

## Project: AFI 9/13

### Thinning history of the Foundation-Thiel Trough Ice Stream: a key control on deglaciation of the West Antarctic Ice Sheet, Weddell Sea Embayment

**Principal Investigator:** Professor Mike Bentley (Durham University)

**Co-Investigators:** Dr Tibor Dunai (University of Edinburgh)  
Dr Richard Hindmarsh (BAS)  
Professor Stewart Freeman (SUERC)  
Dr Andreas Vieli (Durham University)

**Location:** Pensacola Mountains, Weddell Sea embayment

**Field Personnel:** Mike Bentley  
James Wake (BAS Field Assistant)

#### **Overall aim of the project**

The overall aim is to determine the long-term (last 20,000 years) thinning history of the Foundation Ice Stream in the south-central Weddell Sea. This ice stream is a key contributor to the Filchner-Ronne ice shelf, and its thinning history will reflect the overall retreat history of the West Antarctic Ice Sheet (WAIS) in the central Weddell Sea, which is currently poorly known (Fig 1). The specific objectives are (a) to identify geomorphological evidence of ice sheet thinning at a number of sites in the Pensacola Mountains flanking the Foundation Ice Stream and then to (b) date this evidence by sampling bedrock and glacial erratic boulders and to measure their concentrations of *in situ* cosmogenic nuclides. These data will provide constraints for ice sheet models being developed as part of the overall AFI project. The importance of the study is to provide a long-term context for understanding the present-day behaviour of the WAIS and to validate models that seek to predict the future of the ice sheet.

#### **Fieldwork objectives.**

Our aim was to map and sample the glacial geomorphology of the Pensacola Mountains, with a view to understanding the deglacial history. Throughout our emphasis was on taking samples that will allow us to date any changes in ice altitude/extent. We visited a series of sites in turn (see below) and at each one we carried-out the following activities:

- geomorphological mapping – from satellite imagery, aerial photography, ground truthing, small amount of sediment sampling, surveying and GPS traverses.
- sampling erratics, bedrock and sediment from altitudinal transects: sampling consisted of hammer and chisel, petrol- or battery-powered rock saw (in a few instances), and pits dug into glacial sediments.

#### **Sites**

We primarily worked in the following areas.

- Williams Hills (83 05' S, 066 30' W).
- Schmidt Hills (83 15' S, 058 00' W)
- S end of Neptune Range (84 05' S, 056 30' W)
- Thomas Hills (84 20' S, 065 00' W)
- Weber Ridge (84 20' S, 063 00' W)
- Blackburn nunatak (84 S, 066 W)

#### **Highlights**

We were deployed in the last week of November and completed the 400 km transect by early January with little or no logistical hold-ups. This was helped by excellent weather, with little or no wind for much of the season. We were able to visit and sample all of our target sites, and in total were able to retrieve 250+ erratic and bedrock samples for cosmogenic isotope analysis, as well as several depth profiles of tills that we were able to excavate. The quality of the samples is excellent as the majority of the lithologies we sampled were quartz-rich sandstones and quartzites.

Our geomorphological mapping has revealed a complex landscape and glacial history for the Pensacola Mountains. From the sediments, moraines and erosional landforms preserved in the Neptune and Patuxent Ranges we have identified a series of ice sheet advances (thickening) and retreats (thinning). Our sampling programme for cosmogenic isotope analysis will allow us to date most, if not all of these advances. From weathering criteria, and analogy to other Antarctic deposits we have worked on previously we estimate that the age of the preserved glacial deposits encompass the period from pre-Quaternary (e.g. > 2 million years old) to the last few hundred years.

25/11/09 Input into Pillow Knob (PKNOB) by Mark Beasley and Riet Van de Velde in BC. Including reconnaissance flight over Academy Glacier. (Rothera-KG-SBR-Patriot Hills-PKNOB)

26/11/09 Ian Potten and Graham Niven arrive in BL from Halley with sledges and the first skidoo. Filled jerrys from depoted petrol.

29/11/09 Ian Potten and Ags Fryckowska arrive in BL bringing the final load from Halley.

30/11-1/12/09 Work in the Williams Hills

2/12/09 Camp move to Schmidt hills via the Childs GI.

3-6/12/09 Work in the Schmidt Hills

7/12/09 Camp move to the Miller Valley (Northern Neptune Range)

8-10/12/09 Worked in the Miller Valley

11/12/09 Camp move to Jones Valley. (Via PKNOB to depot rocks and refuel)

12-15/12/09 Work in Southern Neptune range.

16/12/09 ½ unit trip to PKNOB to refuel and collect depoted samples.

18/12/09 Air move to Mt Lowry (Northern Patuxent range) With Steve King and Andy Webster in AZ. 1000lbs of samples to Rothera.

19-23/12/09 Work in Northern Patuxent range

24/12/09 Camp move to Thomas Hills

25-29/12/09 Worked in Thomas Hills

30/12/09 Camp move across the Foundation ice stream to Blackburn Nunatak.

31/12/09 Work on Blackburn Nunatak.

1/1/10 Awaiting aircraft for uplift

2/1/10 Steve King and Catrin Thomas arrive in BB and take a load to Halley.

3-4/1/10 Uplift to Rothera in BB. Via PHills (overnight stop), SBR and KG

**Thanks to:**

The success of this season was helped immeasurably by the support of James Wake, my field assistant, who remained cheerful throughout, helped carry endless boulders, and regularly asked difficult geological questions. I am also grateful to Mike Dinn and the Field Operations team who gave us first-class support in a logistically challenging area.

**Mike Bentley  
April 2010**



Eastern margin of the Foundation Ice Stream as it flows past the Patuxent Range



Foot of Mt. Bruns, Patuxent Range