FE AND NI ISOTOPE COMPOSITION OF METAL GRAINS FROM CH AND CB CHONDRITES

M. Weyrauch[1], S. Weyer[1] and J. Zipfel[2], [1]Institut für Mineralogie, Leibniz Universität Hannover. Callinstr. 3, 30167 Hannover, Germany. E-mail: m.weyrauch@mineralogie.uni-hannover.de, s.weyer@mineralogie.uni-hannover.de, [2]Senckenberg Forschungsinstitut und Naturmuseum Frankfurt. Senckenberganlage 25, 60325 Frankfurt, Germany. E-mail: jutta.zipfel@senckenberg.de

Introduction: CH and CB chondrites are characterized by very high metal contents ranging from ~40 to ~70 vol%. Moreover, they have bulk composition enriched in refractory and siderophile element abundances (~4-10xCI [1]). CH and CB_b meteorites contain metal grains that are chemically and isotopically zoned [2,3]. Nickel and Co contents are high in grain cores and decrease towards grain rims [2]. Parallel to the chemical zoning, Fe isotope composition changes from light in cores to heavy in rims [3]. These characteristics indicate formation by a condensation process, either in the solar nebula [2] or in an impact-induced vapor plume [4].

In this study, we analyzed refractory element concentrations and Fe and Ni isotope composition in metal of Isheyevo (CH/CB_b breccia), Hammadah al Hamra 237 (HaH 237, CB_b), Gujba and Bencubbin (both CB_a), and Acfer 214 (CH).

Methods: Zoned metal grains were identified by EMPA element mappings collected with the JEOL Superprobe at the Goethe Universität Frankfurt. Additionally, quantitative analyses of major and minor elements were carried out in zoned and unzoned metal grains. Trace element abundances (PGE, Ge, Cu, Au, W, and Mo) and Fe and Ni isotope compositions were determined *in situ*, using a Solstice *fs*-LA system in combination with a Thermo Element SF-ICP-MS or Neptune Plus MC-ICP-MS, resepectively, at Hannover. Iron and Ni isotope analyses were carried out in high mass resolution. IRMM-014 was used as reference material for Fe. NIST RM-1226 was used as reference material for Ni, δ^{62}Ni-values are given relative to NIST SRM-986.

Results: Some of the metal grains show a strong chemical and isotopic zoning with extremely light Fe and Ni isotope compositions in Ni-rich metal cores (e.g.; HaH 237 $\delta^{62/60}$Ni: -7.0±0.2 ‰; δ^{56}Fe: -5.2±0.1 ‰) [3]. Unzoned metal grains have unzoned and heavier Fe and Ni isotope compositions similar to those of the rims of zoned grains (e.g.; HaH237 δ^{56}Fe: -2.08±0.04‰). However, they can also have significantly heavier δ-values, up to δ^{56}Fe ≈1.3±0.1‰. Unzoned metals from CB_a chondrites Bencubbin and Gujba seem to have generally heavier Fe isotope composition than metal from Acfer 214 (CH) and Hammadah al Hamra 237 (CB_b) (δ^{56}Fe= Gujba: 0.6±0.05‰ and Bencubbin: 0.16±0.04‰ vs HaH 237: -0.18±0.04‰ and Acfer 214: -0.31±0.05‰).

Trace element analyses reveal that most refractory siderophile elements are enriched by about 10-19xCI. However, Mo and W are depleted relative to the other highly refractory elements. Correlation matrices of all elements in zoned metal grains display that Ni correlates positively with highly refractory siderophile elements, except for Mo and W. Likewise, zoned metal grains show a parallel zoning of highly refractory elements with that of Ni.

Discussion and Conclusions: The chemical zoning coupled with the light Fe and Ni isotope compositions in the metal cores strongly support a condensation origin of the zoned metal grains of CB and CH chondrites. Furthermore, the parallel zoning of Fe and Ni isotope excludes exchange diffusion as the dominant process causing the chemical and isotopic zoning. The generally light isotope compositions of most zoned metal grains, even at the rims, may indicate that they represent relatively early condensates.

The depletion of Mo and W relative to other refractory elements reflects oxidizing conditions during condensation of the metal grains. The partial pressure of oxygen must have been higher than typically assumed for the solar nebula [5]. This might be caused by a high dust/gas ratio consistent with models of metal condensation in an impact-induced vapor plume.

References:

[1] Campbell, A.J. et al. 2002. *Geochimica et Cosmochimica Acta* 66: 647-660. [2] Meibom, A. et al. 1999. *Journal of Geophysical Research* 104:22053-22059. [3] Zipfel, J. and Weyer, S. 2007. Abstract #1927. 38th Lunar & Planetary Science Conference. [4] Wasson, J.T. and Kallemeyn G.W. 1990. *Earth and Planetary Science Letters* 101: 148-161. [5] Fegley Jr., B. and Palme, H. 1985. *Earth and Planetary Science Letters* 72: 311-326.