

SPITFIRE Doctoral Training Partnership (DTP)

Research Experience Placement 2017

Project Brief

Applications close at Noon, Friday, 2 June 2017

Lead Supervisor: Secondary Supervisor:	Professor Damon A.H. Teagle; Dr Blair Thornton (FEE)
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University/Research Organisation:	University of Southampton
Department:	Ocean & Earth Science
Project Title:	Machine learning investigations of sub-surface weathering of gabbros from the Oman Drilling Project

Total Student Support Costs: £	£2500 (£200 for 10 weeks plus £500 research and training support grant)
<i>Based on a minimum of £200/week full time for a minimum of 8 weeks and maximum of 10 weeks and a £500 Research and Training Support Grant.</i>	

Proposed Start Date: Monday, 26 June 2017	Proposed End Date: Friday, 1 September 2017
<i>Projects should run over the summer vacation and we recommend that projects will have terminated by 15 September 2017.</i>	

Brief Summary – please provide a brief summary (maximum 300 words) of the project.

This should include:

- *Project outline;*
- *Links to staff/School/Centre activity as appropriate;*
- *Supervisory arrangement;*
- *How space/equipment/supporting resource demands will be met;*
- *Elements of the project that will incorporate elements other than computer/modelling e.g. fieldwork and data collection;*
- *How the project will enhance the skills of the appointed student;*
- *Any intellectual property rights concerns that may arise from the work.*

This project will use machine learning image analysis techniques to quantify the occurrence of secondary mineral phases formed by hydrothermal alteration and shallow groundwater reactions in the mountains of the Samail ophiolite, Oman – an ancient slice of ocean crust now preserved on-land. The International Continental Drilling Program “Oman Drilling Project” (see www.omandrilling.ac.uk) has recently recovered more than 1500 m of drill core, with near 100% recovery, from 4 holes drilled into the gabbros and upper mantle rocks of the Samail ophiolite. The outside surfaces of all cores have undergone 360 degree image scanning before being curated for detailed visual core description. This project will

assemble and then interrogate these images to make quantitative estimates of the occurrences of different rock-types and secondary minerals

One of the surprising initial surprising observations in the drill cores is the abundant presence of low temperature (<100 deg C) secondary minerals such as the white, zeolite laumontite ($\text{CaAl}_2\text{Si}_4\text{O}_{12}\cdot 4\text{H}_2\text{O}$) that is observed but not in such abundance in surface outcrops. Laumontite occurs as thick veins in the drillcore. Quantitative estimates of the abundance of laumontite and its dissolution and mobility in near sub-surface ground waters could have important implications for the weathering cycle in basalt terrains.

The Oman Drilling Project boreholes have also been logged using downhole wireline geophysical tools that measure a range of parameters as well as image the borehole walls. Using the borehole wall and the core images, the cores should be able to be re-oriented into an exactly geographic reference frame.

Please give an indicative timescale for the student's work over the length of the project: (maximum 150 words).

This should include:

- *The broad tasks the student will undertake;*
- *An indicative timescale for these tasks.*

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- 1) Assembly of a continuous image of the outside of the drilled core using the 360 deg core images
 - 2) Identification of key features in the core images that can be related to specific features in the cores, such as fault zones, igneous layering, igneous contacts, and thick mineral veins of known mineralogy.
 - 3) Quantification of the occurrence of different rocktypes and mineral veins
 - 4) Correlation of core images with borehole wall features.

Proposed procedure for appointing students, including selection criteria:

Please identify specific criteria that should be considered for the selection of placement students e.g. specific quantitative skills that may be required, subject knowledge etc. If a student has been pre-selected, or the research area has been led by the student, please provide the student's contact details, and a summary of their suitability for the SPITFIRE DTP REP programme.

This project will require a student with excellent computer skills, and experience in image analysis, machine learning and the treatment of very large data sets. It is especially well suited for a student from a numerical computer science background.