedded in the silicate-dominated regions were analyzed with 50 µm spots. Analytical methodology followed [7]. Oxygen isotopic analysis of one 1.5 mg aliquot of a powdered 10 mg bulk silicate sample was performed at CEREGE [8].

Results: The elemental composition of metal in the smaller grains as well as the large metal regions is homogenous. The average element abundances for LoV 263 are given in Table 1. The metal of LoV 263 is low in Ni (5.6%) approaching the cosmic Ni/Fe ratio (0.060 vs. 0.058). The Ni content of LoV 263 is comparable to IIAB irons but does not resemble any of the known iron groups in Ga vs. Ni (Fig. 1) or Ga vs. Ge plots (Fig. 2). The Ga and Ge contents of the metal in LoV 263 are similar to that of IIIAB/Main Group Pallasites (PMG), but the Ni content sets these groups apart from metal in LoV 263. It does not resemble any ungrouped irons in Ni-Ga-Ge relations (not shown).

Table 1: Composition of the metal in LoV 263.

	Conc. (ppm)		*Conc. (ppm)*
V	0.2	Ru	12.4
Cr	4	Rh	1.70
Fe	938000	Pd	1.55
Co	4020	Sn	0.47
Ni	56500	Sb	0.047
Cu	131	W	1.93
Zn	3	Re	1.08
Ga	21.3	Os	11.9
Ge	26.0	Ir	10.6
As	2.14	Pt	18.0
Mo	3.6	Au	0.474

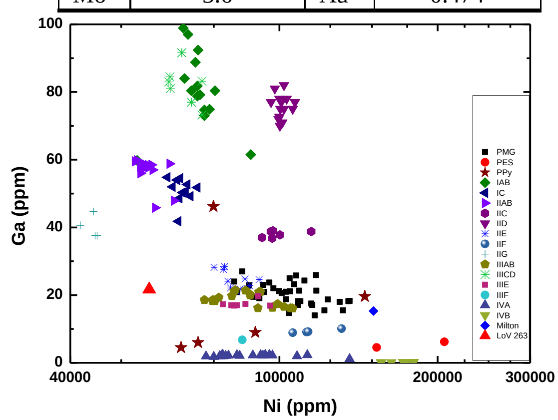

Fig 1. Ga vs. Ni in iron meteorites, showing LoV 263 (solid red triangle) with other irons and pallasites [9,10,11]. PMG – Pallasite Main Group, PES – Eagle Station Pallasite Group, PPy – Pyroxene Pallasites.

The metal from LoV 263 has high Ir and Os compared to PMG (mainly low Ir) which implies that it is early crystallized solid metal. In this respect, it is similar to the Eagle Station group. Figure 3 shows the CI and Ni-normalized siderophile element pattern of metal in LoV 263 as compared to that of Eagle Station. Both Eagle Station and LoV 263 have a sloped profile enriched in compatible siderophile elements and depleted in volatile incompatible siderophile elements (Au, As, Sb, Cu, Ga, Ge, Sn). Eagle Station and LoV 263 show a remarkable similarity in their siderophile profile, except for W, Co, Fe, Ga and Sb.

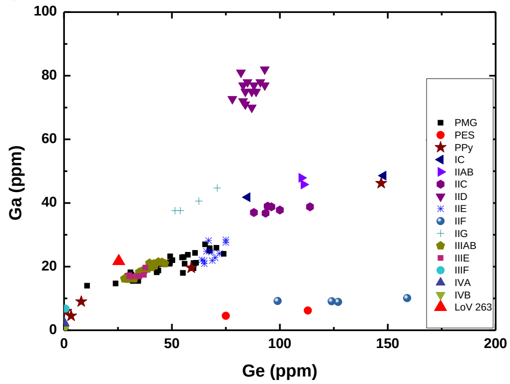

Fig 2. Ga vs. Ge in iron meteorites, showing LoV 263 (red triangle) with other irons and pallasites [9, 10,11].

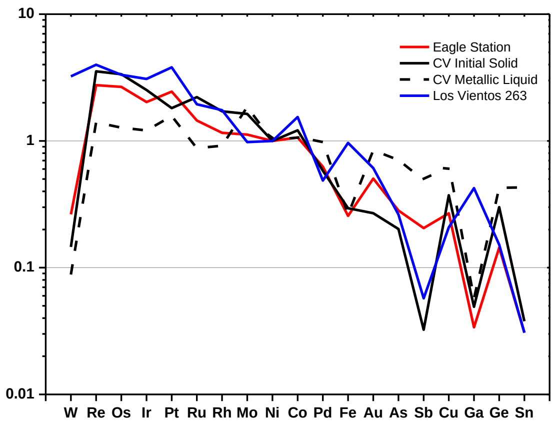

Fig 3. Siderophile element pattern on a Ni and CI-normalized plot for metal from LoV 263, compared with Eagle Station metal and with a metal derived from CV chondrites.

The oxygen isotopic composition of LoV 263 ($\delta^{17}O$=2.09‰ ±0.08‰, $\delta^{18}O$ = 4.34‰ ± 0.12‰, and $\Delta^{17}O$ = -0.187‰ ± 0.03‰) distinguishes it from other pallasites as shown in Figure 4. LoV 263 has a similar $\Delta^{17}O$ signature as PMG, higher than mesosiderites, but has a higher $\delta^{18}O$ than PMG in the same range as mesosiderites. Most pyroxene-bearing pallasites, Milton, and PES plot at much lower $\Delta^{17}O$ (-1 to -5 ‰).

Discussion: Los Vientos 263 is clearly resolved from both the PMG and PES in its elemental composition. The siderophile element profile of metal from LoV 263 looks similar to that of Eagle Station pallasite with the exception of a set of elements that are sensitive to oxidation-reduction processes. The metal from Eagle Station differs from that in LoV 263 by having lower Fe, Co, Ga, and W, which is the result of formation under more oxidizing conditions required to stabilize high-Ni alloy [12]. Thus, a potential relationship between the metals of the two pallasites could include formation of LoV 263 from a more reduced environment. This environment could not have been in its present state, i.e. by reduction of the olivine-opx assemblage in contact with the metal of LoV 263. Equilibration of metal with a basaltic or chondritic liquid, that would supply W and Ga, is required to explain the differences between LoV 263 and Eagle Station.

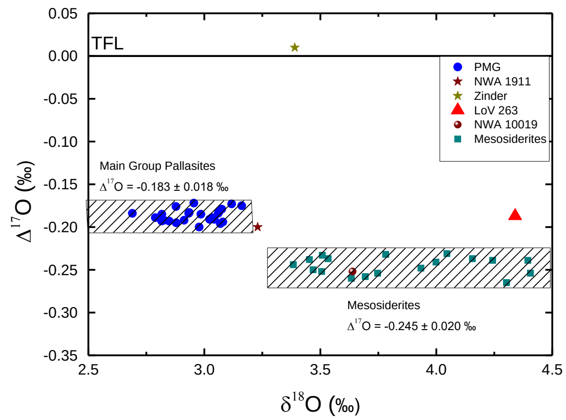

Fig 4. Oxygen isotopic composition of LoV 263 compared to PMG and Mesosiderites [13, 14].

Due to the significant differences in metal chemistry (e.g., Ni) and oxygen isotopes between LoV 263 and PES or PMG, and a lack of similarity to any of the pyroxene-pallasites, e.g. Zinder or NWA 1911 [15], LoV 263 is a unique pallasite. Further relationships and genealogy need to be explored using silicate chemistry and chromium isotopes [16] to understand the geochemical evolution, parent body differentiation and formation of this anomalous pallasite.

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