**E³ PhD studentship proposal**

**Volcanic ash layers and environmental change:** Decoding records of past landscapes held within tephra layers

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**Project summary** (30 words max- for advertising)

This field-based project will use Icelandic tephra layers to reconstruct past landscapes, test models of environmental change, assess long-term human-environment interactions, evaluate societal resilience and the basis of sustainability.

**Project rationale**

Tephra layers are a very important source of palaeoenvironmental data including past eruption volumes, volcanic impacts, past atmospheric circulation patterns and the isochrons which form the basis of tephrochronology (e.g. Engwell et al. 2015, Lowe 2011,Thorarinsson 1967). Tephrochronology has uniquely powerful applications that extend from local (e.g. Streeter and Dugmore 2014) to continental scales (e.g. Davies 2015) and include methodological developments. New uses of tephra layers include the utilisation of layer morphology as a source of data on surface resilience and proximity to threshold crossing events (Streeter and Dugmore 2013). The relationship between tephra layer morphology and surface vegetation has been established (Cutler et al 2016 a,b). We know that locally tephra layer thickness will vary according to vegetation cover, with the highest levels of tephra retention in the areas of densest vegetation or rapid biocrust development. Slope position will not influence tephra layer thickness where vegetation communities are uniform and continuous, slopes <35° and initial tephra deposit thicknesses are moderate (<10cm thick). This creates the potential to develop new uses of tephra layers to reconstruct details of past cultural and natural landscapes and thus test a wide range of ideas about both environmental change and human-environment interactions.

**Aims and Methodology**

The overall aim is to develop and apply a new approach to the use of tephra layers in environmental reconstruction. The focus is on Icelandic tephra layers 1–10 cm thick. Thin layers because of the continental-scale areas they can cover, and Iceland because of the ubiquitous presence of tephra layers and rapidly aggrading aeolian soils, its climatically strategic location in the North.

A conceptual model illustrating the impact of varying vegetation on a tephra layer resulting from the same initial deposit (a) in open, short stature vegetation; (b) a ground layer with scattered shrubs; (c) a continuous shrub canopy (Cutler et al 2016a)
Atlantic, a clearly defined tenth century baseline to human colonisation, a well-known record of human settlement, abundant written sources and archaeology. The approach is field-based and empirical. There will be close collaboration with archaeologists through NABO (http://www.nabohome.org/). Data integration will require the use of statistical analysis and GIS.

**Hypotheses:**

H1: The variability of tephra layers with stratigraphic sections will reflect the structures of the vegetation communities on which they fell, and *inter alia* reflect a record of changing landscape resilience.

H2: Tephra layer thickness will vary across cultural landscapes according to land use with the highest levels of tephra retention in the areas of greatest resilience.

H3: Different land management strategies will have different vulnerabilities to climate change and this will result in contrasting tephra layer morphologies.

Fieldwork will include measurements of tephra layer structures and thickness, geomorphological mapping, use of UAVs and collaboration with field archaeologists.

**Timeline:**

**Year 1:** Literature review, initial field training and fieldwork. Collaboration with archaeological colleagues in Iceland and NABO http://www.nabohome.org/

**Year 2:** Analysis and interpretation of fieldwork from first year. Model development. Second field season. Paper writing.

**Year 3:** Interpret data in a global context; conference presentations. Thesis writing.

**Year 4:** Completion and further papers.

**Research Training**

A comprehensive training programme will include both specialist scientific training and generic transferable and professional skills. Specific topics will include experimental design, tephra studies GIS, geostatistics, landscape mapping and electron probe microanalysis of tephra. The project offers an exciting opportunity to work in an interdisciplinary field and alongside international colleagues in Iceland and NABO http://www.nabohome.org/. Leaving the PhD with expertise in tephrochronology, environmental geography, resilience assessment, human dimension of global change, fieldwork and interdisciplinary research would particularly lend itself to graduate seeking to pursue an academic career.

**Requirements:**

We are seeking a numerate geographer, environmental archaeologist or environmental scientist with interests in fieldwork, archaeology and geomorphology.

**Further reading/ references**