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Letter of Support - Miss Duna Roda Baluda

Duna Roda Boluda accepted a PhD under my supervision at the Department of Earth Science and Engineering, Imperial College in October 2012. She came to Imperial with top grades from Barcelona University and a distinction in her MSc by research at UCL, for which she was funded by a prestigious Caixa scholarship. Duna is a dedicated, enthusiastic and hard working sedimentologist, who has made excellent progress in the first year of her doctoral studies. Duna's PhD research focuses on determining the controls on sediment export, particularly in terms of grain size, from upland catchments to depositional basins. This a thought-provoking and relevant topic, both for understanding the coupling between tectonics, climate, erosion and sedimentation on the surface of the planet, and for decoding the stratigraphic archive that geologists use as a record of Earth history.

Duna's PhD is funded by an Earth Science and Engineering Janet Watson Bursary, which covers her tuition fees and stipend, but not associated fieldwork or lab costs. Consequently, a contribution from the BSRG would make a big difference for her field season as she is not entitled to have UK research council support. Duna plans to study in the field a number of fluvial catchments, which cross tectonically-active faults in Calabria, Italy. She aims to quantify how the grain sizes of sediment exported from these catchments, underlain by different lithologies, help to determine the volume and characteristics of stratigraphy in associated hanging-wall basins, and how this sediment supply signal is modulated by fault slip rate. I think she has picked a great place to do this study, because the tectonic rates are high, the depositional stratigraphy is well-exposed, and there is a wide variety of footwall lithologies. I think her findings will be of wide interest to sedimentologists and stratigraphers because we too often assume there is a direct correlation between the depositional archive and the prevailing tectono-climatic boundary conditions, whereas the fidelity of the signal is likely to depend strongly on catchment erosion rates, the rate of accommodation generation, and bedrock lithology.

I am delighted to provide a letter supporting her request for funding. She has independently researched her field sites, and she has thought carefully about what data she is going to collect and why. I don't doubt that her results will be novel and interesting. She is a really conscientious student, and she has clearly costed all the individual elements of the field project. The budget she has submitted is for part-funding from BSRG, and I confirm that I will cover any additional expenses she incurs. The work should form the basis for a really nice paper and I offer my wholehearted support.

Yours faithfully,

A handwritten signature in blue ink, appearing to read 'Alex Whittaker', with a horizontal line underneath the name.

Dr Alex Whittaker
Lecturer in Tectonics

APPLICATION FOR RESEARCH GRANT

Please read the guidelines for applicants

Please include all relevant information on the form itself – additional papers/incomplete applications are not accepted.

Applications and completed statements of support from two Fellows of the Society must be sent to

Stephanie.jones@geolsoc.org.uk in time for the deadline of 1 February 2014

| | | |
|--|---|--|
| Name in Full: Duna Caterina Roda Boluda | Fellow/Non Fellow: Non Fellow | |
| Student/Postgraduate/other (please state) Postgraduate | Funded by: (research council, university, self, etc.): Departmental bursary (Janet Watson bursary) | |
| Nationality: Spanish | Date of Birth: 17-04-1988 | Name of Grant sought (if identified): |
| Address: Paramount Court, 38-39 University Street Flat 12, WC1E 6JP London. | | |
| Tel: 07428354148 | | E-mail: d.roda-boluda12@imperial.ac.uk |
| Names and email addresses of two supporters: Dr. Alex Whittaker (a.whittaker@imperial.ac.uk) Prof. Philip Allen (philip.allen@imperial.ac.uk) | | |
| Have you discussed this application with your supporters? Yes, a field season in Calabria would be a great opportunity to obtain new field data, because it offers a range of very well constrained tectonic and lithological boundary conditions that complements and contrasts with field data previously acquired from Campania, Basilicata and the Central Apennines. The data obtained in the proposed field season will enable us to develop a detailed picture of the sediment transfer processes that determine sediment export and storage in tectonically active areas. | | |
| Title of Project: Quantifying the lithologic and tectonic controls on sediment supply from normal-fault bounded catchments in Calabria (Italy). | | |
| Amount requested and breakdown of expenses: I am requesting a grant of £1499 to cover the costs of the field campaign. The field campaign will be 16 days long. For safety issues and efficient data collection, I will be accompanied by a field work partner. The fieldwork costs I intend to cover with the grant would be | | |

the car hire, hotel and the subsistence costs for me and my field partner:

- a) Car hire (Economy Manual Group C - Fiat Punto or similar): rented with Avis at Reggio Calabria airport for the extent of the field campaign 16 days at £25/day = **£400**. Public transport in the area is very limited, and the study zones cover an extensive area, so having our own car is essential for reaching the study locations. The costs of the car hire would be fully funded with the grant money.
- b) Accommodation for two persons during 16 days: average room rate per person per night in Calabria is £22 x 2 persons x 16 days = **£704**. We will minimize the costs by sharing a twin room.
- c) Subsistence costs for two persons during 16 days: from previous experience in Calabria, we estimate that the expense on food will be of 15€/person/day x 16 days = **£395**. We will minimize the food costs by buying in local supermarkets, and when possible, cooking our own food.

As applicable, what level of support does the home department provide?

Additional expenses (field work material, etc.) will be covered by the Earth Science and Engineering department. For ¹⁰Be cosmogenic analysis of the samples collected, for estimating erosion rates, we will apply for NERC-CIAF funding before the 1st of April 2014.

Additional funding for this project obtained/applications pending. State amount and from where

Gill Harwood Memorial Fund of the British Sedimentological Research Group: requested £600 to fund transport to and from Calabria, and petrol costs. Application pending. However, the field campaign does not depend on this additional funding.

Details of any previous awards from the GSL. *Applicants who have had a previous award from the Society but who have not submitted an interim or final report will be disqualified.*

I have not applied or obtained previously any awards from the GSL.

- Have all necessary permissions been obtained and the ownership of any specimens collected in the course of the work?

Yes. All field work will be on public land, so formal permissions are not needed. The only samples that will be collected will be channel sediments for ¹⁰Be erosion rate analysis.

- As appropriate, has a risk assessment been carried out/will be carried out?

All fieldwork conducted by Imperial College students and staff must be risk-assessed. A formal risk assessment form is completed two months in advance of the fieldwork, and is authorized by the departmental safety officer. All field work participants have received outdoor first aid training.

Bibliography/list of references (own publications or articles relevant to this application):

Roda Boluda, D., Whittaker, A., D'Arcy, M., Allen, P (2013). "Quantifying the controls of sediment release in normal fault bounded catchments in the Southern Apennines (Italy)". Poster sesión presented at the British Society for Geomorphology (BSG) Annual General Meeting; September 2013; Royal Holloway, University of London.

D'Arcy, M., Whittaker, A., **Roda Boluda, D.** (2013). "New constraints on landscape sensitivity to glacial-interglacial climate change: A detailed and quantitative record from debris flow deposits in Owens Valley, California". Paper presented at the 8th IAG International Conference on Geomorphology; August 2013; Paris.

Poyatos-Moré, M; Duller, R.A., Solé, X., **Roda Boluda, D.**, Badia, A (2013). "Sediment Routing and Fluvial Architecture in Ypresian-Lutetian Corçà Fm. (Àger Basin, South-Central Pyrenees, Spain)". Paper presented at the 30th IAS Meeting of Sedimentologists; September 2013; Manchester.

Whittaker, A. C., M. Attal, et al. (2010). "Characterising the origin, nature and fate of sediment exported from catchments perturbed by active tectonics." Basin Research **22**(6): 809-828.

Cyr, A. J., D. E. Granger, et al. (2010). "Quantifying rock uplift rates using channel steepness and cosmogenic nuclide-determined erosion rates: Examples from northern and southern Italy." Lithosphere **2**(3): 188-198.

Olivetti, V., A. J. Cyr, et al. (2012). "Uplift history of the Sila Massif, southern Italy, deciphered from cosmogenic ^{10}Be erosion rates and river longitudinal profile analysis." Tectonics **31**(3).

1. Background and motivation for the research

The sedimentary record that can be found in depositional basins is the time-integrated product of the sediment fluxes that terrestrial catchments produce as a result of their tectonic and climatic boundary conditions (e.g. Hovius and Leeder, 1998). The nature, grain sizes, magnitude, and frequency of these sedimentary fluxes depend on the catchment erosional dynamics, and are a first-order control on the depositional patterns and facies that are found on the basins. However, the way in which climate, tectonics and lithology interact to determine the magnitude and characteristics of sediment supplied from hillslopes (including from landslides), its transformation through the sediment routing system, and its final transfer into stratigraphy, remains unclear (e.g. Allen et al., 2013). Therefore, in order to understand how the sedimentary record relates to specific boundary conditions affecting the catchment, it is important to quantify in the field how tectonics and lithology help to determine the type, calibre and locus of sediment eroded from upland areas which eventually creates the depositional stratigraphy. Such field data would help test and refine predictive models of depositional stratigraphy and would improve our ability to decipher the stratigraphic archive for tectonics and climate.

2. Aim and objectives

The aim of this research proposal is to understand and quantify how tectonics and lithology determine the grain sizes and volumes of sediment exported from catchments bounded by tectonically active normal faults, and how these signals are preserved in Pleistocene to recent sediments using catchments in Calabria as an exceptionally well-constrained template to address four key objectives:

- (1) Characterize the grain size distribution and volumes being delivered from catchments along normal fault footwalls, as a function of throw rate and lithology.
- (2) Determine the grain size distribution of the sediment supplied by landslides and hillslope erosion, and ground-truthing landslide map to obtain volumetric estimates of sediment supply in the catchments.
- (3) Collect samples which will be used to determine catchment-averaged erosion rates from the concentration of cosmogenic ^{10}Be in modern fluvial sediments, and compare the results with the sediment supply rate estimates obtained in (2).
- (4) Test how the sediment supply signal varies from source to sink, by comparing volumes and grain size distribution of sediment being delivered and sediments stored in the hangingwall basins.

3. Justification for choice of Field Site

Calabria (Fig. 1, B) is a great location to complement and compare with previous field data collected during my PhD and by research supervisor Whittaker because:

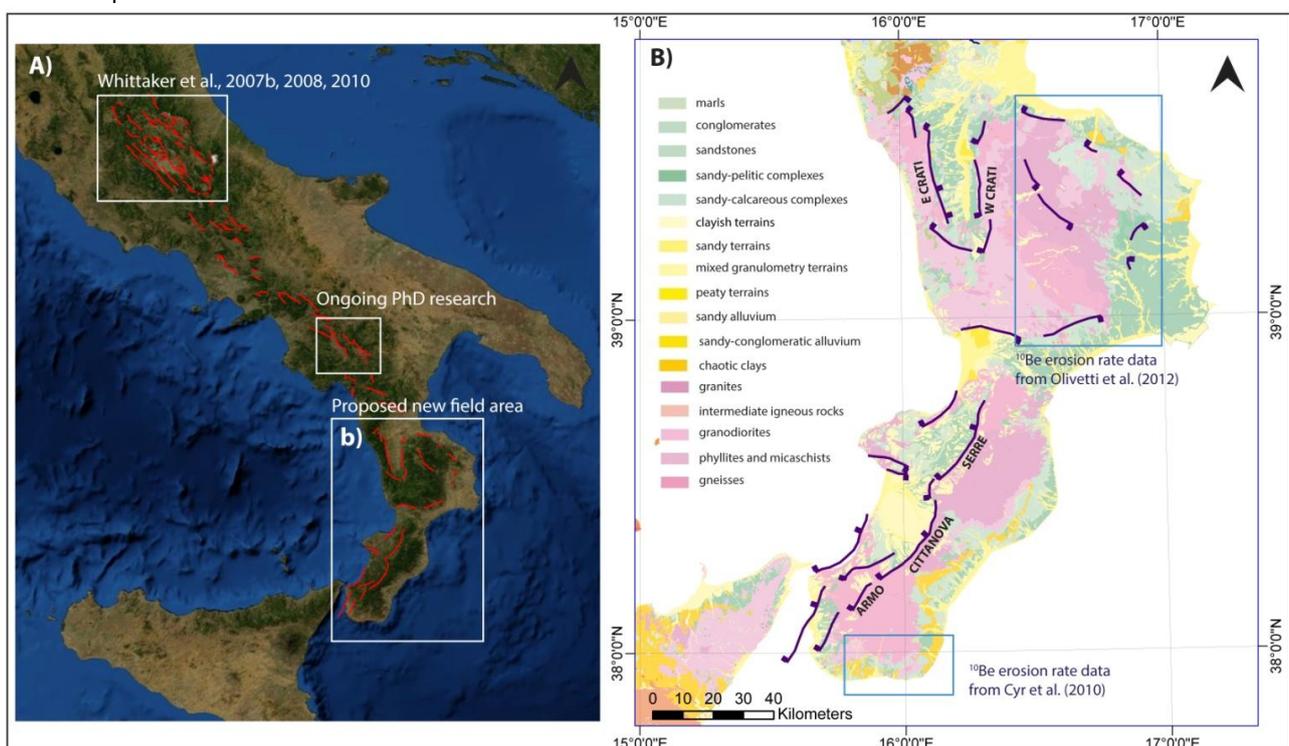


Figure 1. A) Map showing the normal faults of the Central and Southern Apennines. Squares indicate the areas with existing comparable data, and the new proposed field site. B) Lithological map of the Calabria field site. The targeted faults are labelled, and the areas with published ^{10}Be erosion rates are squared.

- I. It is a well-constrained area of active normal faulting, where fault uplift rates are known from geomorphic, sedimentological and tectonic studies (e.g. Catalano et al. 2003, 2008; Tortorici et al., 1995; etc.) and depositional stratigraphy is well-exposed.
- II. There are a wide range of footwall lithologies, including metamorphic and igneous rocks, which will compare nicely with previously published and acquired data on limestones, marls, sandstones, mudstones (Whittaker et al., 2010).
- III. I already have access to the preliminary data needed to prepare the field campaign: landslide maps (Iffi Project, published by ISPRA), geological maps (published by the Italian Geological Survey), and new unpublished detailed throw rate profiles along the faults (done by Sebastian Erhardt at Imperial College in 2012).
- IV. It will give me the opportunity to collect samples for subsequent ^{10}Be erosion rates analysis, which was not possible in my PhD areas that are dominated by carbonates. In addition, performing ^{10}Be erosion rate analysis on targeted catchments will help complementing the ^{10}Be erosion rates dataset that already exists for Calabria (Cyr et al.(2010) and Olivetti et al. (2012)), making possible a regional comparison of erosion rates and sediment supply processes.

Of all the Calabrian fault systems, I propose to target catchments along the on-shore Armo-Cittanova, Serre and West and East Crati faults (Fig. 1, B), because they are the ones with better-exposed associated hangingwall sedimentary sequences that include non-marine alluvial fan sediments (on the Gioia Tauro, Mesima and Crati basins, respectively). The field campaign is planned to be 2 weeks long.

4. Methods

The methodology that will be followed to accomplish the objectives listed in section 2 will be:

- (1) Use photographic and Wolman point count methodologies (e.g. Whittaker et al., 2011) to measure the grain size distribution at the outlet of the catchments along strike of active faults.
- (2) Measure grain size distributions as in (1) on sediments being delivered by hillslopes and landslides on different lithologies, and estimate in the field volumes and ages of the landslides to estimate sediment supply rates.
- (3) Collect samples of recent fluvial sediments for ^{10}Be analysis at the outlet of 6-8 selected catchments that cover a range of uplift rates and lithologies.
- (4) Measure as in (1) grain sizes along active channels, terraces, and associated hangingwall basin stratigraphy on selected catchments that cover a range of uplift rates and lithologies.
- (5) Perform Schmidt hammer and Selby Index tests on the different lithologies present on the catchments to quantify the influence of rock mass strength on landsliding and grain size release.

5. Match with existing data and research activity at Imperial College

This research proposal addresses important research questions in its own right, but also matches and adds value to the work of the Basins Group at Imperial College. Previous work on active faults and sediment export in the Central Apennines by Whittaker et al. (2007b, 2008, 2010) has explored transient landscape response to fault interaction. My PhD research addresses the links between active faulting and erosion in Campania and Basilicata along the Diano, Agri and Monti della Maddalena fault systems (Fig.1, A), where the tectonic boundary conditions (e.g. Papanikolaou and Roberts, 2007) and stratigraphy (e.g. Zembo, 2010) are well-known. Results obtained from these studies show that (1) transient landscape responses to fault interaction and growth control sediment export from catchments to basins; (2) if a fault footwall has an homogeneous lithology, the grain size distribution exported from its catchments scales linearly with uplift rate; (3) Potential sediment supply is often bigger than sediment storage in basins, so sediment must be selectively extracted (by grain size) into the stratigraphy. However, the control of lithology and fault slip rates on sediment release from catchments has never been carefully explored – this proposal will address this important research goal.

6. Expected Outcomes

The results obtained will (i) give new insight into the sediment supply and transfer processes in active tectonic settings and (ii) be used in conjunction with existing data from the Apennines, collected by workers at Imperial College (see section 5) to build a new field-based data set on sediment supply that will encompass a range of tectonic and lithological boundary conditions across normal-fault bounded basins. This research will provide new insights in to the role of tectonics and lithology on the erosional, transport and depositional dynamics in Mediterranean settings. We expect relevant and publishable results that could be submitted to the Journal of the Geological Society in the next 12 months.