

THERMOLUMINESCENCE CHARACTERIZATION OF THE SUTTER'S MILL METEORITE. D. W. G. Sears, NASA Ames Research Center, Mountain View, CA 94035. E-mail: Derek.Sears@NASA.gov.

Introduction: Macrophotography of 11 slices of the Sutter's Mill meteorite cut from specimen SM-48 indicate that the meteorite is a regolith breccia [1]. Rounded clasts of a variety of size and shape are embedded in a matrix. The matrix is generally darker than the clasts, but clasts that are darker than the matrix are also observed as if matrix had been lithified and rounded to form clasts. In fact, there is a range of matrix and clast maturity as if the asteroid surface had been through multiple phases of regolith recycling. Images of Murchison in the literature suggest that it has a similar macrostructure [2]. Additionally, relatively rare dark inclusions of the sort observed in Allende [3] are present in Sutter's Mill. Sutter's Mill fragment SM-2 is an anomalous CM chondrite containing oldhamite and phosphides, unusual phases for this class, and in addition to aqueous alteration appears to have been heated [4]. Thus Sutter's Mill is an anomalous CM chondrite regolith breccia.

Induced Thermoluminescence and Metamorphism: Normal CM chondrites produce no detectable TL signal, reflecting their highly hydrated, unmetamorphosed, state. This is the only class to show no detectable TL, when measured at blue wavelengths. (Note, Murchison shows highly informative red cathodoluminescence [5]). However, the anomalous C2 chondrite MAC 87300, and its paired fragments, shows induced TL properties that resemble those of Colony and places it at the lowest end of the CO chondrite metamorphic range, suggesting that is CM3 [6]. Metamorphism increases induced TL by crystallizing plagioclase, the mineral responsible for the blue TL. Several metamorphosed CM chondrites are now known [7].

Induced Thermoluminescence and Brecciation: The maturity of lunar regolith breccias and soils can be monitored by induced TL because maturation converts plagioclase to various non-luminescence glasses which lowers the TL [8]. Similarly, gas-rich regolith breccia ordinary chondrites have dark matrix to light clast induced TL intensity ratio that correlates negatively with regolith maturity as measured by solar wind gases, charged-particle tracks, and carbon [9].

Induced Thermoluminescence and Sutter's Mill: Induced TL data should inform us on the metamorphic and brecciation history of this meteorite. If metamorphism predated brecciation, clast-to-clast-to-matrix TL variations will reflect maturity. If metamorphism post or co-dated brecciation then the TL properties will be uniform and reflect metamorphic history. I will report results at the meeting.

1. Beauford et al., *this meeting*. 2. Sephton 2001, *Nature* 414, 857. 3. Kojima & Tomeoka 1996. *GCA* 60, 2651. 4. Zolensky, *per. comm.* 5. Sears et al., 1993. *Meteoritics* 28, 669. 6. Sears et al., 1991. *Proc. NIPR Symp. Antarct. Meteor.* 4, 1745. 7. Tomeoka et al., 1989. *Proc. NIPR Symp. Antarct. Meteor.* 2, 36. 8. Batchelor et al., 1997. *JGR-E* 102, 19,321. 9. Haq et al., 1989. *GCA* 53, 1435.