

Juliet Perry Sefton

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Address: Department of Geography, Durham University, Durham DH1 3LE, United Kingdom

Education

PhD candidate in Physical Geography, Durham University, United Kingdom | November 2016 – **current**

Working thesis title: Mangroves – precise indicators of late Holocene sea-level changes?

Supervised by: Dr Sarah Woodroffe, Dr Erin McClymont (Durham University) | Dr Philippa Ascough (NERC Radiocarbon Facility)

Master of Science in Geology (*first class*), Victoria University of Wellington, New Zealand | 2013-2015

Thesis title: An assessment of the influence of orbital forcing on Late Pliocene global sea-level using a shallow-marine sedimentary record from the Wanganui Basin, New Zealand

Supervisors: Prof. Timothy Naish and Dr Robert McKay (Victoria University of Wellington)

Grades: Overall Grade Point Average 8.0/9, thesis grade A (85%)

Quaternary Techniques Short Course, GNS Science, Lower Hutt, New Zealand | May 2014

Bachelor of Science in Geology and Geography, Victoria University of Wellington, New Zealand | 2012

Recent work experience

Research Assistant at the Antarctic Research Centre & School of Geography, Environment and Earth Science, Victoria University of Wellington, New Zealand | May 2015 – October 2016

Research Assistant at Climate Change Research Institute, Victoria University of Wellington, New Zealand | March 2015 – August 2015

Teaching Assistant at Victoria University of Wellington | March 2013 – October 2016

Laboratory and field skills – skills gained from research collaborations and degree work in New Zealand, United States, Chile, Argentina and United Kingdom

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| » Sedimentology | » Micropalaeontology | » Tephrochronology |
| » X-ray fluorescence | » Magnetostratigraphy | » Stable isotopes |
| » Cosmogenic dating | » Drill-site core-logging | » Fission-track analysis |
| » Geological mapping | » Glacial geomorphology | » Geographic Information System analysis |

PhD funding

Van Mildert College Postgraduate Research Scholarship, Durham University | 2016-2019

This is a university/department scholarship which covers international student tuition fees, stipend (£13,500 per annum), and some research costs (£1500 per annum).

Other funding applied for

Royal Geographical Society Monica Cole Research Grant £1000 (applied 18th January)

Royal Geographical Society Henrietta Hutton Research Grant £500 (applied 18th January)

British Sedimentological Research Group – Gill Harwood Memorial Fund £500 (will apply 31st January)

British Sedimentological Research Group – Steve Farrell Memorial Fund £500 (will apply 31st January)

British Society for Geomorphology Postgraduate Award £1000 (will apply 1st February)

Proposed Research

Mangroves – precise indicators of late Holocene sea-level changes?

Juliet Sefton, PhD candidate Durham University

Improving our understanding of late Holocene sea-level changes is necessary because they record the background variability upon which historical and current sea-level trends are imposed. Mangrove forests accumulate sedimentary deposits close to mean sea level, and therefore provide an important palaeo sea-level indicator. However, their utility is limited due to problems with radiocarbon dating and poor fossil preservation. I seek to resolve these issues through a study of sedimentological and biological processes in modern mangrove forests, thereby improving our ability to use them for accurate sea-level reconstructions.

Aims and objectives

My aim is to advance our knowledge of depositional processes in mangroves in order to more accurately reconstruct the sea-level changes they record. To do this, our understanding of how mangrove deposits accumulate over time needs to be improved by field research in modern mangrove environments. A primary objective is to link environmental factors measured on-site (e.g. tidal range, salinity) with what is deposited in sediments, identified by deploying sediment traps. These data will help inform the interpretation of the palaeo-record, to be collected as sediment cores (figure 1). A multi-proxy approach will be applied to both modern and palaeo samples to refine our understanding of the relationship between mangrove deposits and sea-level – employing sedimentology, microfossils, and stable isotope and organic geochemistry (see methodology).

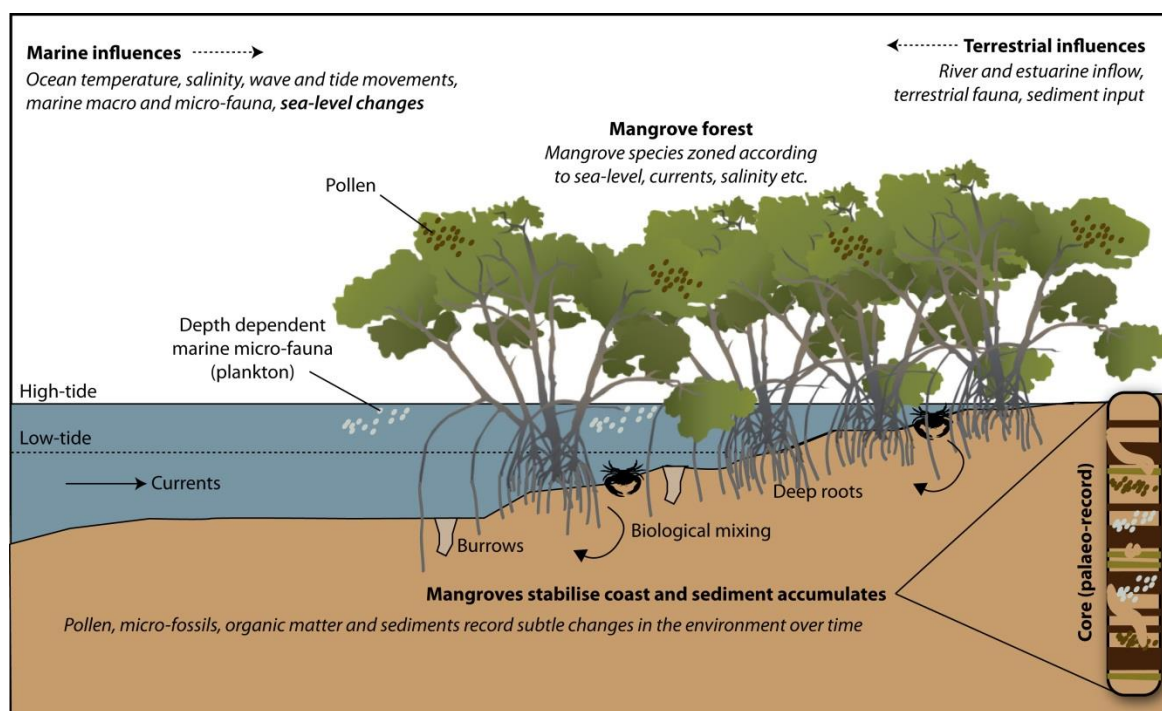


Figure 1: A schematic diagram detailing the complexity of the mangrove environment, and a variety of constituents that appear in the palaeo-record.

The relationship between climate and sea-level can only be understood if past sea-level indicators can be accurately dated. Radiocarbon dating of mangrove deposits is made difficult due to the intensity of bioturbation in these ecosystems, which reworks organic material in the sediment column. Therefore, a second objective is to improve our understanding of what components of the fossil mangrove record are best targeted for reliable radiocarbon dating, expanding on the initial work of Woodroffe et al. (2015). The mangrove environments of volcanically-active Northern Panama have been selected for this study because they present a unique opportunity to independently test radiocarbon methods through the dating of volcanic ashes.

Ultimately, detailed process studies of sedimentary processes within mangrove systems will allow us to identify features that can be more accurately and precisely related to sea level. Application of these observations to palaeo-mangrove sediments combined with improved chronological control will allow us to more accurately than ever before reconstruct sea-level changes from mangroves during the mid-late Holocene (since ~6000 years before present).

Methodology and field work

Funding is sought for field work which will focus on the mangrove forests of north-western Panama – specifically the mangrove-fringed archipelago of Bocas del Toro in the Caribbean Sea. The primary field season will be 3rd June – 4th July 2017, which will involve: 1) surveying of topography and mangrove vegetation zones, 2) surface samples collection to map sedimentology, microfossil assemblages, and geochemistry with elevation in the modern environment, and 3) collection of sediment cores in transects along environmental gradients. Tide gauges, temperature and salinity meters, and sediment traps will be deployed. Monitoring equipment, samples and data will be retrieved during a supplementary field trip in January 2018. Field work will be based out of the Institute for Tropical and Ecological Conservation, where basic laboratory facilities and logistics are available.

Modern mangrove sediment and palaeo samples will be analysed for:

- **Chronology:** Organic matter will be radiocarbon dated to test which materials produce the most reliable chronologies for mangrove sediments. To do this, volcanic ash found in the mangrove sediments (and originating from nearby Panamanian volcanoes) will be geochemically characterised. The geochemical signatures will be linked to existing tephra databases for dating (e.g. Crossweller et al., 2012), and then compared to the mangrove radiocarbon ages.
- **Biomarkers and stable isotope geochemistry:** Biomarkers (molecular remains of plants and animal matter) have been used as palaeoclimate proxies in wetland and mangrove environments (e.g. Ronkainen et al., 2015). I will apply, for the first time, biomarker analyses on mangrove sediments for the reconstruction of sea-level changes. Carbon and nitrogen isotopes are also promising proxy-indicators for sea-level changes (Khan et al., 2015), as they differentiate between marine and freshwater vegetation.
- **Micro fossils:** I will test the assumption that diatoms and foraminifera in Panamanian mangroves are distributed across mangrove environments according to elevation and salinity (e.g. Woodroffe et al., 2005).
- **Pollen assemblages:** The zonation of pollen across mangrove environments reflects zonation in living mangroves, and is used to reconstruct past sea-level changes (e.g. Engelhart et al., 2007). I will investigate the dispersal mechanisms and preservation potential of mangrove pollen, to refine their use for palaeo sea-level reconstruction.
- **Sedimentology:** Sediment textures are direct responses to tide and wave action, which can provide information on past inundation (Ellison, 2009).

Funding received from the British Sedimentological Research Group will be a vital contribution to the field work costs of my PhD project (see budget). Field work in the mangroves at Bocas del Toro, Panama is the main framework of my research, and will enhance my skills as a sedimentologist by improving my understanding of tropical sedimentary systems (which is vital for the outcomes of this project), and in planning overseas field expeditions.

References

- Crossweller, H. S., et al. (2012). *Journal of Applied Volcanology, Society and Volcanoes* 1 (4): 1-13.
- Ellison, J. C. (2009). In: (Eds) Perillo, G. M. E., et al., *Coastal wetlands: an integrated ecosystems approach*.
- Engelhart, S. E., et al. (2007). *Marine Geology* 242 (1-3): 65-81.
- Khan, N. S., et al. (2015). In: (Eds) Shennan, I., et al., *Handbook of Sea-Level Research*.
- Ronkainen, T., et al. (2015). *Journal of Quaternary Science* 30 (3): 189-200.
- Woodroffe, S. A., et al. (2005). *Journal of Foraminiferal Research* 35 (3): 259-270.
- Woodroffe, S. A., et al. (2015). *Holocene* 25 (5): 820-831.

Itemized budget for 2017 Panama field work

Juliet Sefton

Primary field season (3rd June – 4th July 2017)

- Flights from Newcastle (UK) to Bocas del Toro (Panama) return for two (myself and field assistant) - *£1800*
- Accommodation and subsistence at the Institute for Tropical Ecology and Conservation (ITEC) for 30 nights at £40 per person per day for full board and shared room, airport transfers, use of boats and field laboratory - *£2400*
- Panama government permits for sample collection and export – *£200*
- Shipping of equipment and samples back to the UK – *£500*

Total cost of 2017 field work: £4900

Total requested from Trevor Elliott Fieldwork Fund: £500

Funds already secured:

- Internal Durham University PhD scholarship - *£2000* (from PhD scholarship per annum research costs – the remainder to be reserved to part fund the second field trip in 2018)

Other funds applied for and pending:

- Monica Cole Research Grant - *£1000* (applied 18th January 2017)
- Henrietta Hutton Research Grant - *£500* (applied 18th January 2017)
- Gill Harwood Memorial Fund - *£500* (will apply 31st January 2017)
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