

MICROSPHERULES IN THE GEOLOGICAL RECORD

STFC Funded PhD

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Sedimentary rocks contain trace amount of microspherules. These tiny grains have uncertain origins but provide important constraints on environmental, volcanological and cosmic environments.

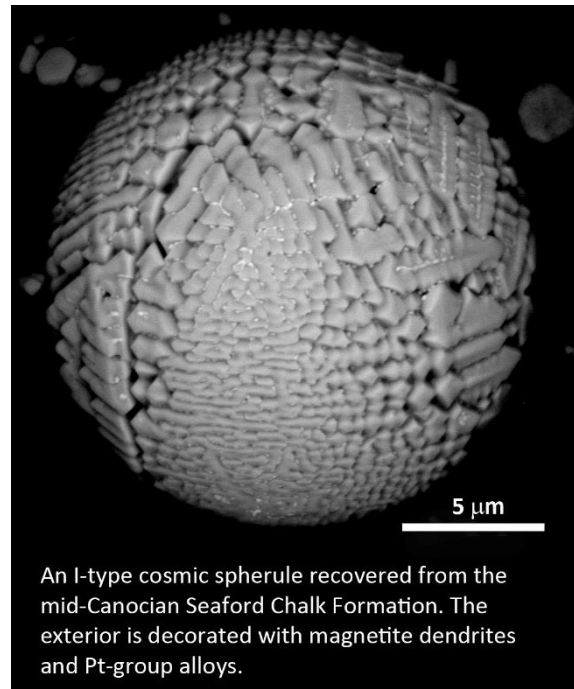
Within most sedimentary rocks with low deposition rates microspherules from 10 to several hundred microns in size are present. Some of these grains dominated by magnetite, wustite and metal are extraterrestrial in origin and are thought to be cosmic dust that fell on Earth at the time of deposition. These particles provide a measure of the interplanetary dust flux and thus the abundance of dust in the near Earth environment – a constraint on the abundance of dust producing collisions in the asteroid belt and the influx of comets into the inner solar system.

Not all microspherules are, however, extraterrestrial. Volcanic microspherules have been discovered in tephra from volcanoes and their abundance globally is unknown. Sedimentary rocks may provide a proxy for global explosive volcanic activity that is independent from proximal ejecta. Microspherules are also produced by the impact of asteroids and comets with the Earth to generate impact craters. These materials include both target and projectile materials and have compositions that are dependent on scale. Large impacts producing probably generating bulk crust compositions and small, localised compositions dependent on the nature of the target.

Environmental processes may also generate microspherules. Lightning strikes generate fulgurites that vaporise and melt sediments. Spray and condensation of vapor generate microspherules that are likely to vary in composition with target rock. Biomass burning (e.g. forest fires) also generate melted or condensed products. Mostly these are re-entrant, fractal smokes, however, spherules at small sizes (<10 microns) are also possible.

The STFC-funded PhD project will investigate the origins of microspherules in the geological record through a multidisciplinary study of spherules found in sediments, experimental production of spherules, and numerical modelling of atmospheric entry of cosmic dust. A wide range of analytical techniques including analytical SEM, electron microprobe, laser ablation ICP-MS and infra-red/Raman spectroscopy will be used to characterise microspherules collected from sediments and produced by experimentation. Sediments will be collected during fieldwork in the PhD and involve evaluations of sedimentary environment.

The PhD would suit student with diverse interests. Many aspects of the study will be grounded in igneous petrology since it relates to the formation of molten droplets in the atmosphere or within volcanic eruptions. An appreciation of sedimentary processes and accumulation biases would also be



favourable. Ultimately it is geochemistry that is likely to be the most important tool in evaluating the origins of microspherules and thus an interest in the qualitative behaviour of elements under a wide range of conditions would be very useful.

Matthew Genge, the lead supervisor, is a planetary scientist of 25 years experience, who is one of the leading experts in cosmic dust. He has recently recovered cosmic dust from Cretaceous chalk and 2.7Ga Archean Limestones. The objective of the PhD is to conduct the first systematic study of the variety of microspherules within sedimentary rocks to allow both the identification of unusual cosmic dust and those particles that have terrestrial applications.

To discuss the project contact Matt Genge (m.genge@imperial.ac.uk)