

Andrew Whitham CASP Fieldwork Award 2022-23 - Winner

Applicant: Thomas Vandyk

Project title: Challenging evidence for Cryogenian glaciation in Utah's high-altitude Wasatch

Award: £3,000

Scientific question and rationale: During the Cryogenian Period (720-635 Ma), according to some models, equator to pole glaciation persisted for millions of years, challenging life on Earth. Opposing this, for other models, glaciation was closer in character to that of today. Detailed field-based geology can resolve this uncertainty by constraining the extent, configuration, behaviour and therefore severity of Cryogenian glaciation. To this end, we will study world-class exposures of the Cryogenian Mineral Fork Formation (MFF), previously considered inaccessible due to technically challenging mountaineering terrain.

Specific objectives and deliverables: Objective/deliverable 1. *To map the 3D geometry and structure of MFF outcrops:* In collaboration with local climbing agencies, the team will use roped access on precipitous cliffs, enabling map production at unprecedented detail. Objective/deliverable 2. *To assess the glacial or non-glacial origin of the MFF and its basal contact:* Using detailed sedimentary logging at repeat intervals to interrogate palaeo-environmental changes in space (laterally) and through time (vertically). Objective/deliverable 3. *To produce accessible geotrail guides of the area:* To maximise value of this challenging venture, we will produce plain English trail guides in web apps such as ArcGIS StoryMaps, alongside a bank of high-resolution images and 3D image spheres. These will be made freely available for the benefit of future geoscience researchers, visitors, and the local community.

Proposed work plan: We will adopt a multidisciplinary approach to reconstruct the extent and characteristics of Cryogenian ice sheets in Utah, combining aerial surveys, sedimentology, photogrammetry and geological mapping. The project relies on field-based data acquisition over a 21-day period between May-October 2022 in the Wasatch Range, near Salt Lake City (Figs. 2-3). Co-investigators in the field: Dr M. Busfield (Aberystwyth) and L. Weaver (Utah Geological Survey), Dr A. Yonkee (Weber State University, Utah).

Work Package 1: Geological Mapping. The 3D geometry of the Mineral Fork Formation and its enigmatic basal contact with the Big Cottonwood Formation will be mapped using a combination of ground investigation, sub-aerial surveys via Uncrewed Aerial Vehicle (UAV), 3D photogrammetric models, and measured stratigraphic thicknesses. This will require roped access on steeper slopes that are often > 35°, while accessible sections will be walked and mapped unroped.

Work Package 2: Sedimentology. Detailed sedimentary logging will permit sub-metre resolution facies analysis and identification of any diagnostic indicators of glacial or non-glacial (e.g. mass flow) deposition, with repeat sedimentary logging along strike (every ~200 m) to identify any lateral variability in extent and nature of adjacent palaeo-environments.

Work Package 3: Geotrail Guides. Digital whole trail geologic guides will be developed combining 3D image spheres acquired via handheld GoPro with our high-resolution imagery, maps, and text explanations (e.g. <https://seekbeak.com/v/YbjNeda2zA7>). These will be made freely available via local geoscience websites, through collaboration with Lance Weaver of the Utah Geological Survey, and trailhead signage.

Proposed expenditure, including details of any other sources of funding:

Expenses requested: Return Flights (x 2) £1500; Car Hire £1300; Fuel £140; Accommodation and subsistence (x 2) £2730.

Funds received: SEPM Grant to Vandyk £746 (\$1000); IAS Grant to Busfield £1,924 (€2311).

Requested funds less received funds = £5670 - £2670 = £3000

Total requested: £3000