

CV3 CHONDRITES: HOW OXIDIZED OR REDUCED? P. A. Bland¹, E. Hoffman², A. N. Krot³ and F. J. Berry⁴,¹Department of Mineralogy, Natural History Museum, Cromwell Road, London SW7 5BD, UK (phib@nhm.ac.uk),¹Physics Department, Morgan State University, Baltimore, MD 21251, USA, ³Hawai'i Institute of Geophysics and Planetology, School of Ocean and Earth Science and Technology, University of Hawai'i at Manoa, Honolulu, HI 96822, USA, ⁴Department of Chemistry, The Open University, Milton Keynes MK7 6AA, UK.

Introduction: CV chondrites were initially divided into the reduced and oxidized subgroups based on apparent oxidation state defined petrographically (relative proportions of metal vs. magnetite and Ni content in sulfides) [1]. Recently, the oxidized subgroup was subdivided further into the Bali-like and Allende-like subgroups also largely based on the secondary mineralization: the former contains fayalite and phyllosilicates, whereas the latter contains fayalitic olivine, nepheline and sodalite [2,3]. It was shown that fayalite and fayalitic olivine postdate oxidation of metal to magnetite and form by preferential replacement of magnetite; this results in a decrease of modal abundance of magnetite in the oxidized subgroup [3,4]. In order to quantify modal abundances of metal, magnetite and sulfides in CV chondrites, including their fine-grained matrices, we used Mössbauer spectroscopy.

A knowledge of the abundance of Fe in a specimen allows absorption intensities in a Mössbauer spectrum to be converted to absolute wt% values of Fe-bearing phases. Previous work used Mössbauer spectroscopy to constrain the abundance of magnetite in bulk samples of Vigarano and Allende [5]. This has now been extended to other CV chondrites.

Experimental: Samples (~0.3 g) were crushed and a 0.1 g aliquot taken for analysis and placed in a lead holder (ca. 1.25 cm²). Iron-57 Mössbauer spectra were recorded at 298K with a microprocessor controlled Mössbauer spectrometer using a ⁵⁷Co/Rh source.

Results: Bulk chemical data of CV's [6,7] indicates wt% Fe of 23.2 ± 0.9. Therefore, from our Mössbauer spectra we can calculate that ALH 85006 contains 8.0 wt% magnetite, Grosnaja 2.6 wt%, Kaba 10.2 wt%, Mokoia 3.2 wt%, Efremovka 3.3 wt%, and Leoville 3.8 wt%. Vigarano is found to contain 4.1 wt% magnetite in the bulk meteorite (3 analyses taken from different areas of the meteorite), and 2.3 wt% in a matrix separate. We do not detect magnetite in Allende or ALH 84028, thus, we estimate that magnetite is present in these meteorites at levels of <0.5 wt%.

Mössbauer spectra also allow us to constrain the abundance of FeNi-metal, sulfides, and Fe-containing silicates.

Discussion: Our data indicate that the oxidized Bali-like and Allende-like, and the reduced CV subgroups, can be separated based on their FeNi-metal, sulfide, and magnetite abundances. The Allende-like meteorites have low abundances of FeNi-metal, sul-

fides, and magnetite; metal and sulfides are Ni-rich. The Bali-like meteorites have variable to high abundances of magnetite, but low (or absent) metal and low sulfides; metal and sulfides are largely Ni-rich. The reduced CV chondrites have intermediate magnetite abundance, and high contents of metal and sulfides; metal and sulfides are largely Ni-poor.

Our recent work [4] may explain this range in abundance for the opaque phases within CV3's. Mineralogical observations and thermodynamic analysis suggest that magnetite, Ni-rich metal and sulfides formed by oxidation of low-Ni-metal-sulfide nodules either in the solar nebula or more likely in an asteroidal environment; a degree of this oxidation was variable through CV chondrites. Subsequently, magnetite of the oxidized opaque nodules was preferentially replaced by fayalite (in Bali-like meteorites), fayalitic olivine (in the Allende-like meteorites), Ca-Fe-rich pyroxenes and andradite in the presence of aqueous solutions in an asteroidal setting.

References: [1] McSween H. Y., Jr. (1977) *GCA*, 41, 1777–1790. [2] Weisberg et al. (1997) *MAPS*, 32, A138–A139. [3] Krot et al. (1998) *MAPS*, 33, 1065–1085. [4] Krot et al. (2000) *MAPS*, submitted. [5] Bland P. A. et al. (1999) *MAPS*, 34, A12–A13. [6] Kallemeyn G. W. and Wasson J. T. (1981) *GCA*, 45, 1217–1230. [7] Jarosewich E. (1990) *Meteoritics* 25, 323–337.