KINETICS OF ORGANIC MATTER DEGRADATION IN THE MURCHISON METEORITE FOR THE EVALUATION OF CHONDRITE PARENT BODY THERMAL EVOLUTION. Y. Kebukawa[1*], S. Nakashima [1] and M. E. Zolensky[2]. [1]Department of Earth and Space Science, Osaka University, 1-1 Machikaneyama, Toyonaka, Osaka 560-0043, Japan. [2]Astromaterials Research and Exploration Science, KT, NASA Johnson Space Center, Houston, TX 77058, USA. [*]E-mail: yoko.soleil@ess.sci.osaka-u.ac.jp.

Introduction: Carbonaceous chondritic meteorites contain abundant carbon up to a few wt%, which exists predominantly in the form of insoluble organic matter (IOM) [1]. Structural changes of IOM have been used to evaluate parent body thermal processes. Recently, Cody et al. [2] demonstrated that the development of graphene sheets observed using carbon X-ray absorption near edge structure (XANES) spectroscopy appeared to correlate well with other estimated degrees of the thermal metamorphism of the chondrite parent bodies. The kinetic expression derived by Cody et al. [2] is most effective for the petrologic type 3 chondrites. Therefore kinetic studies for relatively lower temperatures are needed to evaluate the type 1 and 2 chondrites.

Experimental: In-situ heating experiments of bulk and IOM of the Murchison (CM2) meteorite were conducted under Fourier transform infrared (FTIR) micro-spectroscopy combined with a heating stage. Bulk and IOM of Murchison grains are heated at 240-300ºC isothermally in the heating stage under Ar gas flow for several hours. Infrared spectra are collected in-situ during heating.

Results and Discussions: Decreases of aliphatic C−H peak area with time at each temperature are well fitted with Ginstling-Brounshtein's three dimensional diffusion model, and the rate constants for decreases of aliphatic C−H were determined. Activation energies and frequency factors are estimated from these rate constants at different temperatures using the Arrhenius equation. Activation energy values of aliphatic C−H band area decrease are larger for IOM than bulk. Hence, the mineral assemblage of the Murchison meteorite might have catalytic effects for the organic matter degradation. Using obtained kinetic expressions, the time scale for metamorphism can be estimated for a given temperature with aliphatic C−H band area, or the temperature of metamorphism can be estimated for a given time scale. Aliphatic C−H decrease profiles in a parent body are estimated using a time–temperature history model of Young [3]. The simulation results suggest that aliphatic C−H survives within 2 km depth (maximum temperature of about 40ºC) from the surface of a parent body with a radius of 9 km.

These in-situ heating experiments provide us a new insight into the thermal history of organic matter in carbonaceous chondrites. The kinetic data will constrain temperature and time scales of low temperature or short heating processes for the petrologic type 1 and 2 chondrites.

References: [1] Botta O. and Bada J. L. 2002. *Surveys in Geophysics* 23:411-467. [2] Cody G. D. et al. 2008. *Earth and Planetary Science Letters* 272:446-455. [3] Young E. D. 2001. *Philosophical Transactions of the Royal Society A* 359:2095-2110.