WULONG: A NEW MAIN GROUP PALLASITE. H. C. Liu[1], X. R. Zhang[2], W. Z. He[2], S. Y. Liao[2], W. B. Hsu[2] and Y. Jiang[2], [1]International Center for Planetary Science, College of Geosciences, Chengdu University of Technology, Chengdu, 610059, China. [2]Center for Excellence in Comparative Planetology, Purple Mountain Observatory, Chinese Academy of Sciences. Nanjing, 210023, China (e-mail: yjiang@pmo.ac.cn).

Introduction: The stony-iron and iron meteorites are differentiated meteorites which provide key information on both the formation and differentiation processes governing the evolution of planets. Pallasites are a unique type of stony-iron meteorites mainly composed of olivine and iron metal. They include the main group, the Eagle station subgrouplet, the pyroxene subgrouplet and some ungrouped ones. 80% of pallasites belong to the main group. It has long been thought that main group pallasites sampled from the core-mantle boundary of a differentiated asteroid [1]. But some different hypotheses have been proposed recently, such as hit and run [2], ferrovolcanism [3] and so on. Although pallasites have received a wide attention among the meteoritical society since 1940s [4], no consensus has been reached on their origin so far.

In this study, we report the min-pet characteristics, O isotope composition and metal phase chemistry of the newly found Wulong pallasite, which is a main group pallasite (MGP).

Fig. 1. Slice of Wulong pallasite.

Petrography: Wulong pallasite was found in Wulong Village, ArongQi City, Inner Mongolia, China in 1990. It weighs ~ 70 kg. It is heavily fractured and exhibits evidence of strong weathering (Fig. 1). Petrologic observations were carried out using a Hitachi S-3400 N scanning electron microscope (SEM) equipped with an Oxford INCA 7021 energy dispersive spectroscope (EDS) at Purple Mountain Observatory (PMO). Its interior is composed of olivine grains (~ 72.7 vol.%) set in an iron metal matrix (~ 26.2 vol.%). Minor minerals include troilite, schreibersite, chromite. The metal phase is mainly kamacite.

Mineral chemistry: Mineral chemical compositions were determined with the JEOL JXA-8230 electron microprobe at PMO. The olivine composition in Wulong is: SiO_2 = 40.3, FeO = 12.0, MnO = 0.3, MgO = 47.4 (all in wt%); mean Fa = 12.5±0.2 mole% (n=46). No chemical zoning is observed within olivine grains. The chromite composition is also homogenous with Al/ (Al + Cr) of 15.2±0.9 and Fe/ (Fe + Mg) of 67.9±1.5 (n=7).

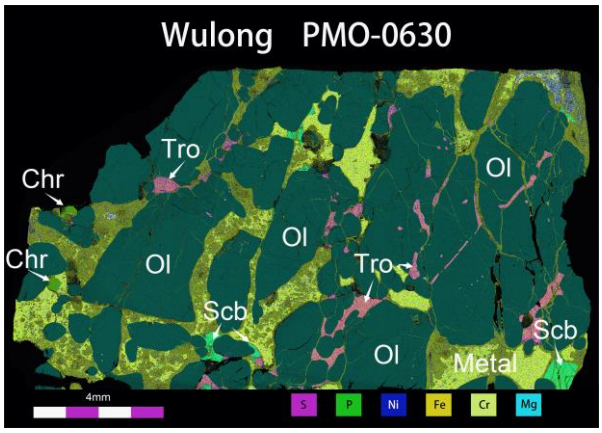

Fig. 2. The BSE image and integrated elemental map of Wulong pallasite, Ol = olivine, Tro = troilite, Chr = chromite, Scb = schreibersite, Metal = metal phase.

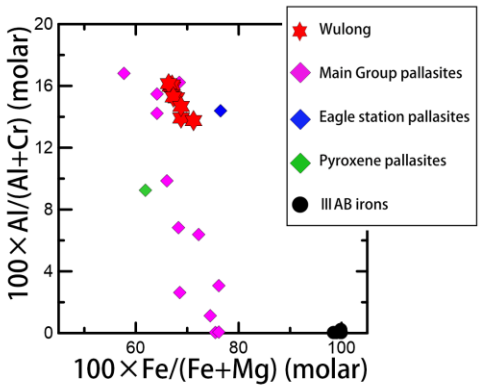

Fig. 3 Chromite chemistry in pallasites and IIIAB irons. Data is from this study and [4].

Iron metal chemistry: Siderophile element contents of a metal phase (~ 0.2 g) were analyzed using a Thermo Scientific™ iCAP™ RQ inductively coupled plasma mass spectrometer (ICP-MS) at University of

Alberta. They are Ni, 7.71 wt%; Co, 0.50 wt%; Mn, 90; Cu, 141; Ga, 17.8; As, 17.4; Ge, 26.2; Ru, 1.1; Pd, 4.5; Ag, 0.009; Cd, 0.008; Sn, 1.76; W, 0.172; Re, 0.01; Os, 0.335; Ir, 0.109; Pt, 1.18; Au, 1.99 (all in ppm).

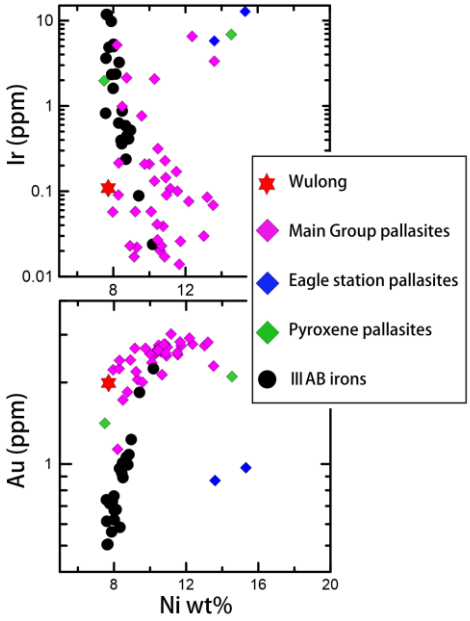

Fig. 4. Metal chemistry in pallasites and IIIAB irons. Data is from this study and [5-6].

Oxygen isotope ratios of olivine: Olivine grains (3~5 mg) were handpicked under stereomicroscope to remove rusty, weathered materials and were analyzed for oxygen isotope analysis by a laser fluorination technique at Nanjing University. The mean $\Delta^{17}O$ value for Wulong olivine is -0.324±0.04, $\delta^{17}O$ value is 1.286±0.008‰, $\delta^{18}O$ value is 3.039±0.008‰.

Discussion: Regardless of its occurrence and morphology, olivine in Wulong is highly uniform ($Fa_{12.5\pm0.2}$) and concordant with that of MGPs ($Fa_{11.2\text{-}13}$ [5]). In addition, Wulong olivine generally plots within the range of MGPs in the triple oxygen isotope space (Fig. 5), but its $\Delta^{17}O$ value (-0.324±0.04) is significantly lower than the mean value of MGPs (-0.183±0.018) [1]. Ir and Au contents in Wulong metal are highly compatible with MGPs, but Ga (17.8 ppm) and Ge (26.2 ppm) are relatively lower than those of Ni-poor MGPs (Ga: 20~27 ppm; Ge: 40~65 ppm) [5], closer to IIIAB irons instead (Ga: 16~26 ppm; Ge: 29~65 ppm) [6]. In terms of its olivine Fa value, metal phase chemistry and oxygen isotope ratios, Wulong could be a new member of MGPs.

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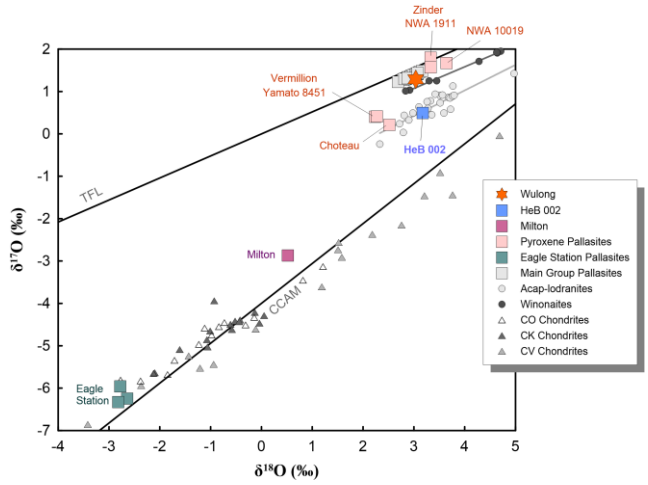

Fig. 5. O-isotopes of Wulong and various pallasites. Data sources: Milton: [7]; Hassi el Biod 002 (HeB 002): [8]; Main group pallasites: [9]; Pyroxene pallasites and Eagle Station pallasites: [10]; CO, CK, and CV carbonaceous chondrites: [11].