# *Irreversible metamorphism of warm C-type Near-Earth Asteroids investigated with carbonaceous chondrites*

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## METHODS AND SAMPLES

Bidirectional reflectance spectroscopy of carbonaceous chondrites under NEA-like environment (pressure $10^{-5}$-$10^{-6}$mbar, from room temperature to 523K), with the spectro-gonio radiometer SHADOWS [1].
Selection of 10 CM chondrites (CM1, CM2 and heated CM2) to be compared with observations with AKARI [2].

## RESULTS

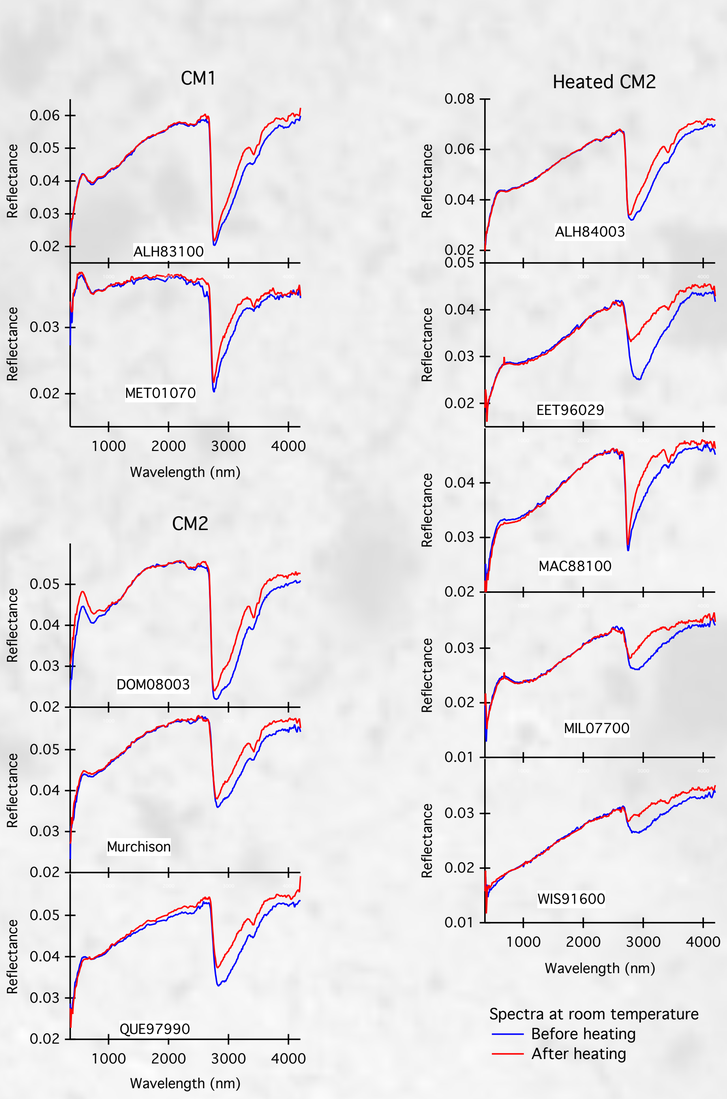


Fig. 1: Resulting spectra acquired at room temperature before and after the temperature experiment

***Visible range***
- Loss of amplitude, broadness
- Shift of the 700 and 900nm band

***3µm band:***
- Loss and amplitude and broadness
- Increase of sharpness
- Shift of the minimum position

***Organics feature***
- Increase of amplitude

$$Slope = \frac{R_{2.45}}{R_{0.55}} \qquad Symmetry = \frac{A - B}{C - A}$$

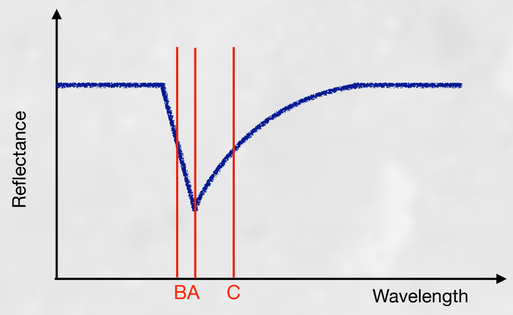


Fig. 2: Scheme of the wavelengths used to calculate the symmetry factor

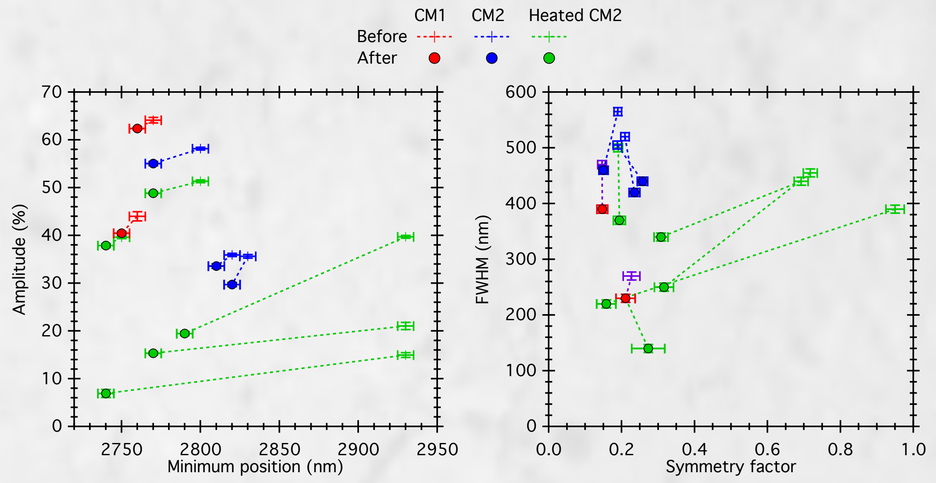


Fig. 3: Variations of the parameters of the 3µm band during the temperature experiment

***The more altered the meteorite, the less variation by the temperature experiment***

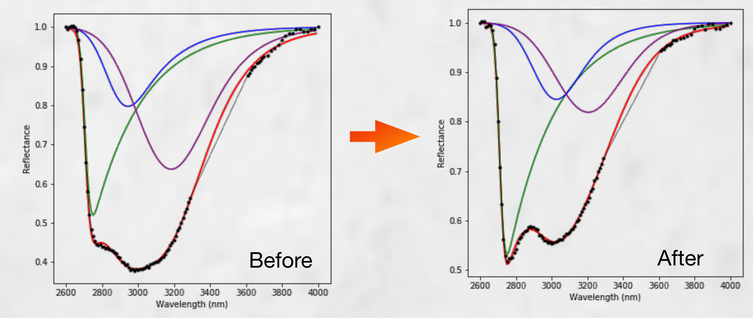


Fig. 4: Modelled 3µm band of the meteorite Tagish Lake before and after the temperature experiment showing the variations of all components

***Apparent shift of the complete band due to alteration of some components***

Order of the polyaromatic carbonaceous matter before and after the temperature experiment assessed using Raman spectroscopy:

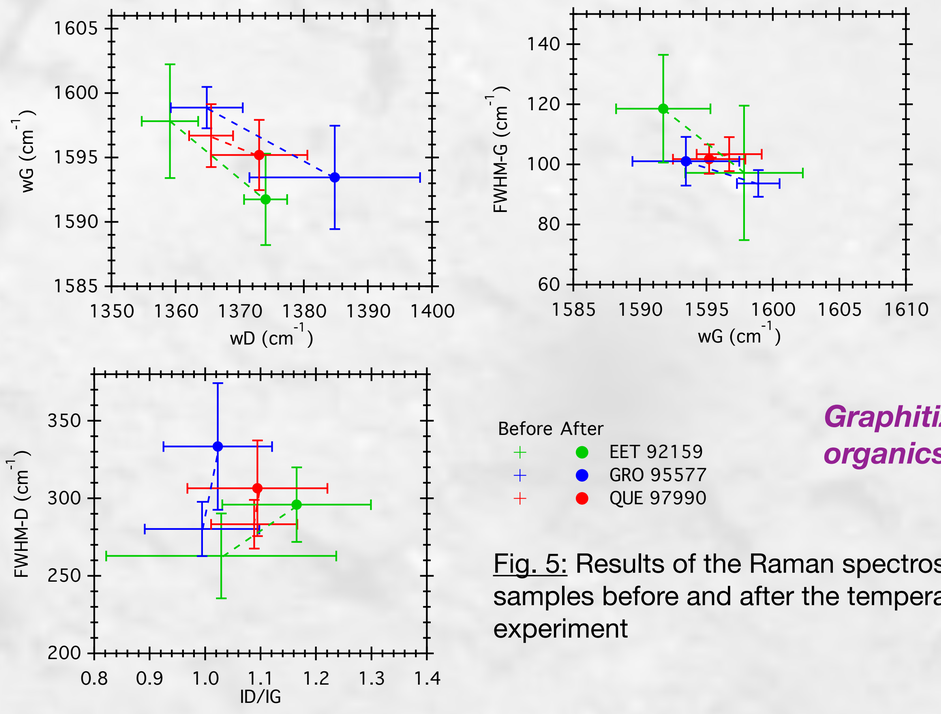


Fig. 5: Results of the Raman spectroscopy of the samples before and after the temperature experiment

***Graphitization of the organics***

## COMPARISON WITH ASTEROIDS OBSERVATIONS

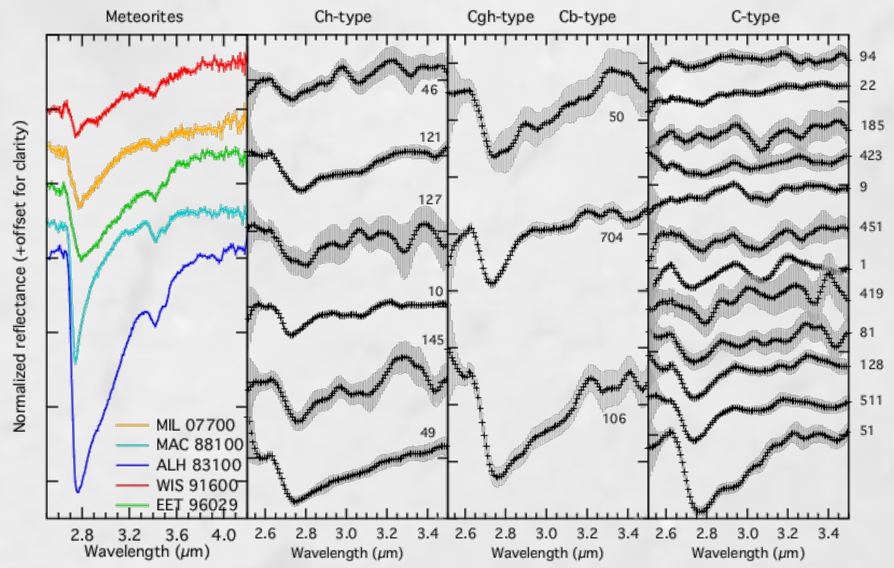


Fig. 6: Reflectance spectra of asteroids taken with AKARI [2] compared to the data from the temperature experiment

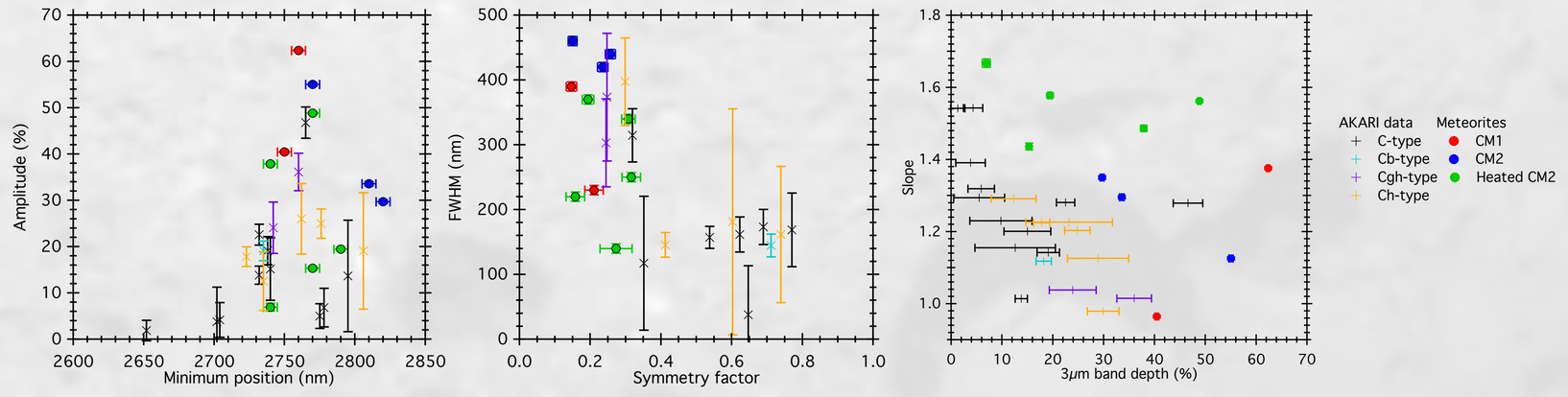


Fig. 7: Parameters of the 3µm band and slope of the asteroids spectra compared to the results of the temperature experiment.

***Depth and position of the bands consistent between temperature experiment and observations, but 3µm band from asteroids thinner, less sharp, and bluer spectra***

No clear sign of organics related features in the reflectance spectra of asteroids

Irradiation experiment on meteorites [3] leads to an amorphization of the carbonaceous matter

***High temperature ⟶ graphitization***
***Space weathering ⟶ amorphization***

*This research is based on observation with AKARI, a JAXA project with the participation of ESA.*

[1] Potin et al. *Applied optics*, 2018 [2] Usui et al. *Publication of the Astronomical Society of Japan*, 2019 [3] Lantz et al. *Icarus*, 2017