Finding your flow: using sedimentology, geochemistry and micropalaeontology to understand South Atlantic Ocean circulation

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Background: Ocean circulation is a major control on global climate, the use of nutrients in ocean ecosystems and the way water and heat are transported around the Earth and a fundamental part of how our planet works. Developing the tools to look at ocean circulation into the geological past is a key challenge for international science, and using these tools to create records of change in ocean circulation is an important part of mapping past global change. The most intensively studied ocean basin in the world is the North Atlantic, and perhaps it is not a coincidence that this region is considered the most important driver of changes in ocean circulation worldwide.

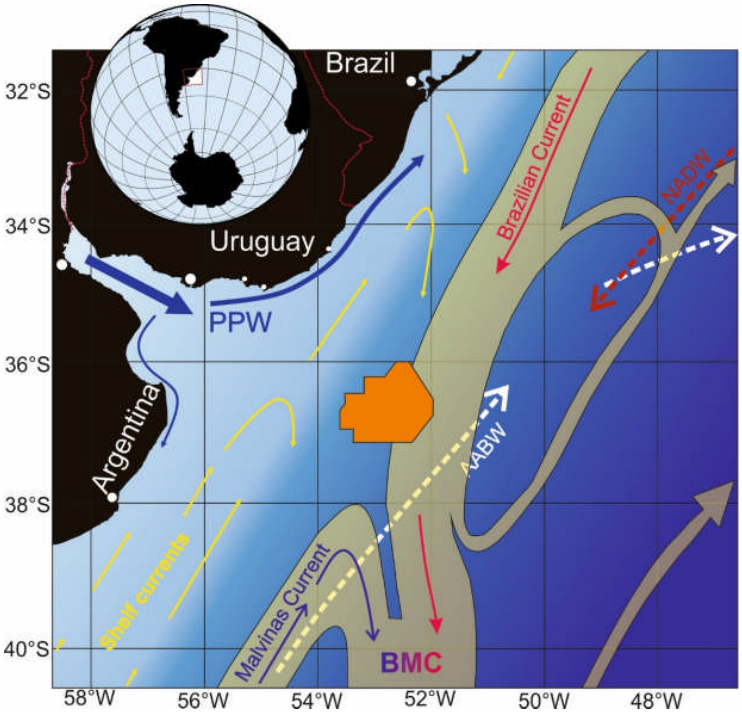

Fig 1. The area from which the ~200 gravity cores were taken (orange area) is shown in relation to the regional oceanographic context and modern Uruguayan coastline.

This project will use unique core material recovered from the Uruguay margin (Fig 1.) to develop new tools and approaches to understanding ocean circulation in the South

Atlantic. The cores are from a large sediment drift, which is occupied by southward flowing water from the North Atlantic and northward flowing water from the Southern Ocean. This student will exploit this outstanding natural laboratory to develop new tools based on neodymium isotopes and also new ways is using classic palaeoceanographic approaches (foraminifera trace elements and isotopes). These new tools will then be used to enhance our understanding of the South Atlantic circulation, making a major contribution to bringing it up to the level achieved for the North Atlantic.

There are over 200 cores available to this project – a quite outstanding resource. Sampling and descriptive work on them will be based in the National Sediment Core Repository in Southampton, with geochemical and micropalaeontological work being undertaken at Leeds and Hull. The project benefits from collaboration with ANCAP in Montevideo, and will involve at lest one research visit to share knowledge and expertise with Uruguayan scientists.

The project will be based in Leeds and will make use of the state-of-the-art laboratory facilities at the University of Leeds, both in the Micropalaeontology Laboratory (sediment processing and microfossil imaging) and the Cohen Geochemistry Laboratories (C and O isotopes, eNd and Mg/Ca and other trace metal analyses on benthic and planktonic foraminifera and bulk sediments). The project is further supported by Mike Rogerson at Hull, and Juan Tomasini and Manuela Demarco Morales from ANCAP.

This interdisciplinary project will provide the successful PhD candidate with highly valued and sought-after tools for investigating palaeoceanography, past climates and species interactions with their environments, such as: analytical geochemistry, morphometrics and taxonomy and sedimentology. This will equip the student with the necessary expertise to become the next generation of palaeontological and climate scientist, ready to carry out their own programme of innovative scientific research. The student will benefit from working within and collaborating with dynamic scientists within the multidisciplinary Palaeo@Leeds group, and the Cohen

Geochemistry Group. There will be opportunities to present results at major, international conferences, e.g. AGU (San Francisco), EGU (Vienna), GSA, PalAss, and attend residential summer-schools (e.g. in Italy, USA, UK) and in-house workshops and courses.

Entry requirements: A good first degree (1 or high 2i), or a good Master's degree in geological or environmental sciences with a focus towards palaeontology, sedimentology or palaeoceanography, experience in micropalaeontology and programming (e.g. *R, Python*) is an advantage.

Further Reading:

Hernández-Molina, F. J. *et al.* A contourite depositional system along the Uruguayan continental margin: Sedimentary, oceanographic and paleoceanographic implications. *Mar. Geol.* **378,** 333–349 (2016).

Hernández-Molina, F. J. *et al.* Contourite depositional system on the Argentine slope: An exceptional record of the influence of Antarctic water masses. *Geology* **37,** 507–510 (2009)

Hernández-Molina, F. J. *et al.* Giant mounded drifts in the Argentine Continental Margin: Origins, and global implications for the history of thermohaline circulation. *Mar. Pet. Geol.* **27,** 1508–1530 (2010)

Jullion, L., Heywood, K. J., Naveira Garabato, A. C. & Stevens, D. P. Circulation and Water Mass Modification in the Brazil–Malvinas Confluence. *J. Phys. Oceanogr.* **40,** 845–864 (2010)