Meteorites from the Australian outback: A new terrestrial climate proxy?

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The goal of this project is to test the novel idea that meteorites can provide a detailed record of changes in the Earth’s climate. This climatic information is stored within ‘desert varnish’, a finely laminated crust that forms on rock surfaces in arid regions. Varnished meteorites recovered from desert floors are potentially far more useful for palaeoclimate studies than terrestrial rocks because the time that has elapsed since they landed and started accreting varnish can be determined precisely by isotope techniques. However, it is unknown whether the varnish on small and isolated meteorites will be sufficiently continuous and well preserved to provide long-term and regionally consistent climate records.

These ideas will be tested by analysing varnished meteorites that have lain exposed on the Nullarbor Plain (Western Australia) for up to 40,000 years, during which time the region’s climate has changed significantly. The student will analyse varnished meteorites from collections at the Western Australian Museum (Perth), and petrographic thin sections of most of them are already available. Varnish microstratigraphies will be characterized by imaging cross-sections using transmitted light, then the chemical and mineralogical ‘fingerprint’ of each layer will be determined by scanning electron microscopy, X-ray microanalysis, laser Raman spectroscopy and transmission electron microscopy. Results of this work will yield a temporally and spatially highly resolved matrix of varnish microstratigraphies, which will be cross-correlated using statistical techniques including time series analysis. In order to test this climate proxy, the dataset will be interrogated by asking questions including: (i) Is there evidence for abrasion or non-deposition of layers? (ii) Are varnish microstratigraphies consistent throughout the region? (iii) Is information from the meteorites consistent with data from Western Australian lake levels and records from further afield (e.g., Antarctic ice cores)? If the meteorite varnish proxy passes these tests it will provide much new information on the climatic evolution of Western Australia, and will be ready to use in palaeoclimatic studies elsewhere.

The student will be trained in a wide range of research skills, and will be part of a vibrant planetary science group within the School of Geographical and Earth Sciences, whose researchers study meteorites from Mars and primitive asteroids, and terrestrial impact craters.

Application procedure: This project is eligible for funding by several schemes within the University of Glasgow. For entry in 2019 apply via the website of the College of Science and Engineering*. The application deadline is 31 January 2019. Please contact the principal supervisor with any questions (Martin.Lee@Glasgow.ac.uk).

*https://www.gla.ac.uk/schools/ges/researchandimpact/postgraduate/#/applyingtoundertakeaphdingeographicalandearthsciences