THE MACROSTRUCTURE OF THE SUTTER'S MILL METEORITE.

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Introduction: A 5.1 gram individual from the Sutter's Mill meteorite fall, designated SM48 by the NASA Ames team and owned by one of the authors (SA), was cut into 11 slices and recorded as photographs and photomicrographs. Examination of micrographs suggests that the meteorite is a regolith breccia with two dominant lithologies present in roughly equal abundances and varied combinations representing generations of mixing, comminution, and lithification expressing degrees of regolith maturity. Cracks within and surrounding clasts suggest the possibility that either (1) some fragments experienced in-situ dehydration and contraction subsequent to emplacement or (2) differed in cohesion from their host material so as to separate when stressed. Complex mixing, expressed at small scales both in clast distribution and variation in hydrous or heat alteration, strongly suggests a complex history on the impact plowed surface of volatile rich body. Recognizing the impacted nature of the origin environment may contextually inform future analysis of metamorphism, volatile loss, and lithologic variation.

Lithologic Distinction: The two dominant lithologies are distinguishable by texture, color, chondrule abundance and appearance, presence of CAIs, and groundmass texture. A chondrule-rich dark (CRD) lithology contains abundant, sharply defined, small (<< 1 mm) chondrules, and a fine, dark matrix containing sparse, sub-millimeter CAIs. This contrasts with a chondrule-poor light (CPL) lithology in which distinguishable chondrules are sparse, possibly larger, indistinct, and have visibly altered rims or dark mantles. The CPL is dominated by a lighter, grainy matrix in which no CAIs were observed. The impression is of differing degrees of hydrous alteration between these dominant types. Dark inclusions (DI) are also present as sub-cm clasts. These regions are very fine grained, black, and nearly featureless at low (<100x) magnification. Other distinct lithologies are suggested, but have not yet been characterized. A possible relation to the clastic character and evidence of a regolithic provenance recorded in the Murchison, Murray, and Nogoya CM chondrites [1, 2] is suggested.

Fusions Crust and Contraction Cracks: The surface is fragile. A thin (<100 µm) fusion crust covers a thicker (<2 mm) zone that is not melted or visibly altered, but separates easily due to contraction cracks that occur both vertical and parallel to the surface. In addition, what appear to be dehydration cracks or stress fractures associated with entry occur along lithology boundaries and within clasts. These fractures likely accentuated fragmentation during atmospheric passage. The similarity between these fractures and the surface heating/cooling cracks begs the comparison of water content within the meteorite and immediately below the fusion crust and suggest a possible role for low level heat induced drying and water depletion in the generation of the present meteorite's characteristics.

References: [1] Nakamura T. et al. 1996. Abstract #1465. 27th Lunar & Planetary Science Conference. [2] Nakamura T. et al. 1999. Geochimica et Cosmochimica Acta 63: 2, pp 257-273.