NEW METALLOGRAPHIC CONSTRAINTS ON METEORITIC WIDMANSTÄTTEN STRUCTURE FORMATION. P. Z. Budka[1] and J. R. M. Viertl[2], [1]2135 Morrow Avenue, Schenectady NY 12309, USA (e-mail: 75302.1764@compuserve.com), [2]1403 Clifton Park Road, Schenectady NY 12309, USA.

The "Widmanstätten structure" is the foundation for calculations of metallographic cooling rates. This approach relies on the fundamental assumption that the Widmänstatten structure is the product of an equilibrium solid state phase transformation (gamma austenite transforms to alpha ferrite). Recent laboratory experiments on iron alloys indicate that a reexamination of the connection between meteoritic Widmanstätten structure, iron alloys and metallographic cooling rates is warranted.

Metallographic cooling rates are founded on metallographic evidence: the connection between Widmanstätten morphology (phases that appear as triangles and squares in a cut and polished specimen) and the Widmanstätten mechanism (the nucleation and growth in the solid state of a second phase along certain crystallographic directions of the parent phase.) The original meaning was strictly that of nickel-iron meteorite morphology. Over time, in the metallurgical literature, the term Widmanstätten structure has been variously applied to platelike or lathlike ferrite solid state transformation products as well as cast structures, further confusing morphology and formation mechanisms [1].

Recent laboratory experiments in two areas highlight the need for a reexamination of fundamental assumptions about the meteoritic Widmanstätten structure.

Body-centered cubic ferrite can be produced directly from a melt (delta ferrite) as well as by a solid state phase transformation (alpha ferrite) [2–4]. The thermal history of body-centered cubic low nickel-iron (alpha or delta) cannot be determined by metallographic techniques. Therefore, the thermal history or mechanism of kamacite formation cannot be reconstructed based solely on crystal structure.

Information from laboratory experiments on iron-nickel alloys in the gamma austenite composition and temperature range is applied to the understanding of meteoritic Widmanstätten formation [5,6]. Ohmori et al. [7] studied the morphology of bainite and Widmanstätten ferrite in steels. Their reason for this study was the confusion created by the various terms applied to metallographically similar structures, namely Widmanstätten ferrite, acicular ferrite, bainitic ferrite and bainite. They define the metallographic feature known today as "Widmanstätten ferrite." It is metallurgically analogous to the "Widmanstätten structure" found in Goldstein's work [5,6]: the nucleation and growth of alpha ferrite in a gamma austenite matrix.

Alpha ferrite and kamacite share the same crystal structure and general "Widmanstätten" morphology. The alpha ferrite phase of iron alloys is traditionally applied in the analysis of kamacite. Metallurgical evidence suggests that delta ferrite can also be used as a kamacite analog. Meteorites probably contain kamacite that is the product of primary crystallization (delta ferrite) as well as kamacite produced by a solid state phase transformation (alpha ferrite). These considerations suggest the need for a reexamination of the intimate connection between the meteoritic Widmanstätten structure, iron alloys and metallographic cooling rates.

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