Project Report

The Field Area

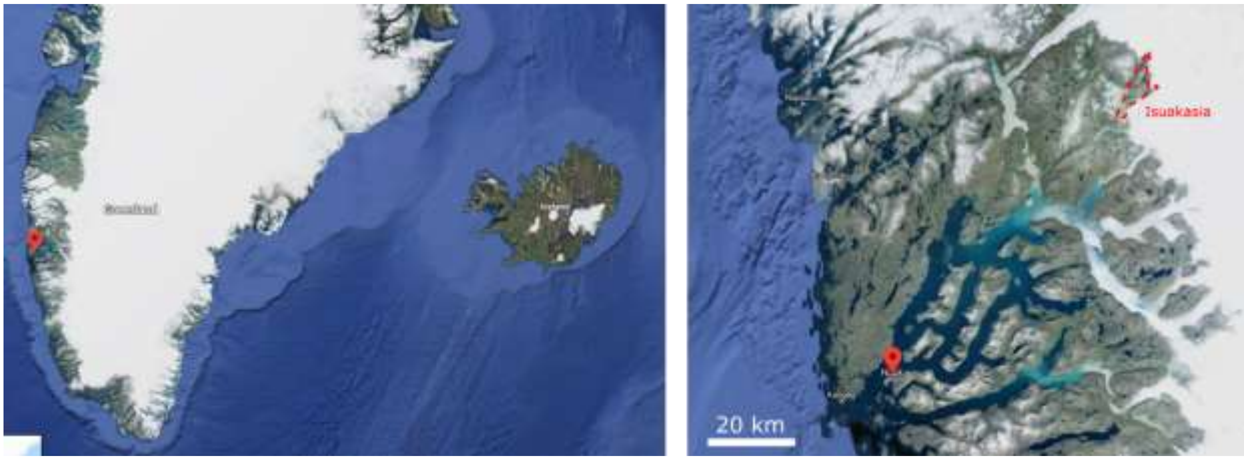

Figure 1 The location of our field area is outlined by the red dashed region. The field area is in Southwest Greenland, and is located approximately 150 km north-east of the capital, Nuuk.

The field locality was part of a region known as Isuakasia which literally translates as '*the end of the line*'. This region is part of the Isua Supracrustal Belt, a region just north of Nuuk, the capital city that hosts some of the oldest and most pristine crustal rocks on Earth. We camped near a small cabin at campground known as 'Appelstad' (65.17596° N, 49.8194° W). From this site we explored the area to the northwest extending right up to the ice sheet, as outlined in Figure 1.

Schedule and Logistics

We arrived in Nuuk on July 26th, in the middle of one of the coldest summers in living memory. We met with Julie Hollis, Head of the Department of Geology to discuss logistics and appropriate sampling for our trip. The following morning we went to Blue Water to collect all our gear and food which had been shipped over in advance. The rest of the day was spent packing everything and ensuring we met our weight limit for the helicopters (115 kg per person, including person weight). Our helicopter flight with Greenland Air was scheduled for the afternoon of July 27th, however inclement weather conditions and low cloud meant we were unable to fly.

On July 28th we were successfully helicoptered into the field. We located our planned campsite with ease because of the cabin. After landing we spent the evening setting up our personal and cook tents. We were also pleasantly surprised to find the cabin well stocked with dried food supplies, a working sink, cooker and heater, a large table, 2 bunks and many geological hammers.

Our schedule was not constrained by hours of daylight, since the sun never fully set. We were therefore able to work depending on the weather conditions rather than the hours of daylight. The first two days were spent scouting the entire area to locate key outcrops and get an understanding for the general geological structure of the area and the terrain we would have to cross, including boulder fields, snow fields and rivers. After this we targeted a specific site for each day of fieldwork. This was based on areas of good outcrop with minimal signs of alteration of weathering and previous geological mapping of the area. We also had to take into account the nearest water source, since water has to be pumped through the drill continuously during drilling to keep the system cold. Walking time to sites of interest ranged from 20 minutes to 2.5 hours.

We flew out of the field a day ahead of schedule on August 6th as the weather was expected to significantly worsen over the next few days. Because of the additional weight of samples on top of all our gear we were flown to the top of the fjord system rather than all the way back to Nuuk. From there we took a boat along the fjords – a wonderful way to finish our trip in clear weather with fantastic views of the icebergs.

Figure 2 Our transition from helicopter to boat amongst icebergs, calm water and clear skies

Scientific Work/Findings

We sampled five main sites, as shown in Figure 4. Sampling sites 1 and 2 are in the lowest metamorphosed area of the region, which have experienced Greenschist facies metamorphism. Both sampling sites were basaltic dykes, which are thought to make up part of the Ameralik dyke complex and the dykes intruded through banded iron formation. We sampled transects across the dyke in order to conduct 'baked contact tests' to see if the direction of magnetization changes away from the dyke. If the direction changes it suggests the age of magnetization of the country rocks pre-dates dyke emplacement (3.85 – 3.6 Ga).

Site 3 was also a baked contact test of a basaltic dyke (dating required) intruding through banded iron formation. However, in this case the peak metamorphic temperatures are thought to be a little higher, approaching lower amphibolite facies.

Figure 3 Drilling the pebble conglomerate at site 4

Site 4 was a rounded pebble conglomerate showing many primary sedimentary features and continuous stratigraphy. We sampled multiple individual clasts as well as the matrix material. If the direction of magnetization between individual clasts is random, it suggests the age of their magnetization pre-dates the formation of the conglomerate.

Site 5 sampled the main norite dyke that runs through the area, and the youngest lithology in the area (emplaced 2.2 Ga). Again, we conducted a baked contact test. This test is perhaps the most significant, since passing the baked contact test will clearly demonstrate there are older records of magnetization preserved in the area. However, this is also the southernmost region and has experienced the highest metamorphic temperatures up to mid-amphibolite facies.

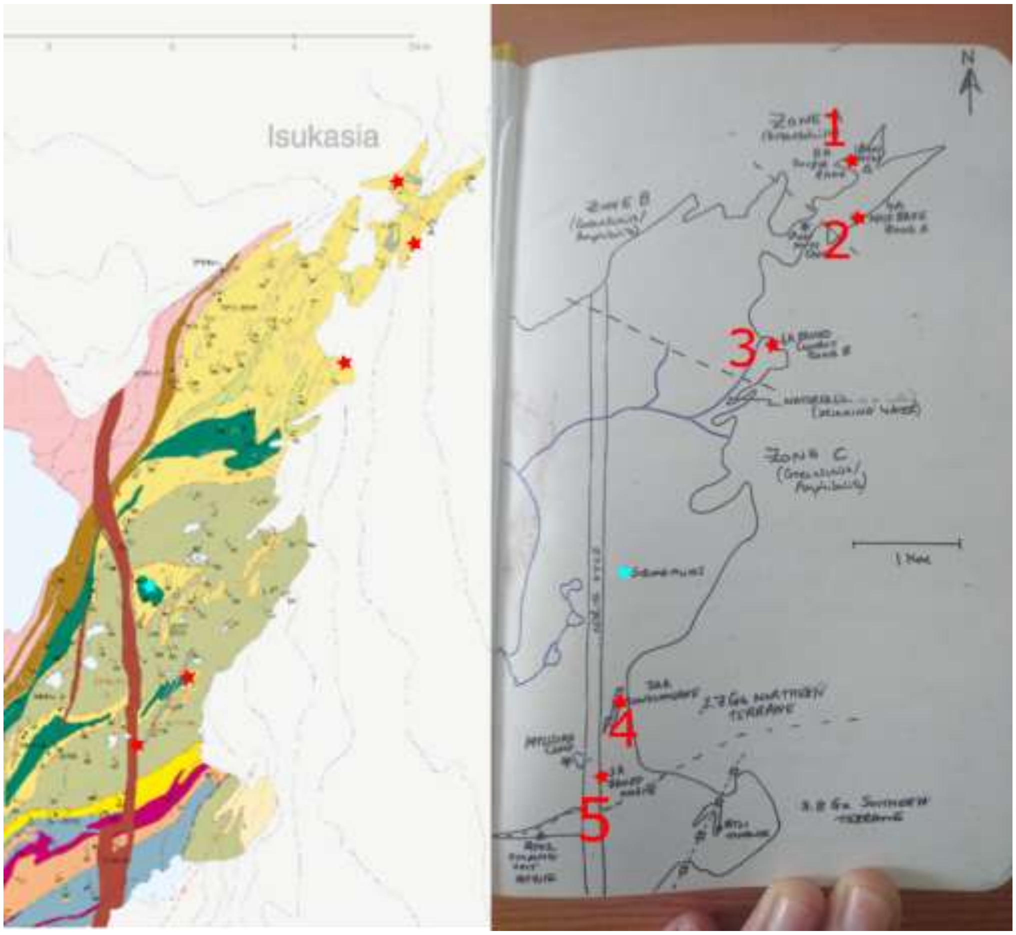

Figure 4 Geological map produced by Nutman et al 2011, alongside a field notebook sketch of the area. Our main sampling sites are shown by the red stars. The blue star represents the 3.7 Ga stromatolite locality suggested by Nutman et al. (2016).

We drilled 118 cores across the five sites. We also took numerous block samples for geochronology, geothermometry and petrological studies. The samples are due to arrive in the lab at the beginning of October. We will then conduct an extensive investigation of their magnetic signals and geological histories, with the aim of finding the first preserved magnetic signals from > 3.5 Ga.

Working in this area also gave us the opportunity to look at the 3.7 Ga stromatolite locality (blue star in Figure 4) proposed by Nutman et al. (2016). These fascinating and tantalizing structures generated a great deal of discussion in camp each evening and we shall be working with our field team from the University of Colorado (Prof. Stephen Mojzsis, Dr Nigel Kelly & Mike Zawaski) to try and understand more about their environmental setting and subsequent geological history as part of this project.