The Burgess Shale biota: short distance bustling commuters or long distance serene surfers?

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**Rationale:** The Burgess Shale is a world-famous Middle Cambrian fossil Lagerstätte; renowned for its exceptional preservation of soft-bodied organisms and the insights it has provided into the Cambrian explosion. At present, there are two schools of thought regarding the organisms entombed within the deposits: (i) that they lived in a different environment and were transported some distance by a sediment-density flow to where they are preserved, and (ii) that transport was minimal and the organisms were living near to the environment of deposition. This has inherent implications for interpreting community structure and ecological interactions at this important juncture in the history of life on Earth. The principal objective of this project will be to conduct novel taphonomic experiments with analogue organisms subjected to transport by a range of laminar to turbulent sediment-laden flow types and durations in an annular flume. Results will enable constraints to be placed upon transport distances in order to test between the competing hypotheses for the Burgess Shale biota.

**Methodology:** Taphonomic studies of fossil Lagerstätten have principally focussed upon decay and the mode of preservation. However, few have considered the effects of pre-depositional transport despite there being several examples where exceptionally preserved organisms are entombed within sediment-density flows. Early transport decay studies involved simple rotating tumbler experiments. However, such a design does not provide a truly accurate analogue or enable investigation of different flow regimes. More recent experimental studies on the effects of abrasion have employed annular flume tanks to more accurately replicate flow processes. This project will utilise a bespoke annular flume housed at the National Oceanography Centre, Southampton, that is capable of creating fully turbulent to laminar flow types with realistic particle sizes and concentrations; and in which flow velocity, duration and deceleration may also be modulated.

The deposits of the Burgess Shale were traditionally interpreted as the product of dilute turbidity currents and that organisms were transported some distance from one environment to another. More recently, analysis of the degree of disarticulation of the fossils has been used as evidence to suggest that transport must have been minimal; however, this latter work did not consider the nature of any sedimentary flow processes. The deposits have also been re-evaluated as being derived from mud-rich slurry flows. This suggests the possibility of a laminar flow regime and has implications for transport and survivorship potential of soft-bodied organisms. Discovery of trace fossils within parts of the Burgess Shale Formation also raises further questions regarding the nature of the different fossil assemblages. The results of this project will be used to test whether different organisms are capable of remaining intact, or not, when subjected to prolonged transport depending on flow type; and thus whether (i) the organisms could have been living a large distance from, or (ii) must have been in close proximity to, the environment of deposition. Taphonomic experiments will be conducted with a range of analogue organisms in an annular flume. Indices of decay and fragmentation will be developed to enable quantification and comparison of the degree of disarticulation across experiments and with Burgess Shale fossil material. Experiments will systematically investigate the effects of a range of flow types, from fully turbulent to laminar, and with different grain size content, concentration, and duration.
**Training:** This project is ideally suited to candidates with a strong interest in palaeobiology, sedimentary processes or taphonomy. Experience of experimental laboratory work is desirable but not essential. Training will be delivered in the operation of the annular flume tank and taphonomic analysis. There are also possibilities for fieldwork, where specific training will be provided on graphic sedimentary logging, sedimentary petrology, geochemical analytical techniques, and trace fossil analysis.

**Wider implications:** The outcomes of this project will enable constraints to be placed on potential transport distances of organisms preserved within sediment-density flows that may be applied to better interpreting the palaeoecological implications of the Burgess Shale and other similar fossil Lagerstätten. This is critical for being able to ascertain the nature of fossil assemblages and to interpret community structure and ecological interactions. The results will also help to focus attention on sedimentary signatures and the types of sediment-density flow deposits that may yield new exceptional fossil discoveries.

**Background reading:**

**Funding Notes:**
The award includes
- UK/EU tuition fees for up to three years
- An annual tax-free maintenance stipend at the standard Research Council rate (£13,863 in 2014-15)
- Research support costs of £1000 per annum

**Eligibility:** Candidates must have a minimum of a First Class or 2.1 Honours degree (or equivalent) in a relevant subject area. Available to UK/EU applicants only.

**Enquiries:** Interested candidates are encouraged to contact, Dr. Nicholas Minter, (nic.minter@port.ac.uk).

**Deadline for applications:** 28th July 2014, interviews to be held 13th August 2014, expected start date: 1st October 2014.

**How to apply:** Complete our online application form, under ‘proposed area of research’ state ‘Bursary: Burgess Shale taphonomy, School of Earth and Environmental Sciences’, please also attach a covering letter and a curriculum vitae. Forms and online submission: [http://www.port.ac.uk/departments/academic/graduateschool/prospectivestudents/howtoapply/formsrequired/](http://www.port.ac.uk/departments/academic/graduateschool/propectivestudents/howtoapply/formsrequired/)