RELATIONSHIPS BETWEEN HED'S, MESOSIDERITES, AND UNGROUPED ACHONDRITES: TRACE ELEMENT ANALYSES OF MESOSIDERITE RKPA 79015 AND UNGROUPED ACHONDRITE QUE 93148. M. Righter[1,2], T. Lapen[2], K. Righter[3], [1]Lunar and Planetary Institute, 3600 Bay Area Blvd, Houston TX 77058 (tamaki@lpi.usra.edu), [2]Geoscience Department, University of Houston, Houston TX 77204, [3]NASA-Johnson Space Center, Mail code KT, Houston TX.

Introduction: Achondritic meteorites are a diverse group of meteorites that formed by igneous activity in asteroids. These meteorites can provide important information about early differentiation processes on asteroidal bodies. The howardite-eucrite-diogenite (HED) meteorites, the largest group of achondrites, are the only group of meteorites for which a potential parent body has been identified (4 Vesta) [e.g., 1].

Mesosiderites are stony-iron meteorites composed of roughly equal amounts of metal and silicates and silicates are broadly similar to HED meteorites [2]. They may have been formed by impact-mixing of crustal and core materials of differentiated meteorite parent bodies. Chemical and oxygen isotopic compositional data suggest that the HED meteorites and silicate portions of mesosiderites originated on the same or closely related parent bodies. Pallasites and IIIAB irons also have similar oxygen isotope compositions and have been thought to be related to the HEDs [3,4]. However, recent high resolution analyses have shown that pallasites and HED's have different oxygen isotopic values, but mesosiderites and HED's have the same isotope compositions implying a close connection [5].

QUE 93148 is a small (1.1g) olivine-rich (*mg* 86) achondrite that contains variable amounts of orthopyroxenene (mg 87) and kamacite (6.7 wt% Ni), with minor augite [6]. This meteorite was originally classified as a lodranite [7], but it's oxygen isotopic composition precludes a genetic relationship to the acapulcoites and lodranites. And also this meteorite has a lower Mn/Mg retio than any major group of primitive or evolved achondrites and suggested that QUE 93148 may be a piece of the deep mantle of the HED parent body [6].

To better understand the relationship between HED's, mesosiderites and related achondrites, we have measured trace elements in the individual metallic and silicate phases. In this study, abundances of a suite of elements were measured for the unusual mesosiderite RKPA 79015 and a ungrouped achondrite QUE93148.

Analysis: One slab (RKPA 79015, 41) and one polished thin section (QUE 93148, 11) were provided by NASA-JSC. Mineralogical analyses were done by Cameca SX100 electron microprobe at NASA-JSC, with a 20kV accelerating voltage and 40 nA sample current.

Trace element microanalysis was performed using a CETAC LSX-213 laser ablation system coupled to a Varian 810-MS ICP-MS at University of Houston. Elemental abundances were determined in line scan and spot mode, from the isotopes: ^{53}Cr, ^{53}Mn, ^{61}Ni, ^{65}Cu, ^{71}Ga, ^{72}Ge, ^{75}As, ^{95}Mo, ^{97}Mo, ^{101}Ru, ^{103}Rh, ^{105}Pd, ^{118}Sn, ^{121}Sb, ^{182}W, ^{185}Re, ^{189}Os, ^{193}Ir, ^{195}Pt, and ^{197}Au. Ablated spots were 80 and 100 μm in diameter, depending on the grain size. The standard used was the Hoba iron meteorite, with Ni as an internal standard for normalization.

Results:

RKPA79015 mesosiderite. RKPA 70915, 41 is a metal rich (66%) slab composed of kamacite, taenite, troilite and orthpyroxene. Kamacite is the most abundant metallic phase (91 %). The compositions of orthpyroxene show a narrow range ($Wo_{\sim1\text{-}2}En_{73.4\text{-}75.3}$).

QUE93148 ungrouped achondrite. The PTS consists of two olivine grains (Fig. 1). Olivine grains contain small metal inclusions. Olivine compositions are homogeneous (molar Mg/[Mg + Fe] =85.6 ± 0.2).

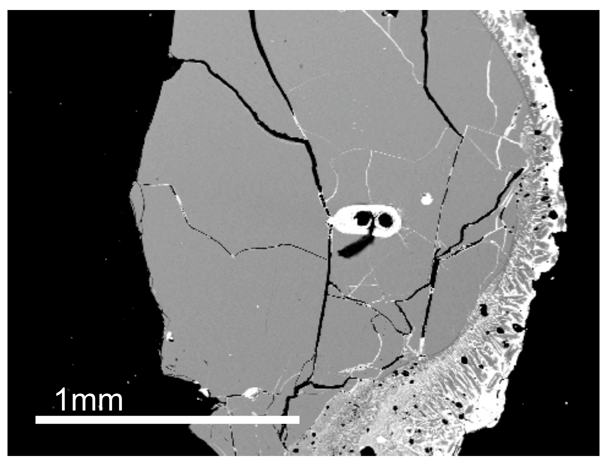

Fig. 1. Backscatterd electron image of QUE 93148, showing olivine grain (grey) with metal grain (white).

Siderophile element data. Table 1 shows siderophile element abundances in metals in RKPA 79015 and QUE 93148. Bulk metal composition of RKPA 79015 was calculated by modal recombination of kamacite and taenite. For QUE 93148, we measured only one kamacite grain because of the small grain size. In Fig. 2 and 3, we show log-plots of Ir, Ge concentrations against Ni compared to those of pallasites, mesosiderites and IIIAB irons. Siderophile

Table 1 Siderophile element compositions of RKPA 79015 and QUE 93148 metals.

		P	Cr	Ni	Co	Ga	Ge	Mo	W	Ir	Pt	Au
RKPA 79015	Kamacite	260	0.36	6.6	0.43	7.2	0.9	9.1	0.84	2.2	5.4	1.21
	Taenite	72	0.30	32.6	0.15	21.8	1.4	9.4	0.85	3.5	8.2	4.45
	Bulk	244	0.36	9.0	0.41	8.5	0.9	9.1	0.84	2.3	5.6	1.5
QUE 93148	Kamacite	339	167	7.4	0.35	0.15	0.033	5.4	0.157	0.197	0.799	0.895

Ni and Co are in wt%, others are in ppm.

concentrations are much lower in the QUE 93148 metal than in those of the other meteorites. The abundances of siderophile elements in RKPA 79015 are generally within the range of mesosiderite metals but shows slightly lower refractory siderophile element concentrations (e.g., W, Re, Ir and Pt) than other mesosiderite metal.

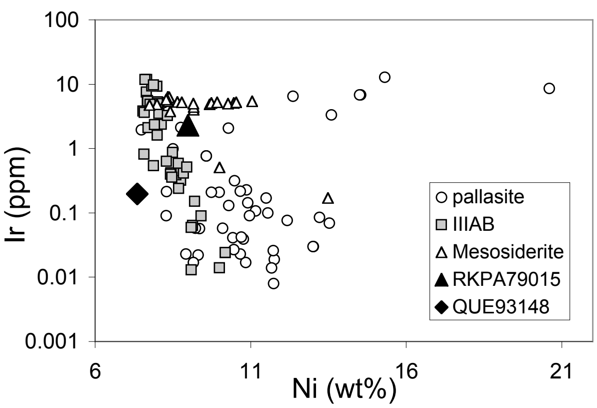

Fig. 2. Ni (wt%) versus Ir (ppm) in RKPA 79015, QUE 93148, pallasites, IIIAB and mesosiderites [8,9,10,11].

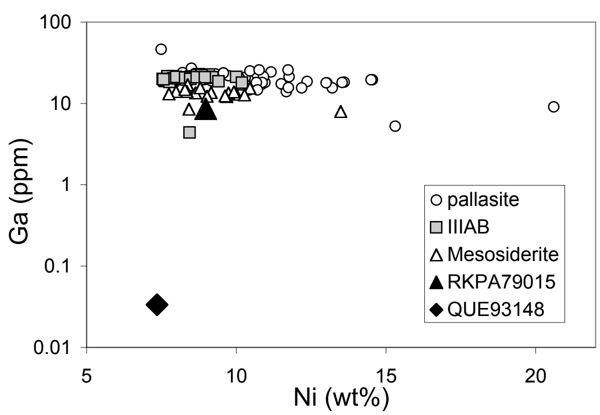

Fig. 3. Ni (wt%) versus Ga (ppm) in RKPA 79015, QUE 93148, main-group pallasites, pyroxene pallasites, IIIAB and mesosiderites. [8,9,10,11]

Siderophile element abundances of QUE 93148 are significantly lower than other meteorites. Especially Ga and Ge concentration are one order of magnitude lower than other meteorite metals.

Discussion: The composition of kamacite grains in RKPA 79015 are very similar to those reported by [11]. RKPA 79015 classified “anomalous mesosiderite” from high metal contents. The metal analyses here show it is not very unusual in metal composition with slightly lower concentrations of some trace elements.

Based on major and minor lithopile element conposition in olivine and orthpyroxene, Floss suggested that QUE 93148 shows a possible relationship with pyroxene pallasite that is genetically related to main-group pallasites [13]. However, our results show systematic differerences siderophile composition between those of QUE 93148 and main-group pallasite and also pyroxene pallasites. The metal phase of pyroxene pallasites has higher siderophile element concentration than main-group pallasite. In contrast, the siderophile elements of QUE 93148 show much lower concentration. This suggested it does not appear to be related to the pallasite. Nevertheless, we only measured a small metal grain in the host olivine grain, and measurement of large metal grains is necessary. And also we will analyse silicates in RKPA 79015 and QUE 93148 to help further define relationships between these groups.

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