Cosmochemical Constraints on Asteroid Accretion

EBEL DENTON S [1,2], MICHAEL K. EISBERG [1,3] AND ELLEN CRAPSTER-PREGONT[1,2]

[1]American Museum of Natural History, Central Park West at 79th St, New York, NY 10024. (*debel@amnh.org)
[2] Lamont-Doherty Earth Observatory of Columbia University, Palisades, New York.
[3] Kingsborough College, City University of New York.

Multiple lines of chemical, isotopic and textural evidence constrain how kilometer-sized bodies accreted. Km-size chondrite parent bodies were likely precursors to planetesimals and the modern planets. **First**: Chondritic meteorites (~90% of known meteorites) contain widely variant modal abundances of their primary components: Chondrules, Ca-Al-rich inclusions (CAIs), and fine-grained matrix containing insoluble organic matter (IOM) and presolar grains (PSG) including graphite and SiC [1], yet are all "chondritic" in composition [2,3]. **Second**: Chondrules, themselves highly variable in Fe/Si, combine to make rocks with bulk chondritic Fe/Si [4]. **Third**: Chondritic meteorites contain most major elements (Si, Mg, Al, Ca, Ti) and rare earth elements (REEs) in solar proportions, with the most variation in Fe, yet CAIs have highly variable REE inventories [5]. **Fourth**: Oxygen isotopes, CAI abundances, and clast sizes suggest each chondrite group formed under locally distinct conditions. Variations in Fe do not affect the present argument. That extraterrestrial materials universally tend towards chondritic major and trace element abundances is, alone, a powerful constraint on disk processes, that has been dubbed "complementarity" [2-4]. That is, the primary components (chondrules, CAIs, matrix) complement each other to produce "chondritic" bulk meteorite composition. Why is this so?

We will present major and trace element (REE) evidence that the parent bodies of chondritic meteorites accreted from local, gravitationally unstable (overdense) accumulations of material of bulk solar or dust-enriched composition [6], subjected, prior to accretion, to varying degrees of highly local heating that produced melted objects (e.g., chondrules) with varying degrees of efficiency [7].

[1] Huss GR & Lewis RS (1994) MaP*S* **29**, 811. [2] Hezel DC & Palme H (2010) *EPSL* **294**, 85-93. [3] Bland PA *et al.* (2005) *Proc. Nat. Acad. Sci.* **102**, 13755-13760. [4] Ebel DS *et al.* (2008) *MaPS* **43**, 1725-1740. [5] Boynton WV (1975) GCA **37**, 1119-1140. [6] Alexander C.M.O'D. *et al. Science 320*, 1617-1619. [7] McNally *et al.* (2013) LPS XLIV, Abs. #2844.

Deformation-related chemical alteration of meta-pegmatites

TOBIAS EBERLEI[1]*, GERLINDE HABLER[1], RAINER ABART[1] AND BERNHARD GRASEMANN[2]

[1]University of Vienna, Department of Lithospheric Research (*correspondence to: tobias.eberlei@univie.ac.at)
[2]University of Vienna, Department of Geodynamics and Sedimentology

Deformation and chemical reactions often occur contemporaneously in nature and a proper understanding of the feedback between the two is required for correctly interpreting rock microstructures and evaluating the $P-T-t-d$ evolution of rocks. Permian meta-pegmatites from the Austroalpine Matsch Unit in the Eastern Alps were deformed at conditions close to the greenschist−amphibolite facies transition during the Cretaceous [1,2], locally producing proto-, meso- and ultramylonites with finite strain gradients at the cm- to m-scale.

We focus on the relation between the Cretaceous deformation and major element re-equilibration of the major metapegmatite phases. Several white mica and feldspar generations are recognised based on combined microstructural and microchemical characteristics. A spatial relationship between specific deformation-microstructures (kink bands, micro shear zones, cracks, strain shadows) and chemical alteration is reflected by cm-sized white mica and plagioclase clasts. A fine-grained phengitic white mica generation dominates mylonitic foliation domains and compressional quadrants of clasts. Primary K-feldspar (Kfs) shows deformation-related replacement by albite, whereas secondary Kfs together with fine-grained biotite, phengitic white mica, albite and quartz precipitated in micro-fractures and extensional quadrants of large albite and muscovite clasts. Fine-grained plagioclase aggregates in the strain-shadows of albite clasts indicate deformation by dissolution-precipitation creep (DPC). The mineral compositions of fine-grained phengitic white mica co-existing with secondary Kfs, biotite, quartz and albite are consistent with $P-T$ conditions of 480 ± 30 °C and 5 ± 1 kbar.

Our results document the correlation between deformation and chemical alteration and yield quantitative PT constraints on deformation based on syntectonic phase assemblages. The study will be further extended to examine the relationship between deformation and isotopic re-setting of the Rb-Sr system in white mica.

[1] Habler, Thöni & Grasemann (2009) *Mineral. Petrol.* **97**, 149-171. [2] Froitzheim, Conti & van Dalen (1997) *Tectonophysics* **280**, 267-297.

www.minersoc.org
DOI: 10.1180/minmag.2013.077.5.5