World-Leading Doctoral Scholarship in Earth and Environmental Sciences and Geography and Sustainable Development

2022 entry

The University of St Andrews is pleased to offer a full scholarship funded by St Leonard’s Postgraduate College, to support an exceptional student undertaking doctoral research in the following project:

The hunt for massive mystery eruptions: novel geochemical tools to interrogate the ice core archive

Project description

Explosive volcanic eruptions have profound environmental and societal consequences. The most powerful events, like the 1815 Tambora eruption, devastate regions in the vicinity of the volcano, and inject prodigious quantities of ash and gas into the stratosphere. Such events lead to prolonged climate cooling and have far-reaching societal impacts due to crop losses, famine, and migration.

For geoscientists our goal is to generate detailed records of the source, style, and impacts of past volcanic events. This information is essential input for climate models that simulate volcanic eruptions, and therefore critical for disaster risk reduction and assessing the vulnerability of our modern globalised world to climate shocks.

Ash and aerosol fallout from major eruptions is captured in polar ice caps, which represent the finest records of volcanism on Earth. Massive eruptions are identified by sulfur-rich horizons. However, for most of these layers we have no idea which volcano was responsible nor whether it was stratospheric and likely had global impact. In the last 2000 years only 6 of the largest 25 ice core sulfur layers are linked to a known volcanic event, and the most famous unidentified eruption occurred in 1808 (only a few years before Tambora, Figure 1). The challenge with these mystery eruptions is that current analytical techniques provide scant information on plume injection height and source location; key parameters that determine climate impact.
This project will use state-of-the-art geochemical tools to reveal the source and eruptive style of the largest unidentified volcanic events in the last millennium (including massive eruptions in 1808, 1230 and 1171). New insights will come from two main innovations:

1. **High time resolution multiple sulfur isotopes in ice core layers.** Sulfur isotopes are a novel approach for determining eruptive plume height based on the presence (or absence) of a mass independent fractionation. Isotopes are also sensitive to the separation of high and low altitude plumes and can constrain eruption latitude.

2. **Novel cryptotephra extraction and microanalysis procedures.** Fine-grained volcanic ash (cryptotephra) is often deposited alongside ice core sulfur layers and we have developed new methods to isolate these grains for imaging and chemical analysis. Ash chemistry can pinpoint the source and setting of the volcano and, importantly, for several of these unidentified eruptions we have found glass shards sufficient for high-precision chemical analysis by electron microprobe (EPMA) and laser ablation (LA-ICP-MS, Figure 2).
Figure 2: Images of cryptotephra extracted from an unidentified eruption.

This project is ground-breaking because it employs the latest methodological advances. St Andrews has led the development of sulfur isotope mass spectrometry and the high precision measurements required for this research. We also have brand new EPMA and LA-ICP-MS facilities for analysing the full suite of major and trace elements in tephra. This combination gives us a unique toolset for ice core volcanology.

Understanding the source of these massive mystery eruptions is one of the outstanding challenges in volcanology and paleoclimate. This project will undoubtedly provide fascinating insights into these exceptional events and stimulate new interactions between volcanologists, climatologists, and historians. By revealing the source and climate impact of these extreme events we will improve climate forcing estimates, allowing us to better predict and mitigate the impacts on society.

This project will suit a student with a geoscience background and interests in volcanology, climate, and geochemistry. They will be trained in all key analytical techniques (EPMA, LA-ICP-MS and MC-ICP-MS) and will develop transferable skills in data analysis and visualization, statistics, and scientific writing. There will be opportunities to conduct ice core sampling at facilities in Europe and to present their results at international conferences. Working between schools will provide opportunities for networking with different research teams, including the St Andrews Isotope Geochemistry laboratory (in SEES) and the Environmental Change Research Group (in SGSD). The project will lead to academic and industry career opportunities in environmental science and risk analysis.

Informal enquiries regarding this scholarship may be addressed to Dr Will Hutchison, wh39@st-andrews.ac.uk.

Eligibility

Geographical criteria

No restrictions.

Domicile for fee status
No restrictions.

**Level of study**

Postgraduate Research (Doctoral)

**Year of entry**

2022-2023 academic year.

**Schools**

Earth and Environmental Sciences

Geography and Sustainable Development

**Additional criteria**

Applicants must not already hold a doctoral degree or be matriculated for a doctoral degree at the University of St Andrews or another institution.

**What does it cover?**

**Duration of award**

What is the length of the PhD? – 3 or 3.5 years

Up to 3.5 years. The successful candidate will be expected to have completed the doctorate degree by the end of the award term. The award term excludes the continuation period and any extension periods.

**Value of award**

The award covers full tuition fees for the award term as well as an annual stipend payable at the standard UK Research Council rate (the 2021-22 annual rate is £15,609).

**Tuition or maintenance award**

Tuition and maintenance.

**About St Andrews**

**Doctoral Research at St Andrews**

As a doctoral student at the University of St Andrews you will be part of a growing, vibrant, and intellectually stimulating postgraduate community. St Andrews is one of the leading research-intensive universities in the world and offers a postgraduate experience of remarkable richness.
St Leonard’s Postgraduate College is at the heart of the postgraduate community of St Andrews. The College supports all postgraduates and aims to provide opportunities for postgraduates to come together, socially and intellectually, and make new connections.

St Leonard’s Postgraduate College works closely with the Postgraduate Society which is one of the most active societies within the Students’ Association. All doctoral students are automatically welcomed into the Postgraduate Society when they join the University.

In addition to the research training that doctoral students complete in their home School, doctoral students at St Andrews have access to GRADskills – a free, comprehensive training programme to support their academic, professional, and personal development.

**How to apply**

1. Apply for admission as a doctoral student. Please see the advice on Research programmes.
2. After submitting the research application form in step 1, you must apply for the scholarship separately by logging into the [My Application](#) portal. **You must allow at least four working days** before you are able to access the portal and apply for this scholarship. Once you have received an email confirming your access to the portal:
   o Enter the catalogue by following the link in the email, then choosing [Scholarships and funding](#) (under 'Useful links’) and then clicking [View the scholarships and funding catalogue](#).
   o Select 2022/3 as the Academic Year and click ‘Refresh list’.
   o Locate the [World-Leading St Andrews Doctoral Scholarship](#) that you wish to apply for in the list of scholarships (using the filter box if necessary), click Apply and complete the application form.
   o You can also use the catalogue to search and apply for other scholarships for which you are eligible.

As part of the scholarship application you will be required to upload a **personal statement**. This should serve as a cover letter for the research project application as a whole, and should include:

- An outline of your suitability for the project (project criteria can be found in the "Eligibility" and "Project Description" sections above).
- Why the project interests you.
- What you would bring to the project in terms of previous skills and expertise.
- Any ideas that you may have for the realisation of the project.

Please contact pgscholarships@st-andrews.ac.uk with any enquiries about the scholarship application process.

**Scholarship application deadline**

January 7, 2022