LAYERED CHONDRULES IN CARBONACEOUS AND ORDINARY CHONDRITES.

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Introduction: Chondrules with sharp concentric layers are reported from CV [2], CR [1-3], CM [4], and ordinary chondrites (OC) [5,6]. Layers vary in texture, mineralogy, and composition. CAIs, and AOAs (transitional to chondrules) also exhibit concentric layers in whole or in parts [7,8]. Many hypotheses exist for layering [1-4, 6-9], and different types of layering may form by different processes. The relative abundances and 3D structures of concentrically layered chondrules are unknown. Few are described in detail. We identified layered chondrules in Renazzo (CR2), Allende(CV3), Semarkona(LL3), Bjurbole(L/LL4), Karoonda(CK4), and Chainpur(LL3) in 3D images of ~1cm^3 pieces from the AMNH collection, using synchrotron x-ray tomographic reconstructions [10], and 2D elemental mapping and spot analyses of slices that were cut guided by 3D images. Layering provides clues to chondrule source materials, crystallization and accretion environments, and possible heating mechanisms.

Results: Types of layering include, from inside to outside: 1) ol-rich to opx-rich; 2) metal-poor to metal-rich; 3) barred ol to coarse ol; 4) metal-rich to ol-rich; 5) coarse metal to fine metal; 6) opx-rich to ol-rich (rare); 7) silicate to metal-rich 'dust'; and 8) CAI-like to ol-rich, in AOAs. Layered objects appear to be more common in the CR than in the CV, and rare in OC [1, 3]. Tomography, however, allowed location of, for example, a rare layered chondrule in Semarkona with multiple type (2) layers.

Discussion: Each meteorite class displays chondrule layering of different kind and extent. The heating process for chondrule formation probably differed in intensity or efficiency in the region from which each class formed. Unlike OC and CV chondrules, many CR chondrules have metal, Mg-silicate, and Ca-, Al-rich components in distinct layers. The OC appear more thoroughly converted from dust into chondrules, by higher degrees of melting and/or remelting, whereas in CV, CR and CK the chondrule rims are sintered into layers to varying extents, preserving earlier growth cycles. In the perhaps most primitive chondrites, CR [12], metal-silicate fractionation occurred very early, recorded in type (2) layering, and rim accretion and re-heating followed chondrule collisions. Some layered chondrules suggest open-system olivine-vapor reaction to form pyroxene, others suggest sintering of lower-temperature, pyroxene-normative dusty rims.

References: *GCA=Geochimica et Cosmochimica Acta; LPS*=Lunar & Planetary Science Conference; *MPS=Meteoritics & Planetary Science.* [1] Prinz M. et al. 1985. *LPS* XVI:677-678. [2] Metzler K. et al. 1988. *LPS* XIX:772-773. [3] Weisberg M.K. et al. 1993. *GCA* 57:1567-1586. [4] Metzler K. et al. 1992. *GCA* 56:2873-2897. [5] Jones R. & Scott E.R.D. Proc. *LPS* 19:523-536. [6] Krot A.N. & Wasson J.T. 1995. *GCA* 59:4951-4966. [7] Weisberg M.K. et al. 2004. *MPS* 39: 1741-1753. [8] Ruzicka A. 1997. *Journal of Geophysical Research* 102:13387-13402. [9] Trigo-Rodriguez et al. 2006. *GCA* 70:1271-12909. [10] Ebel D. S. et al. 2006. *MPS* in press. [12] Wood J.A. 1963. *Icarus* 2:152-180. **(**NASA Cosmochemistry NAG5-12855 (DSE); DOE, Basic Energy Sciences, W-31-109-ENG-38 (APS/GSECARS); NASA Astrophysics Data System Bibliographic Services).