ABUNDANCES AND SIZES OF CLAST TYPES IN THE ALLENDE CV3 METEORITE: NEW RESULTS FROM MAPPING ANALYSIS

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Introduction: The chondritic meteorites resulted from the cooling and accretion of solids in the protoplanetary disk. Large clasts include: Ca-, Al-rich inclusions (CAIs [1]), chondrules, amoeboid olivine aggregates (AOAs [2]), and dark lithic fragments (dark inclusions, DIs)[3]. Their relative abundances are primary data that pertain to the theories of their origin and relevance to planet formation [1], but have not been measured in Allende (CV3) and other CV chondrites since the point-counts reported by McSween in 1977[4].

Procedure: Allende surfaces were mapped in x-ray emission at resolutions between 13 (slabs) and 2 (small areas) microns per pixel using electron microprobe (EMP) techniques of [5]. Element, BSE, and red-green-blue mosaics as registered layers in a drawing program were used to outline clasts by hand and determine their types [5]. Pixels were counted in output images, providing relative surface area abundances of CAIs, AOAs, chondrules (and their subtypes), and matrix, and their size distributions.

Results: We have now measured ~30 cm^2 of slabs at 13 μm/pxl, and small clast abundance in 12 mm^2 of matrix-rich areas at 2 μm/pxl, allowing correction of matrix abundance in slabs for the presence of unresolved clasts (i.e.-isolated 5-10 μm olivines). We find olivine and small chondrules (<100 μm maximum dimension) to be less than 7% of what we classify as matrix at coarser scale. Matrix is 57%, chondrules 32%, CAIs 8%, opaques <1% of Allende by areal analysis. Correcting area for volume fractions assuming packed spherical clasts would increase matrix proportion by up to 10% (i.e., to 62% of the volume).

Conclusions: New methods allow counting and analyzing inclusions efficiently over large areas [e.g, 6], compared to optical point counting. In optical microscopy clasts are defined by the sharp contrast of opaque matrix framing a translucent clast. In EMP mapping boundaries are set by the differences in elemental compositions of accretionary rims around objects, which are not always consistent with those boundaries seen optically. Our findings are similar to those of McSween [4] for relative CAI/AOA/chondrule abundances, but we find more matrix than his 38%. The differences may be due to different criteria used in these procedures when assigning inclusions to individual categories.

References: [1] MacPherson G.J. et al. (2005) In *Chondrites and the Protoplanetary Disk* (eds. Krot A.N. et al.) pp. 225-250. (p.242). [2] Grossman L. & Steele I.M. (1976) *Geochimica et Cosmochimica Acta, 40, 149-155*. [3] Weisberg M.K. & Prinz M. (1998) *Meteoritics and Planetary Science*, 33, 1087-1099. [4] McSween H.Y. Jr. (1977) *Geochimica et Cosmochimica Acta, 41,1777-1790.* [5] Ebel D.S., Brunner C.E. & Weisberg M.K. (2008) *39th Lunar and Planetary Science Conference*, #2121. [6] Mayne et al. (2005) *36th Lunar and Planetary Science Conference*, #1791.