Background and PhD research:

The Arctic is climatically sensitive to global change, and therefore climate records from this region are of key importance. Little, however, is known of the state of the Arctic during the greenhouse period of the Cretaceous. Climate conditions are often assumed to have been warm-temperate as evidenced by the presence of conifers and dinosaur trackways on Svalbard and other Arctic localities (e.g. Harland et al., 2007; Hurum et al., 2006). However, dropstones (Dalland, 1977), glendonites (pseudomorphs after the cold-water mineral, ikaite; Price & Nunn, 2010; Selleck et al., 2007), and isotopic evidence for a more dynamic climate (Price & Mutterlose, 2004; Price & Passey, 2013) has led to a re-evaluation of the question of Arctic ice during the Cretaceous. My PhD research (working title "Early Cretaceous high latitude climate") attempts to resolve the duration and magnitude of proposed "cool episodes" during the Early Cretaceous, through studying evidence from high Arctic sedimentary successions.

The Gill Harwood Memorial Fund, if I receive it, will go towards a second field season based on Spitsbergen (as part of my PhD) studying the Aptian-Albian succession outcropping along the south-western side of Adventdalen. Plymouth University are thus part-funding this project as the results will form a chapter of my PhD thesis.

Proposed project: Aptian-Albian climate of Adventdalen, Spitsbergen

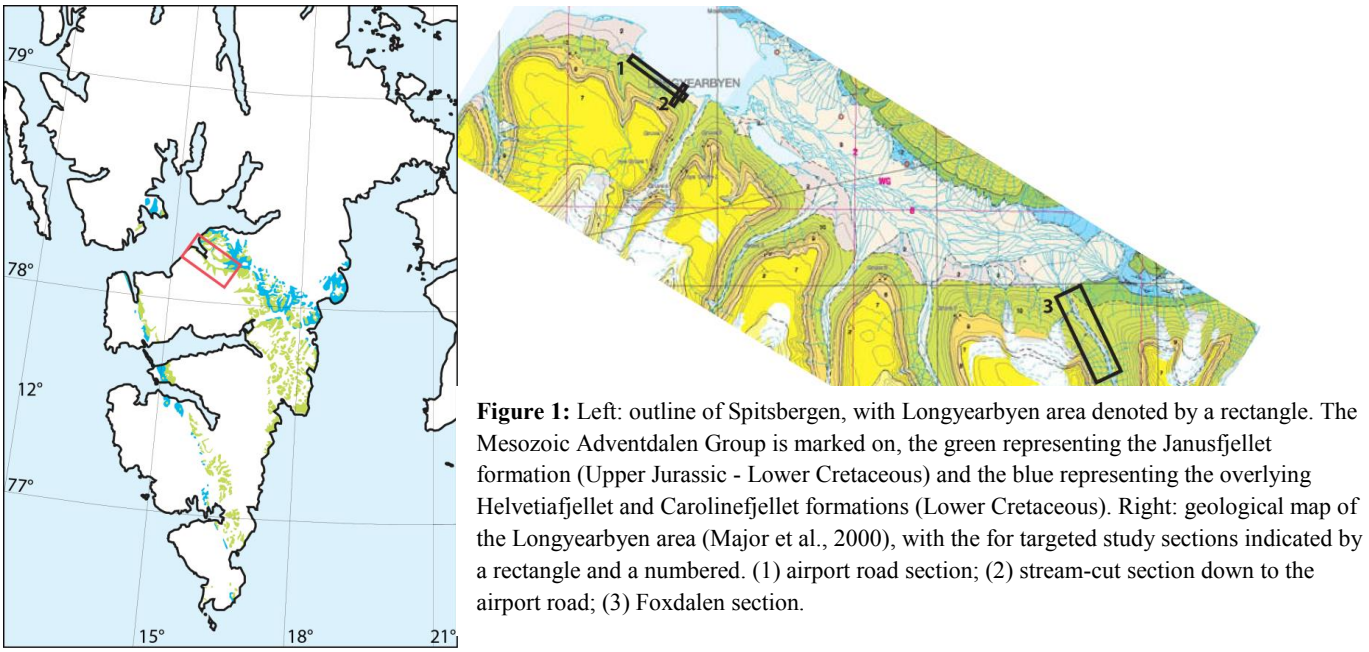

Figure 1: Left: outline of Spitsbergen, with Longyearbyen area denoted by a rectangle. The Mesozoic Adventdalen Group is marked on, the green representing the Janusfjellet formation (Upper Jurassic - Lower Cretaceous) and the blue representing the overlying Helvetiafjellet and Carolinefjellet formations (Lower Cretaceous). Right: geological map of the Longyearbyen area (Major et al., 2000), with the for targeted study sections indicated by a rectangle and a numbered. (1) airport road section; (2) stream-cut section down to the airport road; (3) Foxdalen section.

In Spitsbergen, Svalbard, Early Cretaceous sediments outcrop at numerous localities around the main settlement of Longyearbyen, along the south-western side of Adventdalen and Adventfjorden (see figure 1). This offers a unique opportunity to study high latitude (palaeolatitude of ~60°) Cretaceous sediments and associated fossils in a relatively easily accessible area.

The sedimentary succession in the Adventdalen area consists of Aptian-Albian – aged sediments of the Carolinefjellet formation. This formation consists of prodelta to distal marine shelf deposits – alternating shales, siltstones and sandstones. Previous work has looked at the provenance of the sandstones (Maher et al., 2004), origin of diagenetic carbonate concretions, and the origin of a thin lagoonal iron ooid bed found in the lowest member of the formation (Mutrux et al., 2008). Dating has been attempted using macrofossils (Nagy, 1970; Parker, 1967; Pčelina, 1967) and dinoflagellates (Århus, 1992). However, precise age constraints did not emerge, and general age of Aptian – Albian has been assigned to this formation, and detailed logs of the succession in the Adventdalen are have not been published.

It is the aim of this project to evaluate the palaeoenvironmental and palaeoclimatic character of Cretaceous Svalbard by means of a multiproxy sedimentological and biostratigraphic study of the Aptian-Albian strata on Spitsbergen, and additionally to improve age constraints for this succession.

Methodology:
Seven days of fieldwork will be undertaken in the area around Longyearbyen, Spitsbergen (along the south-western side of Adventfjorden and Adventdalen) by the applicant for funding.

Three outcrop exposures of Early Cretaceous sediments will be investigated (see figure 1). The first two outcrops are sections along the road between Longyearbyen and Longyearbyen Airport (78°13'34.60"N, 15°36'27.15"E to 78°14'00.99"N, 15°33'27.80"E). The third section is along both sides of Foxdalen (78°09'56.58"N, 16°11'29.66"E to 78°08'52.49"N, 16°14'41.00"E). Travel to sections one and two can be achieved by hire car. Daily travel to the Foxdalen section will require driving to the end of the road and hiking for an hour.

Data collection will be via high resolution (bed-scale) logging along with sampling of invertebrate fossils, "outsized" clasts and glendonites.

The samples will be returned to Plymouth University, U.K., for identification, preservation analysis, and stable isotope analysis of the fossils and glendonites.

Planned itinerary:

Day 1: Arrive at Longyearbyen, shopping, equipment acquisition

Day 2: Log and sample Airport Road section

Day 3: Log and sample stream-cut section down to the Airport Road

Day 4-6: Log and sample Foxdalen section

Day 7: Return to Britain

Expected outcomes:

This fieldwork will result in the first detailed, high-resolution logs of these three sections.These results will then be presented at the BSRG AGM 2015, along with C-isotope results from the samples taken. Academically, I will benefit from this experience as I will gather enough data for at least two academic papers, Furthermore, results from this study will make up a key component of PhD, and will allow comparisons with the detailed log of the Festningen section 40km to the WSW of Longyearbyen.

Coupled with improved age constraints, the resulting palaeoenvironmental and sea-level/palaeoclimatic reconstructions may fill an important gap in our understanding of the temporal relationships between the warm and "cool climate" proxies found at other high latitude locations, and the significance of these "cool-climate" indicators.

Organising and conducting scientific research in an extreme and remote environment will develop my organisational skills, physical and mental stamina, self-motivation and dedication. The skills and experience will not only be vital to the success of my PhD, but will also be highly useful for future research projects I do as a postdoctoral researcher in deep-time palaeoclimate.