A HIGH-RESOLUTION TRANSMISSION ELECTRON MICROSCOPY STUDY OF FINE-GRAINED PHOSPHATES IN METAL FROM THE BISHUNPUR LL3.1 ORDINARY CHONDRITE. C. L. Johnson, D. S. Lauretta, and P. R. Buseck, Departments of Chemistry and Biochemistry and Geological Sciences, Arizona State University, Tempe AZ 85287-1604, USA (cljohnson@asu.edu).

Introduction: The Bishunpur (LL3.1) meteorite has experienced minimal aqueous alteration and thermal metamorphism [1–2], thereby allowing examination of the early effects of these processes. Understanding the chemical and physical mechanisms behind these processes is necessary for reconstructing the histories of such primitive rocks.

The diverse crystal chemistry of meteoritic P minerals can be used to constrain the conditions of such alteration processes. We have been studying the composition, structure and distribution of P minerals in Bishunpur [3]. The fine-grained nature of these phases requires transmission electron microscopy (TEM) for detailed study. Here we present TEM data for a P-bearing metal grain in Bishunpur.

Analytical Methods: After locating and imaging areas of interest in a petrographic thin section of Bishunpur, samples were extracted for TEM investigation. They were thinned using a GATAN precision ion polishing system. A JEOL 2000FX TEM equipped with a thin-window KEVEX energy dispersive spectrometer (EDS) was used to obtain bright-field (BF) images, high-resolution TEM (HRTEM) images, selected-area electron diffraction (SAED) patterns, and chemical analyses.

Results: We identified small (0.3–1 µm) phosphate inclusions in a tetrataenite grain from the matrix of Bishunpur (Fig. 1a). The phosphate grains have a round, drop-like morphology. Their composition corresponds to maricite (Fe:Na:P = 1:1:1). SAED patterns of the phosphate are consistent with terrestrial maricite [4], and HRTEM images have the (010) interplanar spacings expected for maricite (Fig. 1b).

Discussion: Na-bearing phosphates have been reported in Bishunpur and other unequilibrated chondrites [3,5–8], however, their origin remains unclear. One model suggests corrosion of P-bearing metal by a Na-rich gas during chondrule formation [5]. Another proposes that Na-rich phosphates crystallized after shock melting [7]. The maricite we observed has a rounded morphology and occurs encased in metal. This suggests that the maricite formed in the liquid state as an immiscible component of a metal-rich melt. More detailed chemical and structural characterization of meteoritic phosphates and their relationships with adjacent minerals is underway. These data are required to more accurately constrain the conditions of phosphate formation.

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References: [1] Sears D. W. G. et al. (1995) *Meteoritics*, *30*, 169–181. [2] Alexander C. M. O'D. et al. (1989) *GCA*, *53*, 3045–3057. [3] Johnson C. L. et al. (2000) *LPSC XXXI*, Abstract #2093. [4] Le Page Y. and Donnay G. (1977) *Can. Min.*, *15*, 518–521. [5] Lauretta D. S. and Buseck P. R. (2000) *LPSC XXXI*, Abstract #1136. [6] Yabuki H. and El Goresy A. (1986) *Proc. Tenth Symp. Ant. Met.*, 235–242. [7] Semenenko V. P. and Perron C. (1995) *Meteoritics, 30*, 577. [8] Grossman J. N. and Rubin A. E. (1999) *LPSC XXX*, Abstract #1639.

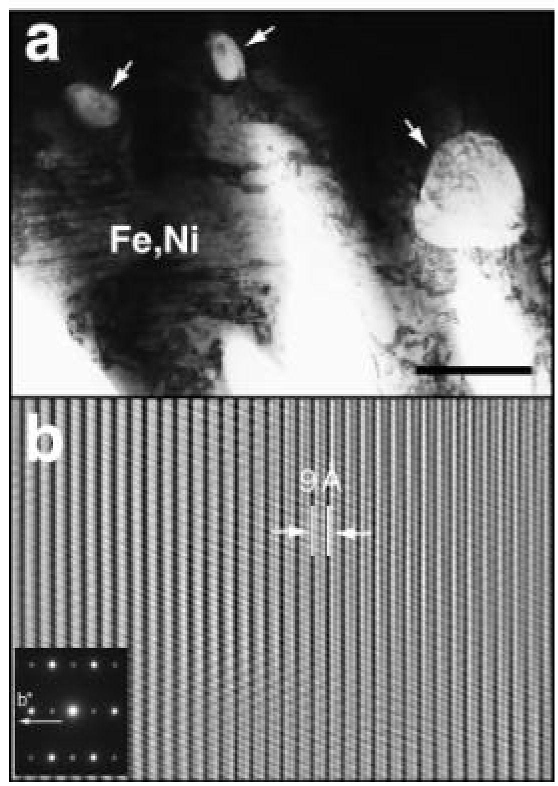

Fig. 1. (a) BF TEM image showing the rounded maricite inclusions (indicated by arrows) in the tetrataenite metal (dark area). The scale bar is 1 µm. (b) [101] HRTEM image (background subtracted) of the maricite with inset SAED pattern.