**Proposed Studentship - FUNDED** 



# Understanding the effects of thermal metamorphism on the water and organic contents of primitive carbonaceous chondrites

Supervisors: Dr Queenie Chan (RHUL), Dr Alex Dickson (RHUL), Dr Ashley King (National History Museum)

### Project background

The effects of thermal alteration on the structure, concentration and chemistry of organic matter have been studied in both terrestrial and extra-terrestrial material (1,2). This study aims at providing a quantitative account of the impact of these processes in order to determine the primordial composition of the rocks, and to properly address the nature of the precursor material of their organics and volatiles. This study offers crucial insights into the ongoing sample-return space missions, Hayabusa2 and OSIRIS-REx, as they sample heated asteroids, while the supervisors (Chan, King) are on the sample analysis teams.

### **Research methodology**

The successful candidate will conduct heating experiments and observe how the mineralogy and organic content of meteorites and organic-rich mudrocks change when subjected to heating. Data of the mineralogy, chemical, isotopic and organic compositions of the samples will be acquired by techniques such as X-ray diffraction analysis (XRD), scanning electron microscopy (SEM), infrared, Raman spectroscopy, nanoscale secondary ion mass spectrometry (NanoSIMS), and X-ray absorption near edge structure (XANES) at Diamond Light Source.

### Training

The successful candidate will be primarily located at Royal Holloway, and also be hosted at the Natural History Museum for a minimum period of 3 months during the project, where the student will have access to world-leading meteorite and mineral collections and state-of-the-art analytical facilities. In addition to the mandatory cohort training events organised by DTP, the successful candidate will be given training for transferrable skills such as wet chemical and clean lab techniques, mineral identification, spectroscopic data interpretation, and the analytical methods necessary for the implementation of this project at RHUL and NHM. Academics at Tohoku University will also provide training for the successful candidate on the experimental heating procedures.

### **Person specification**

We are looking for a student with interest in laboratory analysis, a passion in organic geochemistry and meteoritics, and a background in Geology/Chemistry (or equivalent), preferably with knowledge of mineralogy and geochemistry. Laboratory experiences and some knowledge of meteorites is desirable but not essential. Student should be able to travel to Japan to conduct the heating experiments at Tohoku University.

## Key references

**A. J. Dickson**, E. Idiz, D. Porcelli, S. H. J. M. van den Boorn, The influence of thermal maturity on the stable isotope compositions and concentrations of molybdenum, zinc and cadmium in organic-rich marine mudrocks. Geochimica et Cosmochimica Acta, November 2019 p. 1-16, doi: https://doi.org/10.1016/j.gca.2019.11.001

**Q. H. S. Chan**, A. Nakato, Y. Kebukawa, M. E. Zolensky, T. Nakamura, J. A. Maisano, M. W. Colbert, J. E. Martinez, A. L. D. Kilcoyne, H. Suga, Y. Takahashi, Y. Takeichi, K. Mase and I. P. Wright. 'Heating experiments of the Tagish Lake meteorite: Investigation of the effects of short-term heating on chondritic organics', *Meteoritics & Planetary Science*, September 2018, p. 1-22, doi: https://doi.org/10.1111/maps.13193

P. Lindgren, M. R. Lee, R. Sparkes, R. C. Greenwood, R. D. Hanna, I. A. Franchi, **A. J. King**, C. Floyd, P. E. Martin, V. E. Hamilton, C. Haberle. 'Signatures of the post-hydration heating of highly aqueously altered CM carbonaceous chondrites and implications for interpreting asteroid sample returns', *Geochimica et Cosmochimica Acta*, September 2020, doi: https://doi.org/10.1016/j.gca.2020.08.021

S. Yamashita, K. Mogi, T. Nakamura, M. Matsuoka, Q. H. S. Chan, K. Amano, M. Zolensky, S. Okumura, Y. Furukawa, H. Yabuta, K. Jogo, and M. Ikehara. 'Progressive changes in mineralogy, spectroscopy and water contents of experimentally heated Murchison excluding effects of adsorbed and rehydrated atmospheric water', *Meteoritics & Planetary Science*, 2020
Y. Kebukawa, M. E. Zolensky, Q. H. S. Chan, K. Nagao, A. L. D. Kilcoyne, R. J. Bodnar, C. Farley, Z. Rahman, L. Le, and G. D. Cody. 'Characterization of carbonaceous matter in xenolithic clasts from the Sharps (H3.4) meteorite: Constraints on the origin and thermal processing', *Geochimica et Cosmochimica Acta,* January 2017, p. 74-101, doi: https://doi.org/10.1016/j.gca.2016.09.024

### **Application details**

This project has been shortlisted for funding by the ARIES NERC DTP and will start on 1st October 2021. The closing date for applications is 23:59 on 12th January 2021.

Successful candidates who meet UKRI's eligibility criteria will be awarded a NERC studentship, which covers fees, stipend (£15,285 p.a. for 2020-21) and research funding. For the first time in 2021/22 international applicants (EU and non-EU) will be eligible for fully-funded UKRI studentships. Please note ARIES funding does not cover visa costs (including immigration health surcharge) or other additional costs associated with relocation to the UK.

ARIES students benefit from bespoke graduate training and ARIES provides £2,500 to every student for access to external training, travel and conferences. Excellent applicants from quantitative disciplines with limited experience in environmental sciences may be considered for an additional 3-month stipend to take advanced-level courses in the subject area.

ARIES is committed to equality, diversity, widening participation and inclusion in all areas of its operation. We encourage enquiries and applications from all sections of the community regardless of gender, ethnicity, disability, age, sexual orientation and transgender status. Academic qualifications are considered alongside significant relevant non-academic experience.

All ARIES studentships may be undertaken on a part-time or full-time basis, visa requirements notwithstanding

For further information, please contact <u>Queenie.Chan@rhul.ac.uk</u>