ANALYSIS OF CARBOXYLIC ACID COMPOUNDS IN THE SUTTERS'S MILL METEORITE. J.T. Dillon[1], R. Tarozo[1], Q. Yin[2] and Y. Huang[1,3] [1]Department of Geological Sciences, Brown University, 324 Brook St, Providence, RI 02912, [2]Department of Geology, University of California, Davis, Davis, CA 95616, [3] yongsong_huang@brown.edu

Introduction: Carboxylic acid compounds are a commonly found class of organic molecules in carbonaceous chondrites and are often the most abundant class of organic compounds in CM type chondrites [1]. Numerous carboxylic acids have been reported in the literature including mono-, di- and α-hydroxy substituted acids, but low molecular weight monocarboxylic acids ($<C_9$) are overwhelmingly the most abundant class of organics found in carbonaceous chondrites [1]. The recent fall and recovery of the Sutter's Mill meteorite in 2012 has spurred an immense rush of research aimed at characterizing the potentially wide array of extraterrestrial organic compounds present in this CM type carchondrite [2]. With nearly an entire kilogram in total being recovered, the Sutter's Mill meteorite represents a unique opportunity to examine a meteorite sample still relatively free of terrestrial contamination. In this work we examine the carboxylic acid components present in a meteorite sample from the Sutter's Mill fall using a solid phase micro-extraction technique followed by GC-MS analysis.

Experimental: A small amount of meteorite (143 mg) was rinsed with distilled water and crushed in a clean agate mortar then extracted with 25 mL of an aqueous 0.2 M NaOH solution. The aqueous extracts were combined and adjusted to a pH > 10 using 2M NaOH. The solution was then reduced to a total volume of approximately 1-2 mL by rotary evaporation at 60ºC. The pH was subsequently adjusted to < 2 using 2.0 M HCl. The sample was then analyzed by solid phase micro-extraction (SPME) with GC-MS using a previously established procedure [3,4]. The GC (HP6890) was equipped with a NUKOL capillary column (30 m x 0.25 mm x 0.25 µm) and coupled to a MS detector (HP5973). The SPME fiber (CW-DVB, Supelco) was carefully placed into the sample vial and held in a fixed position for 15 min with constant stirring at 25ºC. The SPME fiber was then placed into the GC injector port and allowed to desorbed for 5 min at 210ºC. A cold trapping injection technique was used by placing an early segment of the GC column in a subzero bath of dry ice and isopropanol and allowing the SPME fiber to extract and desorb sample three times before bringing the GC oven back up to temperature for compound elution. The procedural blank sample showed no detectable carboxylic type compounds.

Results and Discussion: Due to small sample size available to us, direct extraction and analysis of the acid extract using SPME and GC-MS did not produce any detectable monocarboxylic acid peaks. In order increase the amount of sample on the column a cold trapping injection technique was used to keep compounds stationary in the column after desorption of the SPME fiber. This technique allows us to combine multiple SPME extracts into one GC-MS analysis. The adsorption-desorption process with the cold-trapping SPME fiber was carried out three times before bringing the column oven up to temperature and the running programmed temperature gradient for compound elution. We were able to quantify the abundance of five MCA species. The most abundant MCA was acetic acid with an estimated concentration of 181.1 nmol / g of meteorite. The other MCA compounds found were C7-C10 with an estimated abundance ranging from 1-4.2 nmols / g of meteorite (Table 1). The overall concentration of MCAs in Sutter's Mill is significantly lower than those in Murchison. However, it is well known MCA concentrations in different parts of the meteorite samples can be variable. The small sample fragments we used in our analysis may not have been ideal for preserving MCAs, since small MCAs are highly volatile. In comparison with Murchison, the Sutter's Mill contains relatively lower abundance of longer chain MCAs (Figure 1). A larger sample is required to determine the carbon and hydrogen isotopic ratios of MCAs in Sutter's Mill.

Table 1. Preliminary estimates of the five MCA compounds detected in the Sutter's Mill meteorite sample. Values are listed in units of nmols / g of meteorite. The MCAs detected in the Murchison meteorite using the identical extraction procedure are listed for comparison [4].

Compound	Sutter's Mill	Murchison
C2	181.1	770.1
C7	4.2	168.8
C8	2.9	106.7
C9	1.8	181.9
C10	1.0	53.4

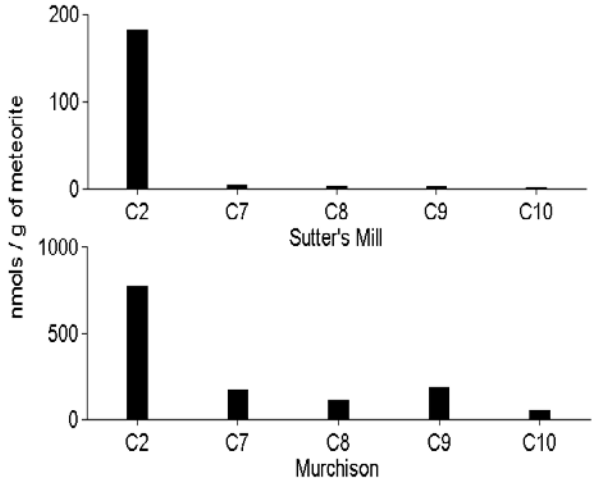

Figure 1. Histograms of selected MCAs in the Sutter's Mill meteorite (top panel) and in Murchison (bottom panel).

References: [1] Sephton, M. (2002) *Nat. Prod. Rep.*, *19*, 292-311. [2] Jenniskens, P. (2012) *Science, 338,* 1583-1587. [3] Huang, Y. et al. (2005) *Geochimica et. Cosmochimica Acta., 69,* 1073-1084. [4] Aponte J. C. et al. (2011) *Geochimica et. Cosmochimica Acta., 75,* 2309-2323.