

**EVIDENCE FROM SILICATE-BEARING IRON METEORITES FOR THE NATURE OF ASTEROIDAL DIFFERENTIATION.** A. Ruzicka and M. Hutson, Cascadia Meteorite Laboratory, Department of Geology, Portland State University, 1721 SW Broadway, Portland, Oregon, 97207, USA, ruzicka@pdx.edu.

**Introduction:** Silicate-bearing iron meteorites (members of groups IAB, IIICD, IIE, IVA and various ungrouped irons), which contain silicates often in the form of inclusions embedded in abundant (mainly >50%) metal, provide important evidence for the differentiation of asteroidal bodies. Most researchers agree that these irons formed by impact-mixing of partly molten metal and silicate, although the nature of the heat sources (exogenic or endogenic, or both) is debatable [1-3].

**Silicate types:** Despite a bewildering diversity of textures and mineralogies, silicates in irons can be subdivided into just four bulk chemical types that appear to have originated in fundamentally different ways [1]. Major element compositions for representative silicates are shown in a pseudoternary olivine (Ol) – quartz (Qz) – plagioclase (Pl) liquidus diagram in Fig. 1. *Type A silicates* have essentially chondritic mineralogies and major-element compositions (Fig. 1) and REE abundances (~1-2 x CI chondrites). Textures range from granoblastic to igneous. Type A is characteristic of IAB irons and of “unfractionated IIE” irons including Netschaëvo and Watson, and also includes the ungrouped irons Bocaiuva and possibly NWA 176, Enon, and Puente del Zacate. *Type B silicates* have igneous textures and are present in “fractionated IIE” irons (e.g., Miles, Weekeroo Station, Colomera), in some IABs such as Caddo County and Udei Station as basalt-gabbro, and in the ungrouped irons Guin, Sombereete, and Mbosi. These silicates have alkali-silica-rich compositions, which in Fig. 1 project close to the ternary peritectic (R to R\*) and along the olivine – low-Ca pyroxene boundary. Bulk REE contents are mainly ~4-8 x CI (~10-15 x CI for Sombereete). *Type C and D silicates* project close to the plagioclase – quartz and olivine – quartz joins, respectively (Fig. 1). Type C consists of glassy or fine-grained feldspar-silica inclusions in fractionated IIE irons; Type D is coarse grained and mineralogically diverse, and includes peridotite in Udei Station and pyroxene – silica in the Steinbach and São João Nepomeceno IVA stony irons.

**Origin of silicate types:** The properties of Type A silicates can be explained by intense metamorphism with limited amounts of silicate melting (most IAB and IIICD, Netschaëvo) or by melting with little silicate melt-solid separation (Watson, a likely impact melt [4]). Type B silicates can be modeled as equilibrium partial melts of chondrite parent bodies similar to O

and C chondrites [1, 5, 6, 7], involving higher (Miles, Mbosi) or lower amounts (Colomera, Sombereete, Guin, IAB basalt) of silicate partial melting [1]. The origin of Type C is unclear, but could have formed by partial impact melting of Type B silicate or by partial separation of fractionally crystallizing melt from Type B silicate [1]. Type D formed by feldspar loss, as restites from equilibrium partial melting (Udei Station peridotite) [5] and as cumulates of a siliceous melt (IVA stony irons) [8]. Radiometric dating implies formation of silicate-bearing irons within ~10 Ma of CAI formation, consistent with internal heating by <sup>26</sup>Al decay, although ages were sometimes partly re-set by later impact events (summarized by [1]). The data support the idea that endogenic heating was largely responsible for producing melted and differentiated materials in silicate-bearing irons, but suggest an important role for collisional processes as well.

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Fig. 1

