FISCHER-TROPSCH TYPE SYNTHESIS OF ORGANICS USING IRON-SILICATE GRAINS. N. M. Johnson[1], G. D. Cody[2], and J. A. Nuth III[1], [1]Astrochemistry Branch, NASA-Goddard Space Flight Center, Greenbelt, MD, [2]Geophysical Laboratory, Carnegie Institution of Washington, Washington, DC.

Introduction: Fischer-Tropsch type (FTT) synthesis produces hydrocarbons by hydrogenating carbon monoxide via catalytic reactions. The overall reaction is represented by

$$nCO + (2n + 1)H_2 + \text{catalyst} \rightarrow C_nH_{2n+2} + nH_2O + \text{catalyst}.$$

The products of these reactions have been well-studied using 'natural' catalysts [1] and calculations of the efficiency of FTT synthesis in the Solar Nebula suggest that these types of reactions could make significant contributions to the composition of material near three AU [2]. We use FTT synthesis to coat Fe-silicate grains [3] with organic material to simulate the chemistry in the early Solar Nebula. This work differs from previous studies because we focus on the carbonaceous material deposited on the grains. In our experiments, we roughly simulate a model of the nebular environment where grains are successively transported from hot to cold regions of the nebula. In other words, the starting gases and FTT products are continuously circulated through the grains at high temperature with intervals of cooling (see §Experiments). We also examine the efficiency of the catalyst as organic solids are deposited on the grains. Overall, organics generated in this manner could represent the carbonaceous material incorporated in comets and meteorites. We will present the results of these experiments.

Experiments: We circulate CO, N_2, and H_2 gas through Fe-silicate grains that are maintained at a specific temperature. The gases are passed through an FTIR spectrometer and are measured to monitor the reaction progress. Each cycle begins with 75 torr N_2, 75 torr CO, and 550 torr H_2 before the grains are brought to temperature (i.e., 400, 500, 600°C). After the gas has circulated for a predetermined amount of time, the heating element is turned off and the gas is pumped away. We repeat this process from twenty to forty times. Some of the catalyzed grains are then subjected to either thermal annealing or hydration to determine how these processes affect the deposited organic layers. Samples are analyzed using FTIR, GCMS (including pyrolysis) and potentially by NMR spectroscopy.

We thermally annealed the 500°C post-catalyzed grains under vacuum at 600°C and 700°C. Thermal annealing of the coated grains (particularly at 700°C) deposited an oily brown residue on the walls in the cooler regions of the reaction vessel. Three separate aliquots of the catalyzed grains at 500°C were hydrated at room temperature (~23°C), ~65°C, and 90°C (at atmospheric pressure) respectively.

Initial results: We examined the abovementioned brown oily residue for organic compounds using pyrolysis GCMS. The results indicate an organic content as rich and varied as the Tagish Lake meteorite organics [4]. This residue contains primarily saturated and unsaturated hydrocarbons. The following were also identified: alkyl-benzenes, alkyl-phenols, alkyl-phenyl ethers, alkyl-styrenes, alkyl-naphthalenes, alkyl-quinolines, and traces of poly-cyclic aromatic hydrocarbons. If these results are any indicator, we may have uncovered some clues about the origins of meteoritic organics.

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References: [1] Hayatsu R. and Anders E. (1981) *Top. Curr. Chem.. 99,* 1-37. [2] Kress M. E. and Tielens A. G. G. M. (2001) *Meteorit. Planet. Sci., 36,* 75-91. [3].Nuth J. A. et al. (2002) *Meteorit. Planet. Sci., 37,* 1579-1590. [4] Pizzarello S. et al. (2001) *Science, 293*, 2236-2239.