

Spitfire Doctoral Training Partnership

Microbial Nitrogen and Carbon Cycling in the Twilight Ocean: Pinpointing the Active Processes with Targeted Proteomics Approaches

University Supervisors: Phyllis Lam (p.lam@southampton.ac.uk), Dr Paul Skipp, Prof. Tom Bibby (University of Southampton)
PML Supervisor: Andy Rees (apre@pml.ac.uk)

Background: The twilight ocean (mesopelagic, ~100-1000m), sitting beneath the sunlit surface ocean, is responsible for the remineralisation of >90% organic matter that sinks out from the surface – resulting in only a small fraction escaping into the deep ocean. The mesopelagic thus represents an important barrier to carbon export into the deep (*biological carbon pump*) and remineralisation therein affects the ocean's ability to sequester atmospheric CO₂ long-term^[1]. Meanwhile, surface primary production is often limited by the availability of inorganic nitrogen, which relies on the resupply from mesopelagic/ deep ocean after release from the remineralisation of organic matter. However, the exact mechanisms of N-remineralisation and their relationships with carbon-turnovers are poorly characterised. Although mesopelagic communities are generally considered to be heterotrophic, recent studies have revealed significant chemolithoautotrophy that might help counterbalance the surprisingly large carbon demand by these communities^[2]. Nonetheless, the identities, metabolic pathways and biogeochemical functions of mesopelagic microorganisms remain largely unknown; whereas biogeochemical flux measurements are often obscured by interacting processes.



This PhD aims to take advantage of recent advances in metaproteomic and metatranscriptomic technologies, to establish a targeted omics approach to pinpoint the *active* cycling processes, in order to illuminate the underlying mechanisms driving N-/C-balance in the twilight ocean.

The SPITFIRE DTP programme provides comprehensive personal and professional development training alongside extensive opportunities for students to expand their multi-disciplinary outlook through interactions with a wide network of academic, research and industrial/policy partners. The student will be registered at the University of Southampton and hosted at *University of Southampton, Ocean and Earth Science and Centre of Proteomics Research (Biological Sciences)*.

Requirements and Research environment: The student will join a multidisciplinary research group, with exposure to a wide variety of biogeochemical and molecular ecological research. Full training will be provided in the range of techniques required. The student will join a highly active group engaged in researching marine biogeochemical cycles. The student must be fit and able to go to sea, have the ability to work well in teams as well as independently, and have an aptitude for practical fieldwork on research cruises.

Candidates are encouraged to contact the lead supervisor at Southampton (Phyllis Lam – p.lam@southampton.ac.uk) or at PML (Andy Rees – apre@pml.ac.uk).