

Geological mapping of Mercury's H-11 (Discovery) quadrangle

Supervision team: Professor David Rothery and Professor Matt Balme

External supervisor: Dr Valentina Galluzzi, INAF - Istituto di Astrofisica e Planetologia Spaziali, Rome

Collaborator: Dr Jack Wright, The Open University

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Description:

A team of European researchers has been making 1:3 million scale geological maps of Mercury, in preparation for the arrival of the BepiColombo spacecraft in orbit about the planet in 2025. Mercury is divided into 15 mapping quadrangles. Of these, H-11 (Discovery) has no complete map, although its tectonic structures have been mapped by Valentina Galluzzi (INAF, Rome). The student will take the lead in collaboration with Galluzzi to complete the geological mapping of this quadrangle. The project will use ArcGIS software to integrate data from NASA's MESSENGER narrow- and wide-angle-camera images with topographic and spectral data, available from NASA's Planetary Data System. The student will be primarily responsible for mapping morphostratigraphic contacts and classifying craters bigger than 20 km by degradation state, and will liaise with a fellow PhD student who will have started mapping the adjacent south polar region in February 2021. The finished product will be a 1:3M geological map of the H-11 quadrangle for publication in Journal of Maps.

In addition, the student will choose a smaller region of the planet for experimental mapping at a larger scale (to be decided, but probably 1:1M, or 1:500k).

Although maps will be the main specified deliverables at the outset of this study, the intimate insight gained by close examination of any part of Mercury offers many opportunities for spin-off science, and we expect the student to define and pursue a topic of interest. This could, for example, be volcanological, geomorphological, tectonic, related to space-weathering, or related to volatile processes, according to the student's interests. We would expect the student to present findings at international meetings and the British Planetary Science Conference (to be hosted by the OU in January 2022), to become active in the BepiColombo Young Scientists Study Group (currently meeting remotely), and also to submit papers for publication in peer-reviewed journals. There will also be opportunities to inform and influence BepiColombo target selection and prioritisation.

Mapping will follow 'mapping standards' protocols and conventions adopted by the 'Planmap' consortium, which are consistent with US Geological Survey practice. Online digital publication facilitates the inclusion of multiple layers, so that (for example) this new generation of maps could have a chronostratigraphic version (surface units divided by age, such as smooth plains, intercrater plains, and so on) and a more innovative lithostratigraphic version (for example subdividing plains into spectral types).

The supervisors will train the student in ArcGIS and planetary geological mapping. Experience of geological mapping of Earth would be an advantage.

References:

Rothery, D.A., Barraud, O., Besse, S., Carli, C., Pegg, D.L., Wright, J., and Zambon, F. 2020. On the asymmetry of Nathair Facula, Mercury. *Icarus* doi.org/10.1016/j.icarus.2020.114180

Wright, J., Conway, S.J., Morino, C., Rothery, D.A., Balme, M.R. and Fassett, C.I., 2020. Modification of Caloris ejecta blocks by long-lived mass-wasting: A volatile-driven process? *Earth and Planetary Science Letters*, 549, p.116519.

Wright, J., Rothery, D.A., Balme, M.R. and Conway, S.J., 2019. Geology of the Hokusai quadrangle (H05), Mercury. *Journal of Maps*, 15(2), pp.509-520.

Qualifications required:

A first class or upper second class MSci degree (or equivalent) in Earth Sciences or related discipline. Previous experience in using ArcGIS or a comparable GIS package for geological mapping of Earth or another body would be an advantage, as would evidence of previous interest of experience in planetary science.