The timing of Quaternary glaciation in southernmost South America

Christopher M. Darvill

Department of Geography, Durham University; e-mail: christopher.darvill@durham.ac.uk

Project aim and objectives

The timing of ice advances in southern South America can yield important information regarding past changes in temperature and precipitation in the southern mid-latitudes. Such changes are linked to globally important climatic systems, such as the Southern Westerly Winds, the variability of which are poorly constrained in the palaeo-record. This project aims to test between two alternative hypotheses for the age of a major moraine system on Tierra del Fuego, southernmost South America. The distinction is important because one hypothesis implies that glacial ice responded in a similar manner to the rest of Patagonia, whereas the other hypothesis implies that ice advanced more recently and to a greater extent than other glaciers. Thus, the age of the moraine system will allow us to better constrain the long-term climate forcing in this region. The moraine system in the Bahía Inútil – San Sebastián depression on Tierra del Fuego either dates from MIS 12 (*ca*. 450 ka) or from the last glacial cycle (*ca*. 110-10 ka), forming the two opposing hypotheses (Darvill *et al*., 2014, 2015a).

Methodology

This project combines new geomorphological mapping (Darvill *et al*. 2014) with a fresh methodological approach to cosmogenic exposure dating (Darvill, 2013). A traditional approach would use exposure dating on moraine boulders to assess the timing of ice advances and boulder deposition. However, the method has proven problematic in this region due post-depositional processes linked to high levels of wind erosion (Darvill *et al*., 2015a). Rather, the methodology adopted is a novel approach in which depth profiles are sampled through outwash units linked to the moraines, which are then modelled for cosmogenic nuclide accumulation to account for post-depositional processes (Darvill et al., 2015b). In order to further constrain the depth-profile approach, this funding application was made to support preliminary radiocarbon dating of shells within outwash linked to the oldest, outermost moraine limit.

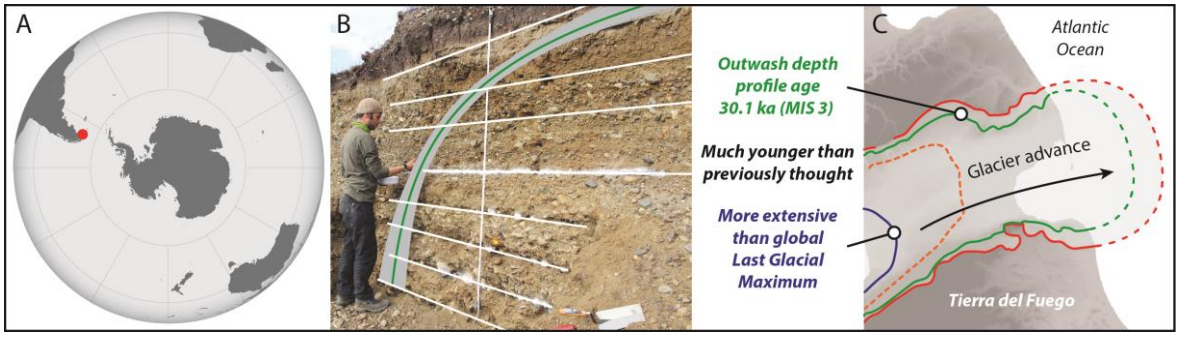

Figure 1: (A) Location of study area in the Southern Hemisphere. (B) Graphic portrayal of modelling cosmogenic nuclides through an outwash depth profile. (C) The advance of ice and moraine limits in Tierra del Fuego (adapted from graphical abstract of Darvill *et al*., 2015b).

Principle research findings

The outwash depth-profiles proved an effective way of obtaining more robust dates on the glacial moraine limits. The limits were found to be substantially younger than previously thought (*ca*. 45.6 ka and 30.1 ka), and so were deposited within the last glacial cycle (Darvill et al., 2015b). Radiocarbon dating of shell samples from within the outwash units provided ages of >43.5 ka (in effect, likely infinite ages given their proximity to the upper age limit for radiocarbon dating). While the dates to not provide an exact constraint on the modelling, they do demonstrate that the outermost moraine limit was likely deposited prior to 43.5 ka. This is important, as the modelling approach was less constrained for the oldest limit and so the errors on the age estimation were greater. The best-fit modelled age for the oldest, outermost limit was *ca*. 45.6 ka, which is not disputed by the radiocarbon dates.

I am grateful to the BSG for awarding me a Postgraduate Award in support of my Ph.D. research at Durham University (2011-2015)

References

Darvill, C.M. (2013). Section 4.2.10: Cosmogenic nuclide analysis. In: Clarke, L. (Ed.) *Geomorphological Techniques* (Online Edition). British Society for Geomorphology

Darvill, C.M., Stokes, C..R., Bentley, M.J. & Lovell, H. (2014). *Journal of Maps*, 10, 500-520

Darvill, C.M., Bentley, M.J. & Stokes, C.R. (2015a). *Geomorphology*, 228, 382-397

Darvill, C.M., Bentley, M.J., Stokes, C.R., Hein, A.S. & Rodés, A. (2015b) *Earth and Planetary Science Letters*, 429, 157-169