LA-ICP-MS STUDY OF TRACE ELEMENTS IN THE CHAUNSKIJ METAL. M. Petaev[1,2] and S. B. Jacobsen[2], [1]Harvard-Smithsonian Center for Astrophysics, Cambridge, MA 02138, USA, [2]Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA 02138, USA. E-mail contact: (mpetaev@cfa.harvard.edu).

Introduction: Although some data on average chemical compositions of mesosideritic metals have been obtained in earlier studies [1], the most comprehensive chemical dataset was first presented by Hassanzadeh et al. [2] who measured concentrations of Fe, Ni, Co, Cr, Cu, Ga, As, Sb, W, Re, Ir, Pt, and Au in the large metal nodules from 13 mesosiderites. Using cluster analysis, they divided mesosideritic metals into three groups with different concentrations of Ni, Cu, Au, As, and W. The authors noted that the strong depletion of RKPA79015 in refractory siderophiles along with the slight enrichment in volatile siderophiles requires 'a formation distinct from common mesosiderite metal'.

Wasson et al. [3] reported the concentrations of Fe, Ni, Co, Cr, Cu, Ga, As, W, Re, Ir, Pt, and Au in two small samples (442 and 516 mg) of the Chaunskij host metal that differ significantly from one another as well as from the mesosideritic metals reported by [2]. Both samples contain small amounts of silicates and/or troilite. Although the concentrations of many elements in Chaunskij metal are consistent with an extrapolation of compositional trends established by [2], the Ir concentrations are much lower than those in typical mesosiderites.

The presence of anomalous metals in at least two metal-rich mesosiderites, Chaunskij and RKPA79015, raises the question of multiple sources of mesosideritic metals. Another important question which needs to be answered is whether or not the compositions of the host metal and the metal of silicate inclusions in Chaunskij are similar. If not, then at least two different types of metal must have been mixed with silicates during the metal-silicate mixing event(s).

Samples and analytical procedures: Eight metal grains ranging from ~ 120 to ~160 microns from both igneous and metamorphic lithologies [4] of the polished thin section TS1 of the Chaunskij mesosiderite were selected for the LA-ICP-MS study. Prior to LA-ICP-MS analyses all metal grains were BSE-imaged and then analyzed for Fe, Ni, Co, Cr, Si, P, and S using a JEOL SuperProbe 733. All grains but TS1-02 were Ni-rich and slightly zoned, with Ni contents increasing outward from ~ 40 to ~50-52 wt. %. The grain TS1-02 (the lowest Ni content in Figs. 2 and 3) with typical M-profile of Ni consisted of minor kamacite (4.0 – 4.6 wt. % Ni) and predominant taenite (37 – 50 wt. % Ni).

The concentrations of Fe, Ni, Co, Cr, Cu, Ga, Ge, As, Mo, Ru, Rh, Pd, Sb, W, Re, Os, Ir, Pt, and Au were measured using the GV Platform XS ICP-MS instrument interfaced to the 266 nm NYG laser ablation system. The analytical protocol and the reduction procedure were the same as [5], except that (1) no N_2 was added to the Ar gas, (2) the spot size was 95 μm, and (3) concentrations of Fe, Ni, and Co were calculated by normalizing them to 100 %. Although small thickness of the metal grains in the thin section limited the signal to 3-4 time-slices only, the differences between the measured and literature data [1, 3, 5-7] for the Coahuila drift monitor (Fig. 1) are still within 5 % for all elements except for Cr (31 %), As (15 %), and Sb (24 %).

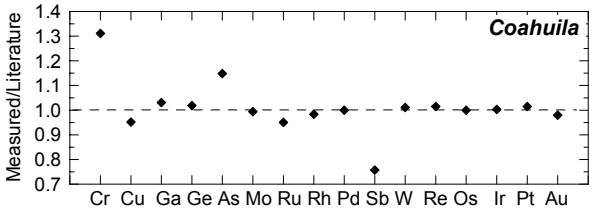

Fig. 1. Measured vs. literature data for the Coahuila drift monitor.

Results and Discussion: Fig. 2 reports new data on Mo, Rh, Ru, Pd, and Os in metal grains from the Chaunskij silicate inclusions, and Fig. 3 compares our Cu, Ga, Ge, As, Sb, W, Re, Ir, Pt, and Au data with corresponding literature data for mesosideritic metals [2, 8] as well as for the host metals of Chaunskij [3] and RKPA 79015 [2]. The compositional differences between the metal grains from the Chaunskij silicate inclusions and the mesosideritic nodules are obvious (Fig. 3), with the Chaunskij metal grains being depleted in all refractory trace elements such as Re, Ir, P, and, to a lesser degree, W. The volatile elements – As, Au, Ga, Ge, and Sb – show more complicated behavior, with As and Au being depleted and Ge and Sb enriched in the Chaunskij metal grains.

There are also some compositional differences between metal grains from the silicate inclusions and the host metal of Chaunskij, with the host metal being depleted in Ni, As, Au, Ga, Ge, W, and Cu and enriched in Co, As and Au. The question is whether these differences are primary, or if they resulted from the kamacite-taenite partitioning during slow subsolidus cooling? Although the concentrations of Cu, Co, and, to a lesser degree, Ga can be reconciled with the kamacite-taenite distribution coefficients [9, 10], the Ge, Re, Ir, Pt, and Au are inconsistent with low-temperature metamorphic equilibration. It appears that the compositional differences between the metal grains from the silicate inclusions and the host metal of Chaunskij are primary.

Thus, our data support earlier conclusions [2] that there were at least two different types of mesosidritic

metal found in (1) common mesosiderites and (2) metal-rich mesosiderites RKPA 79015 and Chaunskij. Moreover, it appears that at least two different types of metal must have been mixed with silicates during the metal-silicate mixing on the Chaunskij parent body.

References: [1] Mittlefehldt D. W. et al. (1998) *Rev. Mineral., 36*, 195 p. [2] Hassanzadeh J. et al. (1990) *GCA, 54*, 3197-3208. [3] Wasson J. T. et al. (1998) *GCA, 62*, 135-149. [4] Petaev M. I. et al. (2000) *Geochem. Int., 38*. Supl. 3, S322-S350. [5] Petaev M. I. and Jacobsen S. B. (2004) *MAPS, 39*, 1685-1697. [6] Buchwald V. F. (1974) Handbook of Meteorites. [7] Grady M. (2000) Catalogue of Meteorites. [8] Wasson J. T. et al. (1974) *GCA, 38*, 135-149. [9] Campbell A. J. and Humayun M. (1999) *LPS XXX*, #1974. [10] McDonough W. F. et al. 1999) *LPS XXX*, #2062.

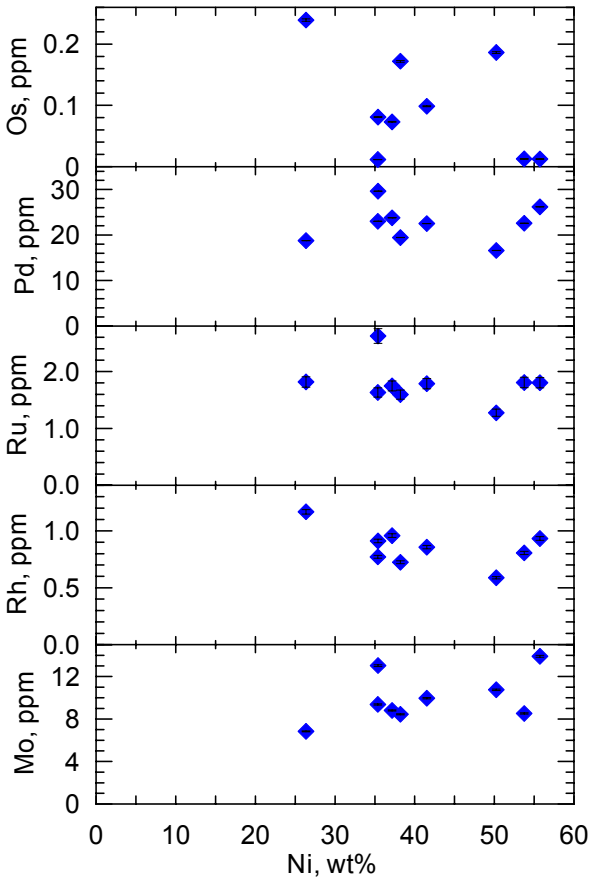

Fig. 2. Concentrations of trace elements in the metal grains from the Chaunskij silicate inclusions.

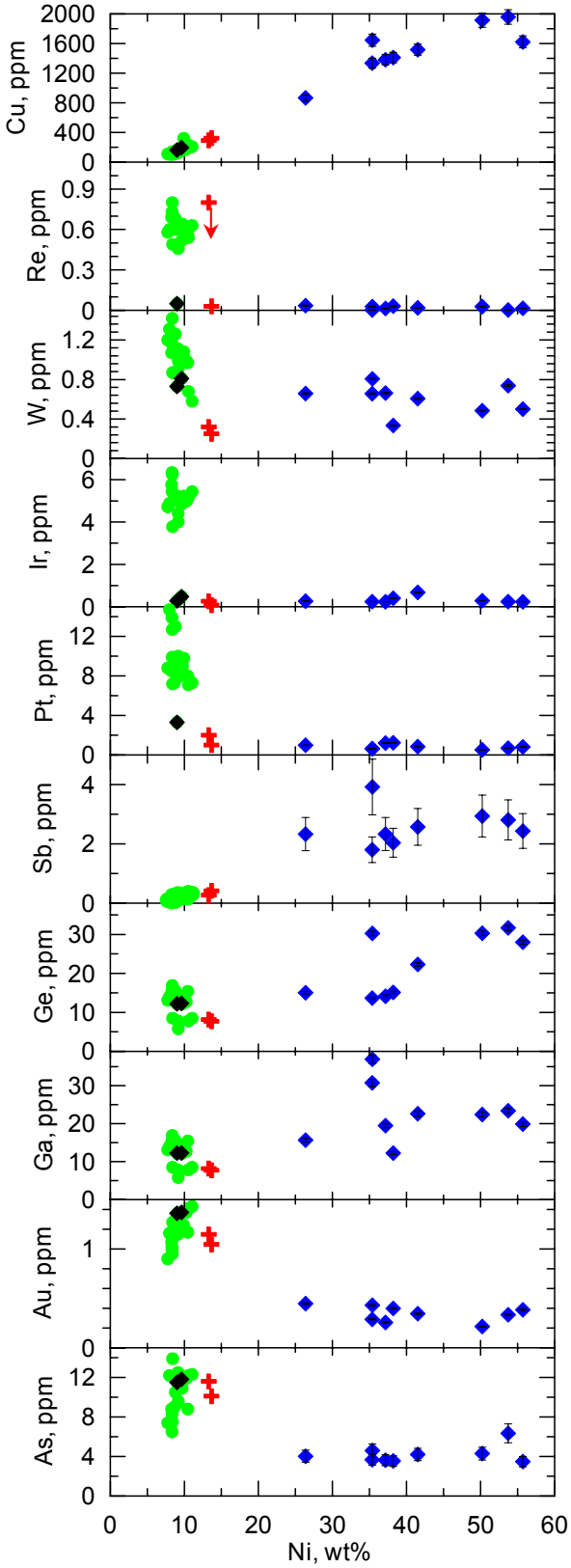

Fig. 3. Trace elements in mesosideritic metal nodules (green), metal grains from the Chainskij silicate inclusions (blue), and host metals of Chaunskij (red) and RKPA 79015 (black).