1. A brief CV emphasising the academic qualifications back to first degree level.

Name: Orla Bath Enright

Education:

Current Education: PhD student studying palaeontology in the School of Earth and Environmental Sciences (SEES) at the University of Portsmouth. Project Title: "The Burgess Shale: Short distance bustling commuters or long distance serene surfers?"

Undergraduate degree: BSc (Hons) Earth and Ocean Sciences (2010 – 2014) at the National University of Ireland, Galway. This course gave me a firm understanding of basic geology, especially sedimentology, palaeontology and geological field techniques.

Research:

My research started in October of 2014. The project is fully funded by the University of Portsmouth, Faculty of Science Postgraduate Research Bursary, which includes additional research support costs (£1000 per annum) for my experiments and conference attendance. The project is supervised by Dr. Nicholas Minter (University of Portsmouth), Dr. Esther Sumner (University of Southampton), Professor Gabriela Mángano and Professor Luis Buatois (University of Saskatchewan). The key aim of my project is to answer a crucial question that integrates sedimentology and palaeontology. How do different soft-bodied organisms disarticulate when transported by various types of sediment density flows? This has important implications for understanding how fossil accumulations reflect sedimentary flow processes and whether they represent true palaeocommunities. To date I have been:

- Reviewing and developing indices for categorising the degree of disarticulation of organisms
- Identifying and sourcing analogue organisms
- Planning my experimental protocol and I will begin my first experimental stage this spring

Apart from the £1000 per annum for experimental costs and conference attendance there are no other sources of funding so I have applied for both the Gill Harwood and Steve Farrell Memorial Funds for fieldwork travel expenses. The field expedition will be timely following my initial phase of experiments.

Skills and Training:

GSDP: The Graduate School Development Programme: These workshops are taken throughout the year to develop as a researcher and improve my research skills and training.

- Principles of research design
- Academic writing group
- Design and implementation of ethical research involving animals
- Taking your research design forward
- Qualitative research skills
- Introduction to SPSS
- Understanding data and descriptive statistics

APEX (GPROF): Graduate Students Professional Development Programme provides development and training workshops to build up skills, abilities and intellectual qualities that I need for my research and my teaching responsibilities.

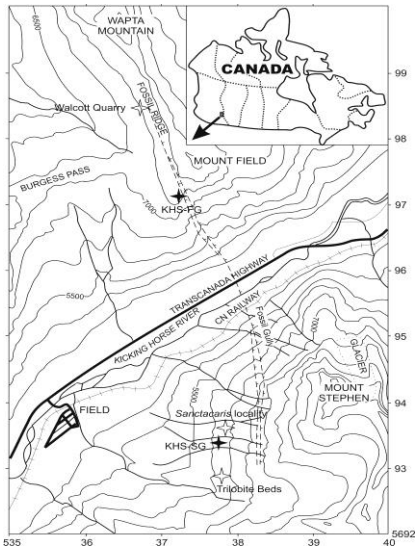
- Working with groups
- Working with individual students
- Fieldwork (demonstrating/assisting

Athena SWAN: PhD Representative, committee member. My role on this committee is to represent the postgraduates within SEES and I have responsibility of the Co-Development Action Plan.

2. An outline of present and proposed research

Principal PhD research question: The principal aim of my research is to answer one central question. How do different organisms disarticulate when transported by different types of sediment density flow? For my research I will conduct novel systematic disarticulation experiments in an annular flume such that my results will have a broad applicability. The inspiration behind this question comes from a fundamental debate regarding the Burgess Shale biota of British Columbia, Canada (Fig-1a). Namely, whether these soft-bodied organisms were living within or close to the environment of deposition or could they have been transported from one environment to another. The deposit was traditionally interpreted as the product of dilute turbidity currents (Fig-1b) where the animals may have been caught up in a turbulent cloud of sediment in suspension that was moving down-slope, and the bodies buried as the current slowed down and the suspension settled out (Piper 1972; Conway Morris 1979; Whittington 1980). More recently, analysis of the degree of disarticulation have argued that transport of these animals was minimal (Caron & Jackson 2006).

1a



1b

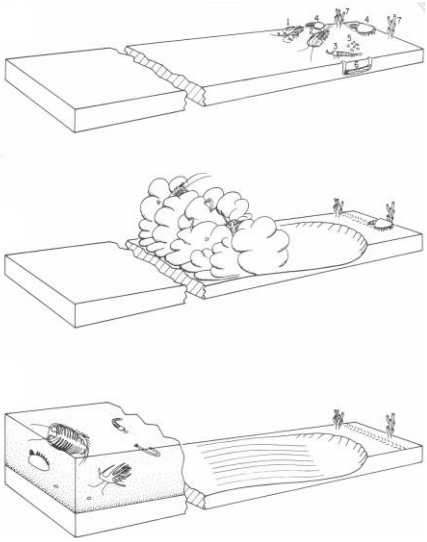


Fig-1a Geographic location of the Burgess Shale (after Fletcher & Collins 2003). Fig-1b Traditional interpretation of the manner of deposition of the Burgess Shale fauna (after Whittington 1980).

Fundamental to this debate are two key questions:

A) What are the effects of different sediment-density flow regimes and durations on the disarticulation of different body plans?
B) What are the sedimentological characteristics of the deposits of the Burgess Shale and do they vary throughout the sequence?

Brief overview of experimental programme: The first question will be investigated by experimental research in which I will use an annular flume to replicate various sedimentary flows. Experiments have played a key role in understanding how flow conditions are related to deposit type (Sumner *et al*. 2008, Talling *et al.* 2012). I will begin my experimental work this coming spring at the National Oceanography Centre in Southampton in which the flume tank is housed. The annular flume will allow flow velocity to be controlled and can recreate fast to long-duration waning flows of different sediment concentrations and Reynold's number.

My experiments will involve analogue organisms with similar body plans to the Burgess Shale type fauna. The polychaete *Nereis virens* will be the initial analogue of a soft-bodied organism and *Crangon crangon* as an arthropod analogue. In the past, a simple rotating tumbler (Allison 1986) was used for decay transport studies, which did not allow for accurate replication of sedimentary flows. Here, the annular flume will enable a more realistic re-creation of different flow types. Preliminary experiments will involve just water and analogue organisms, with the next two phases introducing sandy and muddy sediments respectively.

Rationale behind proposed fieldwork: Recent re-assessment of the Phyllopod Bed of the Walcott Quarry Shale Member as representing the deposits of mud-rich slurry flows (Gabbott *et al*. 2008) suggest the possibility of a laminar flow regime. This has implications for the soft-bodied organisms and our understanding of their palaeogeographic range. The experiments will systematically investigate the survivorship of the analogue organisms of staying intact or not, when subjected to prolonged transport depending on laminar, turbulent or transitional flow regimes.

The sedimentology of the Burgess Shale has received far less attention compared to the fossils, despite the obvious significance that this aspect has on the process that led to their exceptional preservation. The second key question identifies this problem and will investigate the nature of the deposits of this fossil lagerstätte. With traditional interpretations of the Burgess Shale thought to be distal turbidites (Piper 1972; Conway Morris 1979; Whittington 1980) and more recent studies interpreting the deposits of the Phyllopod Bed as mud-rich density flows (Gabbott *et al*. 2008). It is essential therefore to test these competing hypotheses and to ascertain how sedimentological characteristics vary throughout the Burgess Shale Formation. Recent advances in identifying the deposits of different sediment-density flows and the process responsible (Sumner *et al.* 2008, Talling *et al.* 2012) mean that this project can conduct a novel approach of interpretation to that of the Burgess Shale Formation.

The field expedition will involve sedimentological analysis of the Phyllopod Bed but will also encompass other members such as the Kicking Horse Shale Member where trackways have been described (Minter *et al*. 2012) and to the Raymond Quarry Shale Member where burrows have been identified (Allison and Brett 1995). I plan to expand to the newer localities of the "thin" Stephen Formation and Marble Canyon where a large proportion of new species have been described (Caron *et al*. 2010; Caron *et al.* 2014) but no detailed sedimentological analysis has been undertaken. The aims of the fieldwork will be to characterise the variation across the deposits of the Burgess Shale and resolve the relationship this has to the stratigraphic extent of exceptional preservation and the presence of trace fossils. Results on grain size analysis distributions will feed back directly into my experimental design to model the flows that produced the Burgess Shale deposits.

The project objectives comply with the BSRG Gill Harwood and Steve Farrell Memorial Funds as the fieldwork aims to re-evaluate the flow type and depositional processes that enabled such unique circumstances to occur providing the entombment and exceptional fossil preservation of the Burgess Shale biota. The importance of the sedimentary processes involved in the preservation of Burgess Shale type deposits has yet to be truly investigated, especially that of the newer described localities. This fieldwork will allow me an excellent opportunity to investigate this.

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Caron, J.B. and Jackson, D.A. (2006). Taphonomy of the Greater Phyllopod Bed community, Burgess Shale. *Palaois*, **21**, 451-465.

Caron, J.B., Gaines, R.R., Mángano, G., Streng, M. and Daley, A.C. (2010). A new Burgess Shale-type assemblage from the "thin" Stephen Formation of the southern Canadian Rockies. *Geology*, **38**, 811-814.

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3. A breakdown of the Budget

The field expedition to the Burgess Shale site in British Columbia will last two weeks between the summer months of August and September of 2015. Requested funds will be used for travelling expenses. Additional local expenses will be covered by the expedition team.

Return air fare London Heathrow – Calgary (Canada): **£956**