Exploration Geology

Undergraduate (BSc) Dissertation

C2078956

Comparison between the morphology and geochemistry of gold grains within the Treffgarne and Clarbeston drainage basins

Abstract

From the 11th of July to 19th of August 2022, the author worked with Sarn Helen Gold Ltd, a Welsh Gold Exploration Company focusing on collecting alluvial gold grains and soil samples within Pembrokeshire and Carmarthenshire, to build their understanding of likely gold sources in the regions.

The project consists of an analysis of alluvial gold grains collected within the company's Pembrokeshire license area. Focusing specifically on a morphological and geochemical comparison between grains from the Treffgarne and Clarbeston areas in Northern Pembrokeshire, to determine if they have the same source.

Optical microscopy, reflective light microscopy and SEM analysis were conducted on select grains to allow for statistical and spatial analysis of gold from both regions, to produce a comparison of alluvial gold from the two areas.

Whilst statistical analysis proved important, spatial analysis was almost impossible to conduct due to the small number of panning locations. For this reason, it has been largely left out of the report.

Overall, this report concludes that the likely source of gold in each area is different. Grain morphology showed both areas were significantly different to each other, however, spatial analysis of morphological characteristics showed no significant patterns for each area.

Geochemical analysis also showed the source is different between the sites, however, it looks possible that there is more than one type of source within each area due to the varied results.

The geology of North Pembrokeshire implies there are many possible sources of gold, which has been seen in the results of this project with highly varied morphologies and geochemistry.

However, as this report only focuses on a comparison between alluvial gold from the two regions, further analysis of the results would be needed to determine deposit types.

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List of Abbreviations

SHG- Sarn Helen Gold Ltd.

BGS- British Geological Survey

MRP- Mineral Reconnaissance Programme

BGS MRP- British Geological Survey Mineral Reconnaissance Programme

GIS- Geographic Information System

GPS- Global Positioning System

SEM- Scanning Electron Microscope

pXRF- Portable X-ray Fluorescence

VMS- Volcanogenic Massive Sulfide

mm- millimetres

Kya- Thousand Years Ago

Mya- Million Years Ago

Au- Gold

Ag- Silver

Si- Silica

Fe- Iron

Mo- Molybdenum

Sn- Tin

List of Appendices

1. Introduction

1.1 Project Background

The exploration dissertation placement undertaken by the student with Sarn Helen Gold (SHG) during July and August 2022, focused on collecting geochemical data and alluvial gold grains within the Treffgarne and Clarbeston regions of Pembrokeshire, south-west Wales.

This involved soil sampling and gold panning within the license areas held by SHG with permission from landowners, to improve mapping of potential source regions of alluvial gold and anomalous soil geochemistry.

The question proposed for the Project focused on analysing alluvial gold grains collected by the student with SHG.

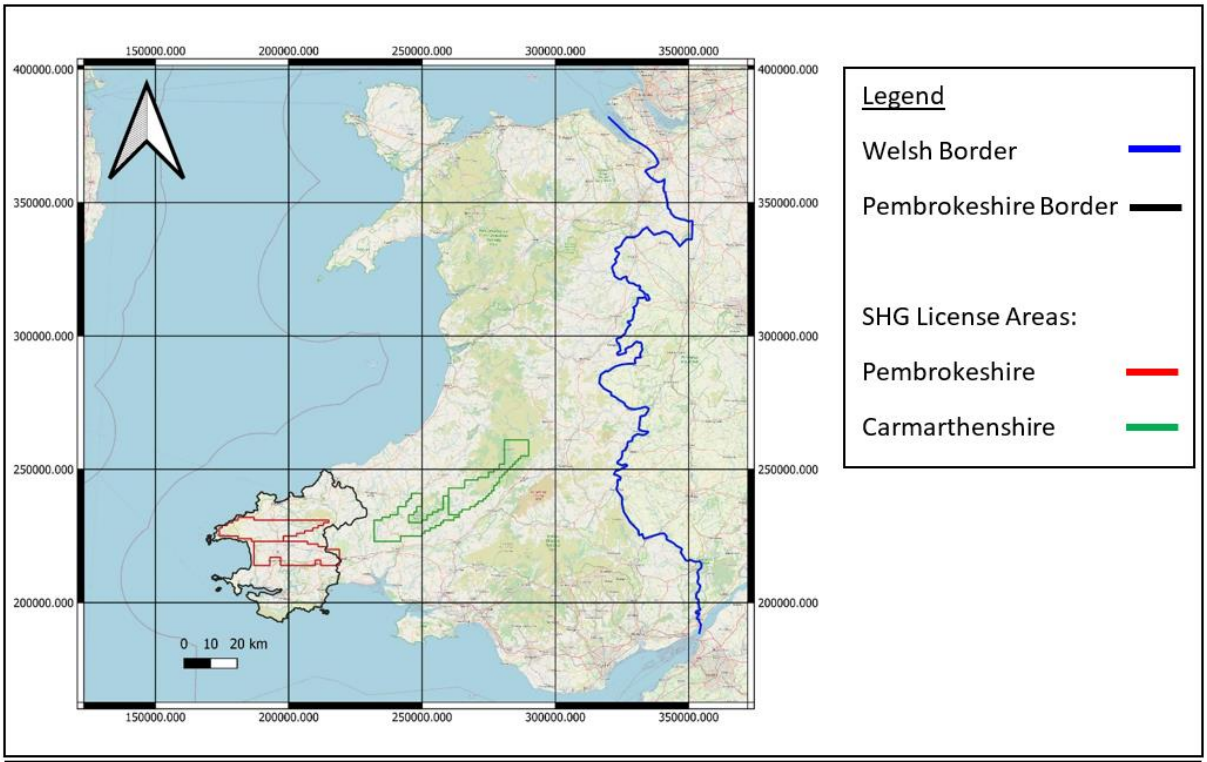


Figure 1. Map of Wales showing Sarn Helen Gold license areas

1.2 Project Area

This project focuses on gold grains sampled from two main sampling locations within the Pembrokeshire license areas. These are defined by where SHG has sampled for gold in 2021 and 2022.
The Clarbeston study area is approximately 83.4km^2 and is in the east of the county, consisting of one large drainage basin.
The Treffgarne study area in the west, consists of one main drainage basin, with a smaller drainage basin to the west of the study area near the village of Roch. The Treffgarne study area is therefore a study of the region between the villages of Treffgarne and Roch.

1.3 Aims and Objectives

The aim of this project is to analyse alluvial gold grains collected from Clarbeston and Treffgarne whilst on placement and determine whether the two regions have the same source.

Aims:

1. Compare the morphology and geochemistry of the two study areas
2. Determine if gold grains from Treffgarne and Clarbeston are from the same source

Objectives:

- Compare the underlying geology of Treffgarne and Clarbeston
- Construct a primitive idea of likely sources for each area
- Define the drainage basins within the study areas
- Analyse the morphology of the grains using optical microscopy and images to select grains for SEM analysis
- Determine the likely transport distance of the grains
- Prepare polished blocks for SEM analysis
- Analyse the chemical composition (geochemistry) of the grains using the SEM
- Compare results to determine likelihood of grains having the same source

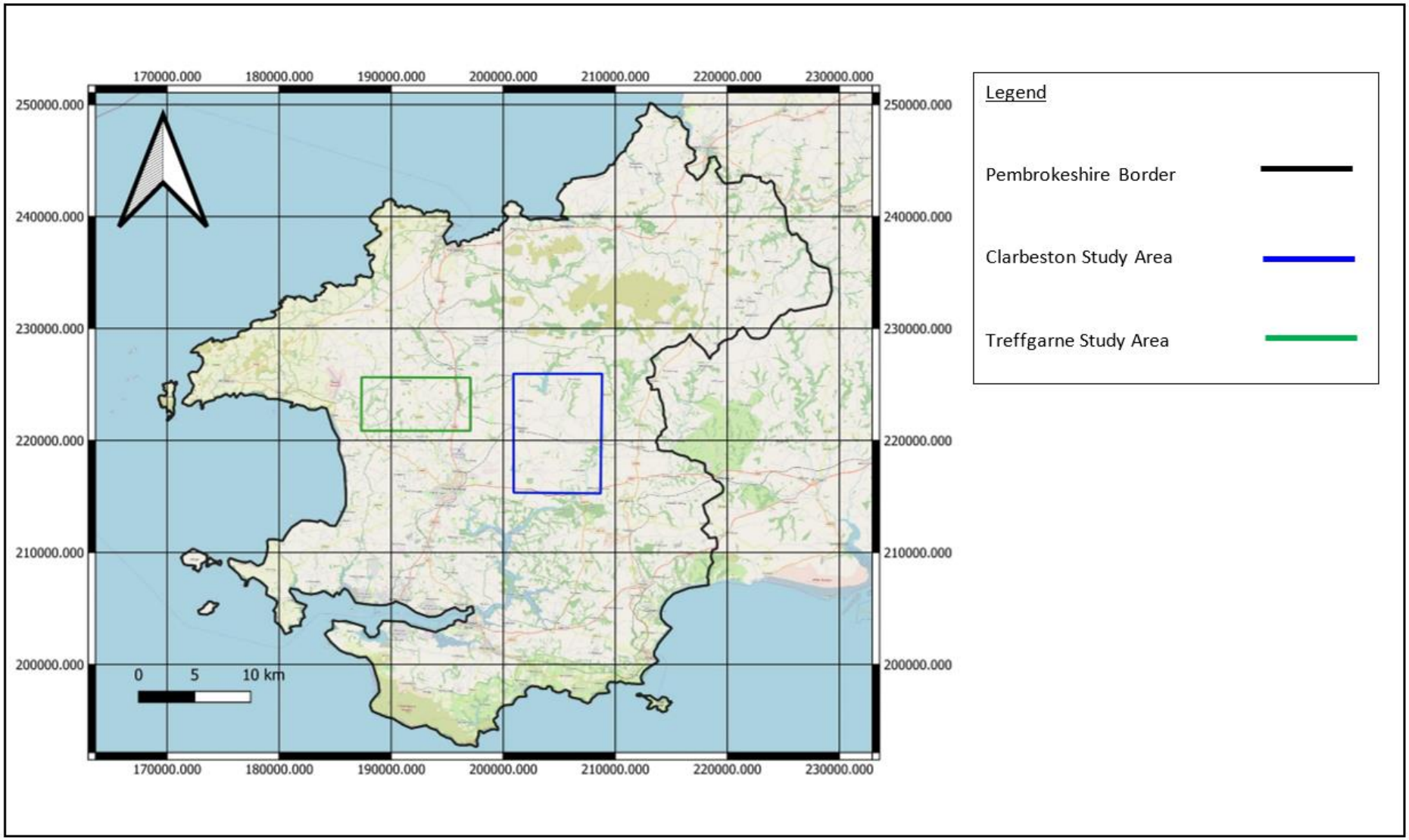


Figure 2. Map of Pembrokeshire showing the Clarbeston and Treffgarne study areas

1.4 Previous Exploration and Mining

1.4.1 Pembrokeshire

Pembrokeshire has had a fair history of metalliferous mining, however, there are no records of significant gold mining except for some reports of a mine near Bridell, North Pembrokeshire and a possible mine in Minwear (south of Clarbeston) (Claughton, 1999), however, this report from Minwear is likely a mistaken translation from a Welsh report.

A summary of historical metalliferous mining and exploration located in Pembrokeshire are shown in Table 1. below.

Due to Pembrokeshire's lack of significant rock outcrops, until recent years exploration for mineralisation in the area had been limited without geophysical surveys. However, the regional geology is attractive for exploration as other regions with similar geology have produced volcanogenic sulphide and precious metal mineralisation (Cooper, Exploration for volcanogenic mineralisation in south-west Wales, 1995).

The most extensive exploration of the region was carried out by the British Geological Survey (BGS) in the late 20th century, who produced a series of reports exploring the potential for metalliferous mining in Pembrokeshire.

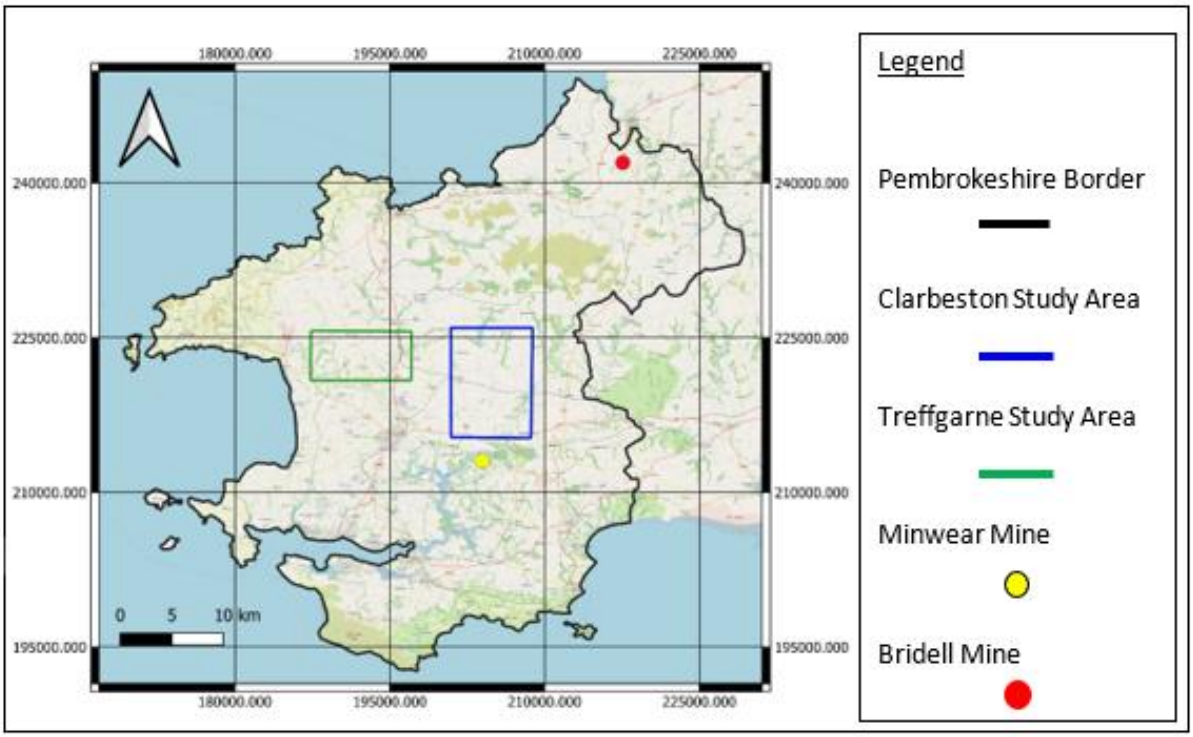


Figure 3. Map of Pembrokeshire showing the possible locations of historical gold mines

Table 1. Summary of historical metalliferous mining and exploration within Pembrokeshire (Information summarised from (Claughton, 1999))

Resource	Location	Historical Mining/Exploration
Iron	Saundersfoot	▪ Iron ore was extracted from the cliffs
	Ambleston	▪ Possible slags from ancient iron smelting
	Minwear	▪ Iron workings/trial adit
	Manorbier	▪ Mine operated from 1864-5, reworked in 1908-9
	Penally	▪ Iron trials, opened in 1864-5
Silver-lead	Llanfyrnach	▪ Mine operated between 1752 and 1890 producing large quantities of silver-lead ore
	Fronlwyd	▪ Small mine of two audits. Worked as a trial around 1864 and 1874
	Mynachlogddu	▪ Possible trial adits
	St Elvis	▪ Small mine operated intermittently from 1528 to end of 17th century
	Brawdy	▪ Trial adit on cliff top
Silver	St Elvis, Solva	▪ Silver bearing deposit discovered in the 1520s but not extracted
	Minwear	▪ Trial for silver
	Narbeth	▪ Possible silver mine
Zinc	Llanfyrnach	▪ The silver-lead mine began extracting zinc ore in the late 1800s
Copper	St Dogmaels	▪ Copper ore discovered at St Dogmaels in 1851, but no evidence of extraction
	Newport	▪ Copper reported in coastal deposits near Newport, no evidence of extraction
	Bridell	▪ Copper workings, possibly active in 1865
	Llanwnda	▪ Possible copper trial
	St Davids	▪ Trial adit, possibly for copper
	Treginnis	▪ Small mine on cliff top from around 1820 to 1883
	Ogof Mwn	▪ Copper trial in base of cliff
	St Elvis	▪ Small mine operated intermittently from 1528 to end of 17th century
	Brawdy	▪ Trial adit on cliff top
	Marletwy	▪ Copper lease granted in 1798, possible workings
	Dale	▪ Small mine, evidence of trial workings from 1769
Gold	Bridell (Fron-las)	▪ Gold workings, possibly active in 1865, evidence of visible gold
	Treffgarne	▪ Rumors of gold workings in area south of gorge. Alluvial gold found in Cleddau river
	Minwear	▪ Possible historical gold mine near Minwear
Manganese	Llanstinian (Fishguard)	▪ Reports of a manganese mine operating from 1889
	Minwear	▪ Manganese workings/trial adit
Lead	Clydey	▪ Evidence of three possible lead trials- late 19th/early 20th century
	Llanycefn	▪ Reports of a lead vein discovered in 1771
	Martletwy	▪ Copper lease granted in 1798, possible workings
	Herbrandston	▪ Small mine operated intermittently from 1740 till end of 18th century
	Castlemartin	▪ Application for mining grant in 17th century, lead ores reportedly found

1.4.2 Treffgarne

The earliest record of gold in Treffgarne come from a possible gold-bearing vein found around 1940 (Davies, 1948) which suggests the hydrothermally altered and veined rocks forming the Roch Volcanic Group (rhyolite) as a potential host rock.

The most extensive exploration occurred when the BGS mineral reconnaissance programme (MRP) produced a report on the Treffgarne region in 1987, summarising the potential for volcanogenic mineralisation, focusing on Ordovician volcanic rocks and Precambrian intrusive and extrusive rocks.

The survey used pre-existing data as well as geological, geochemical, and geophysical surveys to investigate mineralisation. This includes three boreholes drilled in the Roch Rhyolite (shown in Figure 4. Below), and the report concluded this formation as potential source of mineralisation due to the Caledonian orogeny.

Other reports from the BGS MRP have explored potential porphyry copper mineralisation near Llandeloy (Slater, 1985), which could influence the Treffgarne study area.

Based on these reports the likely source comes from the Roch rhyolite. Both porphyry copper and VMS style deposits have been proposed due to the alteration seen in the rhyolite and due to Wales's location in a back-arc setting during the rhyolite's formation (Primidi, 2015).

Alteration can be seen in the area with quartz and pyrite veins, pyrite in rivers and the possible gold-bearing vein found in 1940 (D C Cooper M. J., 1987).

However, due to no significant base metal concentrations and insufficient details in the reports, it is hard to relate the Roch rhyolites to a specific volcanic setting (D C Cooper K. E., 2000).

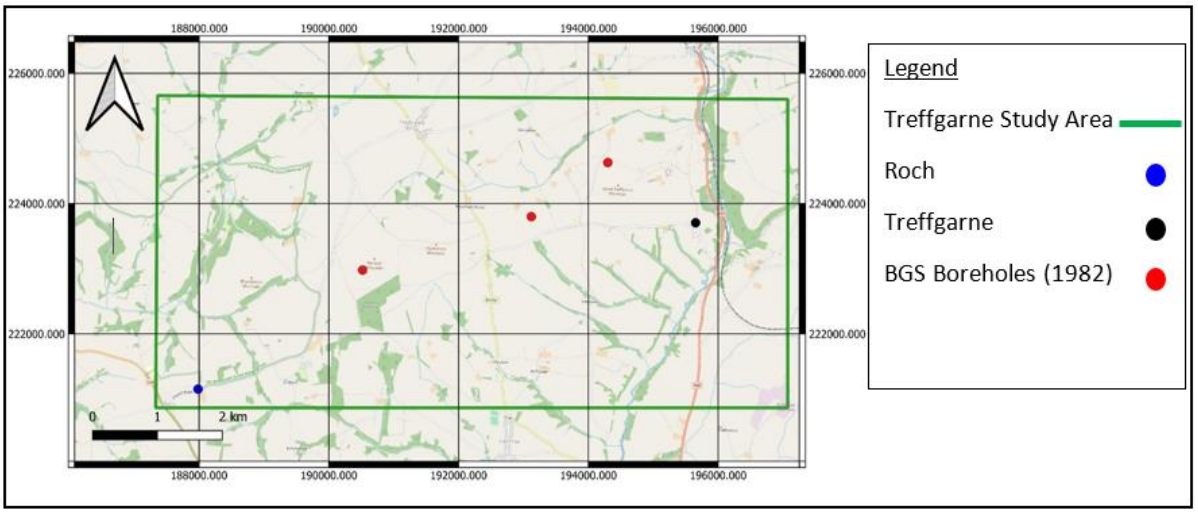


Figure 4. Map of the Treffgarne study area showing BGS boreholes drilled in 1982 to explore the potential for VMS deposits (British Geological Survey, 2022).

The boreholes are situated entirely on the Roch Rhyolite Group (shown in Figure 9.) and extend to a maximum of 194.15m deep (British Geological Survey, 1982).

1.4.3 Clarbeston

Other surveys of south-west Wales (encompassing Clarbeston) have been conducted by the BGS, looking specifically at gold mineralisation in lower Palaeozoic and Precambrian rocks. The report published in 2000 focused on rock geochemistry, geophysical surveys, satellite imagery and geochemistry to explore for potential gold mineralisation.

The results suggest some of the gold could be locally derived, however it is also possible gold has been transported into the area by glacial or fluvial action in the Quaternary period (G E Norton, 2000).

The report noted a lack of pathfinder elements for gold in the area, however, there was a spatial relation between anomalous gold concentrations and shallow magnetic features (G E Norton, 2000). The study then analysed composition of the grains finding a relation to granitic rocks which are not found in the study area but further west (G E Norton, 2000).

The report concluded palaeoplacers, porphyry-style copper-gold mineralisation and black-shale/shear-zone mineralisation as the likely sources of alluvial gold in south-west Wales (G E Norton, 2000).

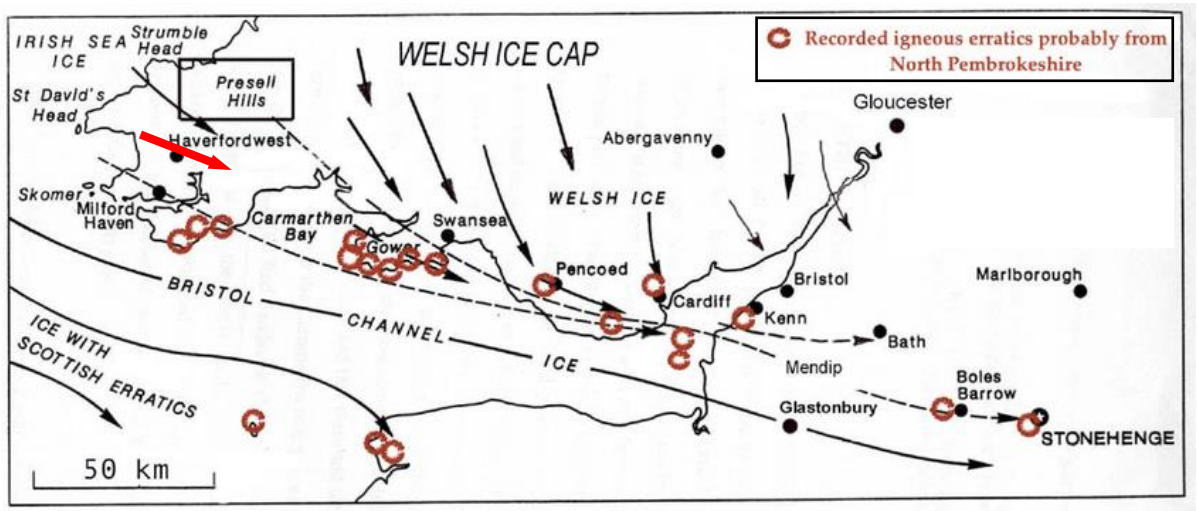


Figure 5. Map of Southwest Wales and England showing Anglian Glacial Flow (John, 2018)

The map shows during the Anglian glaciation, Irish Sea Ice could have transported gold from a northwest direction (John, 2018) and deposited it in the Clarbeston basin.

The BGS produced a similar paper exploring the potential for mesothermal gold and VMS deposits in the Welsh Basin. The primary gold bearing deposits in Wales include VMS, mesothermal gold, base metal vein-style mineralisation and turbidite-hosted slate-belt deposits (Cooper, Exploration for volcanogenic mineralisation in south-west Wales, 1995).

The Ordovician/Silurian age sediments underlying Clarbeston show similarities to gold-bearing successions like the black carbonaceous pyritic shales in Dolaucothi (D C Cooper K. E., 2000), these shale beds would provide the most economic potential if they were the source. Geochemical analysis of the rocks show enrichment in gold within sandstones and conglomerates from the Slade and Redhill Beds which could represent another source (G E Norton, 2000). However, gold was also found in the Dicranograptus Shales outside of the study area which may influence alluvial gold in the Deepford Brook which drains through these shales and into the study area.

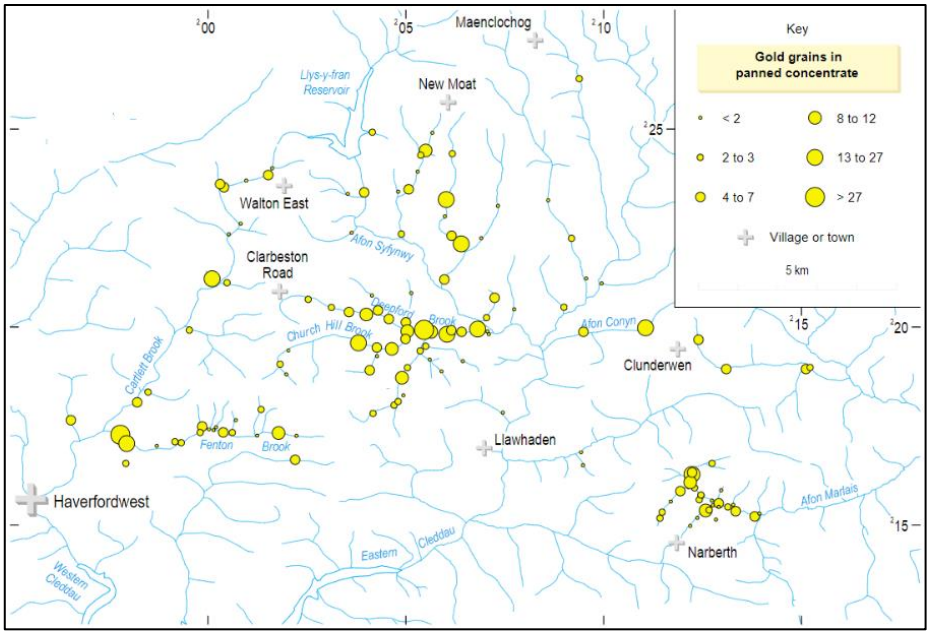


Figure 6. Areal distribution of gold grains in panned-concentrate samples from (G E Norton, 2000)

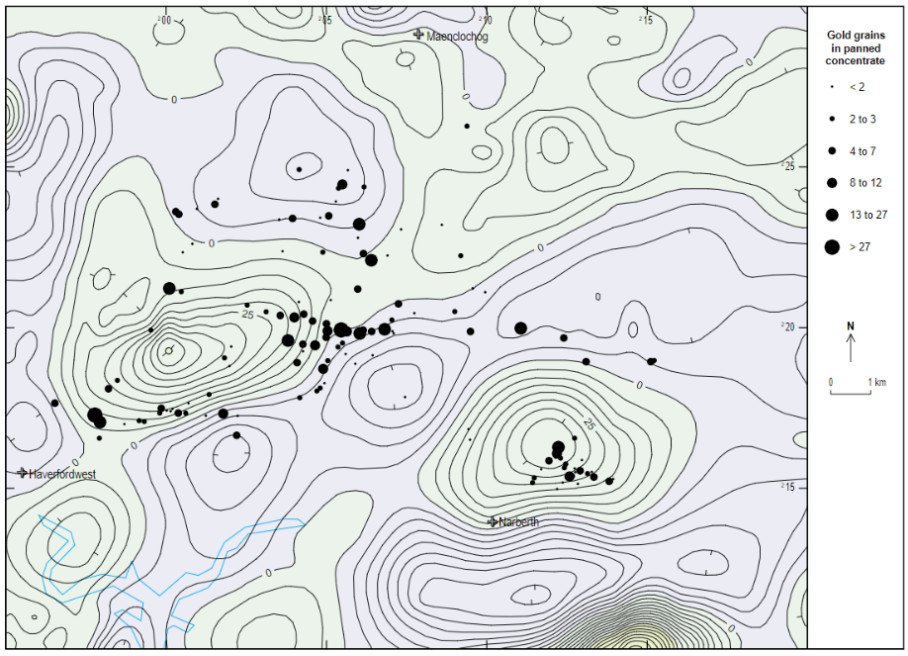


Figure 7. Filtered aeromagnetic map showing locations of alluvial gold from (G E Norton, 2000)

This map shows an apparent spatial relationship with magnetic anomalies which may represent a source

2. Geology

2.1 Pembrokeshire Geology

Pembrokeshire sits within south-west Wales and can be divided into two distinct regions of North and South Pembrokeshire, each with different geological facies.

The Clarbeston and Treffgarne areas sit within North Pembrokeshire which is older and dominated by Pre-cambrian to Silurian age rocks (>540 to 395Mya) (British Geological Survey, 2022). These include mostly Pre-cambrian igneous intrusions and volcanic tuffs, Cambrian basal conglomerates, mudstones and sandstones, Ordovician mudstones and shales, and Silurian sedimentary and volcanic rocks (British Geological Survey, 2022).

This region shows NE-SW trending strata due to the Caledonian Orogeny, which affected the region between the late Cambrian and mid Devonian (around 490 to 390Mya) (The Geological Society, n.d.). During the closure of the Iapetus Ocean, Wales was located in a back-arc basin setting in Avalonia, and the resulting orogeny led to folding, faulting and low-grade metamorphism within the Welsh basin (Primidi, 2015).

The entire county also contains sequences of superficial deposits of glaciofluvial, and tidal material deposited during the Quaternary (British Geological Survey, 2022).

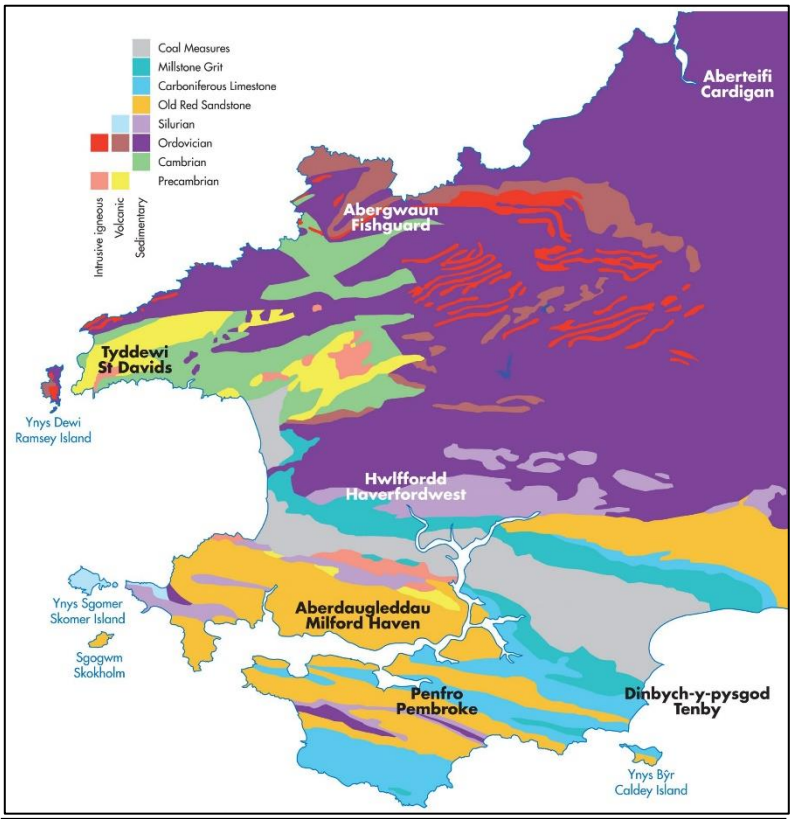


Figure 8. Simplified Geological Map of Pembrokeshire

This map shows the major bedrock units and rock types present in Pembrokeshire (Pembrokeshire Coast, 2023).

2.2 Treffgarne

The region under investigation lies between the towns of Treffgarne and Roch, two towns in North Pembrokeshire which sit predominantly on the Treffgarne Volcanic Formation. The study area (shown in Figure 3) is approximately 46.3km^2**.**

2.2.1 Bedrock Geology

The bedrock geology of Treffgarne is more varied than Clarbeston, including roughly nine different sequences (summarised in Table 2.) of sedimentary or igneous rock. These units range from Neoproterozoic to Carboniferous in age, and include tuff, rhyolite, granite, sandstones, mudstones, and siltstones.

These lithologies are predominantly Cambrian sedimentary rocks and Ordovician igneous intrusions (resulting from volcanism during the Caledonian orogeny), apart from Ediacaran tuff and Carboniferous coal measures.

The region also shows clear NE-SW trending strata running from Roch in the West to Treffgarne in the East.

The study area is situated around an elevated ridge running northeast to southwest between the two villages. This ridge (shown Figure 9.) is formed of predominantly Roch rhyolite deposited in the Ordovician. Gold grains collected for the project were found in streams either side of the elevated ridge. Running parallel to this ridge in the South is a band of sandstones and mudstone, with the Treffgarne Volcanic Group (Trachytic rock) further south.

The region to West draining the Brandy Brook, however, has a more complicated geology, with the stream passing through NE-SW trending bands of sandstones, mudstones, coal measures and igneous tuff.

Table 2. Geological units within the Treffgarne study area (British Geological Survey, 2022)

Unit Name	Age (Ma)	Rock Type	Lithologies	Period
Unnamed Igneous Intrusion	1000-541	Igneous	Granite	Neoproterozoic
Ramsey Sound Group Formation	635-541	Igneous	Tuff	Ediacaran
Caerfai Bay Shales Formation	526-508	Sedimentary	Mudstone	Cambrian
St Non's Sandstone Formation	526-508	Sedimentary	Sandstone, conglomerate	Cambrian
Caerbwdy Sandstone Formation	526-499	Sedimentary	Sandstone	Cambrian
Ligula Flags Formation	508-485.4	Sedimentary	Sedimentary Bedrock	Cambrian
Treffgarne Volcanic Formation	485.4-477.7	Igneous	Trachytic rock	Ordovician
Roch Volcanic Formation	477.7-465.5	Igneous	Rhyolite	Ordovician
SW Middle Coal Measures	318-309.5	Sedimentary	Mudstone, siltstone, sandstone	Carboniferous

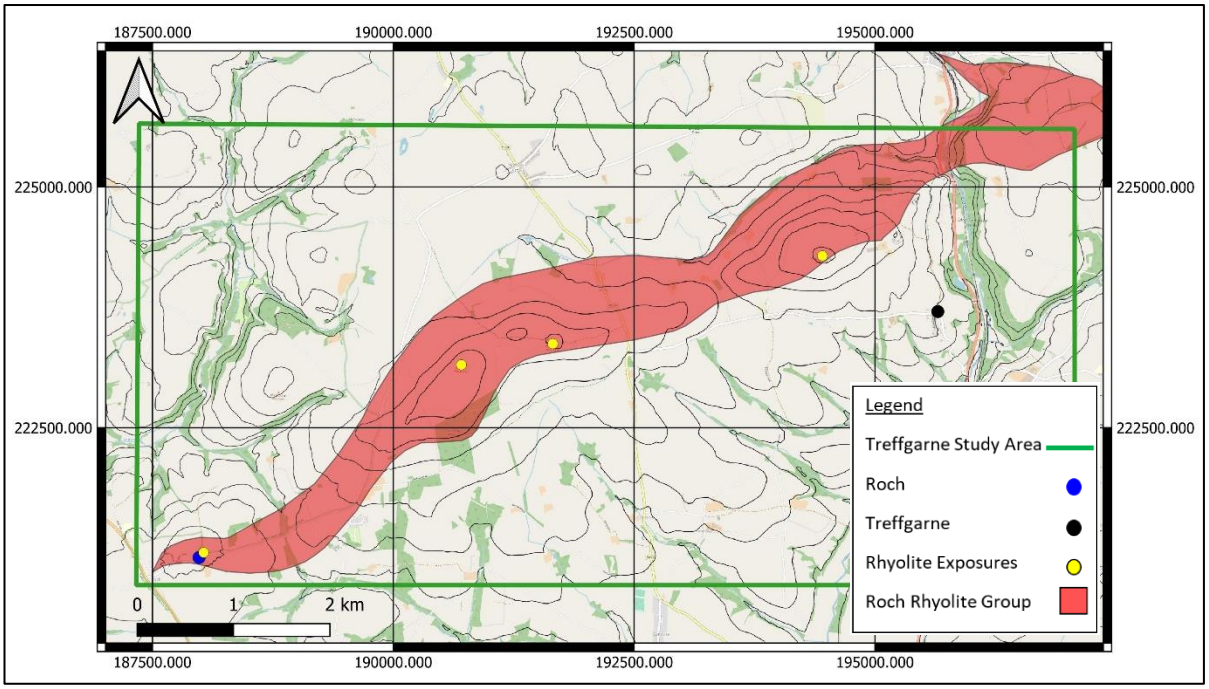


Figure 9. OSM Basemap with contours showing Roch Rhyolite Group extending northeast-southwest

This ridge hosts four main Rhyolite exposures; Great Treffgarne Mountain, Plumstone Mountain, Dudwell Mountain and Roch Castle (right to left)

Figure 10. Roch Rhyolite exposed at Great Treffgarne Mountain

Photo Credit: (Limburn, 2022)

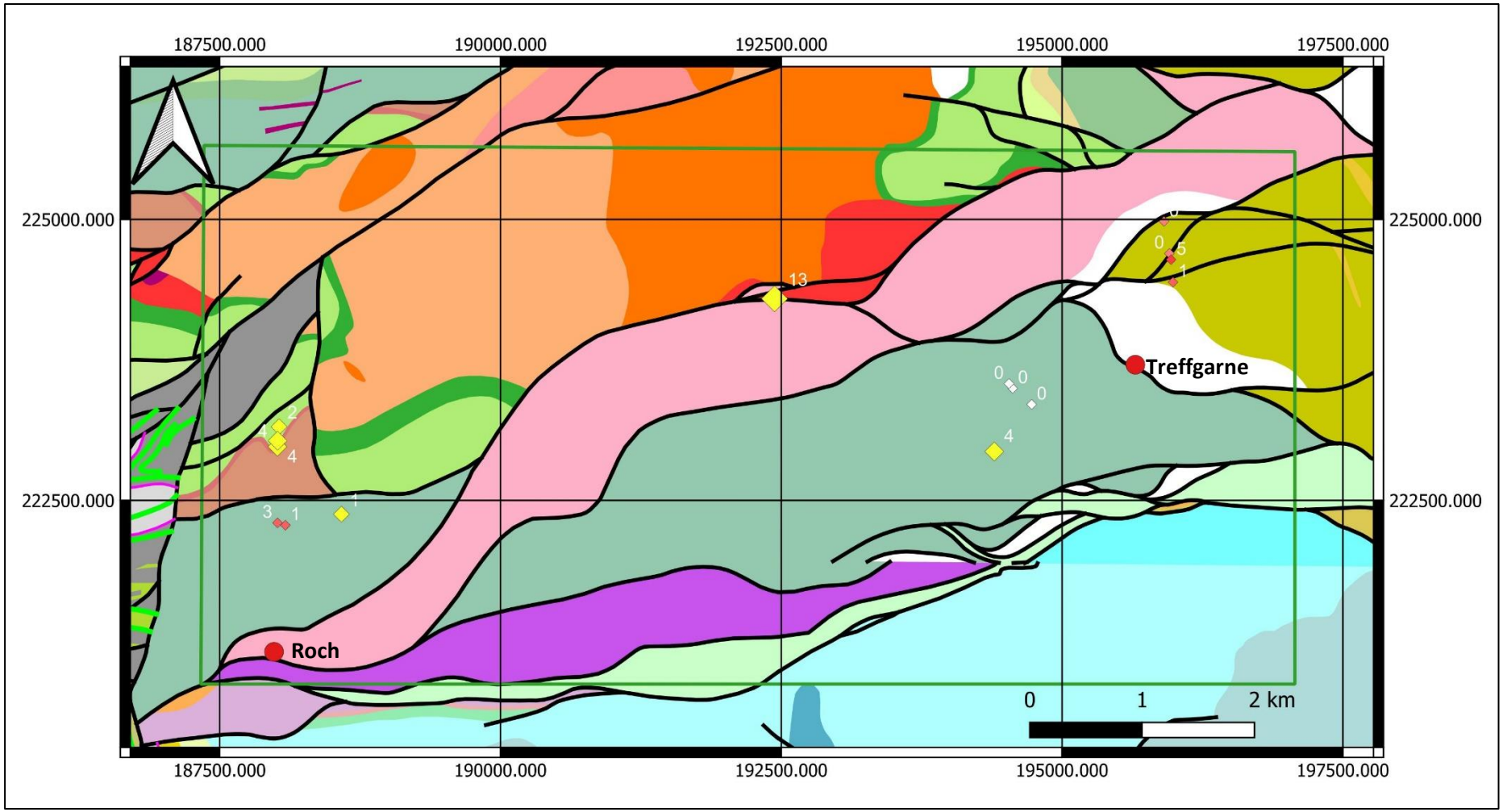


Figure 11. Bedrock Geology of the Treffgarne study area (British Geological Survey, 2022)

(Legend on Page 24)

Figure 12. Legend for Figure 11. (EDINA, 2023)

2.2.2 Superficial Geology

The superficial geology of the region is far less varied, containing four main categories of superficial deposit.

Table 3. Summary of Superficial Deposits found in the Treffgarne Study Area

Deposit Type	Age	Features
Glacial Till	Devensian 116 to 11.8 thousand years ago (British Geological Survey, 2022)).	• Formed during the last glacial advance in Europe, the Devensian. • This advance only partially covered Pembrokeshire (N. F. Glasser, 2018), so Devensian glacial sediments are confined to the Treffgarne study area.
Glaciofluvial	Devensian 116 to 11.8 thousand years ago (British Geological Survey, 2022)).	• Deposits of sand and gravel further south that formed during the Devensian, which are younger than those found in Clarbeston.
Head	Quaternary Period 2.588 Ma to present (British Geological Survey, 2022).	• Formed of silt, sand, clay, and gravel. • These smaller streams can be seen draining Southwest from the Roch Volcanic Formation and entering the Western Cleddau river. Multiple Alluvial Fan deposits can be seen here where the streams enter the main river.
Alluvium (same constituents as Head)	Since around 11.8 thousand years ago (British Geological Survey, 2022).	• The major rivers in the drainage basins (The Western Cleddau and Brandy Brook) and parts of the Nant-y-Coy Brook contain large amounts of Alluvium. • Transported from the smaller tributaries.

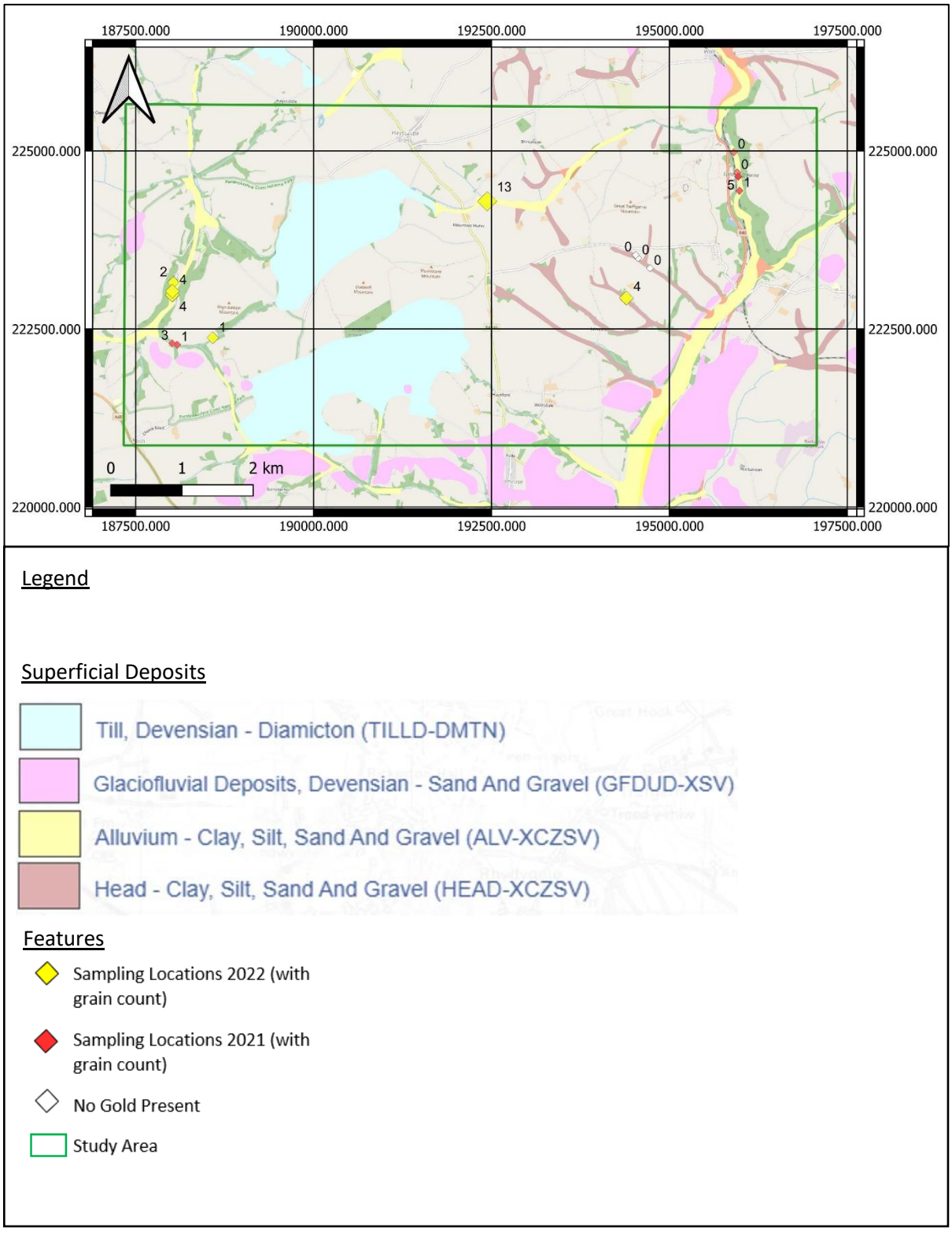


Figure 13. Superficial Geology of the Treffgarne study area (EDINA, 2023)

2.3 Clarbeston Geology

2.3.1 Bedrock Geology

Clarbeston contains a wider range of rock formations (approximately fifteen). These are mostly Ordovician in age except for two mudstone formations that extend from the Ordovician to the Silurian.

The rocks are mostly sedimentary, of which most are mudstones and sandstones, with two interbedded limestone and argillaceous rock formations. The different formations are shown in Table 4.

The northern part of the study area (from which the gold analysed in this report was collected) is formed predominantly of mudstone formations of varying ages, deposited during the Ordovician period (485.4 to 443.8 Ma) (Holland, 2021). These formations run approximately east to west showing a linear trend, with two Ordovician age tuffs (the Didymograptus Bifidus beds and Llanfallteg formation) in-between, an interbedded formation of limestone and argillaceous rocks and a muddy sandstone formation in the northwest.

Due to its age, the whole region has undergone deformation due to the Caledonian Orogeny, with the resulting linear features shown in Figure 14.

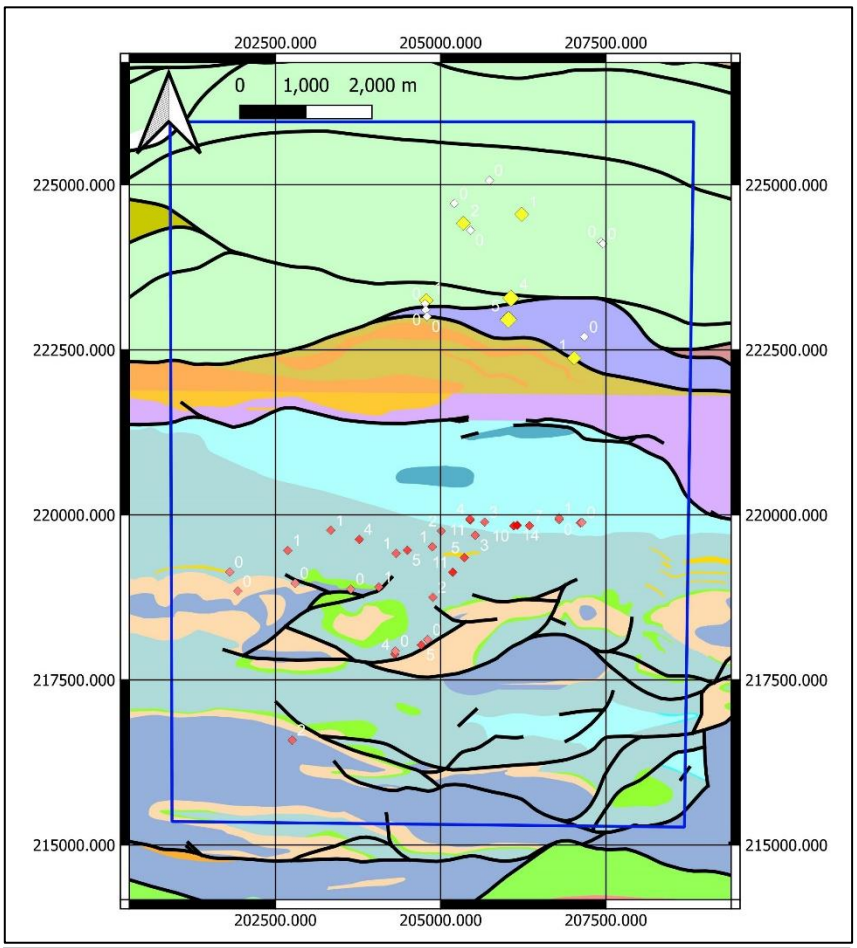


Figure 14. Bedrock Geology of the Clarbeston study area (British Geological Survey, 2022)

Figure 15. Legend for Figure 14. (EDINA, 2023)

Table 4. Geological units within the Clarbeston study area (British Geological Survey, 2022)

Unit Name	Age (Ma)	Rock Type	Lithologies	Period
Penmaen Dewi Shale Formation	477.7-465.5	Sedimentary	Mudstone	Ordovician
Ogof Hen Formation	447.7-465.5	Sedimentary	Sandstone	Ordovician
Llanfallteg Formation	470-465.5	Sedimentary	Mudstone	Ordovician
Llanfallteg Formation	470-465.5	Igneous	Tuff	Ordovician
Didymograptus Bifidus Beds	465.5-460.5	Igneous	Tuff	Ordovician
Didymograptus Bifidus Beds	465.5-460.5	Sedimentary	Mudstone	Ordovician
Abergwilli Formation	465.5-458.4	Sedimentary	Mudstone	Ordovician
Llandelio Flags Formation	465.5-449	Sedimentary	Limestone and Argillaceous rock (interbedded)	Ordovician
Mydrim Shales Formation	458.4-449	Sedimentary	Mudstone	Ordovician
Slade and Redhill Formation	449-443.8	Sedimentary	Mudstone	Ordovician
Slade and Redhill Formation	449-443.8	Sedimentary	Sandstone	Ordovician
Robeston Wathen Limestone and Sholeshook Limestone	449-443.8	Sedimentary	Limestone and Argillaceous rock (interbedded)	Ordovician
Portfield Formation and Haverford Mudstone Formation	449-433.4	Sedimentary	Mudstone	Ordovician-Silurian
Portfield Formation and Haverford Mudstone Formation	449-433.4	Sedimentary	Conglomerate	Ordovician-Silurian
Cethings Sandstone Member	445.2-443.8	Sedimentary	Sandstone	Ordovician

2.3.2 Superficial Geology

The superficial geology in Clarbeston is similar to Treffgarne, containing the same four types of superficial deposits, with the addition of River Terrace deposits.

As mentioned in 2.2.2, the Devensian Glaciation didn't reach central Pembrokeshire, so Glaciofluvial deposits and Till found in Clarbeston are the result of the Anglian Glaciation (around 450,000 years ago (Ice Age Ponds, n.d.)), where ice sheets covered the whole county.

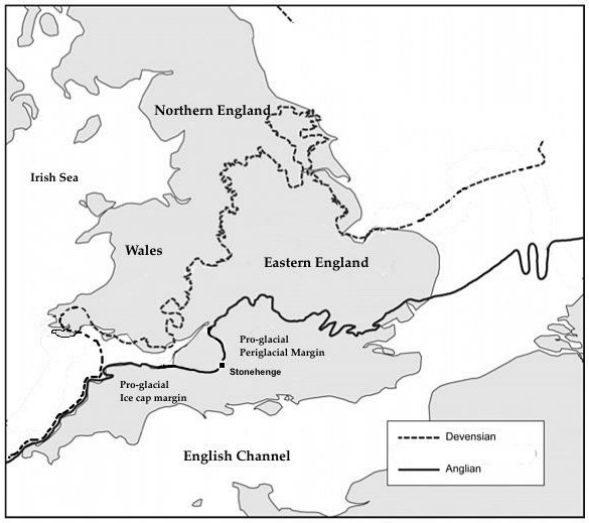
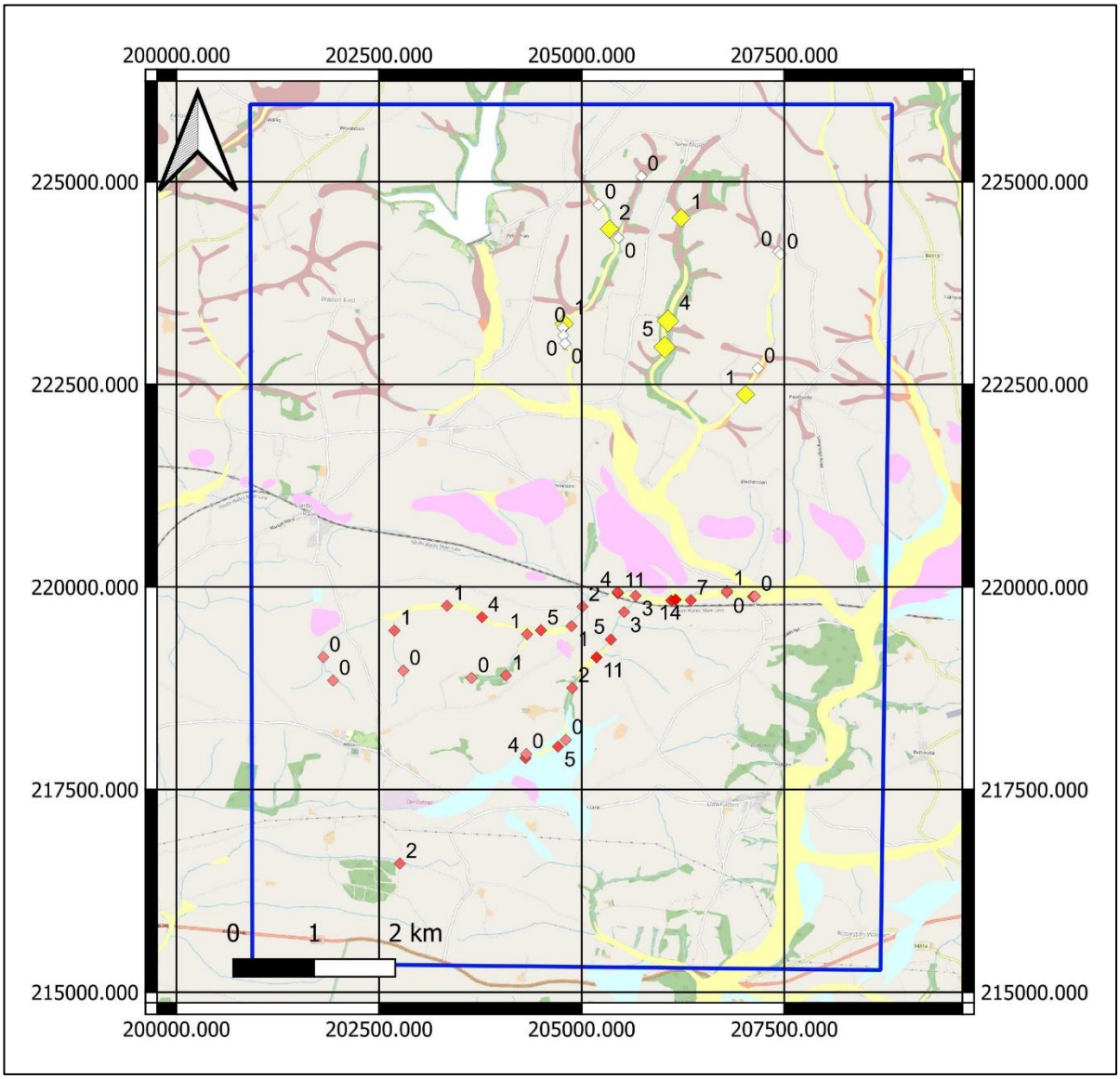


Figure 16. Partial map of the UK showing Ice sheet extent during the Devensian and Anglian Glaciations (Best, 2016)

Table 5. Summary of Superficial Deposits found in the Clarbeston Study Area

Deposit Type	Age	Features
Glacial Till	Quaternary period (2.588 Ma to present) (British Geological Survey, 2022).	• Found in the south of the study area. • Formed during the Anglian Glaciation. • Much older than Till found in Treffgarne.
Glaciofluvial	Quaternary period (2.588 Ma to present)	• Sand and gravels deposited earlier than those in Treffgarne. • Formed during the Anglian Glaciation.
Head	Quaternary period (2.588 Ma to present) (British Geological Survey, 2022).	• Found in small streams draining into the Eastern Cleddau. • Similar to those found in Treffgarne.
Alluvium (same constituents as Head)	Quaternary period (2.588 Ma to present) (British Geological Survey, 2022).	• Found in the larger streams and rivers in the area. • Transported from smaller tributaries.
River Terrace Deposits (similar so Alluvium)	Late Quaternary (11.8 thousand years till present) (British Geological Survey, 2022).	• Found in the larger streams and rivers in the area.



Legend

Superficial Geology

- Till - Diamicton (TILL-DMTN)
- Head - Clay, Silt, Sand And Gravel (HEAD-XCZSV)
- River Terrace Deposits (Undifferentiated) - Sand And Gravel (RTDU-XSV)
- Alluvium - Clay, Silt, Sand And Gravel (ALV-XCZSV)
- Glaciofluvial Deposits - Sand And Gravel (GFDU-XSV)
- Alluvial Fan Deposits - Sand And Gravel (ALF-XSV)

Features

- Sampling Locations 2022 (with grain count)
- Sampling Locations 2021 (with grain count)
- No Gold Present
- Study Area

Figure 17. Superficial Geology of the Clarbeston study area (EDINA, 2023)

3. Methodology

3.1 Sampling

3.1.1 Sample Preparation

Bag Writing

Figure 18.a Pre-written Soil Sampling bag with code

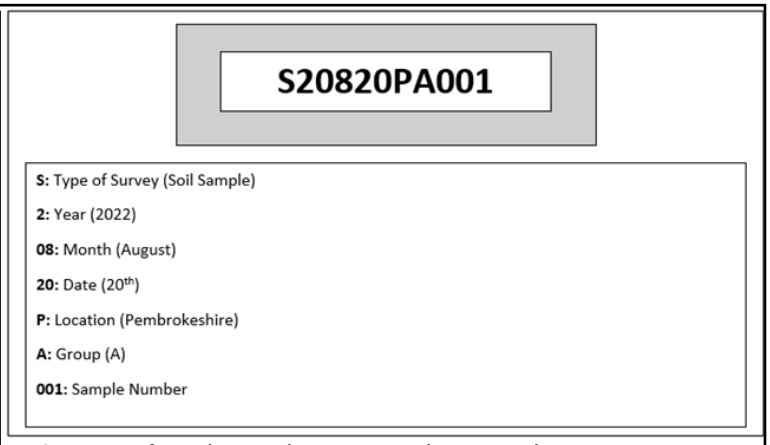


Figure 18.b Soil Sampling Bag Code Legend

Figure 18. Sample Bag Preparation

Sample bags were pre-written in the office with a specific sample code before entering the field.

Approximately 80 bags were written for each field day.

GIS

Figure 19.a Garmin GPSMAP 65 MULTI-BAND Handheld GPS

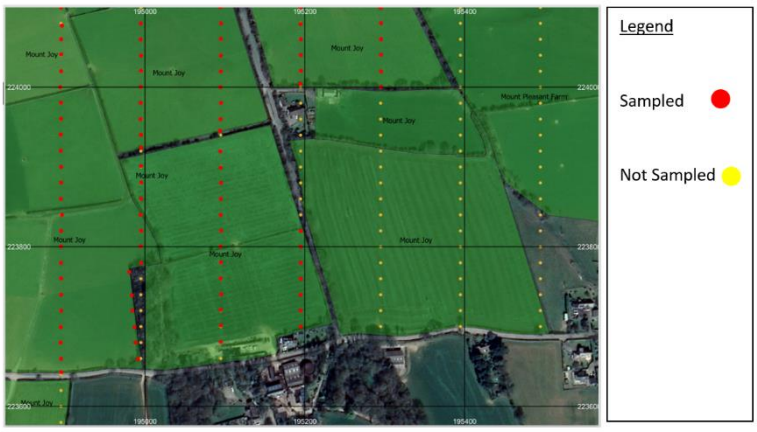


Figure 19.b Section of Mount Joy Farm, Pembrokeshire taken from Avenza Maps showing soil sample points.

Figure 19. GPS and Mapping software used to locate sample locations in the field

Sample locations were plotted on QGIS by SHG Field Supervisors and uploaded to a Garmin GPSMAP 65 handheld GPS and sent to students via Avenza Maps for field use.

Land Access

Determined using QGIS to identify potential sample sites of interest to SHG. Contact details of the relevant landowner was obtained through the HM Land Registry or other landowners in the area. A meeting was then arranged to discuss the potential for sampling on the property. Land could only be accessed with permission from the owner (unless common land).

3.1.2 Gold Panning

Locating a suitable sample location

Using Avenza Maps or a Garmin GPS, students would locate the river for sampling. Students would walk along the river to find a location where a sudden change in water velocity would allow gold grains to settle (gold trap).

Figure 20. Small waterfall trap at Brunant Farm, Dolaucothi

Sudden change in velocity will allow gold to settle in the pool below the waterfall, especially during heavy rain.

Recording location data

At each sample location, in a notebook students would record the type of gold trap, depth (in cm) the sample was taken from, the number of gold grains collected, then take a photograph of the trap on a mobile phone. Sample coordinates were recorded using a GPS, with each sample having a code corresponding to a bag (Figure 18).

Gold panning process

sarn helen gold

1. Using a shovel, students would fill two 13.5L buckets of river sediment, preferentially choosing finer sediment close to bedrock and not boulders.

2. Sediment is then tipped into a series of sieve trays, as water is poured into them to allow fine sediment to accumulate in the bottom tray.

3. This can be aided by shaking the sieve as the water is poured.

4. Once the sediment has been separated, three trays of <2mm, <10mm and >10mm sediments remain (sediments >10mm are checked then discarded).

5. Starting with the <10mm tray, students would pour the contents into a 14 or 16inch plastic pan, and in a suitable location downstream from the trap, pan the contents until only heavy particles remain.

6. Once only heavy particles remain, the pan concentrate is swirled to isolate the heaviest particles at the 'tail' end of the swirled sediment.

7. Gold grains present are removed from the pan using blue tape, then stuck inside a clear plastic bag with a code corresponding to the GPS code.

8. Remaining Pan Concentrate is placed in a separate, labelled bag for later analysis.

Figure 21. Official Sarn Helen Gold Panning Process

Figure 22. SHG Official Gold Panning Process

Detailed Methodology of the gold panning process showing equipment used, and step-by-step procedure for separating gold grains from the initial sediment collected in the bucket.

The Figure shows an example of <10mm sediment being panned to produce a pan concentrate and gold grains

Gold Panning Process with Sluice (not Official SHG sampling method)

Table 6. Gold Sluicing Methodology

A sluice provided by Cardiff University was used later in the project to bulk out samples in Treffgarne. The sluice proved more effective than using a sieve and gold pan and helped collect significantly more gold grains.

	▪ The sluice was placed in a suitable location that allowed water to flow over it ▪ Sediment was then collected using a bucket and shovel from a gold trap ▪ The sediment was slowly poured into the sluice ▪ Once enough sediment had been poured though the sluice, it was carefully removed from the water keeping any trapped grains inside it
	▪ The sluice was placed over a pan and any trapped sediment was carefully washed into the pan with drips of water until the sluice was clean ▪ The sediment collected in the pan was then panned using the normal panning method to isolate and gold grains ▪ This process was repeated as many times as possible at the locality to maximise the number of grains collected

Data Upload

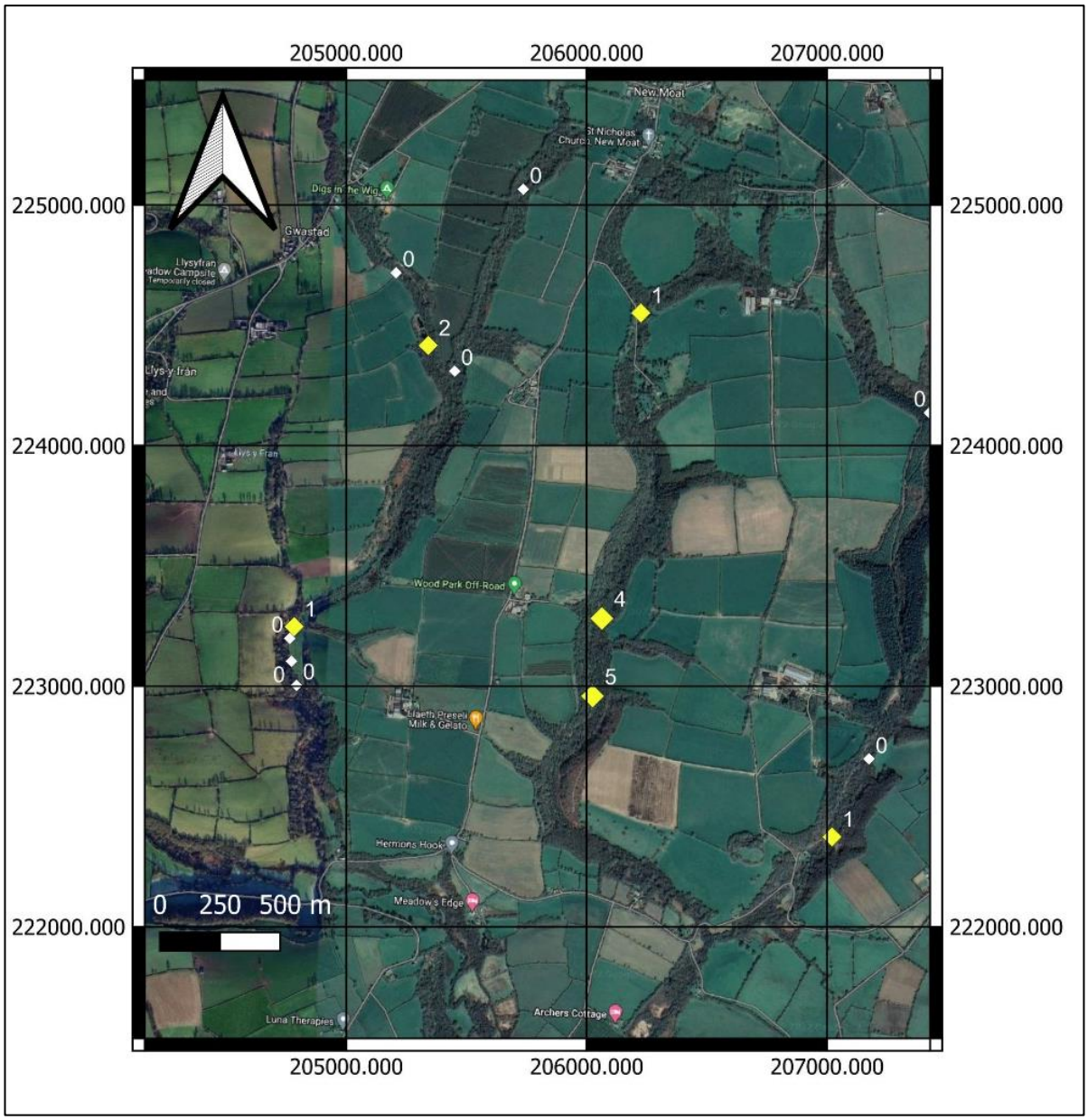


Figure 23. Google Basemap with Panning Locations and Grain Count

Panning location coordinates were then uploaded from the GPS to QGIS and plotted on a Google Basemap along with the number of gold grains found

3.2 Laboratory Analysis

3.2.1 Optical Microscopy

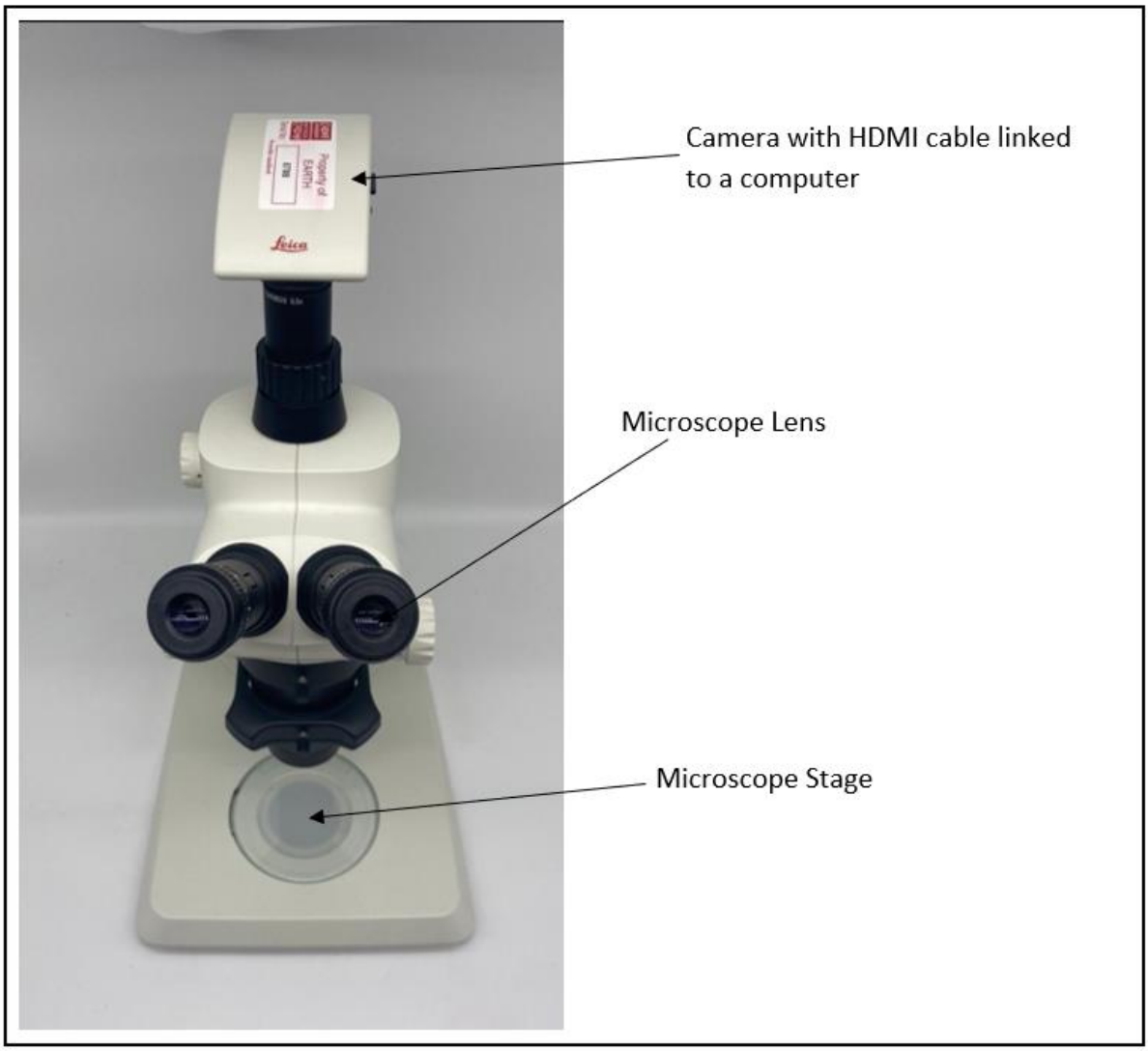


Figure 24. Labelled diagram of an Optical Light Microscope used to analyse and photograph gold grains

Samples collected by the student whilst on placement were transported to Cardiff University for further analysis. Samples first underwent optical microscopy in order to:

- Confirm which grains are gold
- Photograph for statistical analysis (to measure length, width, surface area, sphericity and roundness)
- Select grains for SEM (scanning electron microscope use)

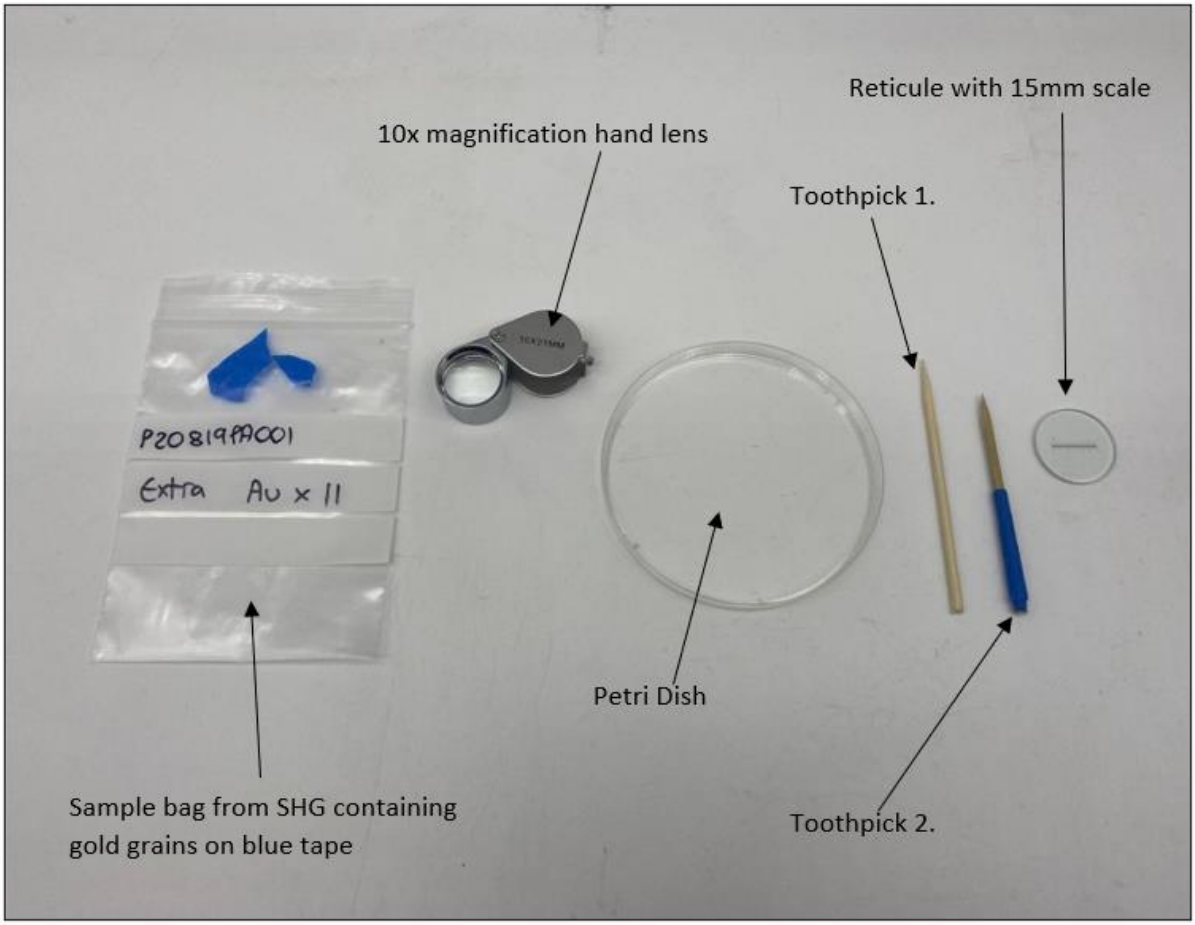


Figure 25. Labelled photograph of equipment used during optical microscopy

Optical Microscopy Process:

- A hand lens was used to identify grains on the blue tape within the sample bag
- Grains were removed from the sample bag using toothpick 1 and placed into the petri dish
- Grains were then moved from the petri dish to the reticule using toothpick 1
- Once on the reticule, grains were moved into position along the scale (in descending size) using toothpick 2
- A maximum of fifteen grains were placed along the scale at one time
- Grains identified as not gold grains were removed
- A photograph was taken using the phone mount as well as using the camera located on the microscope
- Photographs taken using the microscope camera were uploaded to Leica Application Suite (LAS) V4 .12 and labelled with the sample code
- Grains identified as gold were then removed from the reticule using blue tape and placed into a new labelled sample bag

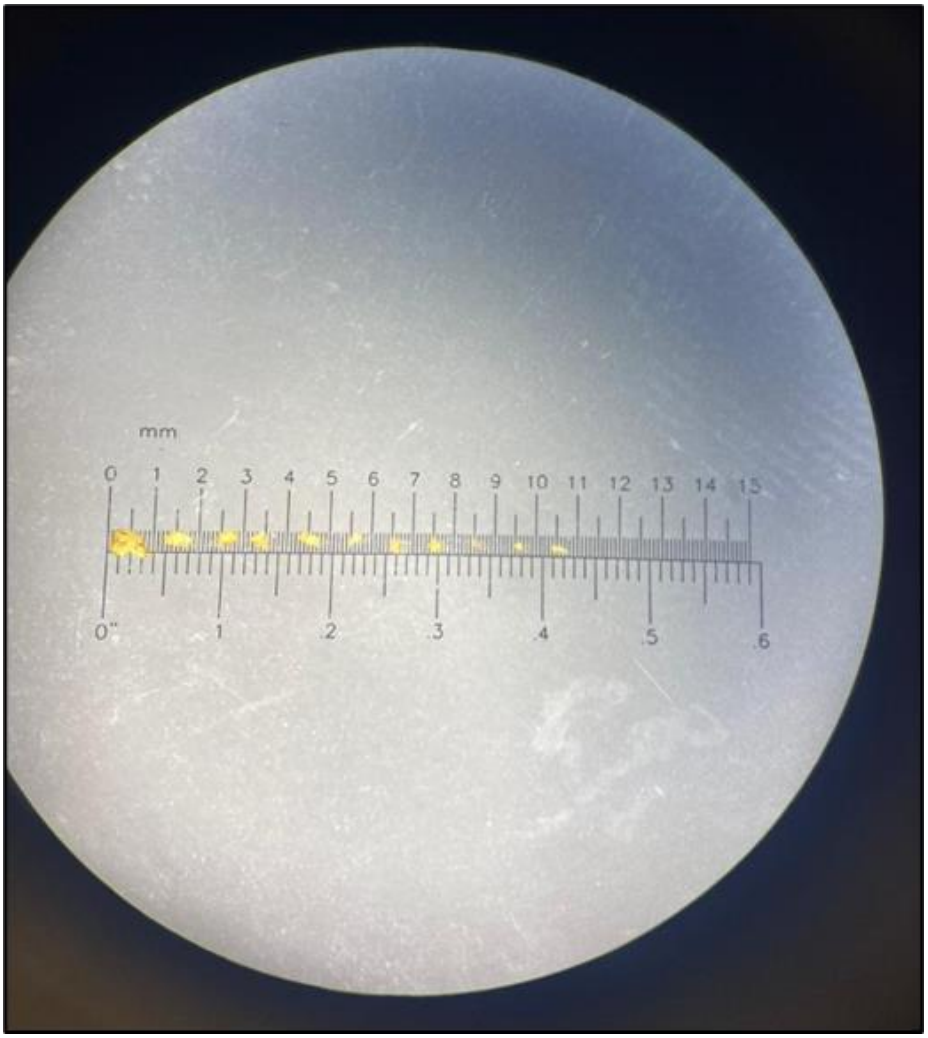


Figure 26. Photograph taken using a mobile phone mounted on the microscope

The image shows 11 gold grains along the 15mm reticule

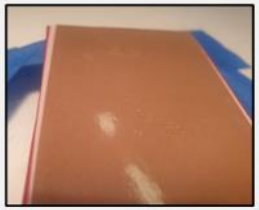
3.2.2 Polished Block Creation

Once grains had been selected for the SEM, the student created two polished resin blocks for SEM analysis (one block for Treffgarne and one block for Clarbeston) with the assistance of Tony Oldroyd at Cardiff University.

Grains from a separate locality near Minwear were accidentally mistaken for grains from Treffgarne and so were set on the Treffgarne SEM Block. These grains were identified and have not been analysed.

1. Students used a 25mm diameter circular plastic mould to imprint the circumference of the mould on a piece of adhesive brown tape

2. Grains were removed from the sample bag using a toothpick and placed onto the tap.
Once on the tape, grains were arranged into order using a separate toothpick



3. Once all grains were arranged on the tape, the plastic mould was placed over the top of the grains
Araldite resin was then poured slowly into the plastic mould until it covered the grains

4. The resin was allowed to harden in a drying cupboard at 50 degrees Celsius for 2 hours
The mould was then filled to the top with resin and left for 24 hours to set

5. Once set the resin block was polished on the bottom using a Diamond impregnated grinding wheel

6. The top side of the block was then polished by hand using 4nm sandpaper and water mixed with 0.3 Micron Ultra Fine Aluminium Oxide powder, whilst repeatedly checking the exposure of the grains using a reflective light microscope

7. Once sufficiently exposed, a hole was drilled in the bottom of the block so it could be placed securely into the

8.The resin blocks were polished using a Logitech PM5 machine for 5 minutes

9. They were then cleaned using tap water and placed into an ultrasonic bath for 1minute

Figure 27. Polished Resin Block Creation Process

3.2.3 Reflective Light Microscopy

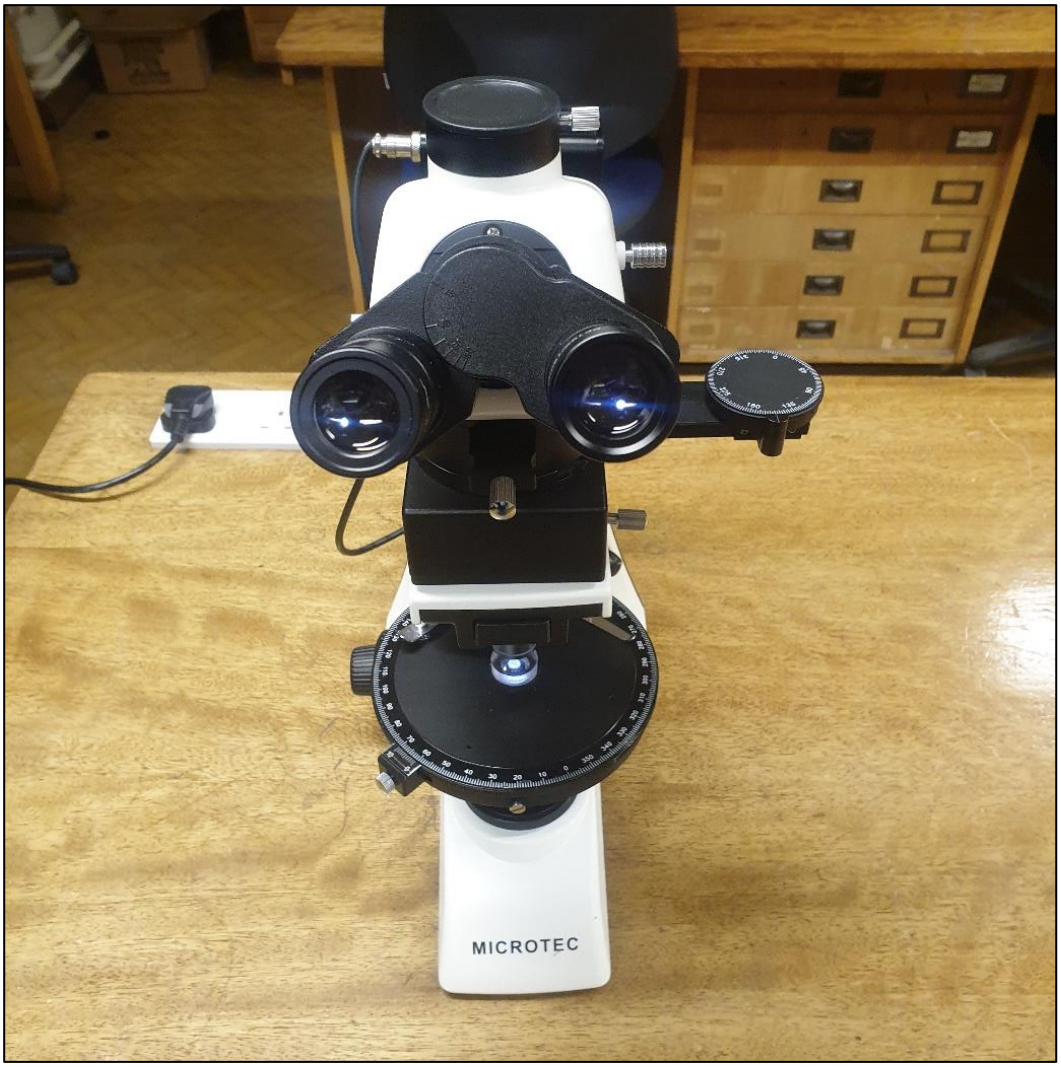


Figure 28. Reflective Light Microscope used to analyse inclusions and grain rims in Plain Polarised Light and Crossed Polarised Light

Reflective Light Microscopy was carried out using the Polished Resin blocks to:

- Identify Inclusions for SEM analysis
- Measure the size of grain rims (Rims are created by a loss of Silver from the grain during transport (Townley et.al, 2003))
- Identify grains of interest for SEM analysis

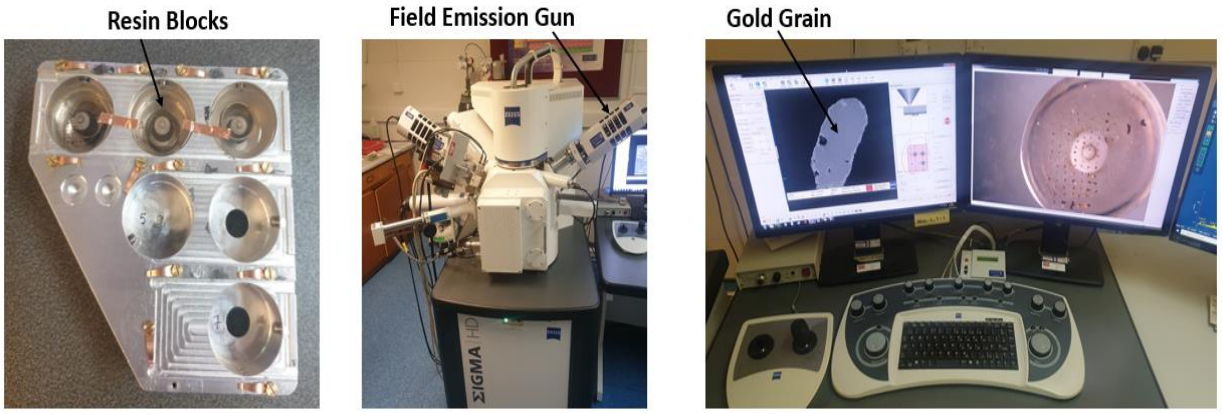
3.2.4 SEM

3.2.4.1 Carbon-coating

Resin blocks were then coated in a carbon layer 12.3nm thick to improve image quality before SEM use.

Figure 29. Carbon coating in progress at Cardiff University

3.2.4.2 Microscopy



- The resin blocks were then placed on a tray and placed into a ZEISS Sigma HD Scanning Electron Microscope (shown in the centre) for analysis, with the help of Duncan Muir at Cardiff University.
- A Field Emission Gun was used to focus a beam of electrons onto each grain, producing a spectrum (showing element composition) for specified parts of each grain (core, rim and inclusions).
- This produced a series of spectrums and diagrams for later analysis.

Figure 30. SEM Process

3.3 Drainage Basin Definition

Drainage basins were created using QGIS 3.16 with LIDAR basemaps. The SAGA processing tool was used to create channel networks with a Strahler order of 7. This allowed the outline of the watershed to be created using a polygon and the definition of each basin surrounding the channel networks.

3.4 Spatial Analysis

Spatial analysis was conducted using gold grain sample locations plotted over a geology basemap on QGIS 3.16 to look for spatial patterns in panning locations.

3.5 Statistical Analysis

3.5.1 Statistical Analysis of Grain Morphology

- Using the optical microscope, for each grain the length, width, sphericity and roundness was measured.
- This data was then used to calculate the surface area and Krumbein score for each grain.
- Summary statistics were calculated and used to plot graphs.
- A correlation matrix was constructed for each location.
- Anderson-Darling tests were carried out for normality.
- Kruskal-Wallis tests were carried out to test for equal medians.

All statistical analysis was carried out using Microsoft Excel and PAST 3.01.

3.5.2 Statistical Analysis of Grain Geochemistry

- Gold and Silver atomic percentages were plotted for grain cores and rims
- Electron Images and Elemental Spectrums produced by the SEM were used to analyse grain core, rim and inclusions
- Statistical tests were used to test the normality of core compositions
- Inclusions were analysed separately to show different elements present

3.6 Limitations

Table 7. Major Limitations encountered during the Project

Stage of Project	Limitation
Placement	▪ Insufficient time spent panning ▪ Lack of locations panned (spatial coverage) ▪ Some gold traps had no gold ▪ Insufficient number of grains collected ▪ Sluice not available for most sampling days
Optical Microscopy	▪ Grains were hard to remove from blue tape ▪ Blue tape fell apart if wet ▪ Grains were hard to move around using toothpicks ▪ Grains lost due to small size ▪ Grains were hard to arrange on reticule ▪ Static charge made some grains jump around reticule
Resin Block Creation	▪ Hard to arrange all grains on one block without disturbing each other ▪ Tracking all grains and keeping them in specific orders was hard ▪ Polishing using sandpaper had to be slow with constant checks using a reflective light microscope, so no grains were lost ▪ Grains were scratched by sandpaper ▪ Grains were lost during polishing with the Logitech PM5 machine
Reflective Light Microscopy	▪ Hard to see inclusions and rims due to different levels of exposure of gold grains- Gold beneath resin appears like inclusions ▪ Exposed gold is isotropic but gold beneath resin is still gold coloured ▪ Rims impossible to identify due to different levels of polishing
SEM Analysis	▪ Insufficient time spent with the SEM ▪ Insufficient number of grains analysed ▪ Insufficient time to look for inclusions in detail ▪ Hard to distinguish between grain cores, rims or inclusions in some circumstances
Morphological Analysis	▪ Hard to compare study areas due to significantly larger sample size of Clarbeston ▪ Spatial analysis couldn't be carried out with any reliability due to the poor spatial coverage
Geochemical Analysis	▪ Some spectrums labelled as grain cores appear to show compositions of grain rims- human error with SEM ▪ Insufficient number of grains analysed by SEM for truly reliable geochemical analysis ▪ Spatial coverage was too poor to carry out spatial analysis

4. Analysis

4.1 Drainage Basin Analysis

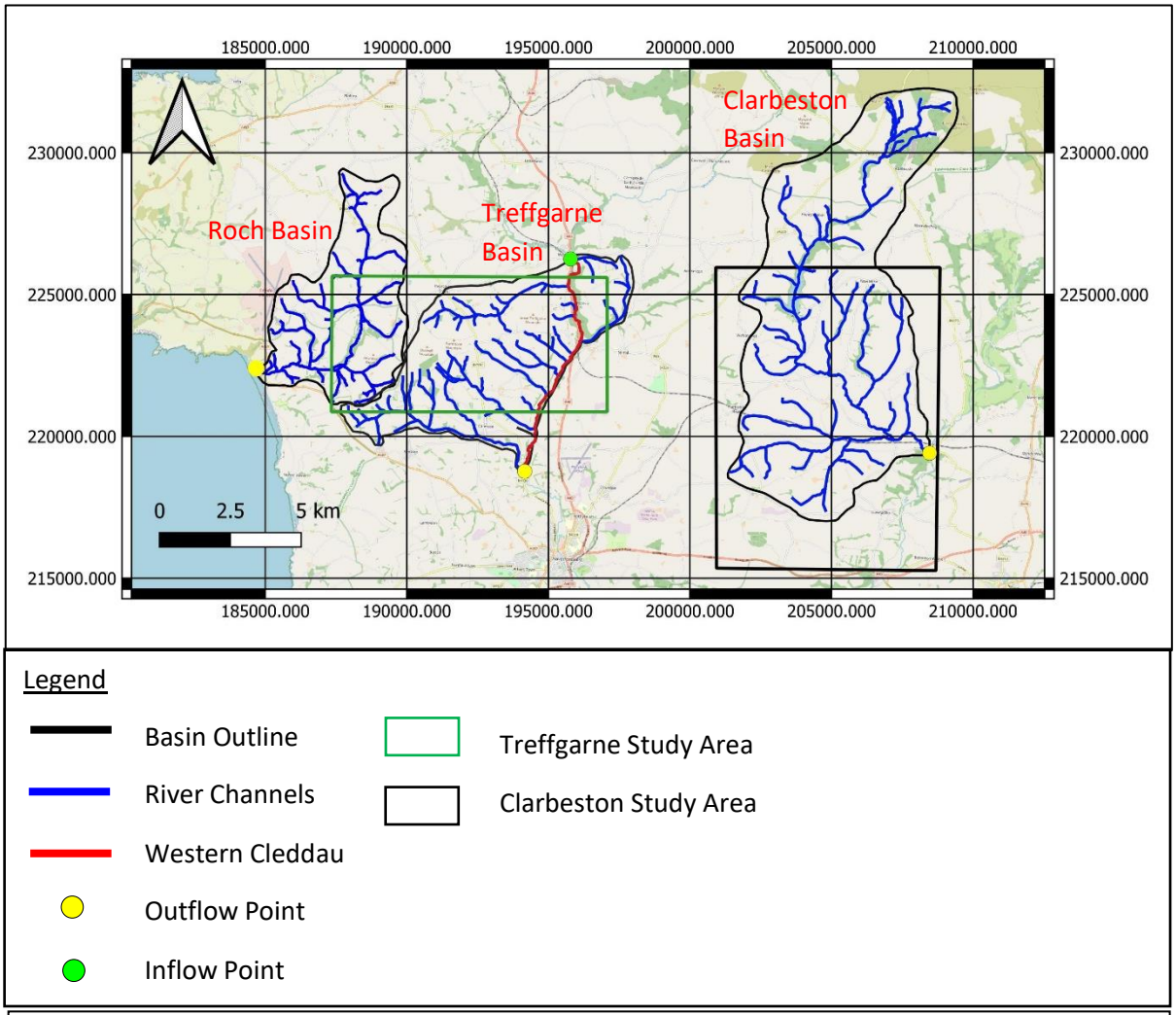


Figure 31. Map showing the three drainage basins identified

In total three main drainage basins were identified for the project.

Grains sampled in the Clarbeston study area come from the Clarbeston basin, which is approximately 73.8km^2 stretching from the Preseli mountains in the north to Llawhaden in the south. All grains sampled during 2022 come from rivers draining either Penmaen Dewi Shale or Abergwilli Mudstone found in the centre of the basin.

The Treffgarne study area, however, is situated within two drainage basins, the Roch basin (25.8km^2) and the Treffgarne basin (>200km^2).

The Roch basin to the west is smaller and stretches from Trehale Farm in the north to its outflow at Newgale beach in the southwest.

The Treffgarne area is larger and encompasses a large portion of north Pembrokeshire draining into the Western Cleddau. All grains panned in the Treffgarne basin (in 2022) come from tributaries draining from the Roch Rhyolite or neighbouring units, so most of the basin which drains rock units elsewhere is irrelevant for the project. Therefore, a new basin defined by tributaries draining the rhyolite was created with an inflow in the north at Wolf's Castle and an outflow in the south at the confluence of the Camrose Brook with the Western Cleddau. This 'new' basin is 38.4km^2.

4.2 Spatial Analysis of Panning Locations

4.2.1 Treffgarne Basin

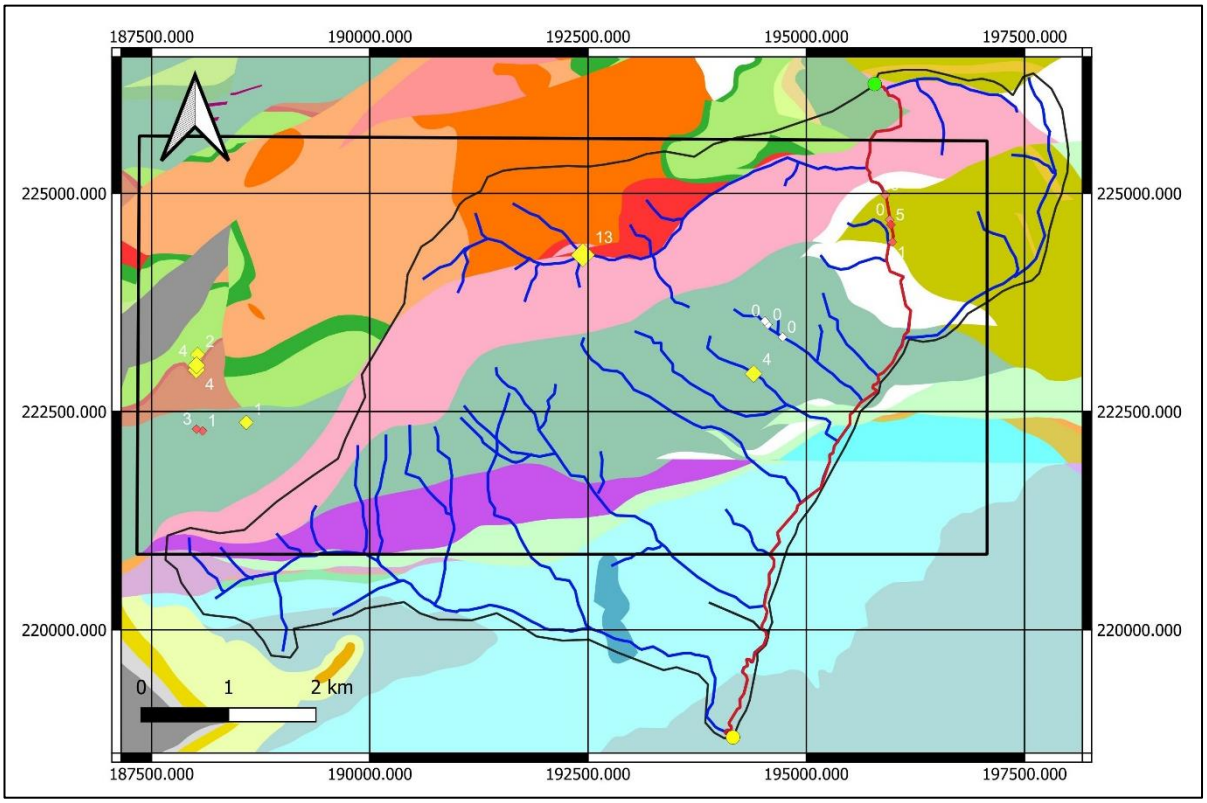


Figure 32. Treffgarne Basin defined for the Project with 2021 and 2022 panning locations (British Geological Survey, 2022) (Legend on page 48)

Spatial analysis shows grains panned during 2022 only come from rivers draining the Roch Rhyolite or neighbouring units in the Mountain Water to Mount Joy region, so the variation of possible source rocks is small.

Grains panned during 2021 are located in the Western Cleddau and may have another source further upstream, however, only grains from 2022 were analysed for the project.

Unfortunately, samples were only collected in a few locations, so with current data it is impossible to see any spatial trends.

Figure 33. Legend for Figure 32 and Figure 34 (EDINA, 2023)

4.2.2 Roch Basin

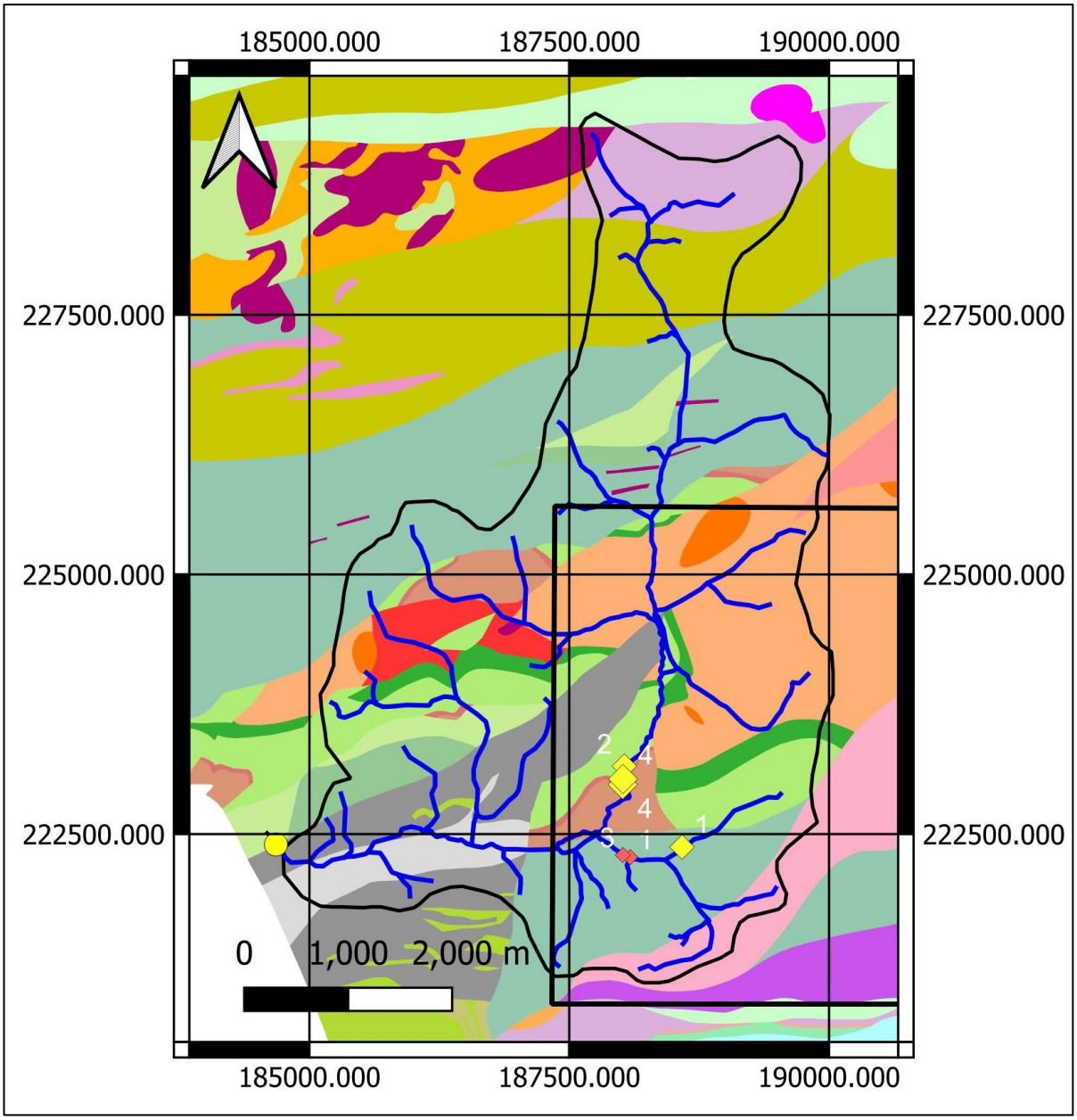


Figure 34. Roch Basin defined for the Project with 2021 and 2022 panning locations

(British Geological Survey, 2022) (Legend on Page 48)

Analysis of the Roch Basin shows similar spatial patterns, with all panned gold possibly originating from the Rhyolite in the south-east of the basin. However, grains panned in the Brandy Brook (the main river) may have come from further up the basin, possibly from near Llandeloy in the north, suggesting more than one type of alluvial gold.

4.2.3 Clarbeston Basin

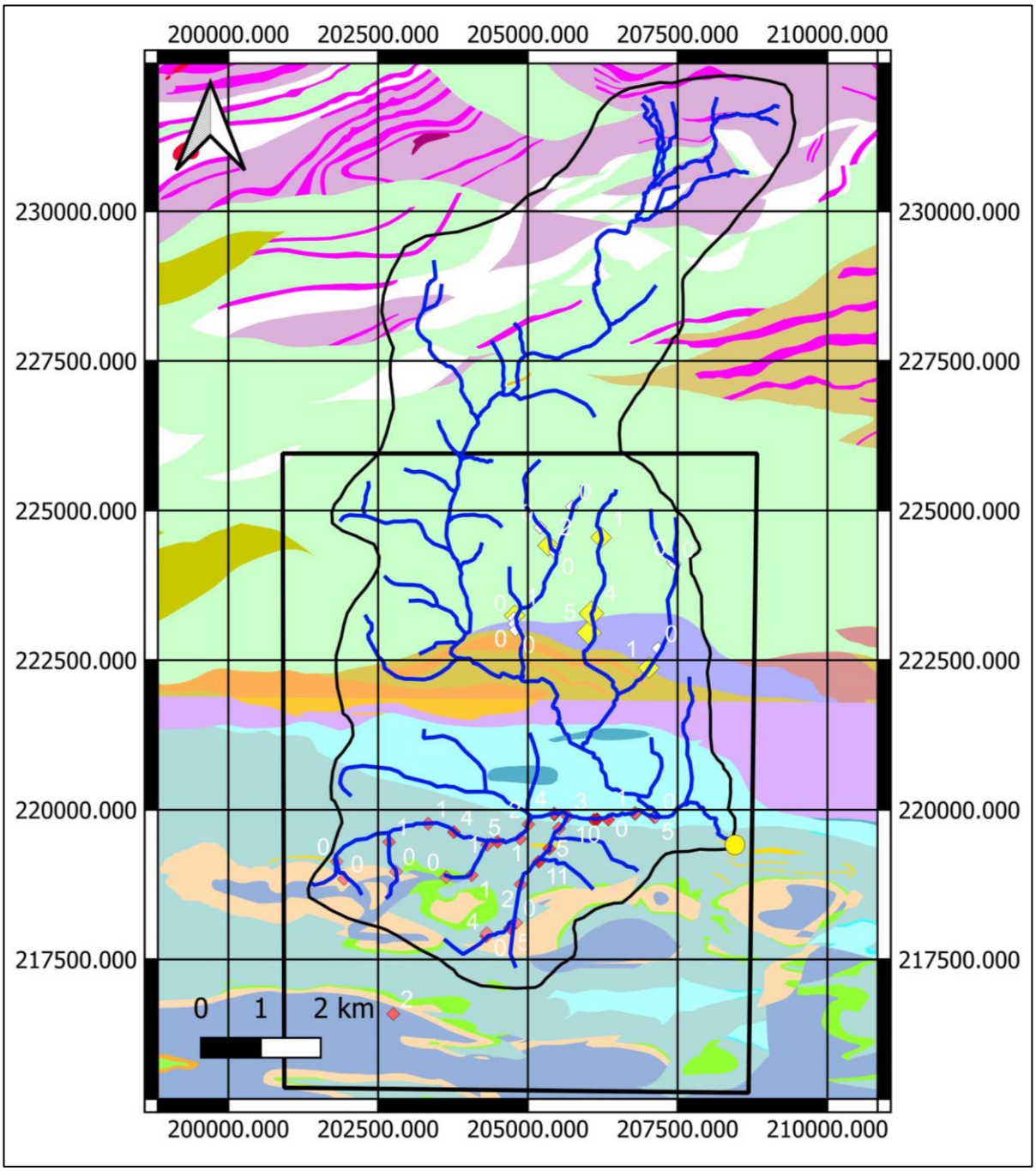


Figure 35. Clarbeston Basin defined for the Project with 2021 and 2022 panning locations

(British Geological Survey, 2022) (Legend on page 51)

Spatial analysis of the Clarbeston Basin shows all sites panned in 2021 were from south Clarbeston, whereas sites panned in 2022 (analysed within this project) come from mid-Clarbeston. Spatial variation between sites is limited as only six sites panned contained gold, and all are situated above either shale or mudstone units.

Many sites panned show no gold grains, however, this is likely due to poor choice of gold trap and has no reflection on a lack of gold in the river or change in bedrock geology, so again there is no obvious spatial variation.

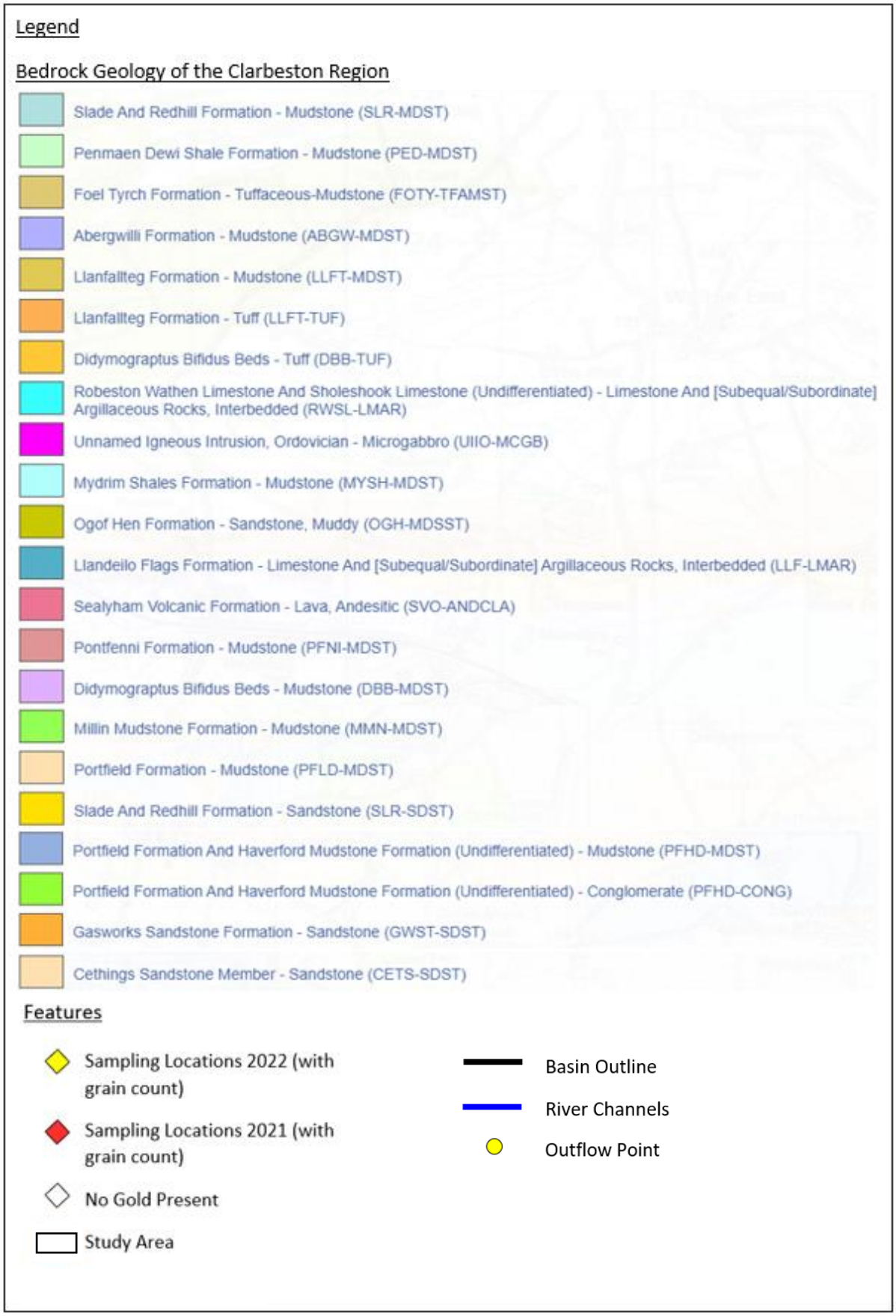


Figure 36. Legend for Figure 35. (EDINA, 2023)

4.3 Grain Morphology

4.3.1 Statistical Analysis

All statistical results for spatial analysis can be found in Appendix 5. and 6.

4.3.1.1 Treffgarne

4.3.1.1.1 Grain Size

Of the 59 grains collected in the Treffgarne region, 49 underwent statistical analysis. This showed the average grain size was 0.30mm by 0.20mm and a mean surface area of 0.078mm^2

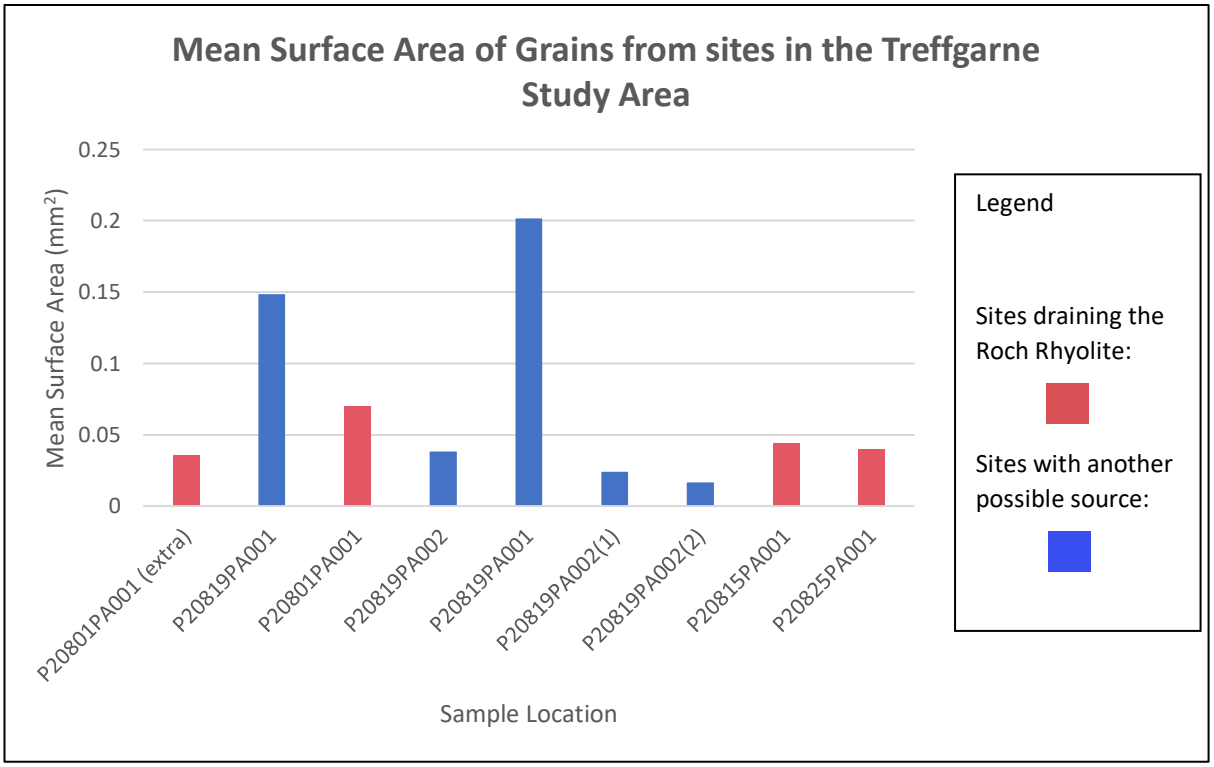


Figure 37. Mean Surface Area of Grains from sites in the Treffgarne Study Area

When the average surface area for each sample location was plotted, it shows the grains from sites draining directly from the Roch Rhyolite are smaller and more uniform on average, than sites with another possible source.

Table 8. Summary Statistics for Treffgarne Gold Grains

	Length (mm)	Width (mm)	Surface Area ($mm^{2)}$	Sphericity	Roundness
Max	0.9	0.65	0.585	0.9	0.9
Min	0.1	0.08	0.008	0.2	0.1
Mean	0.303125	0.198541667	0.078010417	0.525	0.410416667
Median	0.29	0.17	0.04005	0.5	0.35
Mode	0.3	0.1	0.02	0.5	0.5
Range	0.8	0.57	0.577	0.7	0.8
S.D	0.169619803	0.126103463	0.104562666	0.186227955	0.199189403

4.3.1.1.2 Krumbein Score

The Krumbein score for Treffgarne shows the average grain has a low to moderate sphericity and roundness, possibly indicating low levels of transport within the river system and a proximity to the source. However, the range for sphericity and roundness indicates some grains may have travelled much further and are possibly of a different origin.

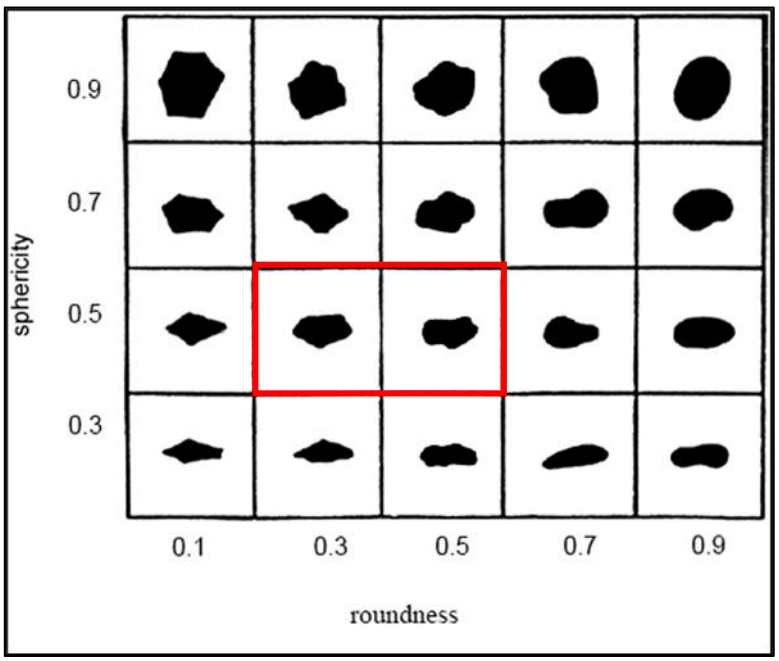


Figure 38. Krumbein Grain Scale chart with average Treffgarne grain shape outlined in red

4.3.1.1.3 Correlation Matrix

A correlation matrix was then plotted to show the Pearson correlation coefficient between different variables used to investigate grain morphology.

This showed a strong positive correlation between corresponding variables like length and width, and sphericity and roundness, however, a much weaker correlation between the remaining pairs of variables.

Table 9. Correlation Matrix for the Treffgarne Study Area

	Length	*Width*	*Sphericity*	*Roundness*
Length	1	Strong	Weak	Weak
Width	0.851196095	1	Weak	Weak
Sphericity	-0.187756763	0.117554057	1	Strong
Angularity	-0.342301532	-0.277214665	0.623763996	1

Table 9a. Legend for Table 9.

Correlation Strength	Positive	Negative
Perfect	0.9 to 1	-0.9 to -1
Strong	0.5 to 0.9	-0.5 to -0.9
Weak	0.1 to 0.5	-0.1 to -0.5
Uncorrelated	0 to 0.1	0 to -0.1

4.3.1.1.4 Normality Test

The normality of each dataset calculated using Anderson-Darling. Table 10. shows the p(normal) for each set is <0.05 and therefore not normal, which is to be expected again due to the large spatial distribution of sample locations, which would result in different environments of transport and therefore different morphologies (on a local scale).

Table 10. Anderson-Darling Test results for Treffgarne

	Sphericity	Roundness	Surface Area (mm^2)	Length (mm)	Width (mm)
Anderson-Darling A	1.705	1.584	5.255	1.233	2.768
p(normal)	0.0001944	0.0003895	3.51E-13	0.002922	4.45E-07

4.3.1.2 Clarbeston

4.3.1.2.1 Grain Size

Analysis of grains from Clarbeston however, shows the average grain size of 0.54mm by 0.30mm is larger than Treffgarne, with the mean surface area of 0.19mm^2 considerably larger. These results show the type of alluvial grain may be different indicating a different source to Treffgarne. However, 116 grains were analysed for Clarbeston, so the sample size was considerably larger making results more accurate.

Table 11. Summary Statistics for Clarbeston Gold Grains

	Length (mm)	Width (mm)	Surface Area (mm$^{2)}$	Sphericity	Roundness
Max	1.7	0.9	1.24	0.9	0.9
Min	0.15	0.1	0.02	0.1	0.1
Mean	0.54	0.3008621	0.1915733	0.5206897	0.4508621
Median	0.5	0.3	0.129	0.5	0.5
Mode	0.5	0.3	0.075	0.5	0.5
Range	1.55	0.8	1.22	0.8	0.8
S.D	0.264150813	0.143366778	0.20304369	0.187207043	0.214879416

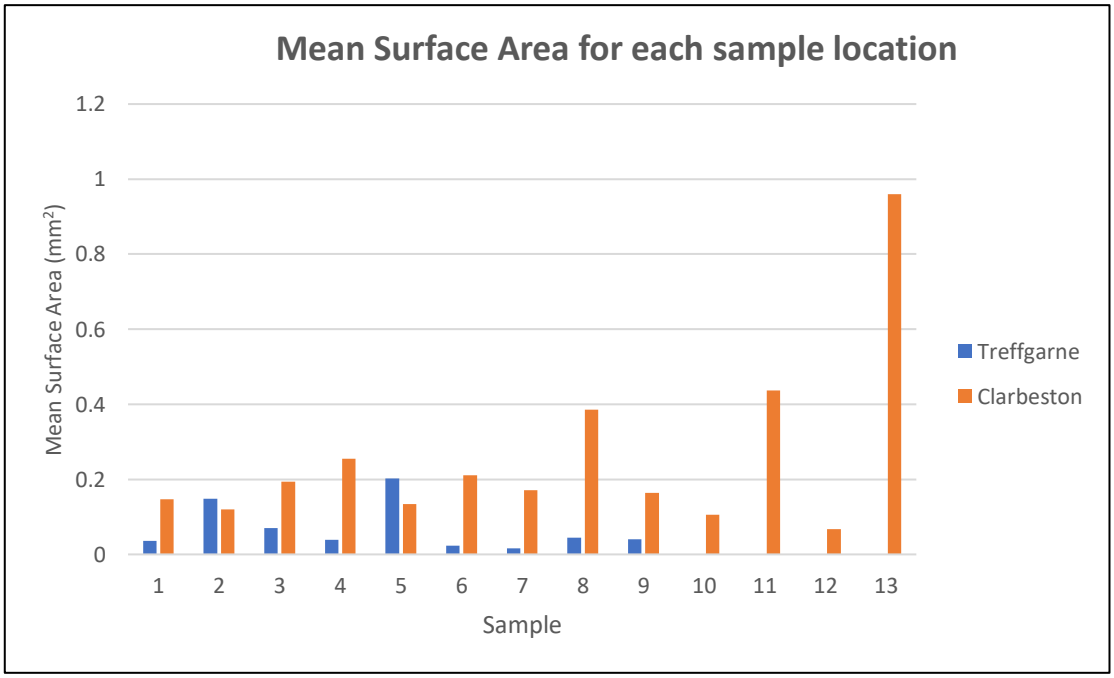


Figure 39. Mean Surface Area for Each Sample Location

This shows the mean surface area of grains in Clarbeston is larger than Treffgarne on average

4.3.1.2.2 Krumbein Score

The Krumbein values for Clarbeston also show the same average as Treffgarne indicating on average a short transport distance However, as Table 11. shows there is a large range in sphericity and roundness indicating some grains are very local, however some may have travelled much further distances.

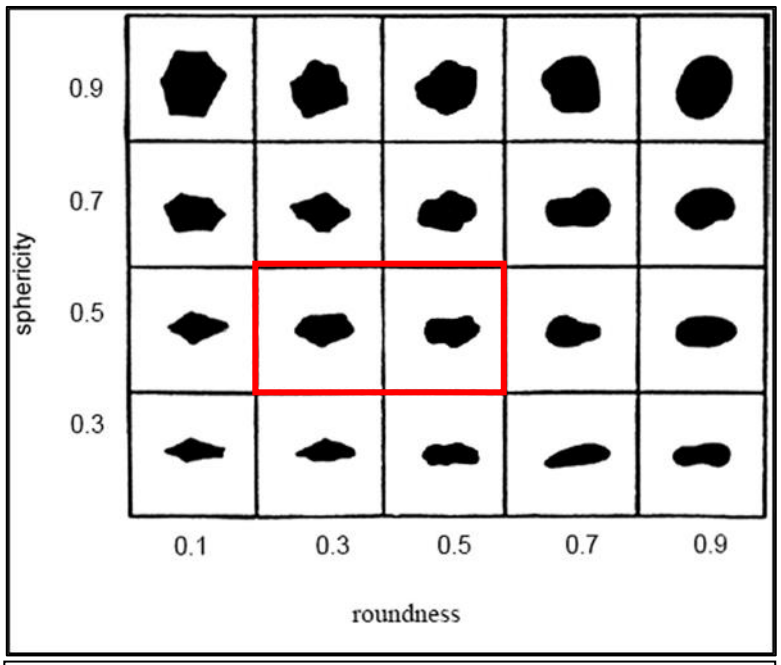


Figure 40. Krumbein Grain Scale chart with average Clarbeston grain shapes outlined in red

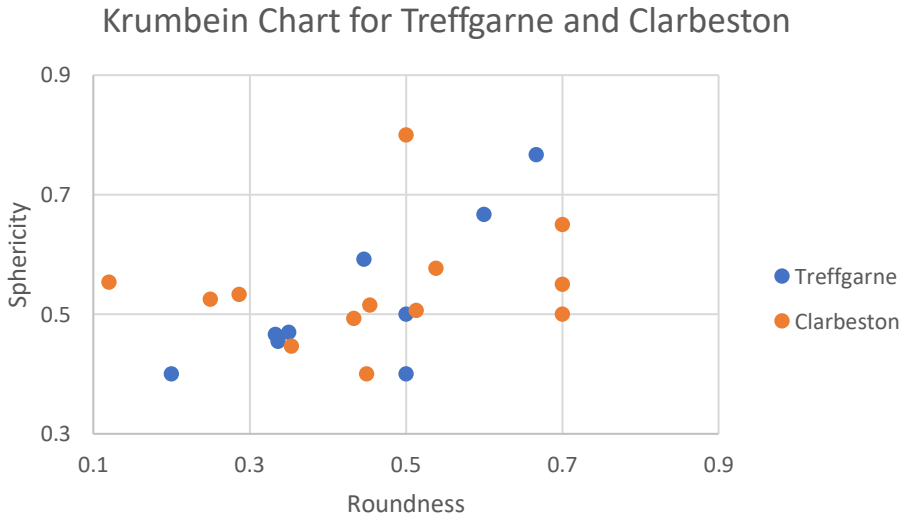


Figure 41. Treffgarne and Clarbeston Krumbein Chart

When Krumbein values for sample sites in both study areas are plotted together, there is a clear spread of values, with no overall trend between both sites. Treffgarne may be interpreted as having a more positive correlation but overall shows very little trend

4.3.1.2.3 Correlation Matrix

The correlation matrix created for Clarbeston shows similar results to Treffgarne with overall weaker correlations, and with no correlation between Width and Sphericity.

Table 12. Correlation Matrix for the Clarbeston Study Area

	Length	*Width*	*Sphericity*	*Roundness*
Length	1	Strong	Weak	Weak
Width	0.775297595	1	Uncorrelated	Weak
Sphericity	-0.308079022	0.084215026	1	Weak
Angularity	-0.249254464	-0.331404809	0.289213719	1

Table 12a. Legend for Table 12.

Correlation Strength	Positive	Negative
Perfect	0.9 to 1	-0.9 to -1
Strong	0.5 to 0.9	-0.5 to -0.9
Weak	0.1 to 0.5	-0.1 to -0.5
Uncorrelated	0 to 0.1	0 to -0.1

4.3.1.2.4 Normality Test

The normality of the data from Clarbeston shows the data is not normal, and to a greater extent than the p(normal) calculated for Treffgarne. This was expected due to the larger sample size.

Because both datasets are non-parametric, this enabled a Kruskal-Wallis test to be carried out, which showed there was a significant difference between the sample medians.

This is evidence to support the source of the gold likely being different for each site.

Table 13. Anderson-Darling Test results

	Sphericity	Roundness	Surface Area (mm^2)	Length (mm)	Width (mm)
Anderson-Darling A	4.202	3.098	9.595	2.682	3.374
p(normal)	1.66E-10	8.11E-08	2.33E-23	8.43E-07	1.72E-08

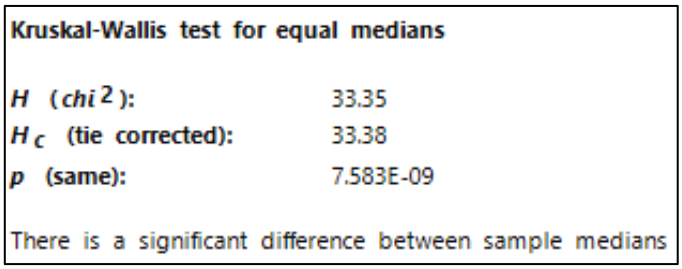


Figure 42. Kruskal-Wallis Test results carried out in PAST 3.01

4.3.2 Reflective Light Microscopy

4.3.2.1 Treffgarne

- No inclusions were identified in grains
- Rims couldn't be identified easily due to the nature of polishing
- No specific grains of interest identified

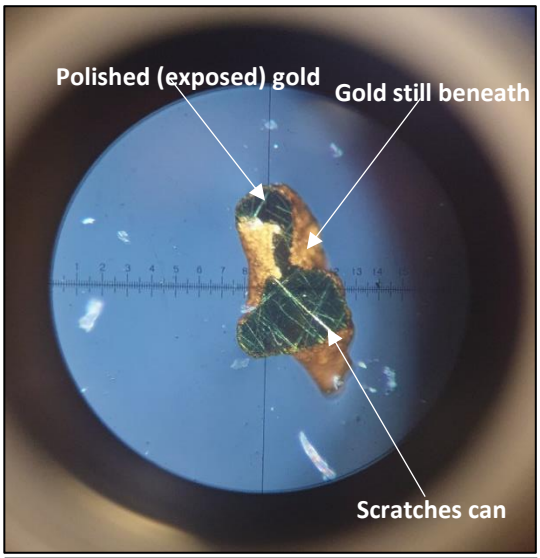


Figure 43. Grain from Treffgarne showing gold exposed by polishing (Isotropic) versus gold beneath the resin (gold colour)

4.3.2.2 Clarbeston

- Some possible inclusions were identified
- Rims appeared larger but hard to distinguish between rim or unexposed gold
- Some grains identified for further SEM analysis

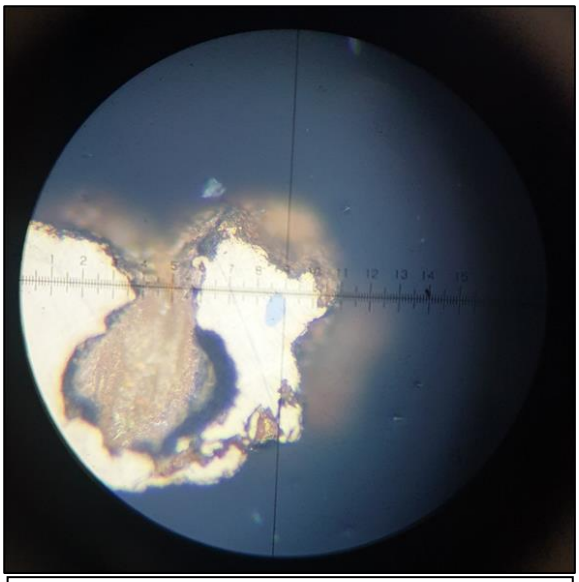


Figure 44. Clarbeston Grain showing a possible grey inclusion to the lower left of the crosshairs

4.3.3 Spatial Analysis of Grain Morphology

The mean surface area and Krumbein values for each panning location were then plotted over a basemap to visualise spatial trends in grain morphology over the basins.

Analysis of the maps has shown there is no spatial trends between any of the factors used to investigate grain morphology. However, this is likely due to most panning locations being in close proximity to another and an overall low number of locations.

The only possible spatial trend surrounds the rhyolite, however, only three locations were panned around the rhyolite. Spatial coverage in Treffgarne is too poor and so insufficient for an accurate spatial analysis, and so cannot be compared to Clarbeston.

Spatial analysis was therefore not included in any detail in this report as it showed no significant trends and was not useful for comparing morphology or geochemistry of the two regions.

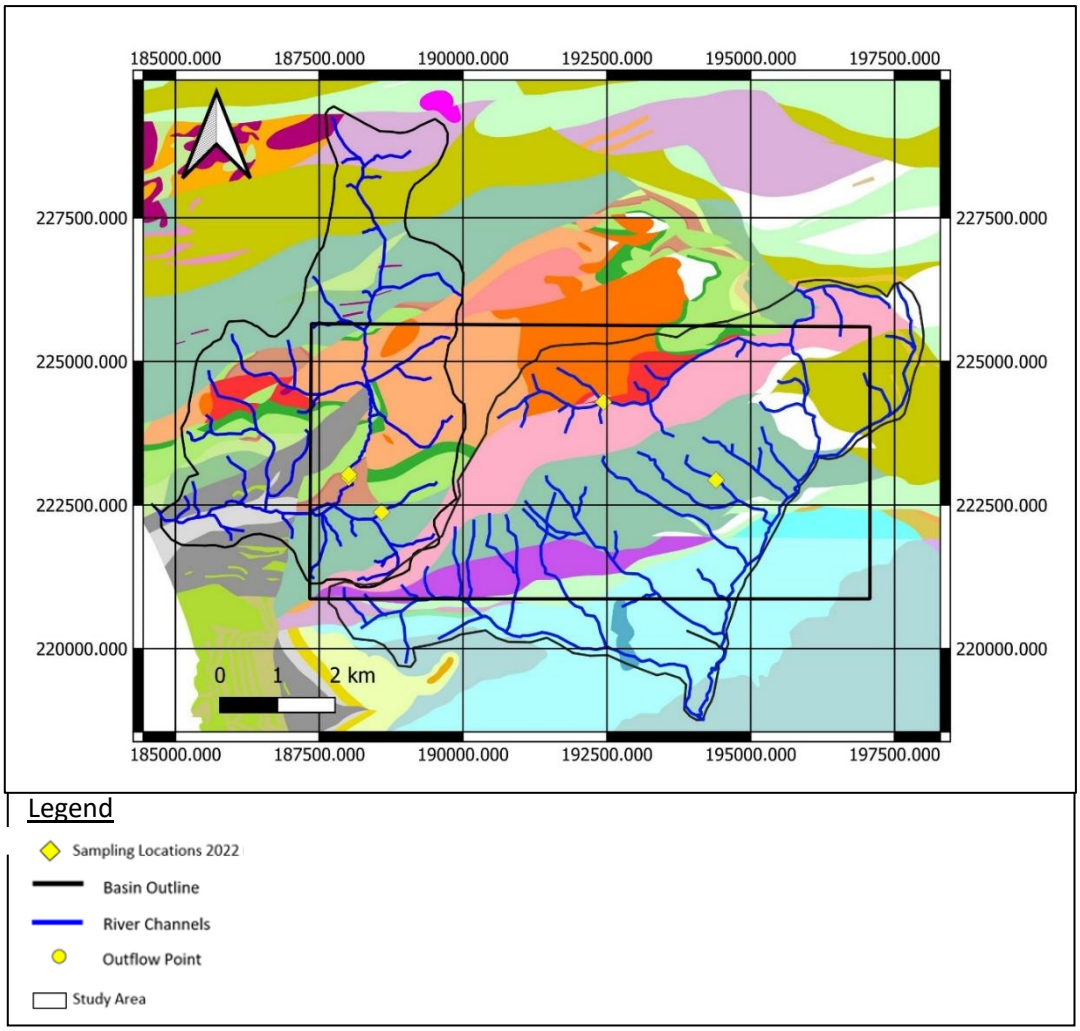


Figure 45. Panning Locations within the Treffgarne Study Area

This figure shows that of the nine locations sampled that contained gold, they only represent four locations within the study area. Therefore, spatial analysis of morphological characteristics cannot be carried out with any accuracy.

4.4 Grain Geochemistry

4.4.1 Treffgarne

SEM analysis of grain geochemistry was carried out on 31 grains from Treffgarne. This produced 107 different spectrums of elemental composition for core, rim and inclusions.

The compositions focused on atomic weight percentages (At.%) of gold and silver, with other elements in trace amounts.

4.4.1.1 Grain Rims

Analysis of the gold and silver weight percentages of grain rims, shows a weak negative correlation, with the majority of rims being heavily depleted in silver. Some grains still show an enrichment in silver, with 13.7% of the rims showing greater than 10 At.%. However, these outliers may also represent inclusions or cores misidentified as rims.

However, visual analysis of Treffgarne grain rims shows many grains lack clearly defined rims, which could indicate most grains have undergone short transport distances; this may however be due to not all rims being exposed during polishing.

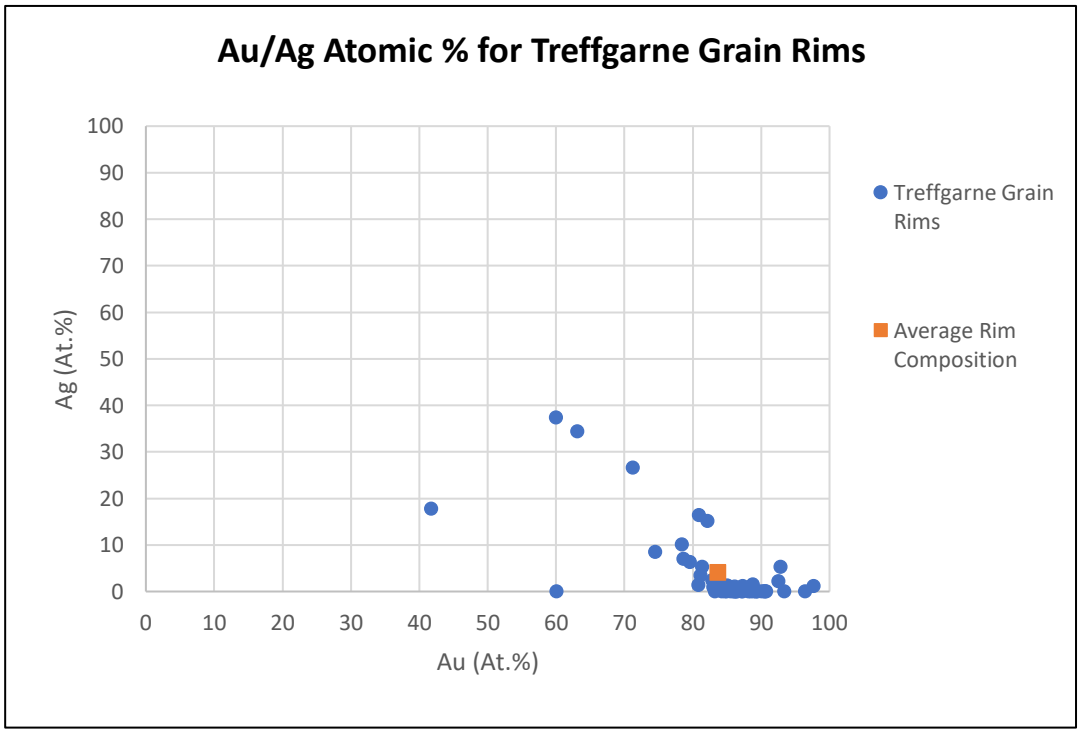


Figure 46. Au/Ag Atomic % for Treffgarne Grain Rims

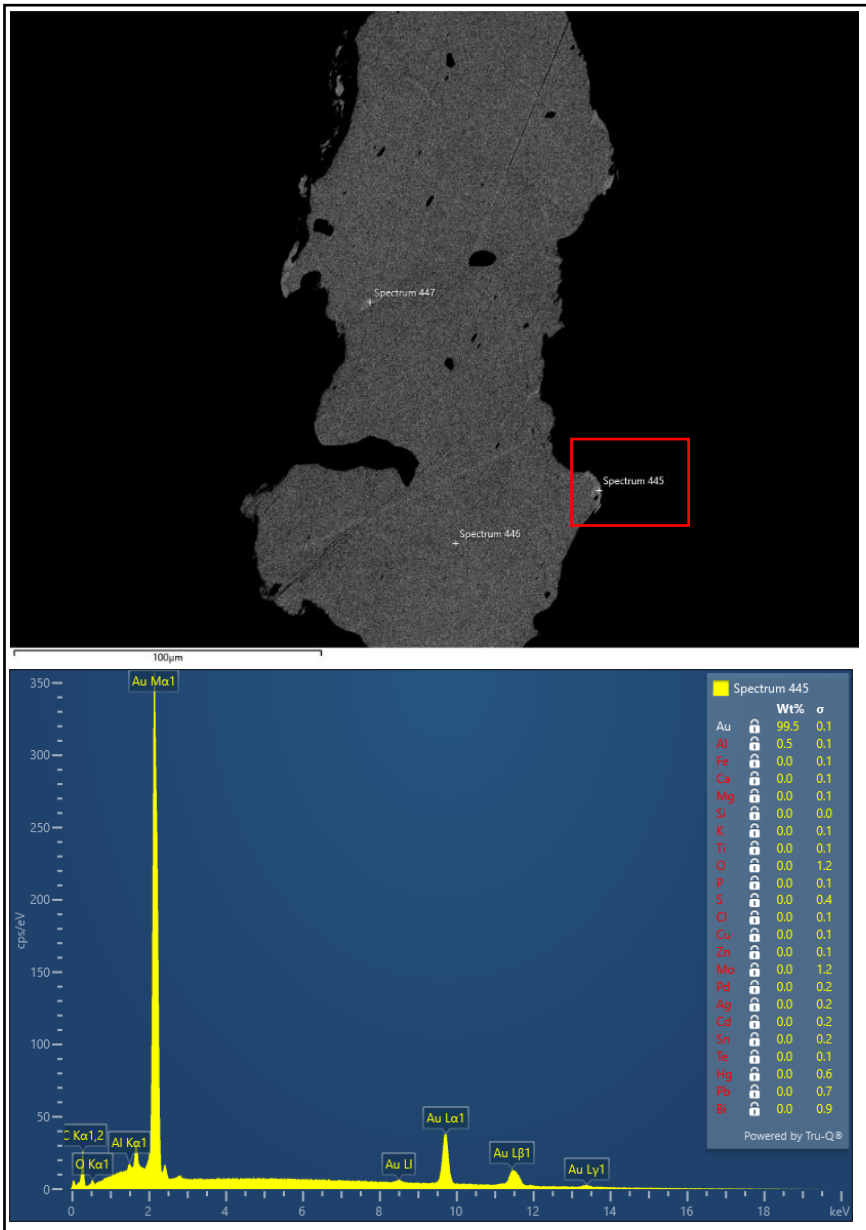


Figure 47a. Electron Image 99 (Top Left) This grain appears to lack any significant rims; however, analysis of Spectrum 445 shows a complete depletion in Ag (0%) compared to a core value of 14.53 At.% Ag (Spectrum 446).

This indicates the grain has undergone fluvial transport and the lack of a visible rim surrounding the whole grain does not indicate short transport distances.

Figure 47b. Spectrum 445 (Bottom Left)

This elemental spectrum for Spectrum 445 (grain core) shows the elements present with a significant depletion in Ag.

Figure 47. Electron Image 99 with Spectrum 445 (grain rim)

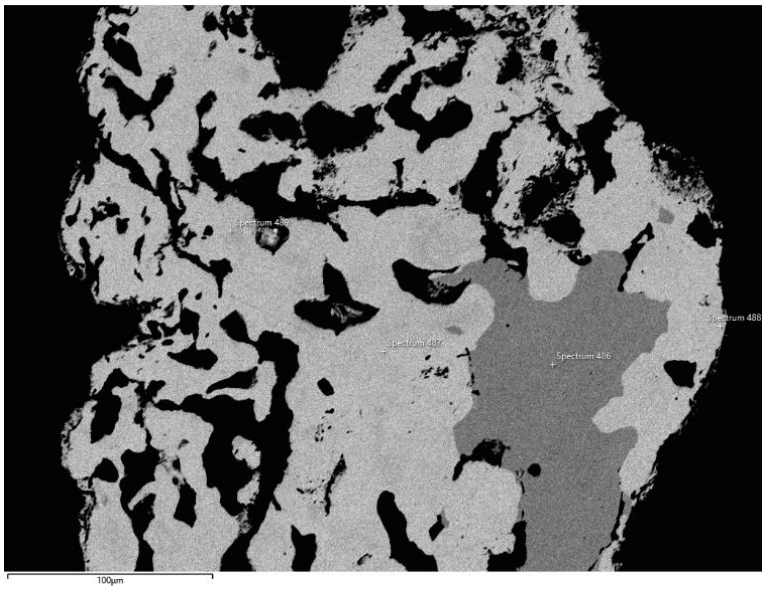


Figure 48a. Electron Image 114 (Top Left)

This grain shows a significant depletion in Ag throughout the entire grain, with only a small core present (darker grey).

This implies the grain has been transported a very long distance, which is possible evidence for it being of a different deposit type than Electron Image 99.

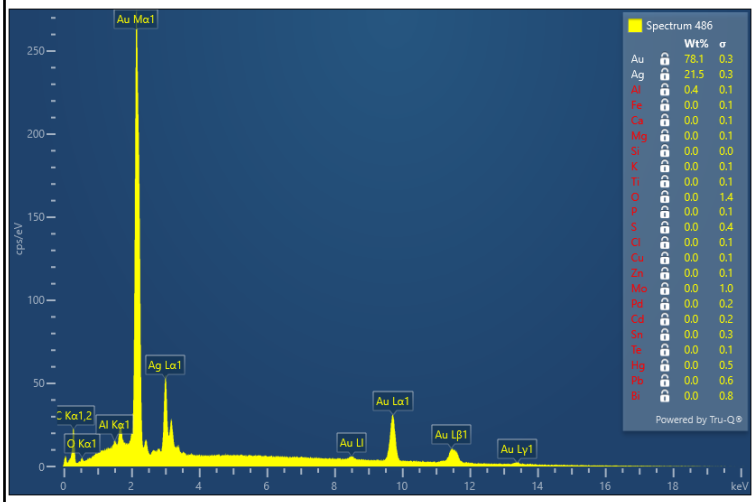


Figure 48b. Spectrum 486 (Middle Left)

This spectrum for the grain core shows a 32.7 At.% Ag composition, which is significantly higher than the Ag value of the core in Electron Image 99 of 14.5 At.% Ag. This is strong evidence that each grain has a different source within the Treffgarne study area.

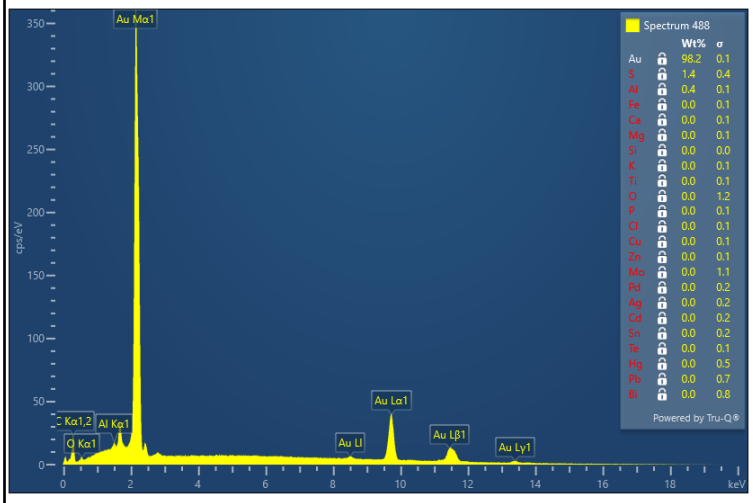


Figure 48c. Spectrum 488 (Bottom Left)

The spectrum for the grain rim shows a complete depletion in Ag, indicating again this grain has travelled significantly further than the grain in Electron Image 99.

Figure 48. Electron Image 114 with Spectrum 486 (grain core) and Spectrum 488 (grain rim)

4.4.1.2 Grain Cores

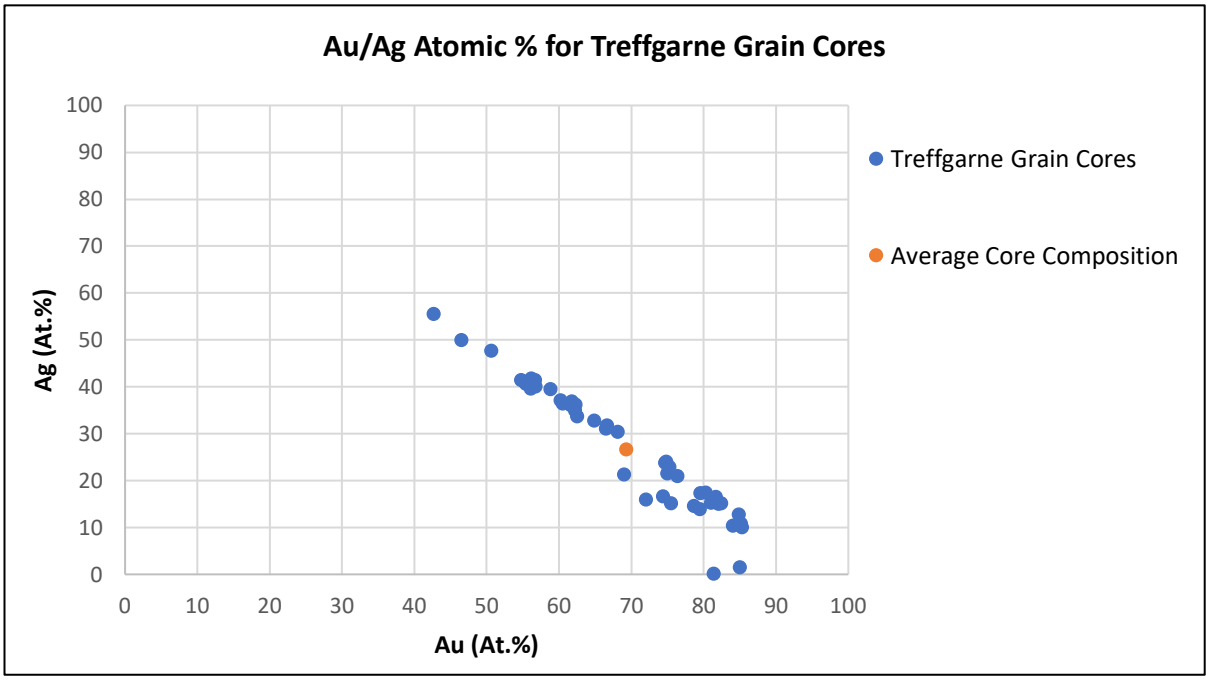


Figure 49. Au/Ag Atomic % for Treffgarne Grain Cores

Analysis of Treffgarne grain core compositions show there is a strong negative correlation as when Au increases, Ag decreases. However, there is a large spread of compositions with some cores containing up to 85 At.% Au with very little Ag, and some grains with 42.8 At.% Au and 55.4 At.% Ag, which indicates an entirely different grain composition, which shows there is a likelihood of different mineralisation processes occurring within the Treffgarne area.

Table 14. Anderson-Darling test carried out on the Au and Ag composition of grain cores within the Treffgarne study area

	Au	**Ag**
Anderson-Darling A	0.7947	0.8016
p(normal)	0.03645	0.03503

Statistical analysis of gold and silver compositions shows both datasets have a p(normal) less than 0.05 and so differ from a normal distribution.

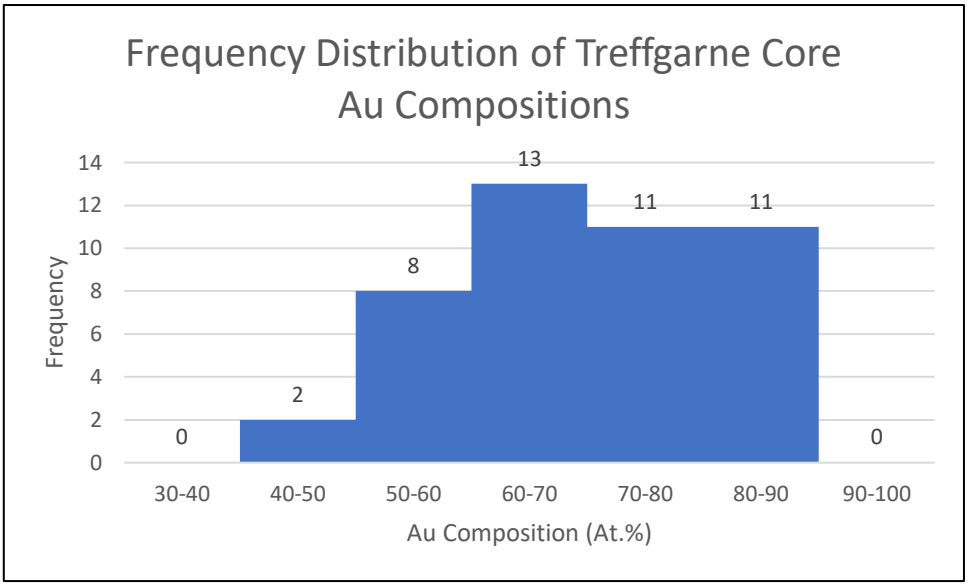


Figure 50. Frequency Distribution of Treffgarne Core Au Compositions

The non-normal distribution of the data can be seen here with a negative skewness.

4.4.1.3 Inclusions

Overall, grains from Treffgarne showed 23 elements (trace and major) which can be found in Appendix 10. Some elements like Aluminium were ignored as it was due to the use of Aluminium Oxide during polishing.

From the SEM, 11 elemental spectrums for inclusions were produced. Overall, Treffgarne grains showed very little inclusions which was expected after reflective light microscopy.

Notable inclusions include Silica, Iron, Potassium and Lead, however, due to the small number of inclusions analysed, it is impossible to carry out and statistical or spatial analysis of the results with any accuracy.

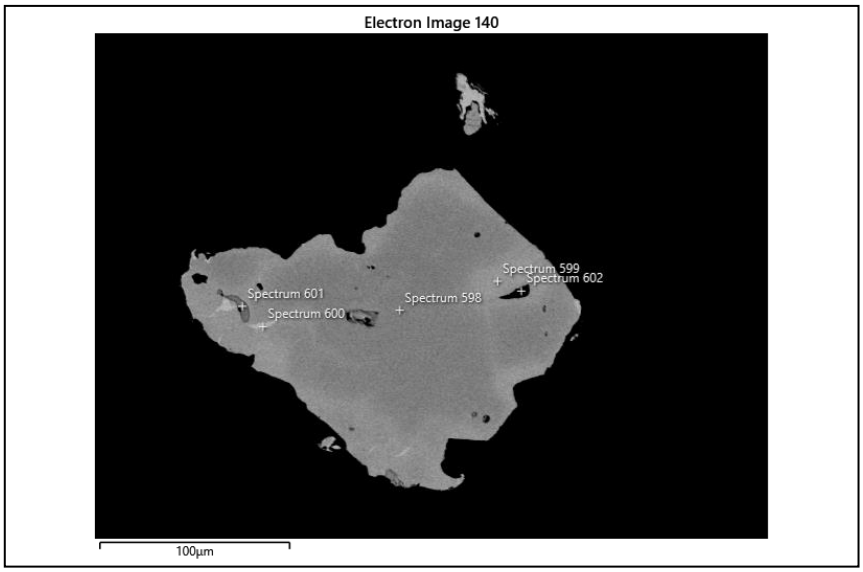


Figure 51. Electron Image 140

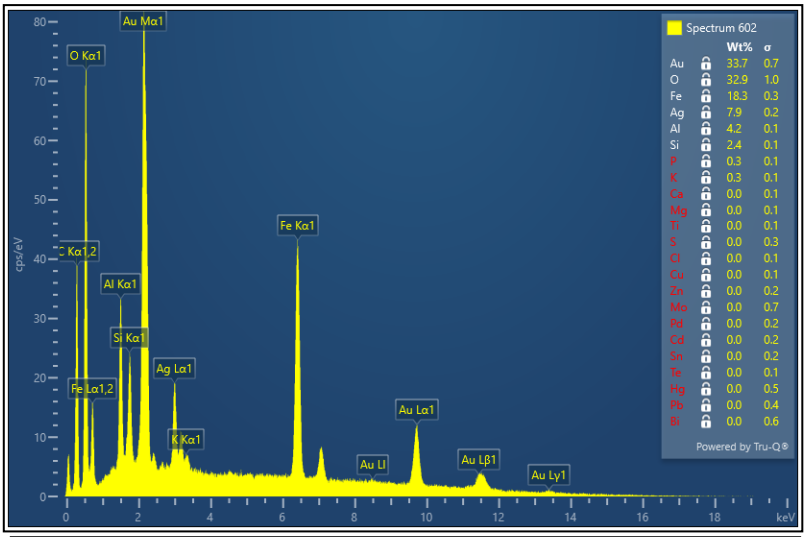


Figure 52. Spectrum 602 (Inclusion) from Electron Image 140, showing high levels of Fe, Si, O, and K

4.4.2 Clarbeston

Within the Clarbeston study area, 80 grains were analysed using the SEM to produce 362 elemental spectrums.

4.4.2.1 Grain Rims

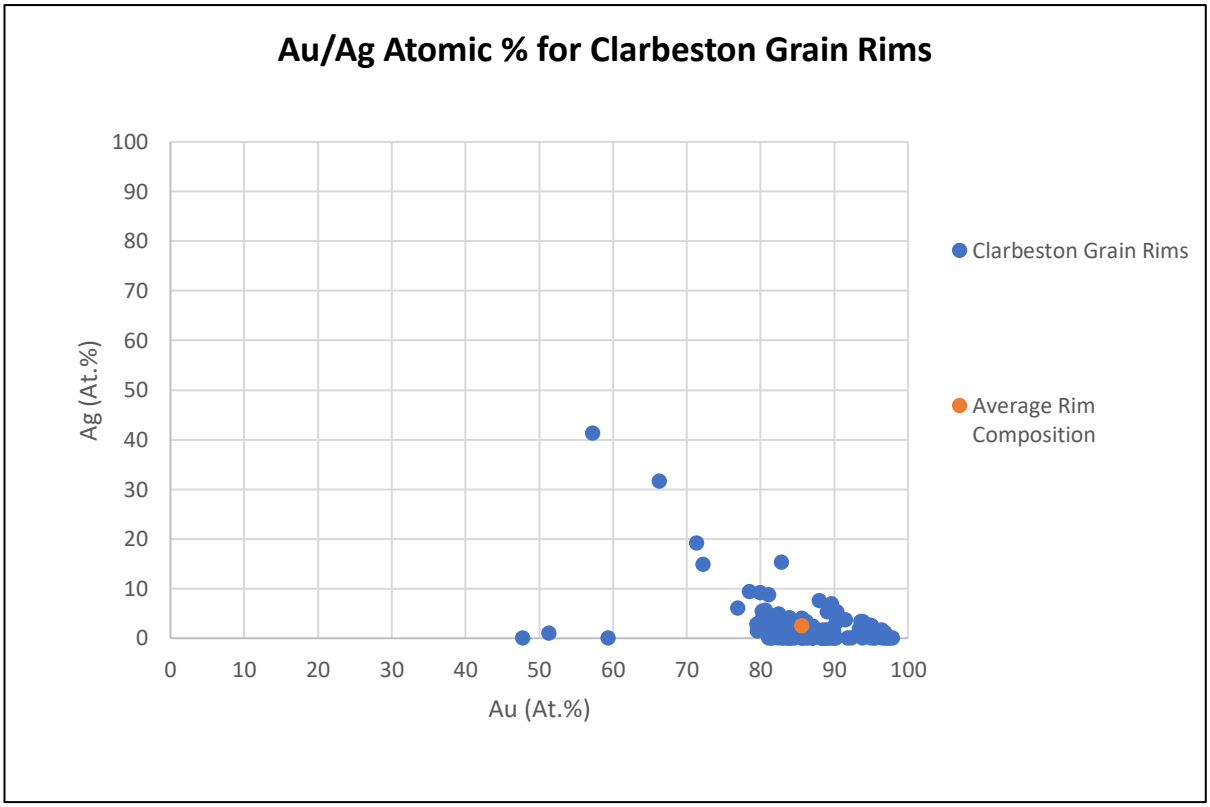


Figure 53. Au/Ag Atomic % for Clarbeston Grain Rims

Analysis of grain rim compositions within Clarbeston shows overall the rims are depleted in Ag with some outliers showing little depletion in Ag and some showing a significant depletion in Au.

This could indicate different types of gold; however, it is possibly due to misidentification of parts of the grains.

Compared to Treffgarne, the rim compositions show a similar spread, however, there are a lot more data points for Clarbeston.

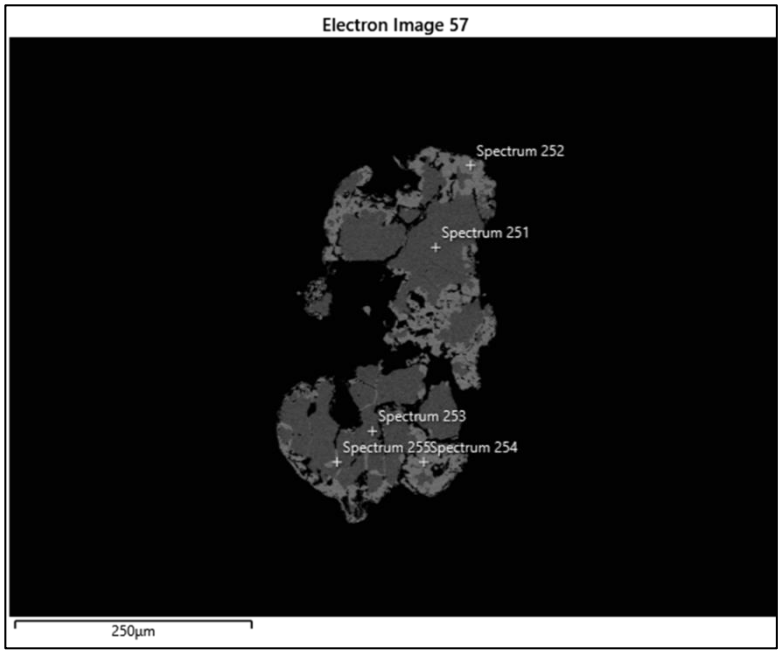


Figure 54a. Electron Image 57 (Top Left)

This shows a typical Clarbeston grain.

Grains from Clarbeston on average show a larger and more prominent rim than grains from Treffgarne, this may indicate a further transport distance.

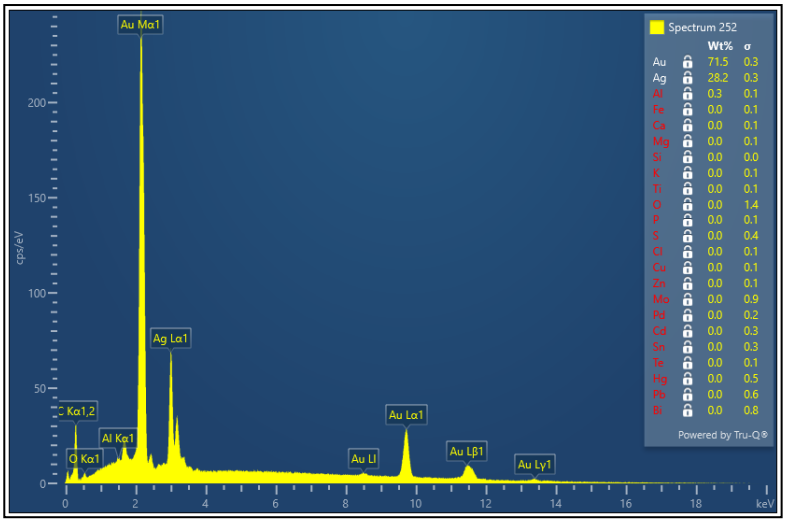


Figure 54b. Spectrum 252 (Middle Left)

This elemental spectrum shows part of the grain rim isn't depleted in Ag, which would possibly indicate short transport distances, however, the composition varies between different sections of the rim.

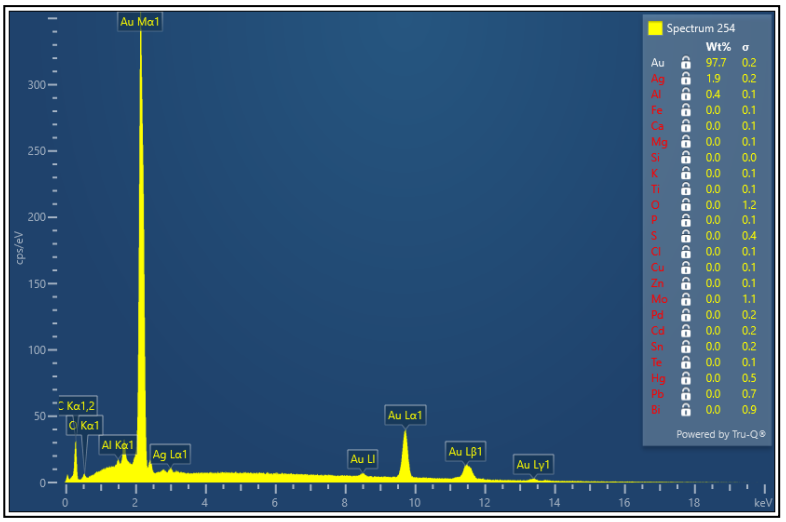


Figure 54c. Spectrum 254 (Bottom Left)

Spectrum 254 comes from another section of the same rim; however, it shows a significant depletion in Ag.

Figure 54. Electron Image 57 with Spectrums 252 and 254 (grain rims)

4.4.2.2 Grain Cores

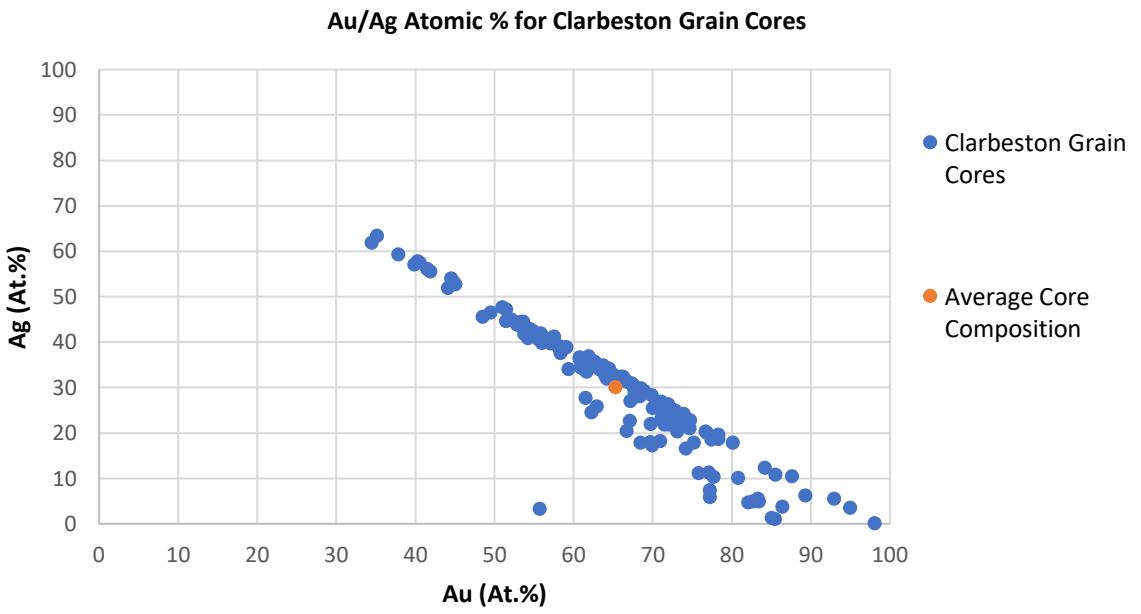


Figure 55. Au/Ag Atomic % for Clarbeston Grain Cores

Clarbeston grain core compositions also show a strong negative correlation between Au and Ag. However, the spread of grain compositions is much larger, and the data could indicate multiple sources of gold based on these compositions. The Ag content of the grain cores on average is higher than Treffgarne which is possible evidence that some of the gold has a different source.

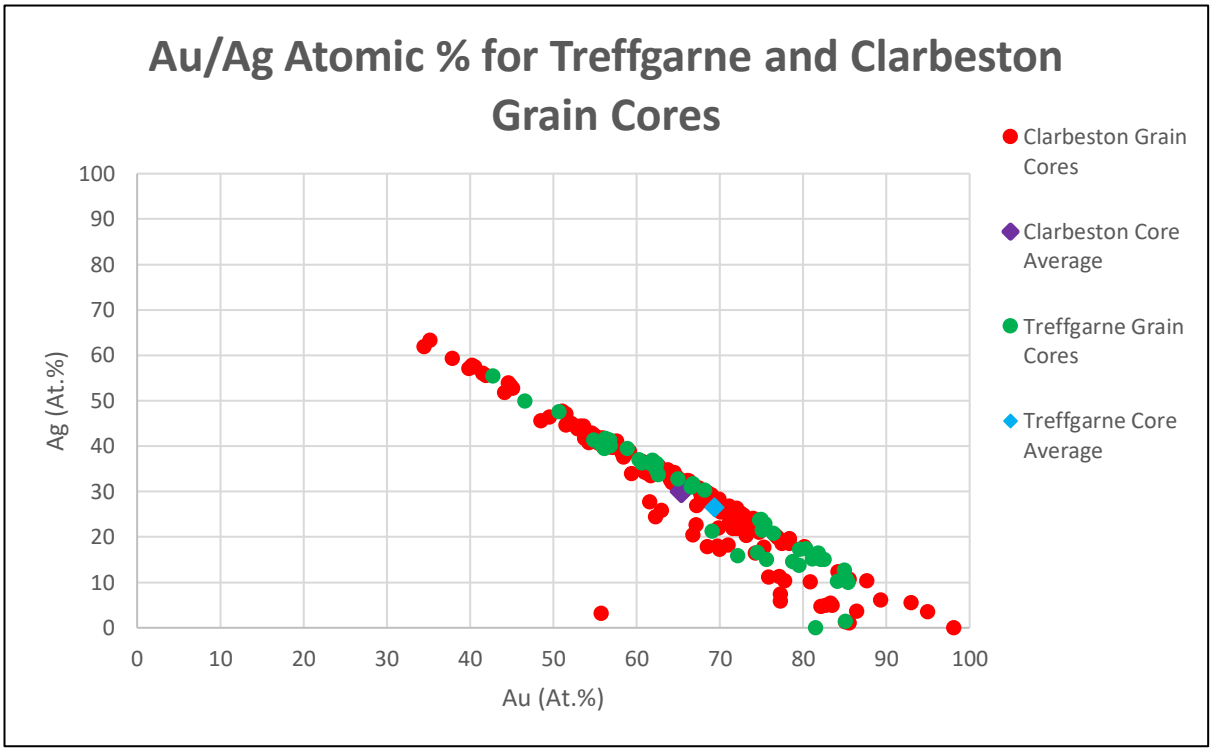


Figure 56. Au/Ag Atomic % for Treffgarne and Clarbeston Grain Cores

This figure shows the data for Clarbeston has a larger spread which could indicate the source of gold is different from Treffgarne. This spread may also show that there is more than once source within Clarbeston.

The mean core compositions plot in a similar place, however, this doesn't necessarily indicate the same type of gold.

Core values are the most useful for comparison as these reflect the internal composition of gold at the source without alteration due to transport (like the rims).

Table 15. Anderson-Darling test carried out on the Au and Ag composition of grain cores within the Clarbeston study area

	Au	**Ag**
Anderson-Darling A	0.6668	0.4412
p(normal)	0.0793	0.2842

Statistical analysis of Clarbeston core compositions, however, shows the p(normal) for Au and Ag is greater than 0.05 and therefore the data is normal.

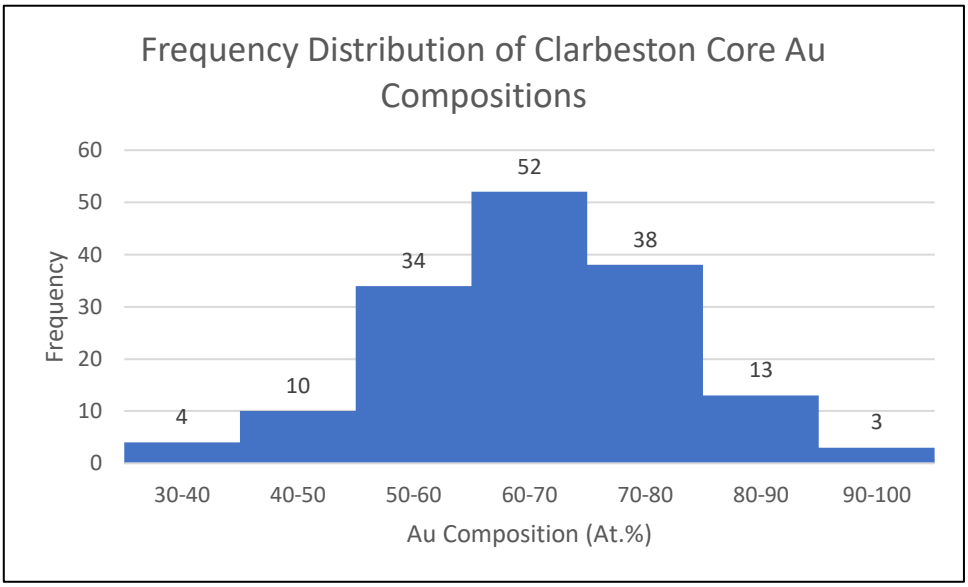


Figure 57. Frequency Distribution of Clarbeston Core Au Compositions

Clarbeston shows a normal distribution which is clearly seen in this figure.

4.4.2.3 Inclusions

Compared to Treffgarne, grains from Clarbeston appear to have more inclusions. During analysis, 59 elemental spectrums were produced from inclusions in Clarbeston. However, a lot more grains were analysed from Clarbeston, so this is likely the reason for more inclusions.

The same elements occur, however, the main noticeable difference in compositions of grains is the much larger occurrence of Fe and Si in grains from Clarbeston. Again, this could be due to a different deposit or due to more grains being sampled in Clarbeston.

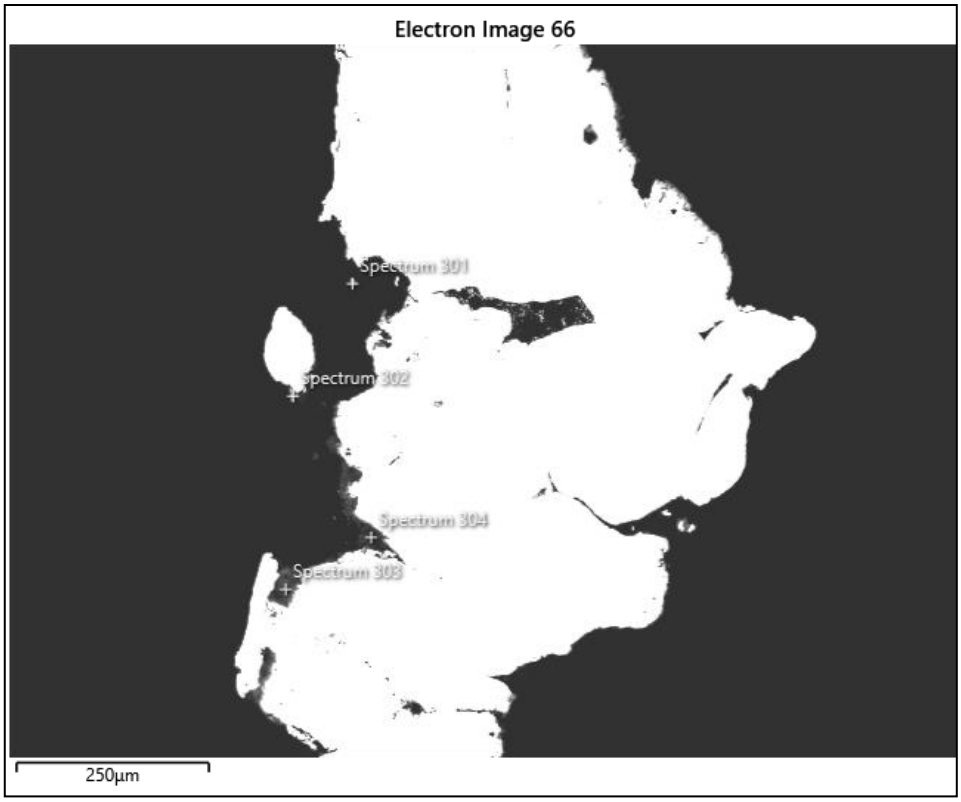


Figure 58. Electron Image 66

A high-contrast image was taken of this grain so inclusions of Silica and Iron (Spectrums 301, 302,303 and 304) could be seen more easily. This inclusion appears to be attached to the left side of the grain.

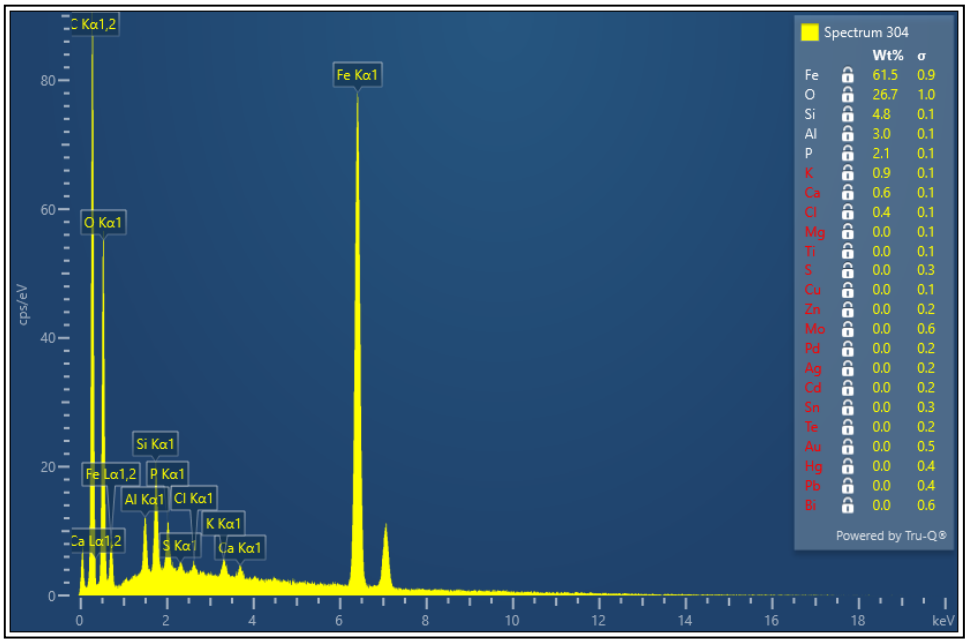


Figure 59. Spectrum 304

The inclusion shows very high levels of Fe, O, Si and P, however, contains no Au or Ag, so is different to the inclusion analysed in Treffgarne (4.4.1.3).

5. Discussion

5.1 Overview

SHG's primary aim was to explore the potential for gold in their license areas, and to map alluvial gold presence and anomalous soil geochemistry to allow for future drilling.

Due to the small size of the company, their resources have limited them to very minor gold grain analysis, and so their main focus was mapping anomalous soil geochemistry. So, this report (specifically grain core SEM data) will provide SHG with new and useful grain data.

At the beginning of the field season, this project was not initially considered, therefore, gold panning was not the main sampling conducted, and any panning conducted was only to prove presence of gold using the SHG official method, and not to collect many grains.

Therefore, this report has been limited by the lack time spent panning, lack of grains collected and the poor spatial coverage, so conclusions drawn from the data may not be truly accurate. Especially when comparing Clarbeston and Treffgarne due to the significantly larger sample size in Clarbeston.

Results for locality and grain numbers are not fully reliable due to the mistakes, misidentification of grains and GPS errors, so any statistical analysis is not one hundred percent accurate.

One objective of the project was to use grain morphology to determine transport distance of the grains in an attempt to locate the source region which is an important tool in gold exploration (Brian Townley, 2003). This stage proved very difficult and ultimately cannot be seen as truly accurate. The apparent randomness of morphological characteristics across both areas was hard to interpret spatially due to the small number of panning locations, although some theories have been stated.

5.2 Treffgarne

Statistical analysis of morphological features has shown that previous reports of gold presence in the Treffgarne region are likely correct in relating the majority of gold to the Roch Rhyolite Group and neighbouring units. However, when morphological features for different sites in Treffgarne are plotted separately (4.3.1.1.1), it shows that all sites that drain directly from the rhyolite and neighbouring units show a different morphology to sites that have another possible source.

This is because spatial analysis of panning locations has shown some sites in the Roch basin on the Brandy Brook have the potential to have travelled from the north of the basin near Llandeloy and so may not be sourced from the rhyolite.

Previous exploration by the BGS has identified the presence of Porphyry Copper mineralisation near Llandeloy (Slater, 1985), and so this may be a possible explanation for the variation in grain morphologies within the Treffgarne study area.

However, spatial analysis for Treffgarne has been very limited due to the nature of gold panning. Because SHG only sampled to prove the presence of gold and with their limited time panning, only four distinct locations were sampled. So, any apparent difference in morphology may not be accurate.

As mentioned in 5.1.1, studies of morphological characteristics associated with distance from source (such as The Antena District case) have shown they are a useful tool (Brian Townley, 2003), however, within Treffgarne, the proposed rhyolite source extends for around 3km, so relating morphology and transport distance is very hard as the major streams flow parallel to the rhyolite.

Geochemical analysis conducted with the SEM has shown grain rims are depleted in silver and so have likely undergone a fair transport distance. This contrasts to visual analysis with the SEM where most grains appear to lack defined rims, however, this is likely due to the polishing process. Because of this it is hard to say with any accuracy the transport distance travelled by the grains, although distinctly different sets of grains with small rims and large rims indicating two possible sources (supported by BGS literature).

Grain core analysis has shown a range of compositions within the known ranges for VMS and Porphyry deposits (Lui, 2021). This large spread indicates there is likely more than one mineralisation process occurring in Treffgarne.

Unfortunately, due to time constraints with SEM use there wasn't sufficient time to look for inclusions, so only 11 spectrums for inclusions were produced. These have shown some interesting elements present that aren't mentioned in any literature, however, an insufficient number of inclusions were found for statistical analysis.

5.3 Clarbeston

Grain morphology in Clarbeston has shown the sources of the two regions are likely different. The grains are larger on average supporting another possible source, however, as mentioned the sample size is considerably larger than Treffgarne.

However, grain shape within Clarbeston is considerably more varied and random than Treffgarne, appearing to show no trends. This possibly supports the theory different sources on a local scale (most likely glacially transported gold and orogenic gold).

Glacially transported gold undergoes rounding and bending during transport, with the extent used to calculate transport distance (M.B McClenaghan, 2018). Grains in Clarbeston appear to show both rounding and bending but not consistently enough to accurately attribute glacial transport to the cause.

Orogenic gold is also likely present as spatial analysis has shown all gold collected drains directly from Shale and Mudstone formations, known for hosting gold elsewhere in Wales.

Statistical tests have sown morphology is significantly different enough to conclude at least some grains from Clarbeston and Treffgarne likely have two separate sources.

Geochemical analysis again was brief due to time constraints. Rim analysis showed a similar trend to Treffgarne, however, visual analysis showed larger rims on Clarbeston grains indicating a larger transport distance.

Compared to Treffgarne, Clarbeston core compositions plot on a normal distribution, so cannot be compared statistically. However, when plotted together with Au vs Ag there is a considerable overlap indicating at least some grains have the same source composition. This could support the BGS theory that grains in Clarbeston have been transported from the west (near Treffgarne) so some

grains could be the same source. However, in general there is a difference between grains that likely indicates different sources.

Previous literature has proposed the source of gold in Clarbeston to be from granitic rocks further west (G E Norton, 2000). This supports the theory of glacially transported gold. However, geochemical analysis of all spectrums produced by the SEM has noted a lack of Mo and Sn which should be present if the gold is derived from an acid-granite source rock (G E Norton, 2000).

6. Conclusions

The aim of this report was to compare the morphology and geochemistry of Treffgarne and Clarbeston to determine if gold grains are from the same source.

Morphological analysis has shown grains from the two regions are likely of a different source. Statistical analysis of size and surface area has shown Clarbeston grains are significantly larger and although Krumbein values are similar, statistical tests show morphology is significantly different overall.

Further analysis has shown both regions have a low overall transport distance, however, due to the apparent random spread of morphologies, it is unlikely to be an accurate conclusion.
Within each area the morphology appears random, with size, shape and surface area varying. However, detailed analysis has concluded that Treffgarne has two possible sources.
Spatial coverage is very limited due to the nature of sampling, so no conclusions can be drawn about morphology through spatial analysis.

However, due to the significantly larger sample size of Clarbeston, these conclusions may not be truly reliable.

Grain geochemistry has shown grains from Treffgarne have likely undergone a fair transport distance, with some grains showing significant rim sizes, however, some grains appear to lack any rims which may be due to the nature of polishing, so the use of rim sizes to determine transport distance isn't reliable.

Visually Clarbeston grains have more uniform rims and appear to show further transport distances, however, when plotted against Treffgarne they appear to show a similar spread of compositions.

Core analysis has shown compositions vary significantly within both regions, indicating there are different possible sources of gold within the study areas. When core compositions were compared, it shows some grains possibly have the same source, however, overall, most grains from Treffgarne and Clarbeston have different source compositions.

Comparison of Inclusions has been limited due to the lack of inclusions analysed. Clarbeston showed a significantly higher number of inclusions in the grains, with a much higher occurrence of Silica and Iron, however, the larger number of inclusions is likely due to more grains being analysed in Clarbeston.

Spatial coverage is again too poor to allow for grain geochemistry to be analysed spatially within the regions.

7. Recommendations for further exploration

Further exploration recommended to better understand the findings of this report and for further research would be to conduct more gold panning further up the Roch basin, past any tributaries draining from the Roch rhyolite. That way and gold panned would have to come from another source further upstream (possibly porphyry mineralisation near Llandeloy) without the influence of the Rhyolite group.

This could be added to by conducting sampling in the Llandeloy region and comparing findings to the results in this report to determine whether gold from that region was sampled in Treffgarne during 2022.

Overall, the main issue in this report was the lack of panning locations sampled, which meant spatial analysis was unreliable. Further panning is recommended to increase the number of sample locations so that spatial analysis can be carried out. This would be recommended in the Treffgarne region, as panning south of the rhyolite and to the northwest of it was severely lacking.

Finally, further SEM analysis would be useful. This is because time constraints meant not enough samples were analysed using the SEM and insufficient time was spent on analysing inclusions. So further SEM use would be helpful for increasing the accuracy of conclusions drawn in this report.

8. Acknowledgements

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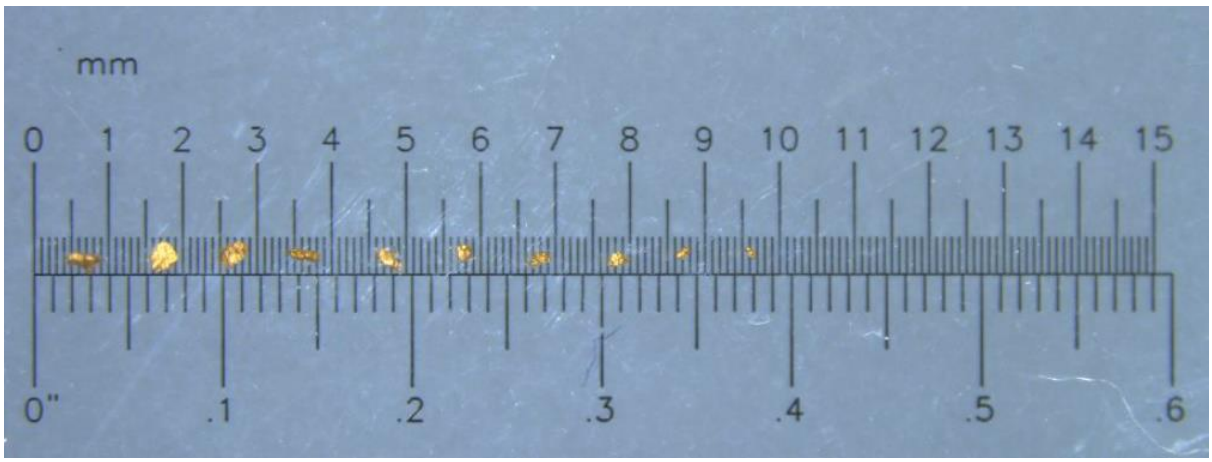
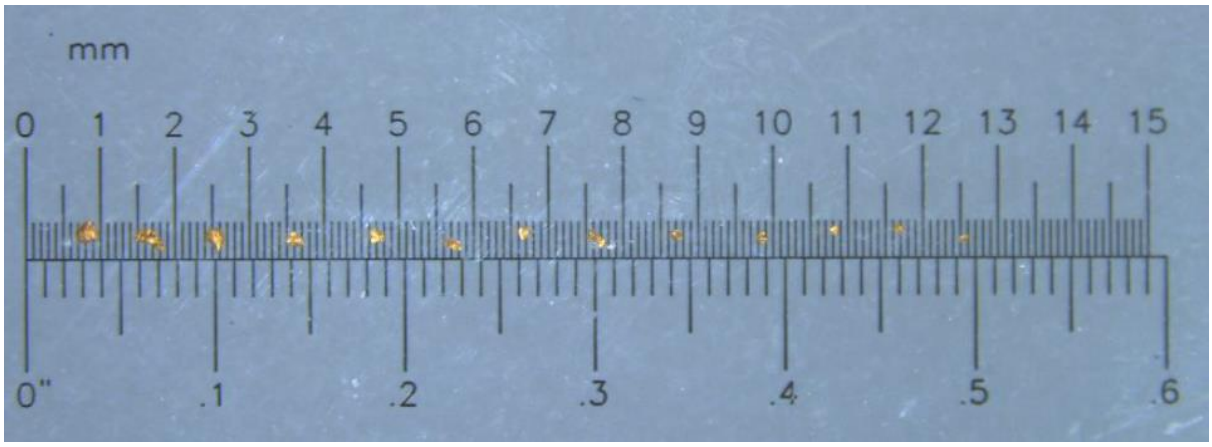
Appendices

Appendix 1. Treffgarne Gold Grains on 15mm Reticule

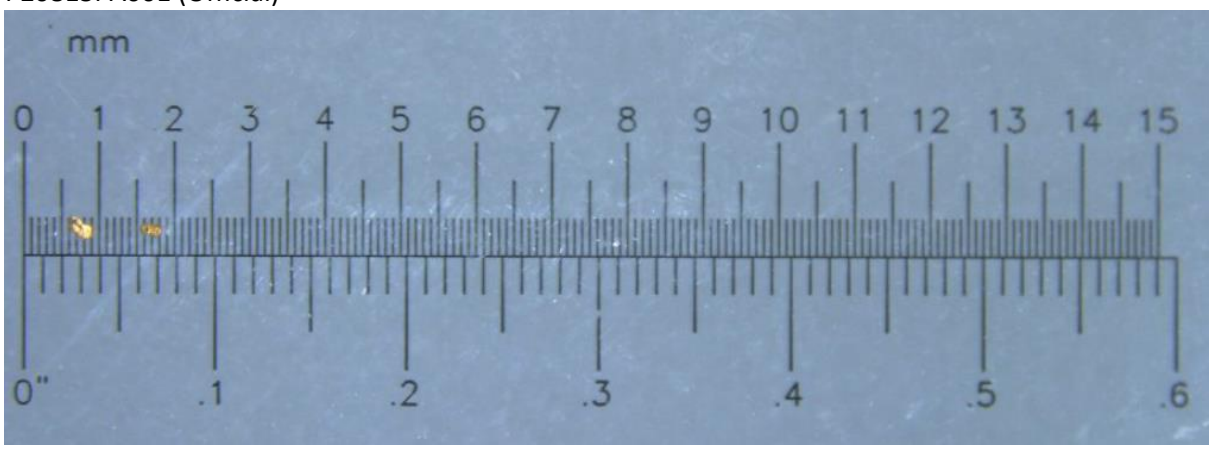
P20801PA001 (Official)



P20801PA001(Extra)

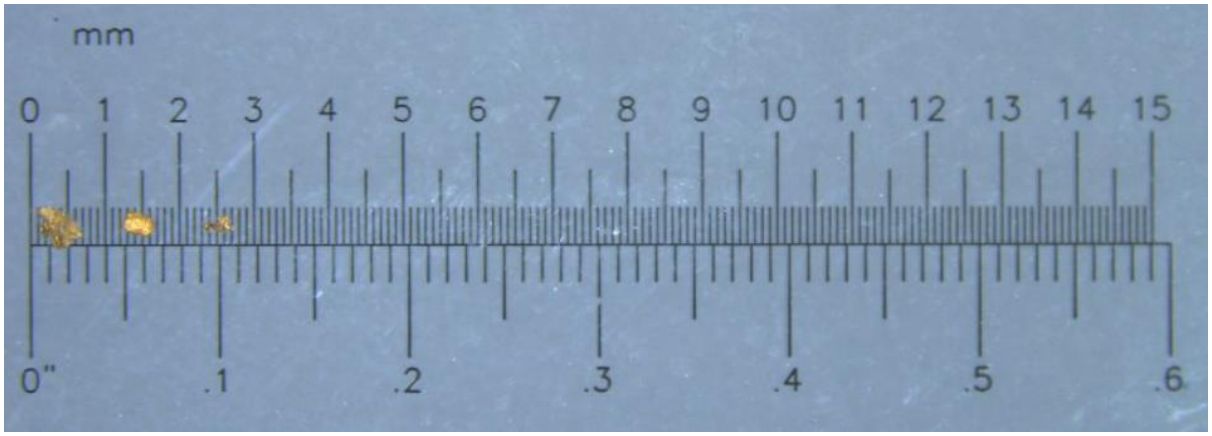


P20815PA001 (Official)

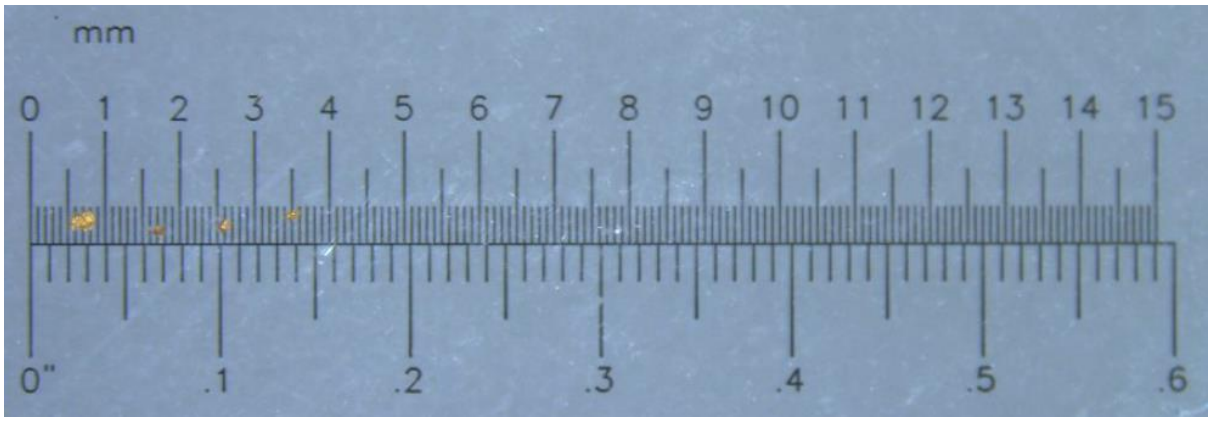


C2078956

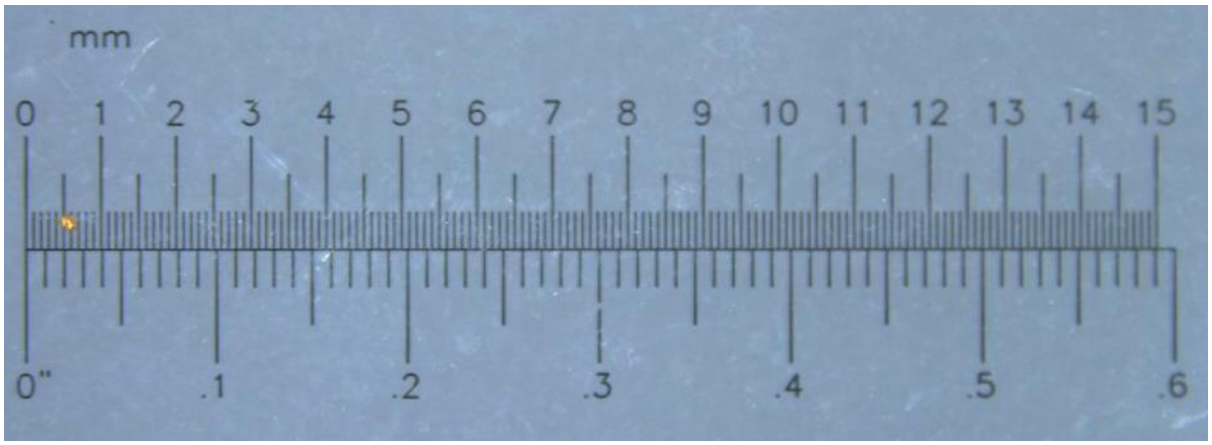
P20819PA001 (Official)



P20819PA002 (Official)

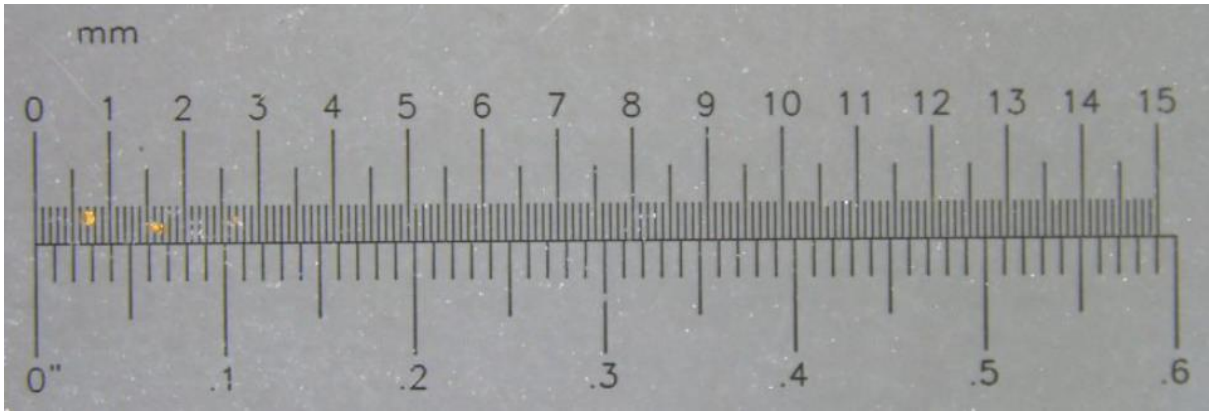


P20825PA001 (Official)

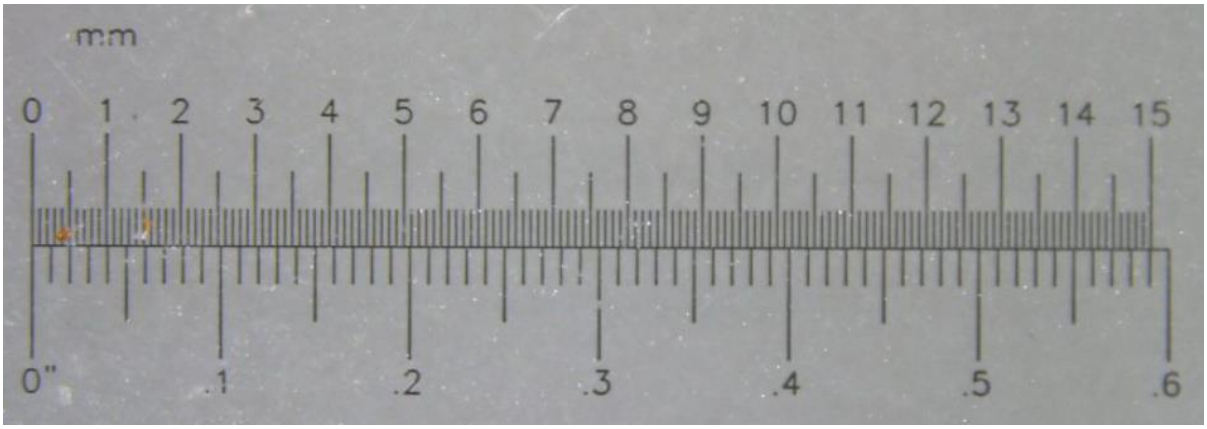


C2078956

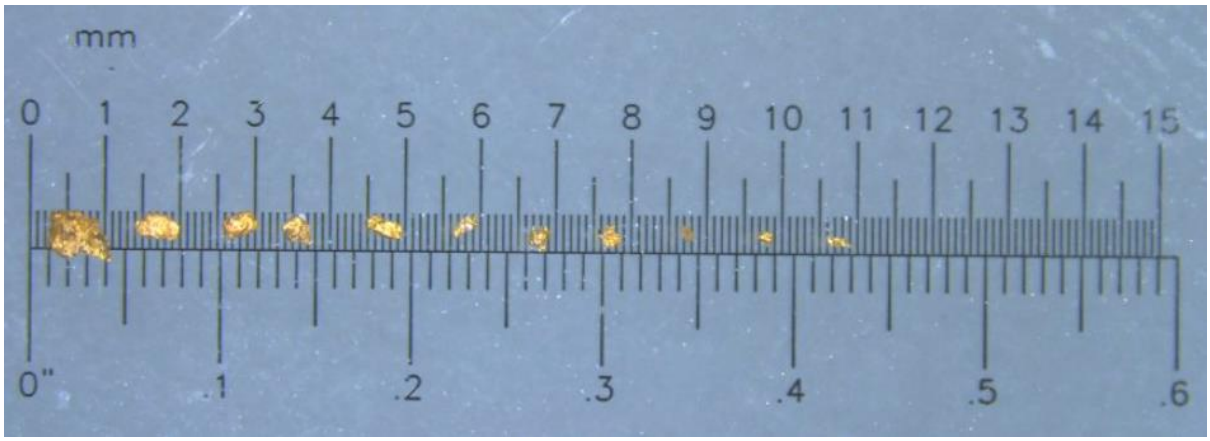
P20819PA002 (1) (Extra)



P20819PA002 (2) (Extra)

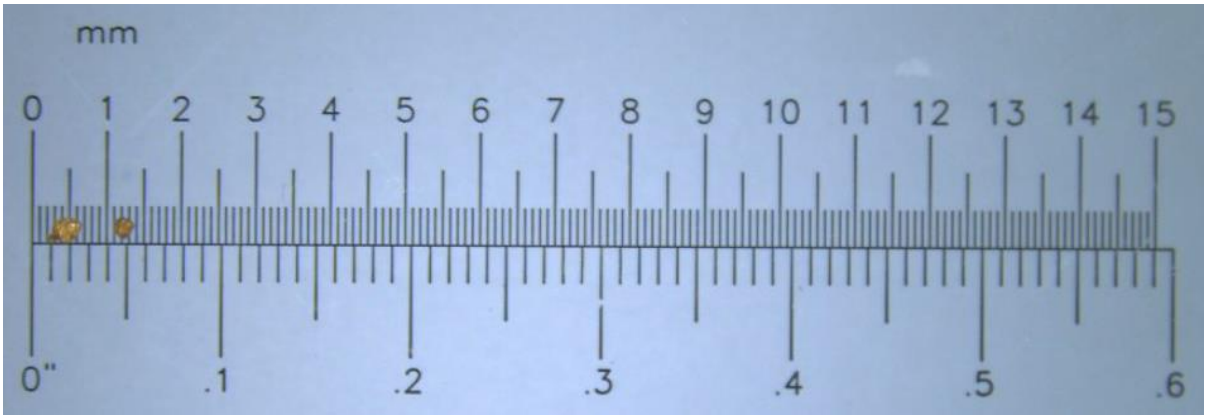


P20819PA001 (Extra)



Appendix 2. Clarbeston Gold Grains on 15mm Reticule

P20805PA001 (Official)



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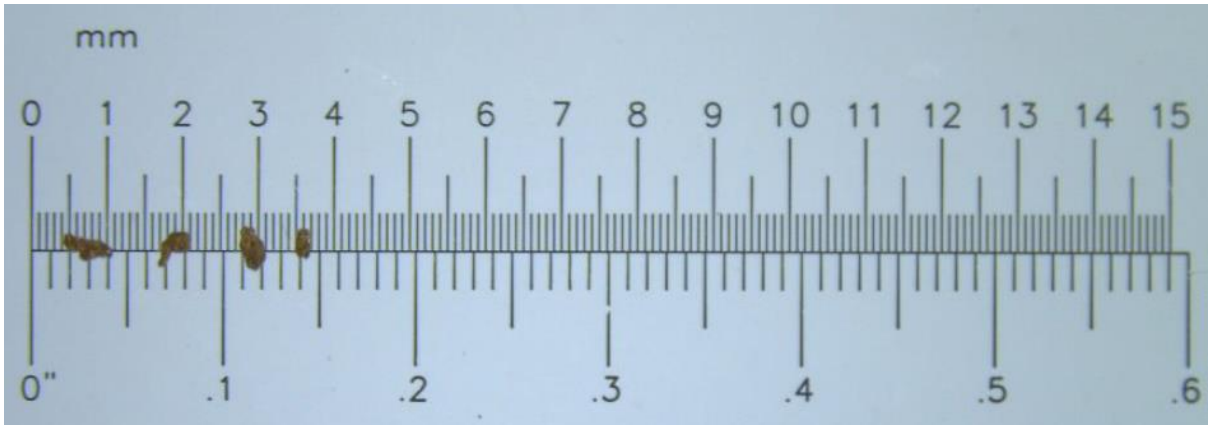
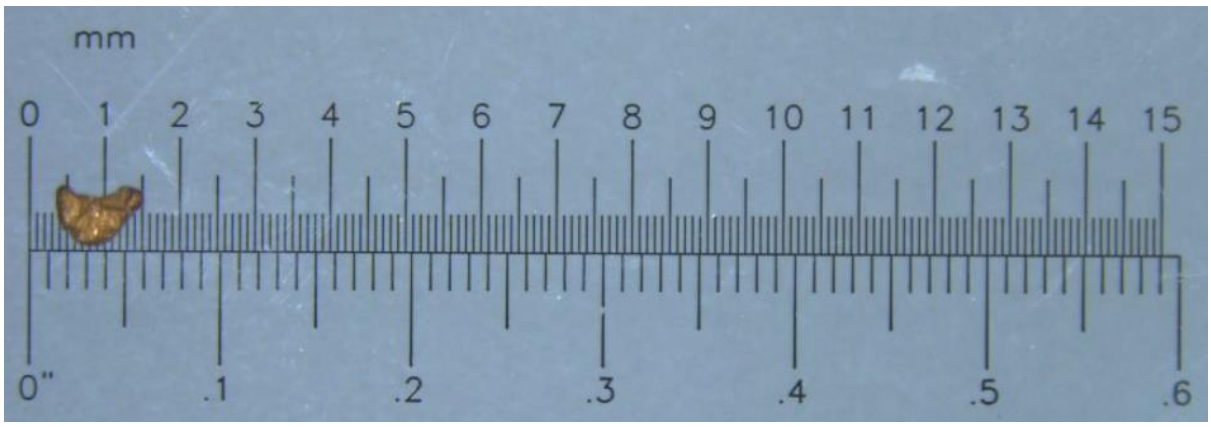
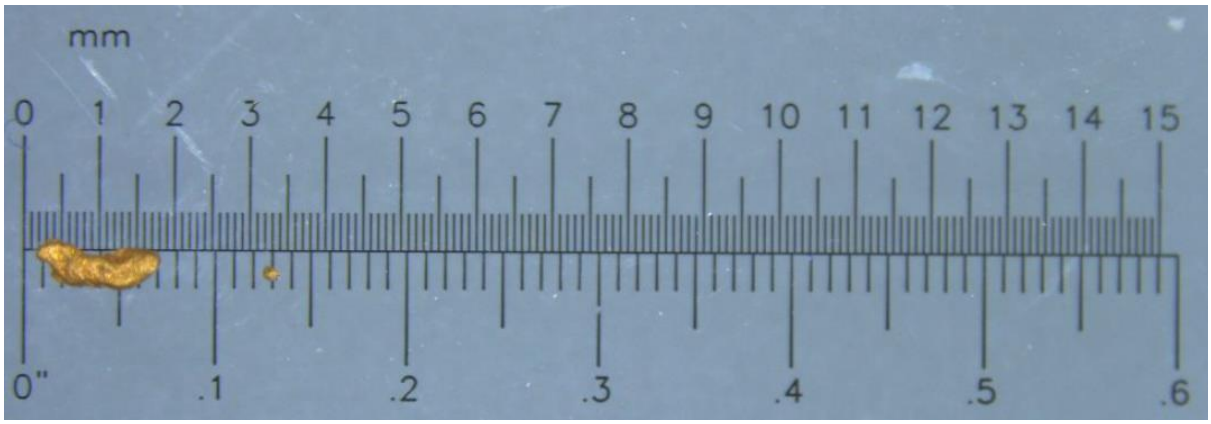


P20809PA001 (Official)

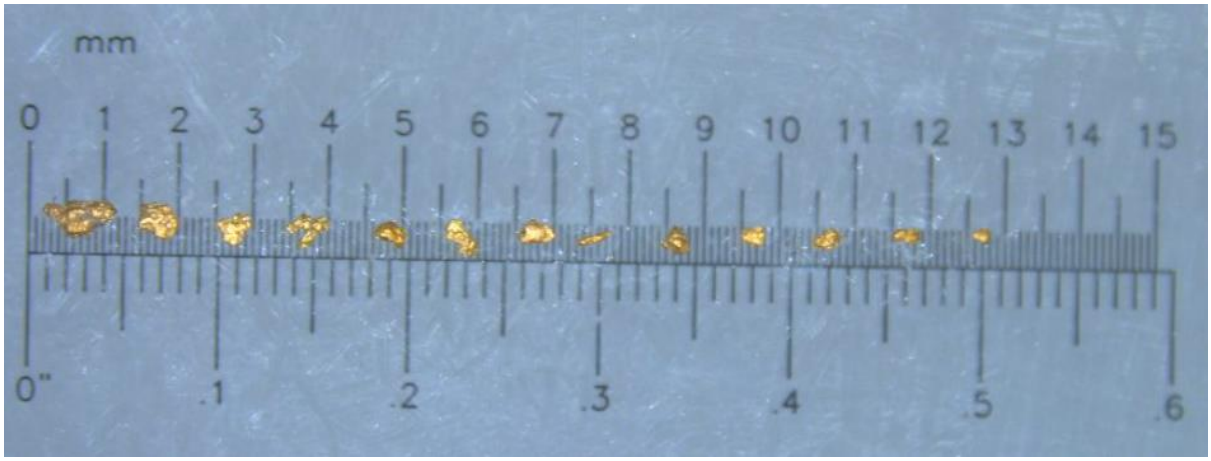


C2078956

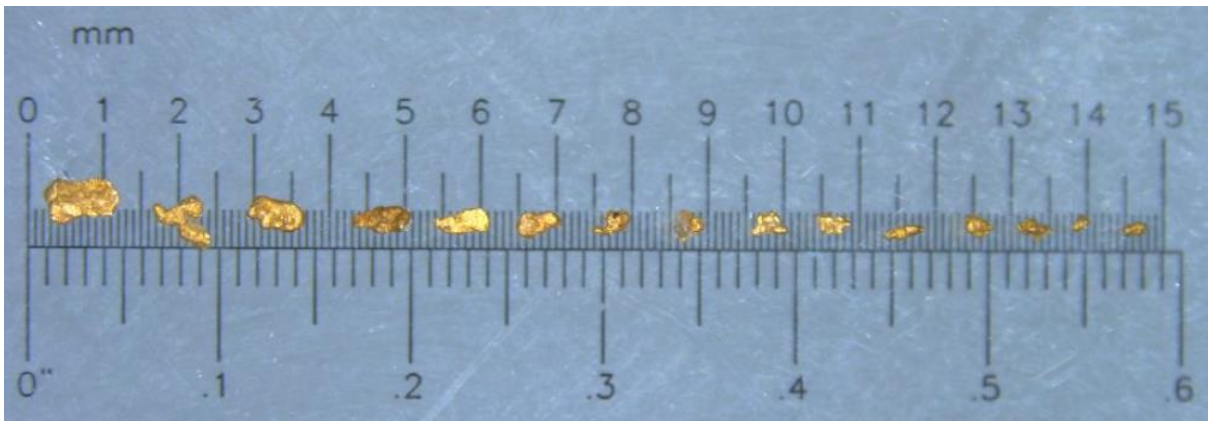
P20817PA001 (Official)



P20805PA002 (1) (Extra)

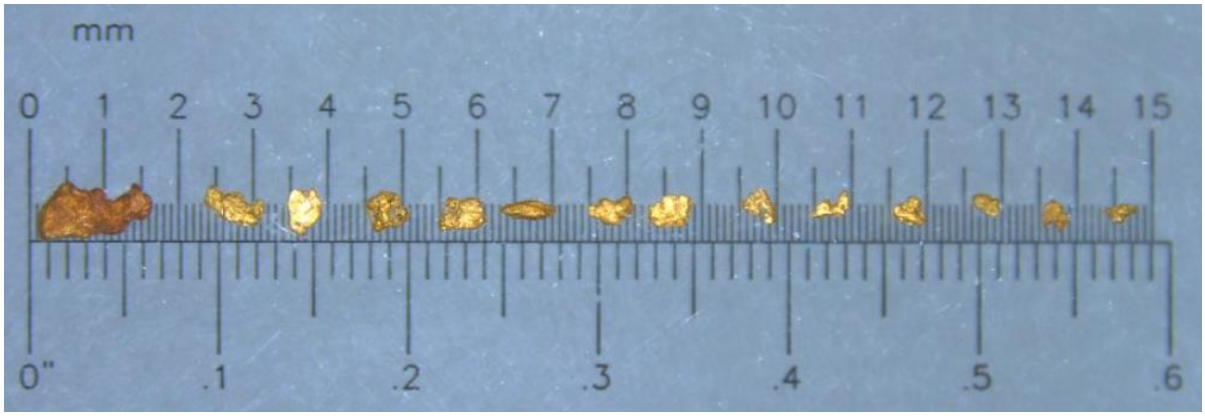


P20805PA002 (3.1) (Extra)

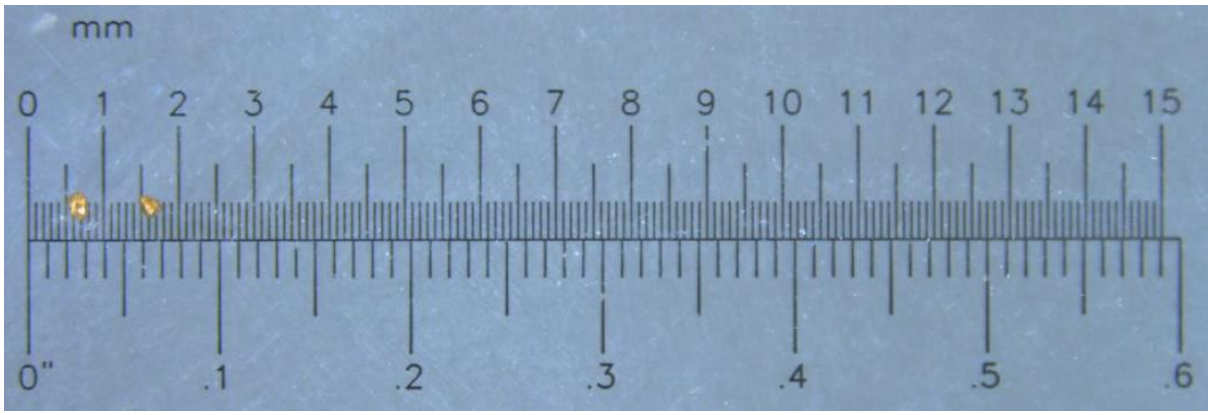


C2078956

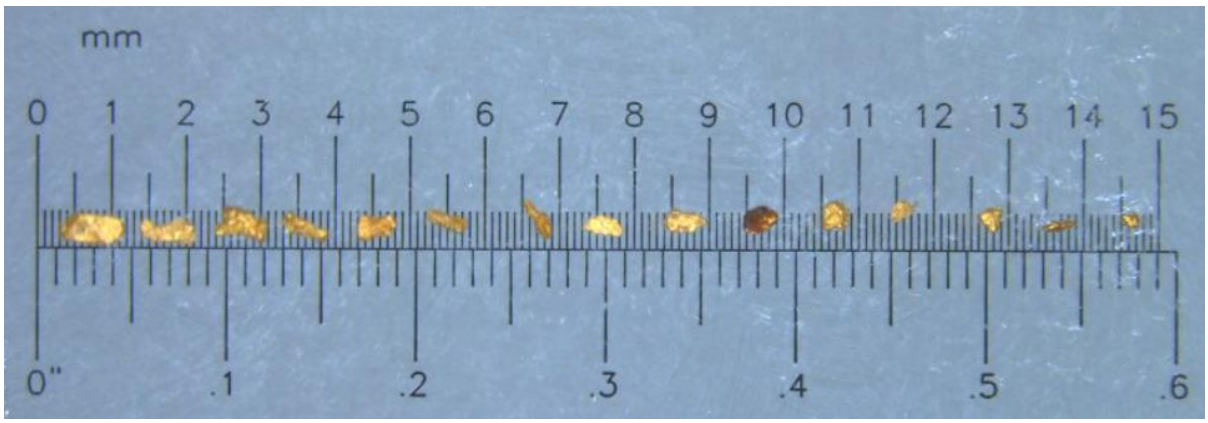
P20805PA002 (3.2) (Extra)



P20805PA002 (3.3) (Extra)



P20805PA002 (4.1) (Extra)



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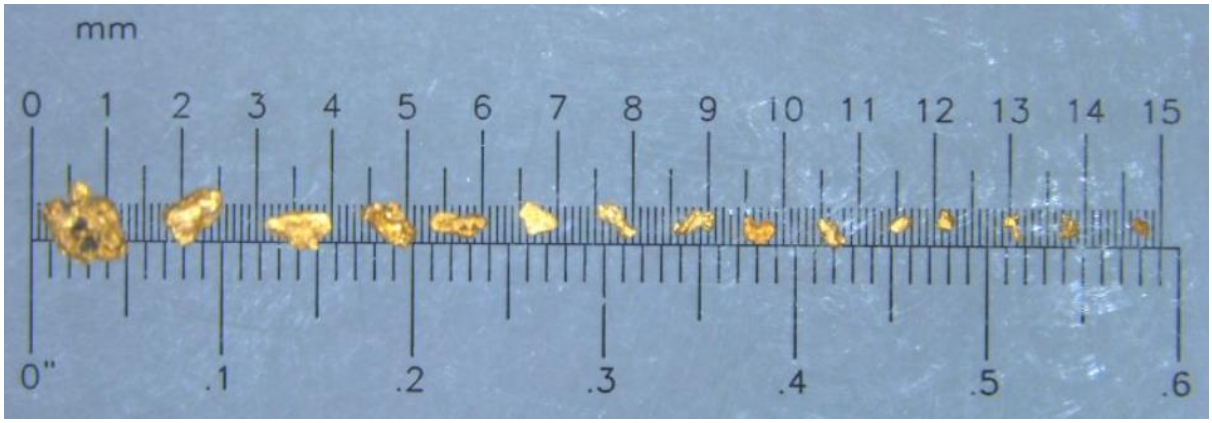

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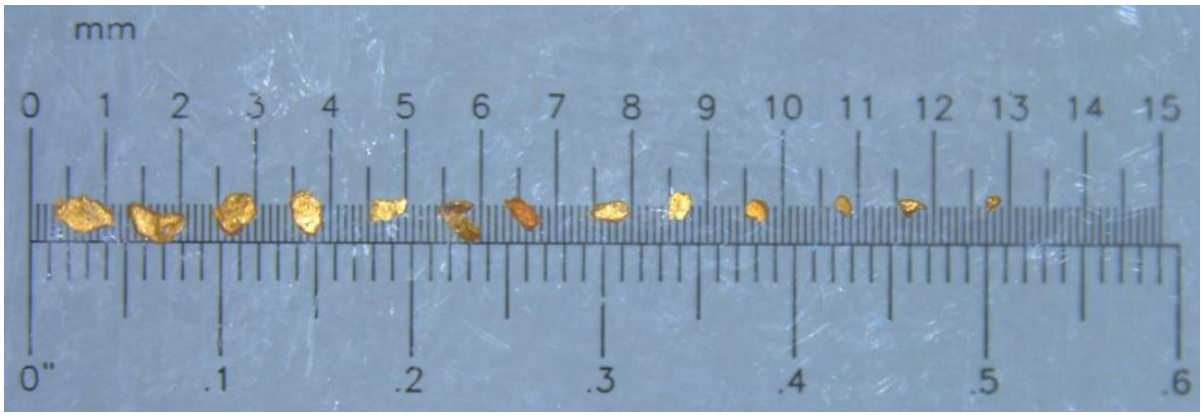
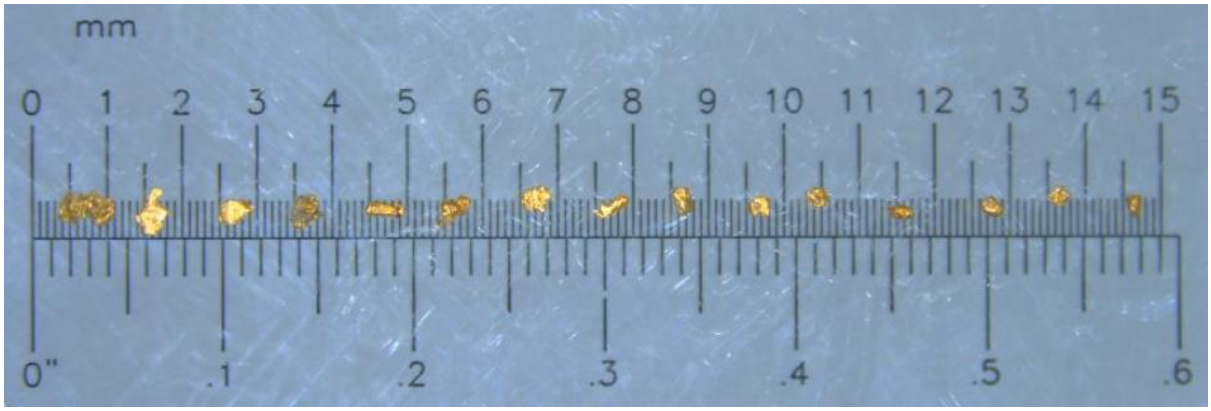
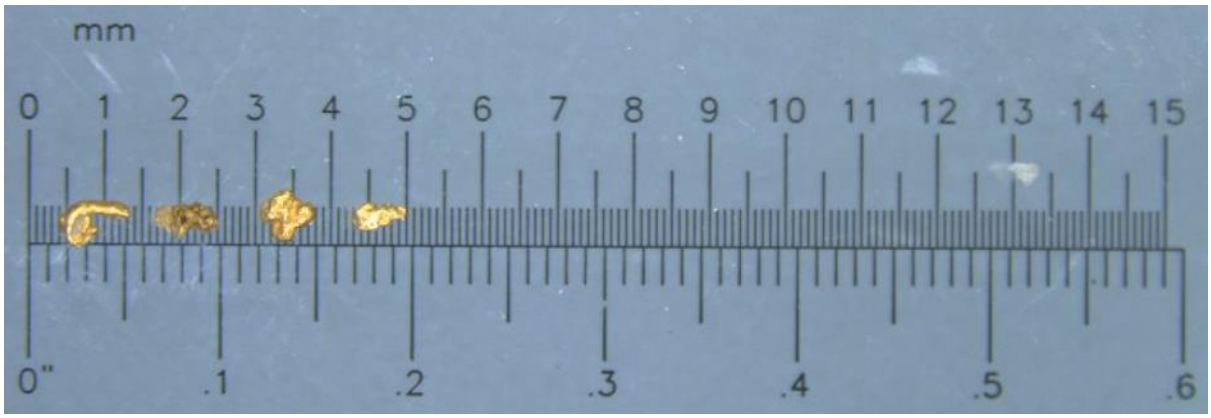


P20805PA002 (2) (Extra)

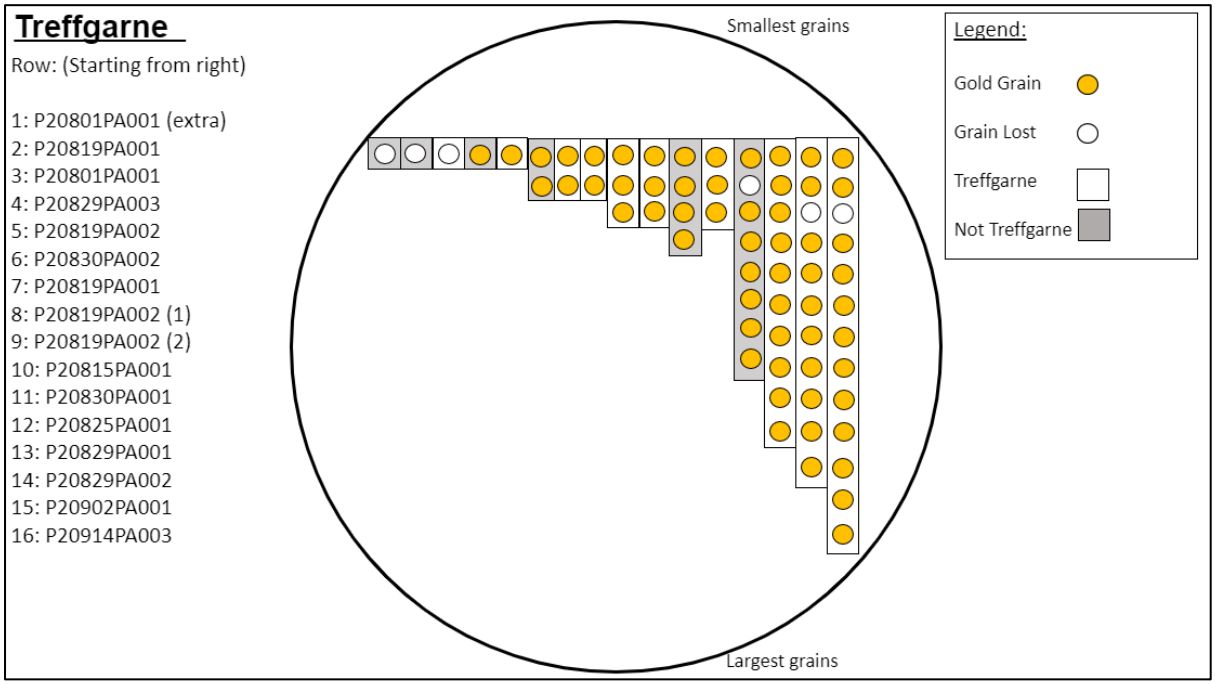


C2078956

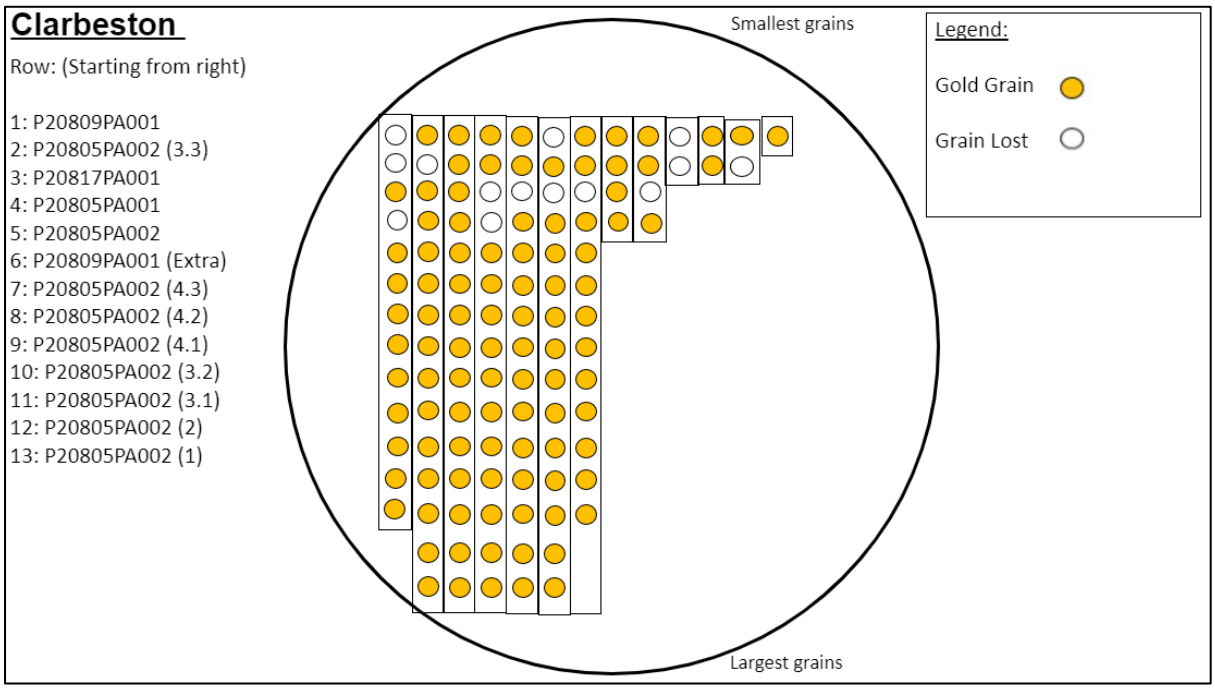
P20809PA001 (Extra)



Appendix 3. Treffgarne SEM Block Legend



Appendix 4. Clarbeston SEM Block Legend



Appendix 5. Treffgarne Grain Record Sheet

Grain Number	Bag Code	Row on SEM	Loss	Size (mm)		Krumbien	Score	Surface Area
				Length	Width	Sphericity	Angularity	(mm^2)
Grain 1	P20801PA001 (extra)	1		0.1	0.08	0.7	0.9	0.008
Grain 2	P20801PA001 (extra)	1		0.12	0.08	0.7	0.5	0.0096
Grain 3	P20801PA001 (extra)	1		0.1	0.11	0.8	0.7	0.011
Grain 4	P20801PA001 (extra)	1		0.13	0.1	0.7	0.3	0.013
Grain 5	P20801PA001 (extra)	1		0.18	0.1	0.7	0.5	0.018
Grain 6	P20801PA001 (extra)	1		0.3	0.1	0.3	0.3	0.03
Grain 7	P20801PA001 (extra)	1		0.12	0.12	0.8	0.8	0.0144
Grain 8	P20801PA001 (extra)	1		0.2	0.1	0.5	0.5	0.02
Grain 9	P20801PA001 (extra)	1		0.2	0.19	0.5	0.2	0.038
Grain 10	P20801PA001 (extra)	1		0.2	0.18	0.6	0.2	0.036
Grain 11	P20801PA001 (extra)	1		0.3	0.25	0.5	0.3	0.075
Grain 12	P20801PA001 (extra)	1		0.5	0.2	0.2	0.3	0.1
Grain 13	P20801PA001 (extra)	1		0.3	0.3	0.7	0.3	0.09
Grain 14	P20819PA001	2		0.3	0.1	0.3	0.3	0.03
Grain 15	P20819PA001	2		0.17	0.15	0.5	0.3	0.0255
Grain 16	P20819PA001	2		0.2	0.1	0.5	0.5	0.02
Grain 17	P20819PA001	2		0.3	0.3	0.4	0.2	0.09
Grain 18	P20819PA001	2		0.3	0.3	0.4	0.2	0.09
Grain 19	P20819PA001	2		0.4	0.16	0.3	0.3	0.064
Grain 20	P20819PA001	2		0.49	0.2	0.3	0.5	0.098
Grain 21	P20819PA001	2		0.5	0.43	0.5	0.2	0.215
Grain 22	P20819PA001	2		0.5	0.35	0.5	0.3	0.175
Grain 23	P20819PA001	2		0.6	0.4	0.7	0.6	0.24
Grain 24	P20819PA001	2		0.9	0.65	0.6	0.3	0.585
Grain 25	P20801PA001	3		0.16	0.09	0.3	0.5	0.0144
Grain 26	P20801PA001	3		0.2	0.1	0.3	0.3	0.02
Grain 27	P20801PA001	3		0.3	0.16	0.3	0.2	0.048
Grain 28	P20801PA001	3		0.27	0.15	0.3	0.3	0.0405
Grain 29	P20801PA001	3		0.28	0.2	0.7	0.5	0.056
Grain 30	P20801PA001	3		0.38	0.2	0.5	0.1	0.076
Grain 31	P20801PA001	3		0.42	0.1	0.3	0.3	0.042
Grain 32	P20801PA001	3		0.4	0.3	0.7	0.4	0.12
Grain 33	P20801PA001	3		0.45	0.4	0.8	0.5	0.18
Grain 34	P20801PA001	3		0.5	0.2	0.5	0.4	0.1
Grain 35	P20819PA002	5		0.12	0.1	0.7	0.7	0.012
Grain 36	P20819PA002	5		0.15	0.1	0.9	0.8	0.015
Grain 37	P20819PA002	5		0.35	0.25	0.7	0.5	0.0875
Grain 38	P20819PA001	7		0.4	0.2	0.2	0.1	0.08
Grain 39	P20819PA001	7		0.43	0.3	0.7	0.7	0.129
Grain 40	P20819PA001	7		0.72	0.55	0.5	0.2	0.396
Grain 41	P20819PA002(1)	8		0.1	0.08	0.7	0.8	0.008
Grain 42	P20819PA002(1)	8		0.23	0.12	0.5	0.5	0.0276
Grain 43	P20819PA002(1)	8		0.2	0.18	0.8	0.5	0.036
Grain 44	P20819PA002(2)	9		0.13	0.1	0.3	0.1	0.013
Grain 45	P20829PA002(2)	9		0.2	0.1	0.5	0.3	0.02
Grain 46	P20815PA001	10		0.22	0.12	0.3	0.5	0.0264
Grain 47	P20815PA001	10		0.31	0.2	0.5	0.5	0.062
Grain 48	P20825PA001	12		0.22	0.18	0.5	0.5	0.0396

Appendix 6. Clarbeston Grain Record Sheet

Grain Number	Bag Code	Row on SEM I	Loss	Size (mm)		Krumbien	Score	Surface Area
				Length	Width	Sphericity	Angularity	(mm^2)
Grain 1	P20805PA002 (1)	1		0.2	0.15	0.7	0.9	0.03
Grain 2	P20805PA002 (1)	1		0.4	0.15	0.5	0.5	0.06
Grain 3	P20805PA002 (1)	1		0.28	0.2	0.7	0.5	0.056
Grain 4	P20805PA002 (1)	1		0.3	0.2	0.5	0.5	0.06
Grain 5	P20805PA002 (1)	1		0.3	0.25	0.5	0.3	0.075
Grain 6	P20805PA002 (1)	1		0.45	0.1	0.2	0.7	0.045
Grain 7	P20805PA002 (1)	1		0.5	0.25	0.7	0.5	0.125
Grain 8	P20805PA002 (1)	1		0.5	0.2	0.5	0.3	0.1
Grain 9	P20805PA002 (1)	1		0.4	0.3	0.7	0.6	0.12
Grain 10	P20805PA002 (1)	1		0.55	0.4	0.2	0.1	0.22
Grain 11	P20805PA002 (1)	1		0.5	0.4	0.5	0.3	0.2
Grain 12	P20805PA002 (1)	1		0.6	0.45	0.7	0.4	0.27
Grain 13	P20805PA002 (1)	1		1.1	0.5	0.3	0.3	0.55
Grain 14	P20805PA002 (2)	2		0.3	0.15	0.7	0.7	0.045
Grain 15	P20805PA002 (2)	2		0.3	0.3	0.7	0.5	0.09
Grain 16	P20805PA002 (2)	2		0.3	0.2	0.7	0.7	0.06
Grain 17	P20805PA002 (2)	2		0.3	0.15	0.5	0.8	0.045
Grain 18	P20805PA002 (2)	2		0.3	0.25	0.7	0.5	0.075
Grain 19	P20805PA002 (2)	2		0.28	0.25	0.9	0.7	0.07
Grain 20	P20805PA002 (2)	2		0.4	0.2	0.5	0.5	0.08
Grain 21	P20805PA002 (2)	2		0.5	0.15	0.3	0.5	0.075
Grain 22	P20805PA002 (2)	2		0.43	0.3	0.7	0.5	0.129
Grain 23	P20805PA002 (2)	2		0.4	0.3	0.3	0.5	0.12
Grain 24	P20805PA002 (2)	2		0.5	0.15	0.3	0.7	0.075
Grain 25	P20805PA002 (2)	2		0.5	0.4	0.9	0.5	0.2
Grain 26	P20805PA002 (2)	2		0.5	0.3	0.4	0.5	0.15
Grain 27	P20805PA002 (2)	2		0.65	0.45	0.2	0.5	0.2925
Grain 28	P20805PA002 (2)	2		0.75	0.4	0.5	0.2	0.3
Grain 29	P20805PA002 (3.1)	3		0.3	0.15	0.5	0.7	0.045
Grain 30	P20805PA002 (3.1)	3		0.2	0.1	0.7	0.7	0.02
Grain 31	P20805PA002 (3.1)	3		0.45	0.3	0.5	0.3	0.135
Grain 32	P20805PA002 (3.1)	3		0.35	0.25	0.7	0.3	0.0875
Grain 33	P20805PA002 (3.1)	3		0.5	0.15	0.3	0.7	0.075
Grain 34	P20805PA002 (3.1)	3		0.5	0.3	0.3	0.1	0.15
Grain 35	P20805PA002 (3.1)	3		0.43	0.3	0.5	0.1	0.129
Grain 36	P20805PA002 (3.1)	3		0.4	0.3	0.5	0.1	0.12
Grain 37	P20805PA002 (3.1)	3		0.5	0.25	0.1	0.3	0.125
Grain 38	P20805PA002 (3.1)	3		0.65	0.3	0.5	0.5	0.195
Grain 39	P20805PA002 (3.1)	3		0.7	0.4	0.5	0.3	0.28
Grain 40	P20805PA002 (3.1)	3		0.8	0.4	0.5	0.3	0.32
Grain 41	P20805PA002 (3.1)	3		0.8	0.4	0.5	0.5	0.32
Grain 42	P20805PA002 (3.1)	3		0.9	0.45	0.1	0.1	0.405
Grain 43	P20805PA002 (3.1)	3		1	0.5	0.5	0.3	0.5
Grain 44	P20805PA002 (3.2)	4		0.21	0.1	0.5	0.3	0.021
Grain 45	P20805PA002 (3.2)	4		0.21	0.1	0.5	0.3	0.021
Grain 46	P20805PA002 (3.2)	4		0.3	0.3	0.7	0.3	0.09
Grain 47	P20805PA002 (3.2)	4		0.45	0.2	0.7	0.7	0.09
Grain 48	P20805PA002 (3.2)	4		0.5	0.35	0.5	0.1	0.175
Grain 49	P20805PA002 (3.2)	4		0.6	0.25	0.2	0.1	0.15
Grain 50	P20805PA002 (3.2)	4		0.55	0.3	0.5	0.1	0.165
Grain 51	P20805PA002 (3.2)	4		0.6	0.4	0.7	0.5	0.24
Grain 52	P20805PA002 (3.2)	4		0.6	0.3	0.3	0.3	0.18
Grain 53	P20805PA002 (3.2)	4		0.7	0.3	0.3	0.7	0.21
Grain 54	P20805PA002 (3.2)	4		0.6	0.45	0.7	0.2	0.27
Grain 55	P20805PA002 (3.2)	4		0.6	0.6	0.7	0.2	0.36
Grain 56	P20805PA002 (3.2)	4		0.65	0.45	0.7	0.3	0.2925
Grain 57	P20805PA002 (3.2)	4		0.8	0.4	0.5	0.1	0.32
Grain 58	P20805PA002 (3.2)	4		1.55	0.8	0.5	0.1	1.24
Grain 59	P20805PA002 (4.1)	5		0.2	0.17	0.9	0.5	0.034
Grain 60	P20805PA002 (4.1)	5		0.5	0.1	0.3	0.6	0.05

Grain 61	P20805PA002 (4.1)	5		0.35	0.3	0.6	0.3	0.105
Grain 62	P20805PA002 (4.1)	5		0.4	0.25	0.7	0.5	0.1
Grain 63	P20805PA002 (4.1)	5		0.35	0.3	0.7	0.7	0.105
Grain 64	P20805PA002 (4.1)	5		0.45	0.3	0.9	0.7	0.135
Grain 65	P20805PA002 (4.1)	5		0.6	0.25	0.5	0.5	0.15
Grain 66	P20805PA002 (4.1)	5		0.5	0.2	0.5	0.6	0.1
Grain 67	P20805PA002 (4.1)	5		0.55	0.15	0.3	0.6	0.0825
Grain 68	P20805PA002 (4.1)	5		0.6	0.15	0.3	0.5	0.09
Grain 69	P20805PA002 (4.1)	5		0.5	0.3	0.4	0.4	0.15
Grain 70	P20805PA002 (4.1)	5		0.65	0.2	0.3	0.5	0.13
Grain 71	P20805PA002 (4.1)	5		0.7	0.3	0.4	0.2	0.21
Grain 72	P20805PA002 (4.1)	5		0.7	0.3	0.3	0.3	0.21
Grain 73	P20805PA002 (4.1)	5		0.9	0.4	0.5	0.8	0.36
Grain 74	P20805PA002 (4.2)	6		0.2	0.15	0.5	0.3	0.03
Grain 75	P20805PA002 (4.2)	6		0.3	0.2	0.7	0.5	0.06
Grain 76	P20805PA002 (4.2)	6		0.4	0.2	0.3	0.1	0.08
Grain 77	P20805PA002 (4.2)	6		0.3	0.2	0.5	0.7	0.06
Grain 78	P20805PA002 (4.2)	6		0.3	0.15	0.5	0.9	0.045
Grain 79	P20805PA002 (4.2)	6		0.4	0.2	0.4	0.3	0.08
Grain 80	P20805PA002 (4.2)	6		0.4	0.2	0.5	0.3	0.08
Grain 81	P20805PA002 (4.2)	6		0.5	0.18	0.3	0.2	0.09
Grain 82	P20805PA002 (4.2)	6		0.5	0.2	0.3	0.3	0.1
Grain 83	P20805PA002 (4.2)	6		0.55	0.3	0.7	0.5	0.165
Grain 84	P20805PA002 (4.2)	6		0.8	0.3	0.3	0.5	0.24
Grain 85	P20805PA002 (4.2)	6		0.8	0.35	0.5	0.5	0.28
Grain 86	P20805PA002 (4.2)	6		0.9	0.4	0.5	0.6	0.36
Grain 87	P20805PA002 (4.2)	6		0.8	0.4	0.7	0.7	0.32
Grain 88	P20805PA002 (4.2)	6		1.3	0.9	0.7	0.1	1.17
Grain 89	P20805PA002 (4.3)	7		0.2	0.15	0.5	0.3	0.03
Grain 90	P20805PA002 (4.3)	7		0.4	0.2	0.5	0.3	0.08
Grain 91	P20805PA002 (4.3)	7		0.2	0.2	0.7	0.8	0.04
Grain 92	P20805PA002 (4.3)	7		0.3	0.3	0.7	0.8	0.09
Grain 93	P20805PA002 (4.3)	7		0.35	0.3	0.7	0.7	0.105
Grain 94	P20805PA002 (4.3)	7		0.55	0.3	0.5	0.8	0.165
Grain 95	P20805PA002 (4.3)	7		0.6	0.2	0.3	0.5	0.12
Grain 96	P20805PA002 (4.3)	7		0.7	0.3	0.3	0.3	0.21
Grain 97	P20805PA002 (4.3)	7		0.5	0.3	0.5	0.3	0.15
Grain 98	P20805PA002 (4.3)	7		0.6	0.4	0.7	0.7	0.24
Grain 99	P20805PA002 (4.3)	7		0.7	0.4	0.9	0.5	0.28
Grain 100	P20805PA002 (4.3)	7		0.8	0.4	0.5	0.5	0.32
Grain 101	P20805PA002 (4.3)	7		0.8	0.5	0.7	0.5	0.4
Grain 102	P20809PA001 (Extra)	8		0.7	0.3	0.4	0.5	0.21
Grain 103	P20809PA001 (Extra)	8		0.8	0.7	0.7	0.3	0.56
Grain 104	P20809PA001 (Extra)	8		0.8	0.4	0.5	0.1	0.32
Grain 105	P20809PA001 (Extra)	8		0.9	0.5	0.5	0.1	0.45
Grain 106	P20805PA002	9		0.35	0.2	0.5	0.7	0.07
Grain 107	P20805PA002	9		0.5	0.35	0.5	0.6	0.175
Grain 108	P20805PA002	9		0.5	0.4	0.3	0.2	0.2
Grain 109	P20805PA002	9		0.7	0.3	0.3	0.3	0.21
Grain 110	P20805PA001	10		0.3	0.25	0.9	0.5	0.075
Grain 111	P20805PA001	10		0.45	0.3	0.7	0.5	0.135
Grain 112	P20817PA001	11		0.15	0.15	0.9	0.7	0.0225
Grain 113	P20817PA001	11		1.7	0.5	0.2	0.7	0.85
Grain 114	P20805PA002 (3.3)	12		0.3	0.2	0.6	0.7	0.06
Grain 115	P20805PA002 (3.3)	12		0.3	0.25	0.7	0.7	0.075
Grain 116	P20809PA001	13		1.2	0.8	0.5	0.7	0.96

Appendix 7. Basin and likely source rock for each sample bag code

Study Area	Bag Code	SEM Block	No. of Grains	Basin (Location)	Likely source rock
Treffgarne	P20801PA001	Treffgarne	10	Treffgarne (Mountain Water)	Roch Rhyolite
Treffgarne	P20815PA001	Treffgarne	2	Treffgarne (Lower Mount Joy)	Roch Rhyolite
Treffgarne	P20801PA001 (extra)	Treffgarne	12	Treffgarne (Mountain Water)	Roch Rhyolite
Treffgarne	P20825PA001	Treffgarne	1	Roch (Kite Farm)	Roch Rhyolite
Treffgarne	P20819PA002	Treffgarne	3	Roch (Brandy Brook)	Porphyry/Rhyolite
Treffgarne	P20819PA001	Treffgarne	3	Roch (Brandy Brook)	Porphyry/Rhyolite
Treffgarne	P20819PA001	Treffgarne	11	Roch (Brandy Brook)	Porphyry/Rhyolite
Treffgarne	P20819PA002(1)	Treffgarne	3	Roch (Brandy Brook)	Porphyry/Rhyolite
Treffgarne	P20819PA002(2)	Treffgarne	2	Roch (Brandy Brook)	Porphyry/Rhyolite
Clarbeston	P20914PA003	Treffgarne	1	Clarbeston (New Moat)	Penmaen Dewi Shale Formation
Clarbeston	P20817PA001	Clarbeston	2	Clarbeston (New Moat)	Penmaen Dewi Shale Formation
Clarbeston	P20805PA002	Clarbeston	4	Clarbeston (New Moat)	Penmaen Dewi Shale Formation
Clarbeston	P20805PA001	Clarbeston	2	Clarbeston (New Moat)	Abergwilli Mdstn Formation/Penmaen Dewi Shale Formation
Clarbeston	P20809PA001	Clarbeston	1	Clarbeston (New Moat)	Penmaen Dewi Shale Formation
Clarbeston	P20902PA001	Treffgarne	1	Clarbeston (New Moat)	Abergwilli Mdstn Formation/Penmaen Dewi Shale Formation
Clarbeston	P20805PA002 (1)	Clarbeston	13	Clarbeston (New Moat)	Abergwilli Mdstn Formation/Penmaen Dewi Shale Formation
Clarbeston	P20805PA002 (2)	Clarbeston	15	Clarbeston (New Moat)	Abergwilli Mdstn Formation/Penmaen Dewi Shale Formation
Clarbeston	P20805PA002 (3.1)	Clarbeston	15	Clarbeston (New Moat)	Abergwilli Mdstn Formation/Penmaen Dewi Shale Formation
Clarbeston	P20805PA002 (3.2)	Clarbeston	15	Clarbeston (New Moat)	Abergwilli Mdstn Formation/Penmaen Dewi Shale Formation
Clarbeston	P20805PA002 (4.1)	Clarbeston	15	Clarbeston (New Moat)	Abergwilli Mdstn Formation/Penmaen Dewi Shale Formation
Clarbeston	P20805PA002 (4.2)	Clarbeston	15	Clarbeston (New Moat)	Abergwilli Mdstn Formation/Penmaen Dewi Shale Formation
Clarbeston	P20805PA002 (4.3)	Clarbeston	13	Clarbeston (New Moat)	Abergwilli Mdstn Formation/Penmaen Dewi Shale Formation
Clarbeston	P20809PA001 (Extra)	Clarbeston	4	Clarbeston (New Moat)	Abergwilli Mdstn Formation/Penmaen Dewi Shale Formation
Clarbeston	P20805PA002 (3.3)	Clarbeston	2	Clarbeston (New Moat)	Abergwilli Mdstn Formation/Penmaen Dewi Shale Formation

Appendix 8. Means for morphological characteristics of Treffgarne sample locations

Sample Code	Row on SEM	No. of Grains	Mean Length (mm)	Mean Width (mm)	Mean Surface Area (mm^2)	Mean Sphericity	Mean Angularity
P20801PA001 (extra)	1	13	0.211538462	0.146923077	0.035615385	0.592307692	0.446153846
P20819PA001	2	11	0.423636364	0.285454545	0.148409091	0.454545455	0.336363636
P20801PA001	3	10	0.336	0.19	0.06969	0.47	0.35
P20819PA002	5	3	0.206666667	0.15	0.038166667	0.766666667	0.666666667
P20819PA001	7	3	0.516666667	0.35	0.201666667	0.466666667	0.333333333
P20819PA002(1)	8	3	0.176666667	0.126666667	0.023866667	0.666666667	0.6
P20819PA002(2)	9	2	0.165	0.1	0.0165	0.4	0.2
P20815PA001	10	2	0.265	0.16	0.0442	0.4	0.5
P20825PA001	12	1	0.22	0.18	0.0396	0.5	0.5
		Total: 48					

Appendix 9. Means for morphological characteristics of Clarbeston sample locations

Sample Code	Row on SEM	Number of Gr	Mean Length (mm)	Mean Width (mm)	Mean Surface Area (mm^2)	Mean Sphericity	Mean Angularity
P20805PA002 (1)	1	13	0.467692308	0.273076923	0.147	0.515384615	0.453846154
P20805PA002 (2)	2	15	0.427333333	0.263333333	0.120433333	0.553333333	0.120433333
P20805PA002 (3.1)	3	15	0.565333333	0.303333333	0.193766667	0.446666667	0.353333333
P20805PA002 (3.2)	4	15	0.594666667	0.353333333	0.254966667	0.533333333	0.286666667
P20805PA002 (4.1)	5	15	0.53	0.244666667	0.1341	0.506666667	0.513333333
P20805PA002 (4.2)	6	15	0.563333333	0.288666667	0.210666667	0.493333333	0.433333333
P20805PA002 (4.3)	7	13	0.515384615	0.303846154	0.171538462	0.576923077	0.538461538
P20809PA001 (Extra)	8	4	0.8	0.475	0.385	0.525	0.25
P20805PA002	9	4	0.5125	0.3125	0.16375	0.4	0.45
P20805PA001	10	2	0.375	0.275	0.105	0.8	0.5
P20817PA001	11	2	0.925	0.325	0.43625	0.55	0.7
P20805PA002 (3.3)	12	2	0.3	0.225	0.0675	0.65	0.7
P20809PA001	13	1	1.2	0.8	0.96	0.5	0.7
		Total: 116					

Appendix 10. Geochemical Values Recorded by the SEM

Spectrum Label	Si	S	Cl	K	Ca	Ti	Fe	Cu	Zn	Ag	Au	Pb	Bi	Project Path
Spectrum 2	0	0	0	0	0	0	0	0	0	42.35	54.96	0	0	2022.12.12/Clarbeston/P20805PA002 1
Spectrum 3	0	0	0	0	0	0	0	0	0	1.88	94.88	0	0	2022.12.12/Clarbeston/P20805PA002 1
Spectrum 4	0	9.16	1.64	0	0	0	0	0	0	2.32	81.86	0	2.37	2022.12.12/Clarbeston/P20805PA002 1
Spectrum 5	0.91	7.23	0	0	0	0	0	0	0	2.08	85.51	0	2.09	2022.12.12/Clarbeston/P20805PA002 1
Spectrum 6	0	0	1.34	0	0	0	0	0	0	34.31	60.96	0	0	2022.12.12/Clarbeston/P20805PA002 2
Spectrum 7	0	8.66	0	0	0	0	0	0	0	5.36	80.25	0	2.05	2022.12.12/Clarbeston/P20805PA002 2
Spectrum 8	0	0	0	0	0	0	0	0	0	32.54	65.04	0	0	2022.12.12/Clarbeston/P20805PA002 2
Spectrum 9	0	9.05	0	0	0	0	0	0	0	4.1	83.94	0	0	2022.12.12/Clarbeston/P20805PA002 2
Spectrum 10	0	0	0	0	0	0	0	0	0	44.56	51.54	0	0	2022.12.12/Clarbeston/P20805PA002 3
Spectrum 11	0	8.53	1.6	0	0	0	0	0	0	4	81.31	0	2	2022.12.12/Clarbeston/P20805PA002 3
Spectrum 12	0	0	0	0	0	0	0	0	0	3.05	94.28	0	0	2022.12.12/Clarbeston/P20805PA002 3
Spectrum 13	0	0	0	0	0	0	0	0	0	44.4	53.66	0	0	2022.12.12/Clarbeston/P20805PA002 3
Spectrum 14	0	0	0	0	0	0	0	0	0	3.25	93.9	0	0	2022.12.12/Clarbeston/P20805PA002 3
Spectrum 15	0	0	0	0	0	0	0	0	0	28.26	69.94	0	0	2022.12.12/Clarbeston/P20805PA002 4
Spectrum 16	0	0	0	0	0	0	0	0	0	25.2	72.48	0	0	2022.12.12/Clarbeston/P20805PA002 4
Spectrum 17	0	0	0	0	0	0	0	0	0	29.24	68.72	0	0	2022.12.12/Clarbeston/P20805PA002 4
Spectrum 18	0	0	0	0	0	0	0	0	0	32.53	65.11	0	0	2022.12.12/Clarbeston/P20805PA002 4
Spectrum 19	0	0	0	0	0	0	0	0	0	25.12	72.55	0	0	2022.12.12/Clarbeston/P20805PA002 5
Spectrum 20	0	0	2.1	0	0	0	0	0	0	4.09	88.35	0	2.3	2022.12.12/Clarbeston/P20805PA002 5
Spectrum 21	0	0	0	0	0	0	0	0	0	0	97.14	0	0	2022.12.12/Clarbeston/P20805PA002 5
Spectrum 22	0	0	0	0	0	0	0	0	0	2.53	94.84	0	0	2022.12.12/Clarbeston/P20805PA002 5
Spectrum 23	0	0	0	0	0	0	0	0	0	25.45	70.1	0	0	2022.12.12/Clarbeston/P20805PA002 5
Spectrum 24	0	7.83	1.71	0	0	0	0	0	0	10.28	77.79	0	0	2022.12.12/Clarbeston/P20805PA002 6
Spectrum 25	0	9.08	1.52	0	0	0	0	0	0	1.78	85.69	0	0	2022.12.12/Clarbeston/P20805PA002 6
Spectrum 26	0	11.33	0	0	0	0	0	0	0	1.12	85.87	0	0	2022.12.12/Clarbeston/P20805PA002 6
Spectrum 27	0	0	0	0	0	0	0	0	0	22.97	74.47	0	0	2022.12.12/Clarbeston/P20805PA002 7
Spectrum 28	0	10.49	1.51	0	0	0	0	0	0	0	83.02	0	2.52	2022.12.12/Clarbeston/P20805PA002 7
Spectrum 29	0	0	0	0	0	0	0	0	0	2.41	95.09	0	0	2022.12.12/Clarbeston/P20805PA002 7
Spectrum 30	0.89	7.29	0	0	0	0	0	0	0	0	88.26	0	0	2022.12.12/Clarbeston/P20805PA002 7
Spectrum 31	0	7.35	1.59	0	0	0	0	0	0	0	86.67	0	2.21	2022.12.12/Clarbeston/P20805PA002 7
Spectrum 32	0	0	0	0	0	0	0	0	0	18.58	78.39	0	0	2022.12.12/Clarbeston/P20805PA002 8
Spectrum 33	0	7.39	0	0	0	0	0	0	0	1.08	85.53	0	0	2022.12.12/Clarbeston/P20805PA002 8
Spectrum 34	1.09	0	1.58	0	0	0	0	0	0	17.74	75.28	0	2.03	2022.12.12/Clarbeston/P20805PA002 8
Spectrum 35	0	8.93	1.52	0	0	0	0	0	0	1.88	83.18	0	2.03	2022.12.12/Clarbeston/P20805PA002 8
Spectrum 36	0	0	1.79	0	0	0	0	0	0	0	92.32	0	2.45	2022.12.12/Clarbeston/P20805PA002 8
Spectrum 37	0	0	1.52	0	0	0	0	0	0	18.51	77.5	0	0	2022.12.12/Clarbeston/P20805PA002 8
Spectrum 38	0	5.56	1.29	0	0	0	0	0	0	25.76	63	0	1.77	2022.12.12/Clarbeston/P20805PA002 9
Spectrum 39	0	9.89	1.54	0	0	0	0	0	0	2.05	81.47	0	2.34	2022.12.12/Clarbeston/P20805PA002 9
Spectrum 40	0	0	1.42	0	0	0	0	0	0	27.96	68.06	0	0	2022.12.12/Clarbeston/P20805PA002 9
Spectrum 41	0	0	0	0	0	0	0	0	0	2.41	95.07	0	0	2022.12.12/Clarbeston/P20805PA002 9
Spectrum 42	0	0	0	0	0	0	0	0	0	32.38	64.99	0	0	2022.12.12/Clarbeston/P20805PA002 10
Spectrum 43	0	10	1.64	0	0	0	0	0	0	2.55	83.2	0	0	2022.12.12/Clarbeston/P20805PA002 10
Spectrum 44	0.88	8.5	1.61	0	0	0	0	0	0	0	83.65	0	2.28	2022.12.12/Clarbeston/P20805PA002 10
Spectrum 45	0	0	0	0	0	0	0	0	0	3.6	91.57	0	0	2022.12.12/Clarbeston/P20805PA002 10
Spectrum 46	0	0	0	0	0	0	0	0	0	32.96	64.97	0	0	2022.12.12/Clarbeston/P20805PA002 10
Spectrum 47	0	0	0	0	0	0	0	0	0	41.17	54.51	0	0	2022.12.12/Clarbeston/P20805PA002 11
Spectrum 48	0	0	1.74	0	0	0	0	0	0	1.83	93.39	0	0	2022.12.12/Clarbeston/P20805PA002 11
Spectrum 49	0	7.59	1.75	0	0	0	0	0	0	2.44	82.91	0	2.31	2022.12.12/Clarbeston/P20805PA002 11
Spectrum 50	0.86	0	0	0	0	0	0	0	0	40.66	55.47	0	0	2022.12.12/Clarbeston/P20805PA002 11
Spectrum 51	0	8.86	1.43	0	0	0	0	0	0	7.35	77.31	0	2.26	2022.12.12/Clarbeston/P20805PA002 12
Spectrum 52	0	8.6	0	0	0	0	0	0	0	0	88.28	0	0	2022.12.12/Clarbeston/P20805PA002 12
Spectrum 53	0	0	0	0	0	0	0	0	0	6.12	89.34	0	0	2022.12.12/Clarbeston/P20805PA002 13
Spectrum 54	0	8.79	1.68	0	0	0	0	0	0	5.85	77.3	0	2.27	2022.12.12/Clarbeston/P20805PA002 13
Spectrum 55	0	0	0	0	0	0	0	0	0	46.4	49.54	0	0	2022.12.12/Clarbeston/P20805PA002 14
Spectrum 56	0	0	1.48	0	0	0	0	0	0	18.06	74.22	0	1.94	2022.12.12/Clarbeston/P20805PA002 14
Spectrum 57	0	0	1.64	0	0	0	0	0	0	3.02	90.25	0	0	2022.12.12/Clarbeston/P20805PA002 14
Spectrum 58	0	0	1.26	0	0	0	0	0	0	45.53	48.53	0	0	2022.12.12/Clarbeston/P20805PA002 14
Spectrum 59	0	0	0	0	0	0	0	0	0	33.4	64.07	0	0	2022.12.12/Clarbeston/P20805PA002(1) 1
Spectrum 60	0	9.95	1.5	0	0	0	0	0	0	0	82.93	0	2.18	2022.12.12/Clarbeston/P20805PA002(1) 1
Spectrum 61	0	8.06	1.61	0	0	0	0	0	0	4.76	82.52	0	0	2022.12.12/Clarbeston/P20805PA002(1) 1
Spectrum 62	0	0	0	0	0	0	0	0	0	32.55	64.08	0	0	2022.12.12/Clarbeston/P20805PA002(1) 1
Spectrum 63	0	0	0	0	0	0	0	0	0	52.7	45.11	0	0	2022.12.12/Clarbeston/P20805PA002(1) 2
Spectrum 64	0.91	7.96	1.82	0	0	0	0	0	0	0.9	82.17	0	2.1	2022.12.12/Clarbeston/P20805PA002(1) 2
Spectrum 65	0	7.62	0	0	0	0	0	0	0	7.83	81.44	0	0	2022.12.12/Clarbeston/P20805PA002(1) 2
Spectrum 66	0	0	1.2	0	0	0	0	0	0	51.82	44.16	0	0	2022.12.12/Clarbeston/P20805PA002(1) 2
Spectrum 67	0	6.51	1.68	0	0	0	0	0	0	11.1	75.87	0	1.95	2022.12.12/Clarbeston/P20805PA002(1) 3
Spectrum 68	0	8.87	0	0	0	0	0	0	0	1.76	84.49	0	2.19	2022.12.12/Clarbeston/P20805PA002(1) 3
Spectrum 69	0	7.38	1.67	0	0	0	0	0	0	7.44	78.46	0	2.5	2022.12.12/Clarbeston/P20805PA002(1) 3
Spectrum 70	0	7.93	0	0	0	0	0	0	0	0	88.78	0	0	2022.12.12/Clarbeston/P20805PA002(1) 3
Spectrum 71	0	0	0	0	0	0	0	0	0	39.09	58.13	0	0	2022.12.12/Clarbeston/P20805PA002(1) 4
Spectrum 72	0	8.88	1.88	0	0	0	0	0	0	3.69	80.87	0	2.32	2022.12.12/Clarbeston/P20805PA002(1) 4
Spectrum 73	0	8.99	1.55	0	0	0	0	0	0	2.85	83.87	0	0	2022.12.12/Clarbeston/P20805PA002(1) 4
Spectrum 74	0	0	0	0	0	0	0	0	0	40.73	56.4	0	0	2022.12.12/Clarbeston/P20805PA002(1) 5
Spectrum 75	0	0	0	0	0	0	0	0	0	1.44	95.39	0	0	2022.12.12/Clarbeston/P20805PA002(1) 5
Spectrum 76	0	9.31	1.48	0	0	0	0	0	0	3.67	80.16	0	2.42	2022.12.12/Clarbeston/P20805PA002(1) 5
Spectrum 77	0	0	1.41	0	0	0	0	0	0	26.89	67.24	0	1.94	2022.12.12/Clarbeston/P20805PA002(1) 5
Spectrum 78	0	7.52	1.84	0	0	0	0	0	0	4.58	81.36	0	2.02	2022.12.12/Clarbeston/P20805PA002(1) 5
Spectrum 79	0	0	0	0	0	0	0	0	0	39.77	56.03	0	0	2022.12.12/Clarbeston/P20805PA002(1) 5
Spectrum 80	0	7.63	0	0	0	0	0	0	0	3.39	85.15	0	0	2022.12.12/Clarbeston/P20805PA002(1) 5
Spectrum 81	0	0	1.74	0	0	0	0	0	0	20.25	73.17	0	1.95	2022.12.12/Clarbeston/P20805PA002(1) 6
Spectrum 82	0	9.25	0	0	0	0	0	0	0	1.13	83.72	0	2.24	2022.12.12/Clarbeston/P20805PA002(1) 6
Spectrum 83	0	9.84	1.67	0	0	0	0	0	0	1.2	81.9	0	2.08	2022.12.12/Clarbeston/P20805PA002(1) 6
Spectrum 84	0	0	0	0	0	0	0	0	0	36.1	60.97	0	0	2022.12.12/Clarbeston/P20805PA002(1) 7
Spectrum 85	0	11.38	1.47	0	0	0	0	0	0	1.12	80.78	0	2.32	2022.12.12/Clarbeston/P20805PA002(1) 7
Spectrum 86	0	0	0	0	0	0	0	0	0	1.69	95.06	0	0	2022.12.12/Clarbeston/P20805PA002(1) 7
Spectrum 87	0	0	0	0	0	0	0	0	0	35.85	61.2	0	0	2022.12.12/Clarbeston/P20805PA002(1) 7
Spectrum 88	0	0	0	0	0	0	0	0	0	38.52	58.25	0	0	2022.12.12/Clarbeston/P20805PA002(1) 8
Spectrum 89	0	9.89	1.52	0	0	0	0	0	0	1.39	79.6	0	2.38	2022.12.12/Clarbeston/P20805PA002(1) 8
Spectrum 90	0	8.03	0	0	0	0	0	0	0	1.35	87.3	0	0	2022.12.12/Clarbeston/P20805PA002(1) 8
Spectrum 91	0	7.83	1.5	0	0	0	0	0	0	1.55	83.7	0	2.14	2022.12.12/Clarbeston/P20805PA002(1) 8
Spectrum 92	0	0	1.48	0	0	0	0	0	0	21.74	73.09	0	0	2022.12.12/Clarbeston/P20805PA002(1) 8
Spectrum 93	0	0	0	0	0	0	0	0	0	28	68.44	0	0	2022.12.12/Clarbeston/P20805PA002(1) 9
Spectrum 94	0	9.64	1.52	0	0	0	0	0	0	0	82.45	0	2.21	2022.12.12/Clarbeston/P20805PA002(1) 9
Spectrum 95	0	8.28	0	0	0	0	0	0	0	2.25	86.28	0	0	2022.12.12/Clarbeston/P20805PA002(1) 9
Spectrum 96	0	7.94	1.68	0	0	0	0	0	0	3.54	80.82	0	2.1	2022.12.12/Clarbeston/P20805PA002(1) 9
Spectrum 97	0	0	1.38	0	0	0	0	0	0	33.93	59.4	0	2.01	2022.12.12/Clarbeston/P20805PA002(1) 10
Spectrum 98	0	0	1.35	0	0	0	0	0	0	32.81	62.43	0	0	2022.12.12/Clarbeston/P20805PA002(1) 10
Spectrum 99	0	0	0	0	0	0	0	0	0	34.53	61.03	0	0	2022.12.12/Clarbeston/P20805PA002(1) 10
Spectrum 100	0	0	0	0	0	0	0	0	0	35.06	60.97	0	0	2022.12.12/Clarbeston/P20805PA002(1) 10

Spectrum 101	1.24	0	0	0	0	0	0.8	0	0	18.79	34.04	0	0	2022.12.12/Clarbeston/P20805PA002(1) 10
Spectrum 102	1.84	0	1.53	0	0	0	0.86	0	0	31.79	56.88	0	0	2022.12.12/Clarbeston/P20805PA002(1) 10
Spectrum 103	0.89	0	1.72	0	0	0	0	0	0	21.78	71.56	0	1.96	2022.12.12/Clarbeston/P20805PA002(3.1) 1
Spectrum 104	0	8.98	1.48	0	0	0	0	0	0	0	85.6	0	2.15	2022.12.12/Clarbeston/P20805PA002(3.1) 1
Spectrum 105	0	0	0	0	0	0	0	0	0	22.7	74.76	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 1
Spectrum 106	0	0	1.31	0	0	0	0	0	0	42.78	54.58	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 2
Spectrum 107	0	6.99	1.61	0	0	0	0	0	0	3.9	85.63	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 2
Spectrum 108	0	8.63	1.54	0	0	0	0	0	0	3.06	82.38	0	2.14	2022.12.12/Clarbeston/P20805PA002(3.1) 2
Spectrum 109	0	7.53	0	0	0	0	0	0	0	4.42	86.25	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 2
Spectrum 110	0	0	0	0	0	0	0	0	0	31.55	66.29	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 3
Spectrum 111	0	8.07	0	0	0	0	0	0	0	0	89.92	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 3
Spectrum 112	0	0	0	0	0	0	0	0	0	10.36	87.65	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 4
Spectrum 113	0	0	1.64	0	0	0	0	0	0	10.7	85.57	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 4
Spectrum 114	0.89	8.33	0	0	0	0	0	0	0	0	88.34	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 4
Spectrum 115	0	0	1.36	0	0	0	0	0	0	33.91	61.42	0	1.75	2022.12.12/Clarbeston/P20805PA002(3.1) 5
Spectrum 116	0	8.74	2.04	0	0	0	0	0	0	3.54	81.09	0	2.59	2022.12.12/Clarbeston/P20805PA002(3.1) 5
Spectrum 117	0	10.07	1.56	0	0	0	0	0	0	2.71	80.06	0	2.62	2022.12.12/Clarbeston/P20805PA002(3.1) 5
Spectrum 118	0	0	0	0	0	0	0	0	0	34.8	62.43	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 5
Spectrum 119	0	0	0	0	0	0	0	0	0	53.91	44.6	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 6
Spectrum 120	0	9.18	1.68	0	0	0	0	0	0	1.7	83.04	0	2.36	2022.12.12/Clarbeston/P20805PA002(3.1) 6
Spectrum 121	0	0	0	0	0	0	0	0	0	53.29	44.84	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 6
Spectrum 122	0	0	1.7	0	0	0	0	0	0	7.54	88	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 6
Spectrum 123	0	0	0	0	0	0	0	0	0	31.5	66.65	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 7
Spectrum 124	0	6.95	1.5	0	0	0	0	0	0	2.37	85.01	0	2.16	2022.12.12/Clarbeston/P20805PA002(3.1) 7
Spectrum 125	0	11.43	2.1	0	0	0	0	0	0	0	81.15	0	2.98	2022.12.12/Clarbeston/P20805PA002(3.1) 7
Spectrum 126	0	0	0	0	0	0	0	0	0	31.44	66.46	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 7
Spectrum 127	0.97	0	1.68	0	0	0	0	0	0	0	91.81	0	2.54	2022.12.12/Clarbeston/P20805PA002(3.1) 7
Spectrum 128	0	0	0	0	0	0	0	0	0	29.64	67.71	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 8
Spectrum 129	0	10.61	1.53	0	0	0	0	0	0	1.02	81.96	0	2.29	2022.12.12/Clarbeston/P20805PA002(3.1) 8
Spectrum 130	0	9.06	0	0	0	0	0	0	0	1.27	86.53	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 8
Spectrum 131	0	0	1.78	0	0	0	0	0	0	1.31	92.16	0	2.4	2022.12.12/Clarbeston/P20805PA002(3.1) 8
Spectrum 132	0	0	0	0	0	0	0	0	0	30.13	67.86	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 8
Spectrum 133	0	0	0	0	0	0	0	0	0	59.29	37.88	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 9
Spectrum 134	0	0	0	0	0	0	0	0	0	0	97.92	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 9
Spectrum 135	0	0	0	0	0	0	0	0	0	21.98	75.66	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 9
Spectrum 136	0	0	0	0	0	0	0	0	0	30.77	67.46	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 10
Spectrum 137	0	0	0	0	0	0	0	0	0	5.92	91.08	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 10
Spectrum 138	0	8.95	0	0	0	0	0	0	0	0	88.39	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 10
Spectrum 139	0	0	0	0	0	0	0	0	0	6.85	89.65	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 10
Spectrum 140	0	5.85	1.29	0	0	0	0	0	0	27.68	61.59	0	1.82	2022.12.12/Clarbeston/P20805PA002(3.1) 10
Spectrum 141	0	0	0	0	0	0	0	0	0	19.57	78.39	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 11
Spectrum 142	0	7.98	0	0	0	0	0	0	0	0	90.1	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 11
Spectrum 143	0	8.45	0	0	0	0	0	0	0	0	88.82	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 11
Spectrum 144	0	7.71	1.44	0	0	0	0	0	0	17.8	68.54	0	2.09	2022.12.12/Clarbeston/P20805PA002(3.1) 11
Spectrum 145	0	0	0	0	0	0	0	0	0	20.95	74.71	0	1.99	2022.12.12/Clarbeston/P20805PA002(3.1) 12
Spectrum 146	0	0	0	0	0	0	0	0	0	1.51	95.48	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 12
Spectrum 147	0	9.8	0	0	0	0	0	0	0	0	85.79	0	2.22	2022.12.12/Clarbeston/P20805PA002(3.1) 12
Spectrum 148	0	0	0	0	0	0	0	0	0	33.92	63.41	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 13
Spectrum 149	0	0	0	0	0	0	0	0	0	0	96.5	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 13
Spectrum 150	0.82	10.94	0	0	0	0	0	0	0	1.86	83.63	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 13
Spectrum 151	0	0	0	0	0	0	0	0	0	33.43	61.73	0	1.78	2022.12.12/Clarbeston/P20805PA002(3.1) 13
Spectrum 152	0	6.17	1.73	0	0	0	0	0	0	24.45	62.32	0	2.21	2022.12.12/Clarbeston/P20805PA002(3.1) 14
Spectrum 153	0	9.02	0	0	0	0	0	0	0	0	86.19	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 14
Spectrum 154	0	8.32	0	0	0	0	0	0	0	2.54	85.83	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 14
Spectrum 155	0	0	0	0	0	0	0	0	0	5.24	90.41	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 14
Spectrum 156	0	9.35	1.91	0	0	0	0	0	0	0	81.43	0	2.25	2022.12.12/Clarbeston/P20805PA002(3.1) 14
Spectrum 157	0	8.45	0	0	0	0	0	0	0	4.45	82.1	0	2.05	2022.12.12/Clarbeston/P20805PA002(3.1) 14
Spectrum 158	0	0	0	0	0	0	0	0	0	5.26	89.06	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 15
Spectrum 159	0	5.21	1.05	0	0	0	0	0	0	3.19	55.79	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 15
Spectrum 160	0	8.02	0	0	0	0	0	0	0	4.88	83.48	0	0	2022.12.12/Clarbeston/P20805PA002(3.1) 15
Spectrum 161	0	0	0	0	0	0	0	0	0	4.39	93.54	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 1
Spectrum 162	0	0	0	0	0	0	0	0	0	34.09	64.56	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 1
Spectrum 163	0	9.4	1.74	0	0	0	0	0	0	2.89	81.44	0	2.24	2022.12.12/Clarbeston/P20805PA002(3.2) 1
Spectrum 164	0	0	0	0	0	0	0	0	0	32.9	64.09	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 1
Spectrum 165	1.38	0	0	0	0	0	0	0	0	61.85	34.51	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 2
Spectrum 166	0	6.99	1.51	0	0	0	0	0	0	9.28	78.5	0	1.99	2022.12.12/Clarbeston/P20805PA002(3.2) 2
Spectrum 167	0	0	0	0	0	0	0	0	0	63.32	35.22	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 2
Spectrum 168	0.85	9.31	1.46	0	0	0	0	0	0	1.88	82.47	0	2.18	2022.12.12/Clarbeston/P20805PA002(3.2) 2
Spectrum 169	0.83	0	1.38	0	0	0	0	0	0	40.74	54.26	0	1.76	2022.12.12/Clarbeston/P20805PA002(3.2) 3
Spectrum 170	0	7.89	1.72	0	0	0	0	0	0	5.61	80.72	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 3
Spectrum 171	0	0	1.33	0	0	0	0	0	0	41.83	55.88	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 3
Spectrum 172	0	8.7	0	0	0	0	0	0	0	3.69	83.2	0	2.14	2022.12.12/Clarbeston/P20805PA002(3.2) 3
Spectrum 173	0	47.34	0	0	0	0	0	0	0	0	0	52.66	0	2022.12.12/Clarbeston/P20805PA002(3.2) 3
Spectrum 174	0	0	0	0	0	0	0	0	0	32.4	65.37	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 4
Spectrum 175	0	10.84	2.12	0	0	0	0	0	0	1.14	81.58	0	2.97	2022.12.12/Clarbeston/P20805PA002(3.2) 4
Spectrum 176	0	0	0	0	0	0	0	0	0	31.9	65.43	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 4
Spectrum 177	1.08	8.65	1.6	0	0	0	0	0	0	1.56	82.73	0	2.14	2022.12.12/Clarbeston/P20805PA002(3.2) 4
Spectrum 178	0	7.38	0	0	0	0	0	0	0	1.54	89.06	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 4
Spectrum 179	0	0	0	0	0	0	0	0	0	32.21	66.34	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 4
Spectrum 180	0	0	1.71	0	0	0	0	0	0	1.6	94.64	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 5
Spectrum 181	0	0	0	0	0	0	0	0	0	47.6	51.08	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 5
Spectrum 182	0	7.39	0	0	0	0	0	0	0	1.18	87.24	0	2.35	2022.12.12/Clarbeston/P20805PA002(3.2) 5
Spectrum 183	0	0	0	0	0	0	0	0	0	47.12	51.52	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 5
Spectrum 184	0	9.15	1.98	0	0	0	0	0	0	1.86	83.24	0	2.28	2022.12.12/Clarbeston/P20805PA002(3.2) 5
Spectrum 185	0	0	0	0	0	0	0	0	0	35.65	62.53	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 6
Spectrum 186	0	8.3	1.63	0	0	0	0	0	0	0	88.57	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 6
Spectrum 187	0	10.86	1.61	0	0	0	0	0	0	1.5	81.47	0	2.88	2022.12.12/Clarbeston/P20805PA002(3.2) 6
Spectrum 188	0	0	0	0	0	0	0	0	0	35.61	62.7	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 6
Spectrum 189	0	7.97	0	0	0	0	0	0	0	0.89	89.29	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 6
Spectrum 190	0	0	0	0	0	0	0	0	0	1.93	96.07	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 6
Spectrum 191	0	0	0	0	0	0	0	0	0	31.2	66.8	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 7
Spectrum 192	0	9.91	1.85	0	0	0	0	0	0	0	83.66	0	2.73	2022.12.12/Clarbeston/P20805PA002(3.2) 7
Spectrum 193	0	0	1.72	0	0	0	0	0	0	1.45	95.35	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 7
Spectrum 194	0	0	0	0	0	0	0	0	0	31.71	65.63	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 7
Spectrum 195	0	0	0	0	0	0	0	0	0	42.87	53.83	0	1.67	2022.12.12/Clarbeston/P20805PA002(3.2) 7
Spectrum 197	0	0	0	0	0	0	0	0	0	50.08	48.55	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 7
Spectrum 198	0	0	0	0	0	0	0	0	0	56.02	41.52	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 8
Spectrum 199	0	0	0	0	0	0	0	0	0	1.6	96.46	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 8
Spectrum 200	0	8.36	0	0	0	0	0	0	0	0	89.18	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 8

Spectrum 201	0	0	0	0	0	0	0	0	0	55.51	41.92	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 8
Spectrum 202	0	8.37	0	0	0	0	0	0	0	0	88.69	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 9
Spectrum 203	0	0	0	0	0	0	0	0	0	26.24	72.03	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 9
Spectrum 204	0	8.47	0	0	0	0	0	0	0	0	87.09	0	2.15	2022.12.12/Clarbeston/P20805PA002(3.2) 9
Spectrum 205	0	6.28	0	0	0	0	0	0	0	22.6	67.18	0	2	2022.12.12/Clarbeston/P20805PA002(3.2) 9
Spectrum 206	0	9.26	0	0	0	0	0	0	0	0	87.05	0	2.15	2022.12.12/Clarbeston/P20805PA002(3.2) 9
Spectrum 207	0	0	0	0	0	0	0	0	0	26.79	71.14	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 9
Spectrum 208	0	0	0	0	0	0	0	0	0	44.35	53.29	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 10
Spectrum 209	0.88	10.59	0	0	0	0	0	0	0	1.79	81.89	0	2.04	2022.12.12/Clarbeston/P20805PA002(3.2) 10
Spectrum 210	1.02	0	1.57	0	0	0	0	0	0	3.91	89.13	0	2.17	2022.12.12/Clarbeston/P20805PA002(3.2) 10
Spectrum 211	0	7.15	0	0	0	0	0	0	0	1.59	88.55	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 10
Spectrum 212	0	0	1.38	0	0	0	0	0	0	43.76	52.92	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 10
Spectrum 213	0	9.53	0	0	0	0	0	0	0	1.31	84.71	0	2.34	2022.12.12/Clarbeston/P20805PA002(3.2) 11
Spectrum 214	0.92	0	0	0	0	0	0	0	0	24.54	71.77	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 11
Spectrum 215	0	9.21	1.52	0	0	0	0	0	0	0	84.1	0	2.04	2022.12.12/Clarbeston/P20805PA002(3.2) 11
Spectrum 216	0	0	0	0	0	0	0	0	0	23.89	72.54	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 11
Spectrum 217	0	9.05	0	0	0	0	0	0	0	2.76	85.29	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 11
Spectrum 218	0	9.11	0	0	0	0	0	0	0	3.37	84.27	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 12
Spectrum 219	0	0	1.36	0	0	0	0	0	0	40.36	53.91	0	1.66	2022.12.12/Clarbeston/P20805PA002(3.2) 12
Spectrum 220	0	8.37	0	0	0	0	0	0	0	3.44	85.74	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 12
Spectrum 221	0	8.62	0	0	0	0	0	0	0	1.63	87.17	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 12
Spectrum 222	0	0	0	0	0	0	0	0	0	41.17	56.15	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 12
Spectrum 223	0	0	0	0	0	0	0	0	0	24.55	71.62	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 13
Spectrum 224	0	8.58	1.74	0	0	0	0	0	0	3.02	80.55	0	2.51	2022.12.12/Clarbeston/P20805PA002(3.2) 13
Spectrum 225	0	8	1.6	0	0	0	0	0	0	0	83.1	0	2.28	2022.12.12/Clarbeston/P20805PA002(3.2) 13
Spectrum 226	0	9.67	1.62	0	0	0	0	0	0	1.75	81.17	0	1.96	2022.12.12/Clarbeston/P20805PA002(3.2) 13
Spectrum 227	0	0	0	0	0	0	0	0	0	28.74	67.79	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 13
Spectrum 228	0	0	0	0	0	0	0	0	0	24.22	71.7	0	0	2022.12.12/Clarbeston/P20805PA002(3.2) 13
Spectrum 229	0	7.55	1.58	0	0	0	0	0	0	1.29	85.3	0	2.16	2022.12.12/Clarbeston/P20805PA002(4.1) 1
Spectrum 230	0	7.08	1.47	0	0	0	0	0	0	17.95	69.75	0	1.86	2022.12.12/Clarbeston/P20805PA002(4.1) 1
Spectrum 231	0	7.34	0	0	0	0	0	0	0	1.15	89.96	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 1
Spectrum 232	0	0	1.52	0	0	0	0	0	0	19.86	76.96	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 1
Spectrum 233	0	0	0	0	0	0	0	0	0	29.74	68.57	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 2
Spectrum 234	0	9.21	1.48	0	0	0	0	0	0	3.18	81.15	0	2.06	2022.12.12/Clarbeston/P20805PA002(4.1) 2
Spectrum 235	0	47.53	0	0	0	0	0	0	0	0	0	52.47	0	2022.12.12/Clarbeston/P20805PA002(4.1) 2
Spectrum 236	0	0	0	0	0	0	0	0	0	2.34	94.61	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 2
Spectrum 237	0	0	0	0	0	0	0	0	0	29.23	69.02	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 2
Spectrum 238	0	0	0	0	0	0	0	0	0	30.8	66.45	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 14a
Spectrum 239	0	0	0	0	0	0	1.01	0	0	36.2	59.53	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 14a
Spectrum 240	35.31	0	0	0	0	0	0	0	0	0	0	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 14a
Spectrum 241	0	0	1.46	0	0	0	0	0	0	30.95	64.88	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 14a
Spectrum 242	0	6.97	0	0	0	0	0	0	0	10.47	77.56	0	2.07	2022.12.12/Lampeter/P20920CA001(1.1) 14a
Spectrum 243	0	0	0	0	0	0	0	0	0	30.81	66.2	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 14a
Spectrum 244	19.92	0	0	3.54	0	0	2.6	0	0	0	0	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 14a
Spectrum 245	35.73	0	0	0	0	0	0	0	0	0	0	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 14a
Spectrum 246	11.47	0	0.74	2.22	0	0.99	10.42	0	0	0	0	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 14a
Spectrum 247	0	8.01	1.76	0	0	0	0	0	0	5.42	83.33	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 3
Spectrum 248	0	10	2.01	0	0	0	0	0	0	0	84.02	0	2.61	2022.12.12/Clarbeston/P20805PA002(4.1) 3
Spectrum 249	0	0	0	0	0	0	0	0	0	5.46	92.97	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 3
Spectrum 250	0	7.61	0	0	0	0	0	0	0	1.5	88.79	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 3
Spectrum 251	0	0	0	0	0	0	0	0	0	41.13	57.62	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 4
Spectrum 252	0	0	0	0	0	0	0	0	0	41.25	57.28	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 4
Spectrum 253	0	0	0	0	0	0	0	0	0	41.08	55.97	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 4
Spectrum 254	0	0	0	0	0	0	0	0	0	3.3	93.61	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 4
Spectrum 255	0	7.11	1.68	0	0	0	0	0	0	4.84	82.64	0	2.23	2022.12.12/Clarbeston/P20805PA002(4.1) 4
Spectrum 256	0	0	0	0	0	0	0	0	0	23.73	72.84	0	2.05	2022.12.12/Clarbeston/P20805PA002(4.1) 5
Spectrum 257	0	9.27	0	0	0	0	0	0	0	1.23	85.67	0	2.21	2022.12.12/Clarbeston/P20805PA002(4.1) 5
Spectrum 258	0	0	0	0	0	0	0	0	0	24.81	72.9	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 5
Spectrum 259	0	9.7	0	0	0	0	0	0	0	1.82	84.02	0	2.11	2022.12.12/Clarbeston/P20805PA002(4.1) 5
Spectrum 260	0	8.58	0	0	0	0	0	0	0	0	87.16	0	2.22	2022.12.12/Clarbeston/P20805PA002(4.1) 6
Spectrum 261	0	7.8	1.64	0	0	0	0	0	0	4.67	82.14	0	2.24	2022.12.12/Clarbeston/P20805PA002(4.1) 6
Spectrum 262	0	9.95	0	0	0	0	0	0	0	0	86.48	0	2.48	2022.12.12/Clarbeston/P20805PA002(4.1) 6
Spectrum 263	0	8.56	0	0	0	0	0	0	0	4.86	82.74	0	2.22	2022.12.12/Clarbeston/P20805PA002(4.1) 6
Spectrum 264	0	10.57	1.43	0	0	0	0	0	0	2.49	81.82	0	2.45	2022.12.12/Clarbeston/P20805PA002(4.1) 7
Spectrum 265	0	0	0	0	0	0	0	0	0	38.53	58.9	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 7
Spectrum 266	0	0	0	0	0	0	0	0	0	1.04	96.87	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 7
Spectrum 267	0	0	0	0	0	0	0	0	0	38.89	58.39	1.38	0	2022.12.12/Clarbeston/P20805PA002(4.1) 7
Spectrum 268	0	0	0	0	0	0	0	0	0	9.31	88.75	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 7
Spectrum 269	0	8.27	0	0	0	0	0	0	0	8.63	81.14	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 8
Spectrum 270	0	0	0	0	0	0	0	0	0	24.08	74	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 8
Spectrum 271	0	7.51	0	0	0	0	0	0	0	11.2	77.16	0	2.07	2022.12.12/Clarbeston/P20805PA002(4.1) 8
Spectrum 272	0	0	0	0	0	0	0	0	0	15.24	82.88	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 8
Spectrum 273	0	0	0	0	0	0	0	0	0	2.45	95.58	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 8
Spectrum 274	0	0	1.6	0	0	0	0	0	0	23.67	73	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 8
Spectrum 275	0	0	0	0	0	0	0	0	0	39.81	56.89	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 9
Spectrum 276	0	8.92	2.14	0	0	0	0	0	0	2.76	81.64	0	2.53	2022.12.12/Clarbeston/P20805PA002(4.1) 9
Spectrum 277	0	0	0	0	0	0	0	0	0	0	98.1	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 9
Spectrum 278	0.92	0	0	0	0	0	0	0	0	39.78	57.63	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 9
Spectrum 279	0	6.85	0	0	0	0	0	0	0	15.81	75.57	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 9
Spectrum 280	0	0	0	0	0	0	0	0	0	29.78	68.47	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 9
Spectrum 281	0	0	1.42	0	0	0	0	0	0	39.64	57.17	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 9
Spectrum 283	0	9.65	1.6	0	0	0	0	0	0	1.49	82.49	0	2.4	2022.12.12/Clarbeston/P20805PA002(4.1) 10
Spectrum 284	0	6.56	1.79	0	0	0	0	0	0	20.37	66.76	0	2.06	2022.12.12/Clarbeston/P20805PA002(4.1) 10
Spectrum 285	0	0	0	0	0	0	0	0	0	0	97.53	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 10
Spectrum 286	0	6.19	0	0	0	0	0	0	0	21.94	69.83	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 10
Spectrum 287	0	0	0	0	0	0	0	0	0	0	97.34	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 10
Spectrum 288	0	0	1.57	0	0	0	0	0	0	21.83	72.06	0	1.97	2022.12.12/Clarbeston/P20805PA002(4.1) 10
Spectrum 289	0.96	8.14	1.49	0	0	0	0	0	0	0	84.09	0	2.28	2022.12.12/Clarbeston/P20805PA002(4.1) 11
Spectrum 290	0	6.66	1.51	0	0	0	0	0	0	17.22	69.99	0	1.92	2022.12.12/Clarbeston/P20805PA002(4.1) 11
Spectrum 291	0	5.92	0	0	0	0	0	0	0	18.18	70.99	0	1.84	2022.12.12/Clarbeston/P20805PA002(4.1) 11
Spectrum 292	0	6.91	0	0	0	0	0	0	0	19.07	71.35	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 11
Spectrum 293	0	0	0	0	0	0	0	0	0	0	96.79	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 11
Spectrum 294	0	0	0	0	0	0	0	0	0	23.63	73.95	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 11
Spectrum 295	0	0	1.51	0	0	0	0	0	0	22.7	71.23	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 12
Spectrum 296	0	0	0	0	0	0	0	0	0	0	95.42	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 12
Spectrum 297	0	9.4	0	0	0	0	0	0	0	1.98	85.48	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 12
Spectrum 298	0	0	1.64	0	0	0	0	0	0	0	93.83	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 12
Spectrum 299	0	7.46	0	0	0	0	0	0	0	0	88.65	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 12
Spectrum 300	0	0	0	0	0	0	0	0	0	23.86	72.35	0	0	2022.12.12/Clarbeston/P20805PA002(4.1) 12

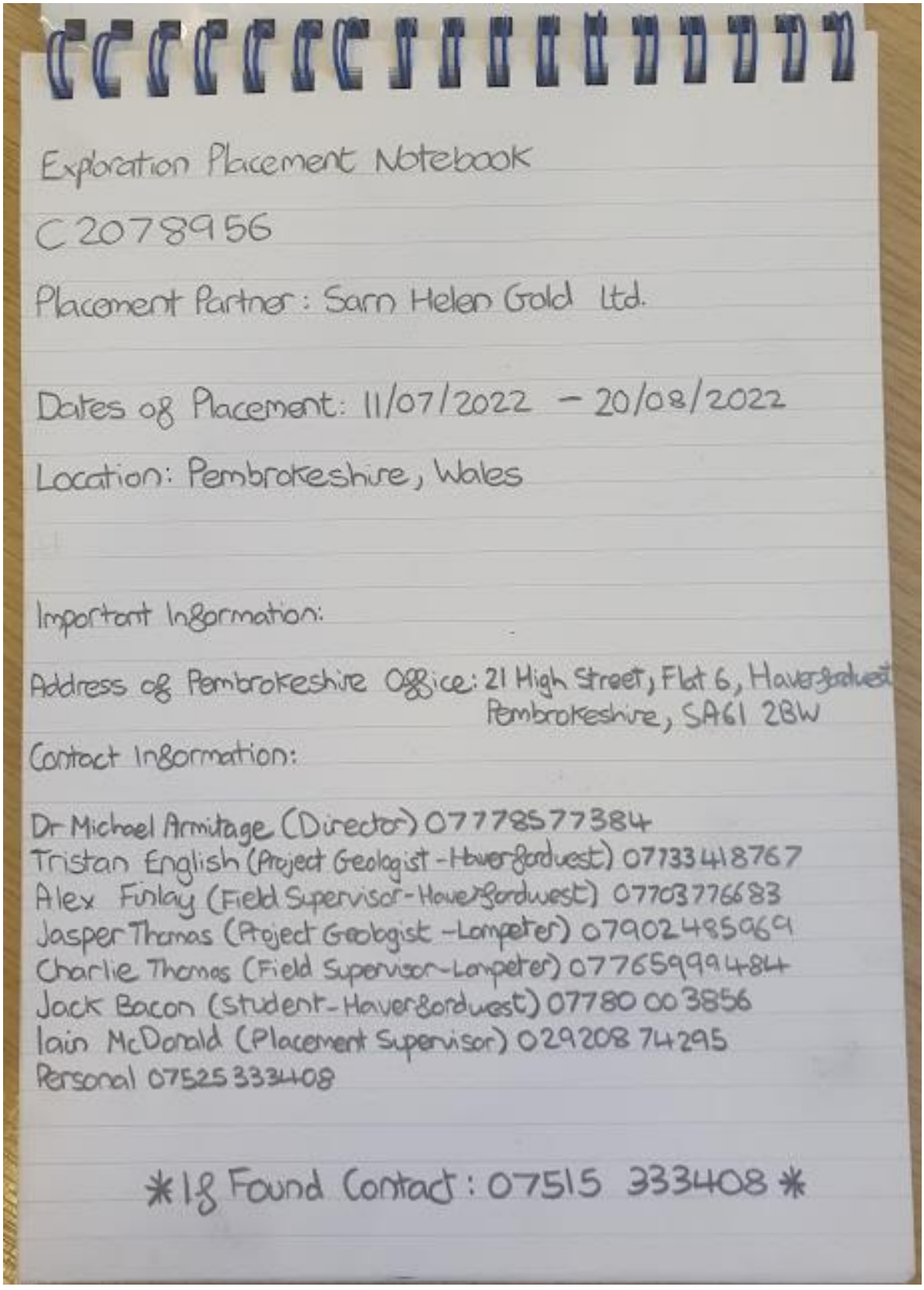
Spectrum 301	1.21	0	0	0	0	0	7.22	0	0	1.43	23.98	0	0	2022.12.12/Clarbeston/P20805Pa002(3.2) 13a
Spectrum 302	6.63	0	0	0.24	0	0	15.88	0	0	0.89	7.52	0	0	2022.12.12/Clarbeston/P20805Pa002(3.2) 13a
Spectrum 303	6.04	0	0.23	0.59	0.3	0	25.14	0	0	0	1.61	0	0	2022.12.12/Clarbeston/P20805Pa002(3.2) 13a
Spectrum 304	5.42	0	0.38	0.69	0.47	0	34.76	0	0	0	0	0	0	2022.12.12/Clarbeston/P20805Pa002(3.2) 13a
Spectrum 309	0	7.14	1.61	0	0	0	0	0	0	3.3	86.16	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 1
Spectrum 310	0	0	1.56	0	0	0	0	0	0	24.57	72.63	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 2
Spectrum 311	0	7.79	1.75	0	0	0	0	0	0	0.87	85.98	0	2.11	2022.12.12/Clarbeston/P20805PA002(4.2) 2
Spectrum 312	0	7.18	1.56	0	0	0	0	0	0	0	83.33	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 2
Spectrum 313	0	8.46	0	0	0	0	0	0	0	3.44	83.46	0	2.07	2022.12.12/Clarbeston/P20805PA002(4.2) 3
Spectrum 314	0	8.95	0	0	0	0	0	0	0	1.89	85.45	0	2.2	2022.12.12/Clarbeston/P20805PA002(4.2) 3
Spectrum 315	0.89	0	0	0	0	0	0	0	0	20.26	76.73	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 3
Spectrum 316	0	9.36	0	0	0	0	0	0	0	1.27	85.09	0	2.45	2022.12.12/Clarbeston/P20805PA002(4.2) 4
Spectrum 317	0	7.03	0	0	0	0	0	0	0	10.05	80.89	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 4
Spectrum 318	0	9.79	0	0	0	0	0	0	0	0.9	87.93	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 4
Spectrum 319	0	0	0	0	0	0	0	0	0	12.26	84.23	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 4
Spectrum 320	0	0	0	0	0	0	0	0	0	36.78	62	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 5
Spectrum 321	0	8.66	0	0	0	0	0	0	0	0	89.36	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 5
Spectrum 322	0	0	1.55	0	0	0	0	0	0	36.26	60.83	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 5
Spectrum 323	0	9.56	0	0	0	0	0	0	0	1.02	85.54	0	2.2	2022.12.12/Clarbeston/P20805PA002(4.2) 5
Spectrum 324	0	0	1.5	0	0	0	0	0	0	36.55	60.82	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 5
Spectrum 325	0	9.76	0	0	0	0	0	0	0	0	90.24	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 5
Spectrum 326	0.89	0	0	0	0	0	0	0	0	32.02	65.99	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 6
Spectrum 327	0.91	9.22	0	0	0	0	0	0	0	0	88.52	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 6
Spectrum 328	0	0	0	0	0	0	0	0	0	32.37	66.14	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 6
Spectrum 329	0	8.46	1.67	0	0	0	0	0	0	3.28	82.74	0	2.02	2022.12.12/Clarbeston/P20805PA002(4.2) 6
Spectrum 330	1.9	7.68	1.81	0	0	0	0.77	0	0	0	81.63	0	2.44	2022.12.12/Clarbeston/P20805PA002(4.2) 7
Spectrum 331	0	0	0	0	0	0	0	0	0	44.37	52.71	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 7
Spectrum 332	0	9.22	1.59	0	0	0	0	0	0	3.35	82.61	0	2.14	2022.12.12/Clarbeston/P20805PA002(4.2) 7
Spectrum 333	0	0	1.36	0	0	0	0	0	0	44.93	52.18	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 7
Spectrum 334	0.92	4.87	0	0	0	0	0	0	0	0	59.39	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 8
Spectrum 335	0	8.04	0	0	0	0	0	0	0	3.66	86.45	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 8
Spectrum 336	0.58	5.5	1.04	0	0	0	0	0	0	0	47.81	0	1.54	2022.12.12/Clarbeston/P20805PA002(4.2) 8
Spectrum 337	0	0	0	0	0	0	0	0	0	3.52	95	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 8
Spectrum 338	0	0	0	0	0	0	0	0	0	34.79	63.78	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 9
Spectrum 339	0	8.55	1.6	0	0	0	0	0	0	2.7	82.98	0	2.09	2022.12.12/Clarbeston/P20805PA002(4.2) 9
Spectrum 340	0	9.67	1.61	0	0	0	0	0	0	1.03	86.1	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 9
Spectrum 341	0	0	1.75	0	0	0	0	0	0	0	95.49	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 9
Spectrum 342	0	0	0	0	0	0	0	0	0	34.67	62.58	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 9
Spectrum 343	1.03	0	0	0	0	0	0	0	0	18.96	78.11	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 9
Spectrum 344	0	9.25	0	0	0	0	0	0	0	0	89.04	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 9
Spectrum 345	0	8.06	0	0	0	0	0	0	0	0	89.69	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 10
Spectrum 346	0	7.42	1.65	0	0	0	0	0	0	14.78	72.21	0	2.17	2022.12.12/Clarbeston/P20805PA002(4.2) 10
Spectrum 347	0	8.68	0	0	0	0	0	0	0	9.09	79.99	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 10
Spectrum 348	0	7.42	0	0	0	0	0	0	0	16.47	74.27	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 10
Spectrum 349	0	0	0	0	0	0	0	0	0	17.79	80.18	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 10
Spectrum 350	0	8.66	0	0	0	0	0	0	0	0	88.64	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 11
Spectrum 351	0	0	0	0	0	0	0	0	0	38.81	59.17	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 11
Spectrum 352	0	8.58	1.94	0	0	0	0	0	0	0	84.63	0	2.28	2022.12.12/Clarbeston/P20805PA002(4.2) 11
Spectrum 353	0	0	0	0	0	0	0	0	0	38.75	59.05	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 11
Spectrum 354	0	7.29	1.72	0	0	0	0	0	0	0	85.63	0	2.43	2022.12.12/Clarbeston/P20805PA002(4.2) 11
Spectrum 355	0	0	1.39	0	0	0	0	0	0	37.53	58.43	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 11
Spectrum 356	0	7.5	1.86	0	0	0	0	0	0	0.92	84.42	0	2.19	2022.12.12/Clarbeston/P20805PA002(4.2) 11
Spectrum 357	0	7.43	0	0	0	0	0	0	0	2.34	87.12	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 12
Spectrum 358	0	0	0	0	0	0	0	0	0	31.86	64.28	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 12
Spectrum 359	0	0	1.7	0	0	0	0	0	0	0	95.01	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 12
Spectrum 360	0.91	7.82	0	0	0	0	0	0	0	1.96	86.2	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 12
Spectrum 361	0	7.62	1.5	0	0	0	0	0	0	1.26	83.75	0	2.09	2022.12.12/Clarbeston/P20805PA002(4.2) 13
Spectrum 362	0	0	0	0	0	0	0	0	0	42.28	54.41	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 13
Spectrum 363	0	8.73	1.83	0	0	0	0	0	0	2.09	81.26	0	2.37	2022.12.12/Clarbeston/P20805PA002(4.2) 13
Spectrum 364	0	7.51	0	0	0	0	0	0	0	2.88	85.17	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 13
Spectrum 365	1.16	0	0	0	0	0	0	0	0	0.91	51.33	0	0	2022.12.12/Clarbeston/P20805PA002(4.2) 13
Spectrum 366	0	0	0	0	0	0	0	0	0	41.69	53.8	1.33	0	2022.12.12/Clarbeston/P20805PA002(4.2) 13
Spectrum 367	0	9.62	1.58	0	0	0	0	0	0	0.94	82.85	0	2.09	2022.12.12/Clarbeston/P20805PA002(4.2) 13
Spectrum 368	4.45	0	2.06	0	0	0	0	0	0	6.52	79.03	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 1
Spectrum 369	0	0	0	0	0	0	0	0	0	31.04	66.5	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 1
Spectrum 370	0	6.92	0	0	0	0	0	0	0	20.75	67.65	0	1.97	2022.12.12/Lampeter/P20920CA001(1.1) 1
Spectrum 371	0.86	0	0	0	0	0	0	0	0	21.71	74.41	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 2
Spectrum 372	0	0	0	0	0	0	0	0	0	6.32	90.46	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 2
Spectrum 373	0	0	0	0	0	0	0	0	0	22.87	74.74	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 2
Spectrum 374	0	6.68	1.66	0	0	0	0	0	0	15.92	70.95	0	2.3	2022.12.12/Lampeter/P20920CA001(1.1) 3
Spectrum 375	0	7.44	0	0	0	0	0	0	0	15.1	73.37	0	1.89	2022.12.12/Lampeter/P20920CA001(1.1) 3
Spectrum 376	0	0	0	0	0	0	0	0	0	24.4	73.25	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 3
Spectrum 377	0	0	1.51	0	0	0	0	0	0	22.13	74.15	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 3
Spectrum 378	0.94	0	0	0	0	0	0	0	0	24.12	72.66	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 3
Spectrum 379	0	0	0	0	0	0	0	0	0	17.69	79.84	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 3
Spectrum 380	0	0	0	0	0	0	0	0	0	18.45	79.15	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 4
Spectrum 381	0	0	0	0	0	0	0	0	0	40.96	56.69	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 4
Spectrum 382	0	0	0	0	0	0	0	0	0	32.08	65.37	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 4
Spectrum 383	0	6.83	0	0	0	0	0	0	0	17.86	73.22	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 4
Spectrum 384	0	6.41	0	0	0	0	0	0	0	20.4	70.86	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 4
Spectrum 385	0	0	0	0	0	0	0	0	0	34.81	63.21	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 4
Spectrum 386	0	0	0	0	0	0	0	0	0	25.71	71.86	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 5
Spectrum 387	0	0	0	0	0	0	0	0	0	33.21	64.4	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 5
Spectrum 388	0	0	0	0	0	0	0	0	0	20.45	77.5	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 5
Spectrum 389	0	0	0	0	0	0	0	0	0	37.13	60.74	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 5
Spectrum 390	0	9.35	0	0	0	0	0	0	0	6.41	79.41	0	2.19	2022.12.12/Lampeter/P20920CA001(1.1) 5
Spectrum 391	0	0	0	0	0	0	0	0	0	20.44	77.55	0	0	2022.12.12/Lampeter/P20920CA001(1.1)6
Spectrum 392	0	0	0	0	0	0	0	0	0	35.23	61.49	0	0	2022.12.12/Lampeter/P20920CA001(1.1)6
Spectrum 393	4.24	4.92	1.41	0	0	0	0	0	0	2.87	49.78	0	1.4	2022.12.12/Lampeter/P20920CA001(1.1)6
Spectrum 394	0	0	0	0	0	0	0	0	0	24.5	73.8	0	0	2022.12.12/Lampeter/P20920CA001(1.1)7
Spectrum 395	0	0	0	0	0	0	0	0	0	43.8	54.16	0	0	2022.12.12/Lampeter/P20920CA001(1.1)7
Spectrum 396	0	0	1.53	0	0	0	0	0	0	26.19	70.28	0	0	2022.12.12/Lampeter/P20920CA001(1.1)7
Spectrum 397	0	0	0	0	0	0	0	0	0	46.97	49.98	0	0	2022.12.12/Lampeter/P20920CA001(1.1)7
Spectrum 398	0	0	0	0	0	0	0	0	0	19.04	78.81	0	0	2022.12.12/Lampeter/P20920CA001(1.1)8
Spectrum 399	1.28	0	0	0	0	0	0.84	0	0	25.71	69.02	0	0	2022.12.12/Lampeter/P20920CA001(1.1)8
Spectrum 400	0	0	0	0	0	0	0	0	0	18.97	78.98	0	0	2022.12.12/Lampeter/P20920CA001(1.1)8

Spectrum 401	1.55	0	0	0	0	0	0	0	0	28.44	67.52	0	0	2022.12.12/Lampeter/P20920CA001(1.1)8
Spectrum 402	0	0	0	0	0	0	0	0	0	24.09	73.8	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 9
Spectrum 403	0	0	1.57	0	0	0	0	0	0	20.19	76.06	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 9
Spectrum 404	0	0	0	0	0	0	0	0	0	52.96	43.16	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 9
Spectrum 405	0	6.06	1.54	0	0	0	0	0	0	18.65	70.09	0	2.23	2022.12.12/Lampeter/P20920CA001(1.1) 9
Spectrum 406	0	7.87	0	0	0	0	0	0	0	1.77	88.32	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 10
Spectrum 407	0	0	0	0	0	0	0	0	0	29.48	68.43	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 10
Spectrum 408	0	0	0	0	0	0	0	0	0	28.98	69.04	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 10
Spectrum 409	0	7.65	0	0	0	0	0	0	0	0.99	88.88	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 10
Spectrum 410	0	0	0	0	0	0	0	0	0	33.42	64.56	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 10
Spectrum 411	0	0	0	0	0	0	0	0	0	14.32	83.62	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 11
Spectrum 412	0	0	1.6	0	0	0	0	0	0	13.27	80.83	0	2.21	2022.12.12/Lampeter/P20920CA001(1.1) 11
Spectrum 413	0	0	0	0	0	0	0	0	0	13.83	83.83	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 11
Spectrum 414	0	7.36	0	0	0	0	0	0	0	12.52	77.94	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 11
Spectrum 415	0	0	0	0	0	0	0	0	0	21.74	75.73	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 12
Spectrum 416	0	0	0	0	0	0	0	0	0	21.69	76.13	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 12
Spectrum 417	0	0	0	0	0	0	0	0	0	21.4	74.76	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 12
Spectrum 418	0	0	0	0	0	0	0	0	0	22.55	75.26	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 12
Spectrum 419	0	6.35	1.48	0	0	0	0	0	0	20.79	69.24	0	0	2022.12.12/Lampeter/P20920CA001(1.1) 12
Spectrum 420	0	0	0	0	0	0	0	0	0	20.81	76.48	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 1
Spectrum 421	0	9.95	1.88	0	0	0	0	0	0	0	83.38	0	2.36	2022.12.12/Treffgarn/P20801PA001 (extra) 1
Spectrum 422	0	0	0	0	0	0	0	0	0	2.11	92.66	0	2.41	2022.12.12/Treffgarn/P20801PA001 (extra) 1
Spectrum 423	0	9.14	1.88	0	0	0	0	0	0	0.87	83.14	0	2.24	2022.12.12/Treffgarn/P20801PA001 (extra) 2
Spectrum 424	0	0	0	0	0	0	0	0	0	15.05	82.55	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 2
Spectrum 425	0	0	0	0	0	0	0	0	0	14.95	82.19	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 2
Spectrum 426	0	0	0	0	0	0	0	0	0	30.97	66.59	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 3
Spectrum 427	0	7.66	0	0	0	0	0	0	0	0	89.34	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 3
Spectrum 428	0	8.61	0	0	0	0	0	0	0	6.94	78.75	0	2.14	2022.12.12/Treffgarn/P20801PA001 (extra) 3
Spectrum 429	0	0	0	0	0	0	0	0	0	33.64	62.65	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 4
Spectrum 430	0	7.39	0	0	0	0	0	0	0	16.67	71.33	0	2.11	2022.12.12/Treffgarn/P20801PA001 (extra) 4
Spectrum 431	0.93	6.75	0	0	0	0	0	0	0	15.86	72.15	0	1.88	2022.12.12/Treffgarn/P20801PA001 (extra) 4
Spectrum 432	0	8.78	0	0	0	0	0	0	0	0	88.29	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 4
Spectrum 433	0	0	0	0	0	0	0	0	0	21.42	75.09	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 5
Spectrum 434	0	8.86	1.5	0	0	0	0	0	0	0	84.84	0	2.04	2022.12.12/Treffgarn/P20801PA001 (extra) 5
Spectrum 435	0	8.93	0	0	0	0	0	0	0	0	86.22	0	2.09	2022.12.12/Treffgarn/P20801PA001 (extra) 5
Spectrum 436	0	9.39	0	0	0	0	0	0	0	2.36	82.99	0	2.17	2022.12.12/Treffgarn/P20801PA001 (extra) 5
Spectrum 437	0	10.01	0	0	0	0	0	0	0	0	87.28	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 5
Spectrum 438	0	7.07	0	0	0	0	0	0	0	21.21	69.1	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 5
Spectrum 439	0	8.73	1.65	0	0	0	0	0	0	0	81.51	0	2.21	2022.12.12/Treffgarn/P20801PA001 (extra) 6
Spectrum 440	0	7.95	1.94	0	0	0	0	0	0	0	85.32	0	2.43	2022.12.12/Treffgarn/P20801PA001 (extra) 6
Spectrum 441	0	8.74	1.68	0	0	0	0	0	0	0	85.26	0	2.05	2022.12.12/Treffgarn/P20801PA001 (extra) 6
Spectrum 442	0	8.12	0	0	0	0	0	0	0	0	89.15	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 6
Spectrum 443	0	7.59	0	0	0	0	0	0	0	0	87.38	0	2.19	2022.12.12/Treffgarn/P20801PA001 (extra) 6
Spectrum 445	0	0	0	0	0	0	0	0	0	0	96.56	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 7
Spectrum 446	0	0	1.63	0	0	0	0	0	0	14.53	78.78	0	2.12	2022.12.12/Treffgarn/P20801PA001 (extra) 7
Spectrum 447	0	7.45	0	0	0	0	0	0	0	0	86.96	0	2.13	2022.12.12/Treffgarn/P20801PA001 (extra) 7
Spectrum 448	0	0	0	0	0	0	0	0	0	17.26	79.63	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 8
Spectrum 449	0	10.78	1.73	0	0	0	0	0	0	1.36	80.92	0	2.27	2022.12.12/Treffgarn/P20801PA001 (extra) 8
Spectrum 450	0	0	1.71	0	0	0	0	0	0	13.77	79.56	0	2.15	2022.12.12/Treffgarn/P20801PA001 (extra) 9
Spectrum 451	0	8.63	1.56	0	0	0	0.75	0	0	0	86.05	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 9
Spectrum 452	0	9.54	0	0	0	0	0	0	0	0	85.08	0	2.33	2022.12.12/Treffgarn/P20801PA001 (extra) 9
Spectrum 453	0	0	1.62	0	0	0	0	0	0	9.98	85.41	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 10
Spectrum 454	0	8.12	0	0	0	0	0	0	0	0	86.57	0	2.27	2022.12.12/Treffgarn/P20801PA001 (extra) 10
Spectrum 455	0	0	0	0	0	0	0	0	0	36.29	60.65	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 11
Spectrum 456	0	9.35	1.46	0	0	0	0	0	0	0	84.33	0	2.31	2022.12.12/Treffgarn/P20801PA001 (extra) 11
Spectrum 457	1	9.2	0	0	0	0	0	0	0	0	85.73	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 11
Spectrum 458	0	10.12	0	0	0	0	0	0	0	1.44	85.11	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 12
Spectrum 459	1.61	0	0	0	0	0	0.86	0	0	1.41	88.91	0	0	2022.12.12/Treffgarn/P20801PA001 (extra) 12
Spectrum 460	0	10.34	0	0	0	0	0	0	0	1.46	83.02	0	2.35	2022.12.12/Treffgarn/P20801PA001 (extra) 12
Spectrum 461	0	0	0	0	0	0	0	0	0	41.27	56.8	0	0	2022.12.12/Treffgarn/P20819PA001 1
Spectrum 462	0	0	0	0	0	0	0	0	0	15.03	82.27	0	0	2022.12.12/Treffgarn/P20819PA001 1
Spectrum 463	0	0	0	0	0	0	0	0	0	41.63	56.3	0	0	2022.12.12/Treffgarn/P20819PA001 2
Spectrum 464	0	0	0	0	0	0	0	0	0	37.34	60.11	0	0	2022.12.12/Treffgarn/P20819PA001 2
Spectrum 465	0	8.67	0	0	0	0	0	0	0	1.04	87.41	0	0	2022.12.12/Treffgarn/P20819PA001 2
Spectrum 466	0	0	0	0	0	0	0	0	0	36.02	61.76	0	0	2022.12.12/Treffgarn/P20819PA001 2
Spectrum 467	0	0	0	0	0	0	0	0	0	34.82	62.34	0	0	2022.12.12/Treffgarn/P20819PA001 3
Spectrum 468	0	0	1.7	0	0	0	0	0	0	0	93.46	0	2.38	2022.12.12/Treffgarn/P20819PA001 3
Spectrum 469	0	0	0	0	0	0	0	0	0	16.35	80.99	0	0	2022.12.12/Treffgarn/P20819PA001 3
Spectrum 470	0	0	0	0	0	0	0	0	0	47.54	50.73	0	0	2022.12.12/Treffgarn/P20819PA001 4
Spectrum 471	0.78	0	1.39	0	0	0	0	0	0	39.45	56.18	0	0	2022.12.12/Treffgarn/P20819PA001 4
Spectrum 472	0.95	7.23	0	0	0	0	0	0	0	10.08	78.49	0	0	2022.12.12/Treffgarn/P20819PA001 4
Spectrum 473	0	0	0	0	0	0	0	0	0	26.57	71.32	0	0	2022.12.12/Treffgarn/P20819PA001 4
Spectrum 474	0	0	0	0	0	0	0	0	0	49.85	46.6	0	0	2022.12.12/Treffgarn/P20819PA001 5
Spectrum 475	0	0	0	0	0	0	0	0	0	34.31	63.19	0	0	2022.12.12/Treffgarn/P20819PA001 5
Spectrum 476	0	8.63	1.65	0	0	0	0	0	0	3.36	81.22	0	2.46	2022.12.12/Treffgarn/P20819PA001 5
Spectrum 477	0	0	0	0	0	0	0	0	0	37.01	60.34	0	0	2022.12.12/Treffgarn/P20819PA001 6
Spectrum 478	0	7.91	0	0	0	0	0	0	0	0.99	88.72	0	0	2022.12.12/Treffgarn/P20819PA001 6
Spectrum 479	0	8.19	0	0	0	0	0	0	0	7.16	80.35	0	2.01	2022.12.12/Treffgarn/P20819PA001 6
Spectrum 480	0	0	0	0	0	0	0	0	0	55.43	42.78	0	0	2022.12.12/Treffgarn/P20819PA001 7
Spectrum 481	0	7.93	1.89	0	0	0	0	0	0	6.25	79.67	0	2.33	2022.12.12/Treffgarn/P20819PA001 7
Spectrum 482	0	7.62	0	0	0	0	0	0	0	0	89.33	0	0	2022.12.12/Treffgarn/P20819PA001 7
Spectrum 483	0	0	0	0	0	0	0	0	0	17.37	80.36	0	0	2022.12.12/Treffgarn/P20819PA001 8
Spectrum 484	0	7.53	0	0	0	0	0	0	0	0.98	86.26	0	2.09	2022.12.12/Treffgarn/P20819PA001 8
Spectrum 485	0	11.05	0	0	0	0	0	0	0	1.07	83.33	0	2.27	2022.12.12/Treffgarn/P20819PA001 8
Spectrum 486	0	0	0	0	0	0	0	0	0	32.7	65	0	0	2022.12.12/Treffgarn/P20819PA001 9
Spectrum 487	0	9.76	0	0	0	0	0	0	0	1.65	83.77	0	2.03	2022.12.12/Treffgarn/P20819PA001 9
Spectrum 488	0	7.64	0	0	0	0	0	0	0	0	89.57	0	0	2022.12.12/Treffgarn/P20819PA001 9
Spectrum 489	0	7.1	1.8	0	0	0	0	0	0	5.17	81.44	0	2.13	2022.12.12/Treffgarn/P20819PA001 9
Spectrum 490	0	0	0	0	0	0	0	0	0	40.55	55.57	0	0	2022.12.12/Treffgarn/P20819PA001 10
Spectrum 491	0	6.93	0	0	0	0	0	0	0	6.79	81.27	0	2.17	2022.12.12/Treffgarn/P20819PA001 10
Spectrum 492	0	9.71	0	0	0	0	0	0	0	1.22	85.12	0	0	2022.12.12/Treffgarn/P20819PA001 10
Spectrum 493	0	0	0	0	0	0	0	0	0	41.35	54.86	0	0	2022.12.12/Treffgarn/P20819PA001 10
Spectrum 494	0	0	0	0	0	0	0	0	0	41.85	54.96	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 1
Spectrum 495	0	0	1.64	0	0	0	0	0	0	20.85	72.83	0	2.22	2022.12.12/Lampeter/P20920CA001(1.2) 1
Spectrum 496	0	0	0	0	0	0	0	0	0	56.15	40.52	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 1
Spectrum 497	0	0	1.42	0	0	0	0	0	0	49.01	46.28	0	1.5	2022.12.12/Lampeter/P20920CA001(1.2) 1
Spectrum 498	0	0	1.41	0	0	0	0	0	0	35.99	60.44	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 2
Spectrum 499	0	0	1.45	0	0	0	0	0	0	19.53	74.55	0	2.08	2022.12.12/Lampeter/P20920CA001(1.2) 2
Spectrum 500	0	0	0	0	0	0	0	0	0	43.44	54.41	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 2

Spectrum 501	0	0	0	0	0	0	0	0	0	22.23	75.29	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 3
Spectrum 502	0	0	0	0	0	0	0	0	0	46.02	50.55	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 3
Spectrum 503	0	0	0	0	0	0	0	0	0	42.58	55.62	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 3
Spectrum 504	0	0	0	0	0	0	0	0	0	38.92	58.64	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 3
Spectrum 505	0	0	0	0	0	0	0	0	0	41.18	55.63	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 3
Spectrum 506	0	0	1.64	0	0	0	0	0	0	23.24	72.99	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 4
Spectrum 507	0	0	0	0	0	0	0	0	0	35.16	61.31	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 4
Spectrum 508	0	0	0	0	0	0	0	0	0	27.15	70.87	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 4
Spectrum 509	0	0	0	0	0	0	0	0	0	23.31	74.58	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 5
Spectrum 510	0	0	0	0	0	0	0	0	0	35.12	63.12	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 5
Spectrum 511	0	0	1.65	0	0	0	0	0	0	18.58	78	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 5
Spectrum 512	0	0	0	0	0	0	0	0	0	28.18	69.96	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 5
Spectrum 513	0	0	0	0	0	0	0	0	0	29.15	69.39	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 6
Spectrum 514	1.71	0	0	0	0	0	0	0	0	34.44	61.19	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 6
Spectrum 515	0	0	0	0	0	0	0	0	0	35.94	62.09	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 6
Spectrum 516	0	0	0	0	0	0	0	0	0	31.88	65.29	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 6
Spectrum 517	0	0	0	0	0	0	0	0	0	23.74	74.81	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 7
Spectrum 518	0	0	0	0	0	0	0	0	0	40.04	57.96	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 7
Spectrum 519	0	5.9	0	0	0	0	0	0	0	32.47	59.29	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 7
Spectrum 520	0	0	0	0	0	0	0	0	0	23.99	74.34	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 7
Spectrum 521	0	0	1.6	0	0	0	0	0	0	24.37	72.34	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 8
Spectrum 522	0	0	0	0	0	0	0	0	0	28.14	70.14	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 8
Spectrum 523	0	0	0	0	0	0	0	0	0	24.75	73.41	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 8
Spectrum 524	0	0	1.49	0	0	0	0	0	0	24.77	71.39	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 8
Spectrum 525	0	0	0	0	0	0	0	0	0	27.24	70.56	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 9
Spectrum 526	0	0	0	0	0	0	0	0	0	27.71	70.24	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 9
Spectrum 527	0	0	0	0	0	0	0	0	0	25.32	73.23	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 10
Spectrum 528	1.9	0	0	0	0	0	0	0	0	24.61	71.81	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 10
Spectrum 529	0	0	0	0	0	0	0	0	0	43.88	54.82	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 10
Spectrum 530	0	0	0	0	0	0	0	0	0	54.05	41.71	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 10
Spectrum 531	0	0	0	0	0	0	0	0	0	25.2	73.08	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 10
Spectrum 532	0	0	0	0	0	0	0	0	0	22.56	75.74	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 11
Spectrum 533	0	0	1.43	0	0	0	0	0	0	26.4	68.72	0	1.87	2022.12.12/Lampeter/P20920CA001(1.2) 11
Spectrum 534	0	0	0	0	0	0	0	0	0	30.02	66.86	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 11
Spectrum 535	0	0	0	0	0	0	0	0	0	22.13	75.89	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 11
Spectrum 536	0	0	0	0	0	0	0	0	0	23.69	74.47	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 11
Spectrum 537	0	0	0	0	0	0	0	0	0	14.47	45.6	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 11
Spectrum 538	0	0	1.8	0	0	0	0	0	0	21.58	74.85	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 12
Spectrum 539	0	0	0	0	0	0	0	0	0	14.73	83	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 12
Spectrum 540	0	0	0	0	0	0	0	0	0	21.86	75.78	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 12
Spectrum 541	0	0	0	0	0	0	0	0	0	16.1	81.56	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 12
Spectrum 542	0	0	0	0	0	0	0	0	0	15.15	82.65	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 12
Spectrum 543	0	0	0	0	0	0	0	0	0	12.93	84.7	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 13
Spectrum 544	0	0	0	0	0	0	0	0	0	12.81	85.03	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 13
Spectrum 545	0	8.47	0	0	0	0	0	0	0	3.1	85.86	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 13
Spectrum 546	0	0	0	0	0	0	0	0	0	26.92	71	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 13
Spectrum 547	0	0	0	0	0	0	0	0	0	26.4	71.36	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 13
Spectrum 548	0	0	0	0	0	0	0	0	0	20.73	77.31	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 13
Spectrum 549	0	0	0	0	0	0	0	0	0	38.9	58.57	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 13
Spectrum 550	0.27	1.66	0.34	0	0	0	0	0	0	4.53	12.12	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 13
Spectrum 551	0	0	1.53	0	0	0	0	0	0	20.3	73.73	0	2.26	2022.12.12/Lampeter/P20920CA001(1.2) 14
Spectrum 552	0	0	0	0	0	0	0	0	0	26.19	71.1	0	0	2022.12.12/Lampeter/P20920CA001(1.2) 14
Spectrum 553	0	0	0	0	0	0	0	0	0	25.23	73	0	0	2022.12.12/Lampeter/P20728CA001 1
Spectrum 554	0	0	0	0	0	0	0.36	60.55	33.86	0.84	3.71	0	0	2022.12.12/Lampeter/P20728CA001 1
Spectrum 555	0	0	0	0	0	0	0.34	63.56	35.26	0	0	0	0	2022.12.12/Lampeter/P20728CA001 2
Spectrum 556	0	0	0.39	0	0	0	0.25	51.53	28.5	0	0	0	0	2022.12.12/Lampeter/P20728CA001 2
Spectrum 557	0	0	0	0	0	0	0	6.64	5.29	0	0	40.92	0	2022.12.12/Lampeter/P20728CA001 2
Spectrum 558	0	0	0	0	0	0	0	27.08	21.39	0	0	20.77	0	2022.12.12/Lampeter/P20728CA001 2
Spectrum 559	0	0	0.7	0	0	0	0	38.34	33.22	0	0	0.91	0	2022.12.12/Lampeter/P20728CA001 2
Spectrum 560	0	0	0	0	0	0	0	61.95	37.51	0	0	0	0	2022.12.12/Lampeter/P20728CA001 2
Spectrum 561	0	0	0	0	0	0	0.39	62.72	36.12	0	0	0	0	2022.12.12/Lampeter/P20728CA001 3
Spectrum 562	0	0	0	0	0	0	0	9.14	6.92	0	0	42.55	0	2022.12.12/Lampeter/P20728CA001 3
Spectrum 563	0.46	0	0	0	0	0	0	7.27	5.13	0	0	38.02	0	2022.12.12/Lampeter/P20728CA001 3
Spectrum 564	0	0	0	0	0	0	0	61.49	37.24	0	0	0	0	2022.12.12/Lampeter/P20728CA001 3
Spectrum 565	0	0	0	0	0	0	0.32	62.29	36.35	0	0	0	0	2022.12.12/Lampeter/P20728CA001 3
Spectrum 566	0	0	0	0	0	0	0	49.76	39.84	0	0	0	0	2022.12.12/Lampeter/P20728CA001 4
Spectrum 567	0	0	0	0	0	0	0	3.02	2.85	0	0	40.28	0	2022.12.12/Lampeter/P20728CA001 4
Spectrum 568	0	0	0	0	0	0	0.26	62.9	35.55	0	0	0	0	2022.12.12/Lampeter/P20728CA001 4
Spectrum 569	0	0	0	0	0	0	0	3.14	2.44	0	0	35.51	0	2022.12.12/Lampeter/P20728CA001 4
Spectrum 570	0	0	0	0	0	0	0	0	0	16.33	81.54	0	0	2022.12.12/Lampeter/P20920CA001 (1.3)
Spectrum 571	0.92	0	0	0	0	0	0	0	0	15.83	80.34	0	0	2022.12.12/Lampeter/P20920CA001 (1.3)
Spectrum 572	7.17	0	1.78	0	0	0	1.22	0	0	14.53	69.76	0	1.96	2022.12.12/Lampeter/P20920CA001 (1.3)
Spectrum 573	0	0	0	0	0	0	0	0	0	15.94	81.7	0	0	2022.12.12/Lampeter/P20920CA001 (1.3)
Spectrum 574	0	0	0	0	0	0	0	0	0	13.78	83.69	0	0	2022.12.12/Lampeter/P20920CA001 (1.3)
Spectrum 575	0	0	1.55	0	0	0	0	0	0	30.23	65.02	0	2.07	2022.12.12/Lampeter/P20805CA001 1.1 11
Spectrum 576	0	0	0	0	0	0	0	0	0	37.21	61.39	0	0	2022.12.12/Lampeter/P20805CA001 1.1 11
Spectrum 577	0	0	0	0	0	0	0	0	0	31.37	67.13	0	0	2022.12.12/Lampeter/P20805CA001 1.1 11
Spectrum 578	0	0	0	0	0	0	0	0	0	39.48	59.26	0	0	2022.12.12/Lampeter/P20805CA001 1.1 11
Spectrum 579	0	0	0	0	0	0	0	0	0	38.8	59.76	0	0	2022.12.12/Lampeter/P20805CA001 1.1 11
Spectrum 580	0	0	0	0	0	0	0	0	0	31.64	67.25	0	0	2022.12.12/Lampeter/P20805CA001 1.1 11
Spectrum 581	0	0	0	0	0	0	0	0	0	25.48	73.45	0	0	2022.12.12/Lampeter/P20805CA001 1.1 10
Spectrum 582	0	6.33	0	0	0	0	0	0	0	17.9	74.53	0	0	2022.12.12/Lampeter/P20805CA001 1.1 10
Spectrum 583	0	7.35	1.64	0	0	0	0	0	0	3.14	84.51	0	2.09	2022.12.12/Lampeter/P20805CA001 1.1 10
Spectrum 584	0.84	0	0	0	0	0	0	0	0	38.23	59.79	0	0	2022.12.12/Lampeter/P20805CA001 1.1 10
Spectrum 585	0	0	0	0	0	0	0	0	0	41.48	57.35	0	0	2022.12.12/Lampeter/P20805CA001 1.1 10
Spectrum 586	0	0	0	0	0	0	0	0	0	24.92	73.86	0	0	2022.12.12/Lampeter/P20805CA001 1.1 10
Spectrum 587	0	0	0	0	0	0	0	0	0	22.48	75.97	0	0	2022.12.12/Lampeter/P20805CA001 1.1 9
Spectrum 588	0	7.88	0	0	0	0	0	0	0	8.7	82.35	0	0	2022.12.12/Lampeter/P20805CA001 1.1 9
Spectrum 589	0	0	0	0	0	0	0	0	0	27.09	71.44	0	0	2022.12.12/Lampeter/P20805CA001 1.1 9
Spectrum 590	0	8.14	1.79	0	0	0	0	0	0	0	85.81	0	2.14	2022.12.12/Lampeter/P20805CA001 1.1 9
Spectrum 591	0	0	1.52	0	0	0	0	0	0	21.75	74.78	0	0	2022.12.12/Lampeter/P20805CA001 1.1 9
Spectrum 592	0	0	0	0	0	0	0	0	0	23.7	74.8	0	0	2022.12.12/Treffgarn/P20815PA001 1
Spectrum 593	0	0	0	0	0	0	0	0	0	23.87	74.96	0	0	2022.12.12/Treffgarn/P20815PA001 1
Spectrum 594	0	7.65	0	0	0	0	0	0	0	0	90.72	0	0	2022.12.12/Treffgarn/P20815PA001 1
Spectrum 595	0.88	6.65	0	0	0	0	0	0	0	16.52	74.51	0	0	2022.12.12/Treffgarn/P20815PA001 2
Spectrum 596	0	9.77	0	0	0	0	0	0	0	0	88.95	0	0	2022.12.12/Treffgarn/P20815PA001 2
Spectrum 597	0	0	0	0	0	0	0	0	0	12.65	84.96	0	0	2022.12.12/Treffgarn/P20815PA001 2
Spectrum 598	0	0	0	0	0	0	0	0	0	39.43	58.92	0	0	2022.12.12/Treffgarn/P20825PA001 1
Spectrum 599	0	0	0	0	0	0	0	0	0	22.84	75.41	0	0	2022.12.12/Treffgarn/P20825PA001 1
Spectrum 600	0	9.98	1.56	0	0	0	0	0	0	0.93	83.89	0	2.16	2022.12.12/Treffgarn/P20825PA001 1

Spectrum 601	0	46.1	0	0	0	0	0	0	0	0	0	53.9	0	2022.12.12/Treffgarn/P20825PA001 1
Spectrum 602	3	0	0	0.23	0	0	11.38	0	0	2.54	5.93	0	0	2022.12.12/Treffgarn/P20825PA001 1
Spectrum 603	0	7.72	0	0	0	0	0	0	0	15.04	75.63	0	0	2022.12.12/Treffgarn/P20819PA002 1
Spectrum 604	0	9.31	0	0	0	0	0	0	0	0	88.61	0	0	2022.12.12/Treffgarn/P20819PA002 1
Spectrum 605	0	0	0	0	0	0	0	0	0	16.39	81.82	0	0	2022.12.12/Treffgarn/P20819PA002 1
Spectrum 606	0	0	1.73	0	0	0	0	0	0	10.24	84.17	0	2.25	2022.12.12/Treffgarn/P20819PA002 2
Spectrum 607	0	9.56	0	0	0	0	0	0	0	0	86.57	0	2.11	2022.12.12/Treffgarn/P20819PA002 2
Spectrum 608	0	7.71	0	0	0	0	0	0	0	0	90.25	0	0	2022.12.12/Treffgarn/P20819PA002 2
Spectrum 609	0	0	0	0	0	0	0	0	0	31.66	66.78	0	0	2022.12.12/Treffgarn/P20819PA002 3
Spectrum 610	0	8.36	1.49	0	0	0	0	0	0	1.12	85.16	0	2.06	2022.12.12/Treffgarn/P20819PA002 3
Spectrum 611	0	7.61	1.96	0	0	0	0	0	0	0	86.28	0	2.44	2022.12.12/Treffgarn/P20819PA002 3
Spectrum 612	0	0	0	0	0	0	0	0	0	36.79	61.9	0	0	2022.12.12/Treffgarn/P20819PA001 (extra) 1
Spectrum 613	0	0	0	0	0	0	0	0	0	36.1	62.41	0	0	2022.12.12/Treffgarn/P20819PA001 (extra) 1
Spectrum 614	0	0	0	0	0	0	0	0	0	5.22	92.94	0	0	2022.12.12/Treffgarn/P20819PA001 (extra) 1
Spectrum 615	0	8.04	0	0	0	0	0	0	0	0	90.59	0	0	2022.12.12/Treffgarn/P20819PA001 (extra) 1
Spectrum 616	0	0	0	0	0	0	0	0	0	15.16	81.13	0	2.19	2022.12.12/Treffgarn/P20819PA001 (extra) 2
Spectrum 617	0	0	0	0	0	0	0	0	0	1.07	97.76	0	0	2022.12.12/Treffgarn/P20819PA001 (extra) 2
Spectrum 618	0	0	0	0	0	0	0	0	0	30.26	68.2	0	0	2022.12.12/Treffgarn/P20819PA001 (extra) 2
Spectrum 619	0	7.43	0	0	0	0	0	0	0	0	90.87	0	0	2022.12.12/Treffgarn/P20819PA001 (extra) 2
Spectrum 620	0	0	0	0	0	0	0	0	0	31.44	66.74	0	0	2022.12.12/Treffgarn/P20819PA001 (extra) 2
Spectrum 621	0	6.02	1.32	0	0	0	0	0	0	0	60.17	0	1.62	2022.12.12/Treffgarn/P20819PA001 (extra) 2
Spectrum 622	0.85	0	0	0	0	0	0	0	0	39.99	56.83	0	0	2022.12.12/Treffgarn/P20819PA001 (extra) 3
Spectrum 623	0.83	9.03	1.75	0	0	0	0	0	0	8.39	74.61	0	2.65	2022.12.12/Treffgarn/P20819PA001 (extra) 3
Spectrum 624	0	0	0	0	0	0	0	0	0	17.76	41.87	0	0	2022.12.12/Treffgarn/P20819PA001 (extra) 3
Spectrum 625	0	0	0	0	0	0	0	0	0	10.68	85.22	0	0	2022.12.12/Treffgarn/P20819PA001 (extra) 3
Spectrum 626	0	0	0	0	0	0	0	0	0	57.45	40.6	0	0	2022.12.12/Clarbeston/P20809PA001
Spectrum 627	0	10	1.54	0	0	0	0	0	0	2.78	79.53	0	2.3	2022.12.12/Clarbeston/P20809PA001
Spectrum 628	0	0	0	0	0	0	0	0	0	0.96	95.77	0	0	2022.12.12/Clarbeston/P20809PA001
Spectrum 629	0	0	0	0	0	0	0	0	0	57.74	40.29	0	0	2022.12.12/Clarbeston/P20809PA001
Spectrum 630	0	0	0	0	0	0	0	0	0	56.99	39.9	1.13	0	2022.12.12/Clarbeston/P20809PA001
Spectrum 631	0	9	2.02	0	0	0	0	0	0	5.98	76.96	0	2.13	2022.12.12/Clarbeston/P20809PA001
Spectrum 632	0	0	0	0	0	0	0	0	0	23.81	73.85	0	0	2022.12.12/Clarbeston/P20805PA002 (3.3) 2
Spectrum 633	0	0	1.48	0	0	0	0	0	0	23.1	71.15	0	2.13	2022.12.12/Clarbeston/P20805PA002 (3.3) 2
Spectrum 634	1.03	9.88	1.47	0	0	0	0	0	0	1.06	82.62	0	2.18	2022.12.12/Clarbeston/P20805PA002 (3.3) 2
Spectrum 635	0	0	0	0	0	0	0	0	0	3.15	93.94	0	0	2022.12.12/Clarbeston/P20805PA002 (3.3) 2
Spectrum 636	0	0	0	0	0	0	0	0	0	22.15	73.21	0	0	2022.12.12/Clarbeston/P20805PA002 (3.3) 2

Exploration Placement Notebook



Exploration Placement Notebook

C2078956

Placement Partner: Sarn Helen Gold Ltd.

Dates of Placement: 11/07/2022 – 20/08/2022

Location: Pembrokeshire, Wales

Important Information:

Address of Pembrokeshire Office: 21 High Street, Flat 6, Haverfordwest Pembrokeshire, SA61 2BW

Contact Information:

Dr Michael Armitage (Director) 07778577384
Tristan English (Project Geologist - Haverfordwest) 07733418767
Alex Finlay (Field Supervisor - Haverfordwest) 07703776683
Jasper Thomas (Project Geologist - Lampeter) 07902485969
Charlie Thomas (Field Supervisor - Lampeter) 07765994484
Jack Bacon (student - Haverfordwest) 07780 003856
Iain McDonald (Placement Supervisor) 029208 74295
Personal 07525 333408

If Found Contact: 07515 333408

Background Information

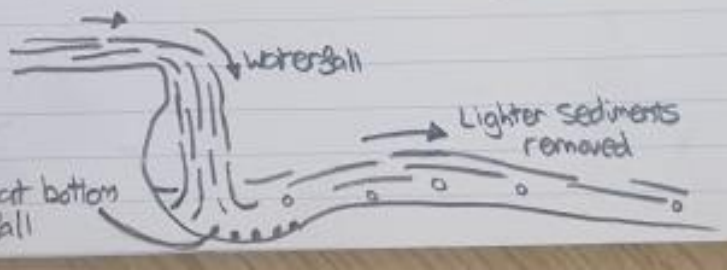
Placement Partner:

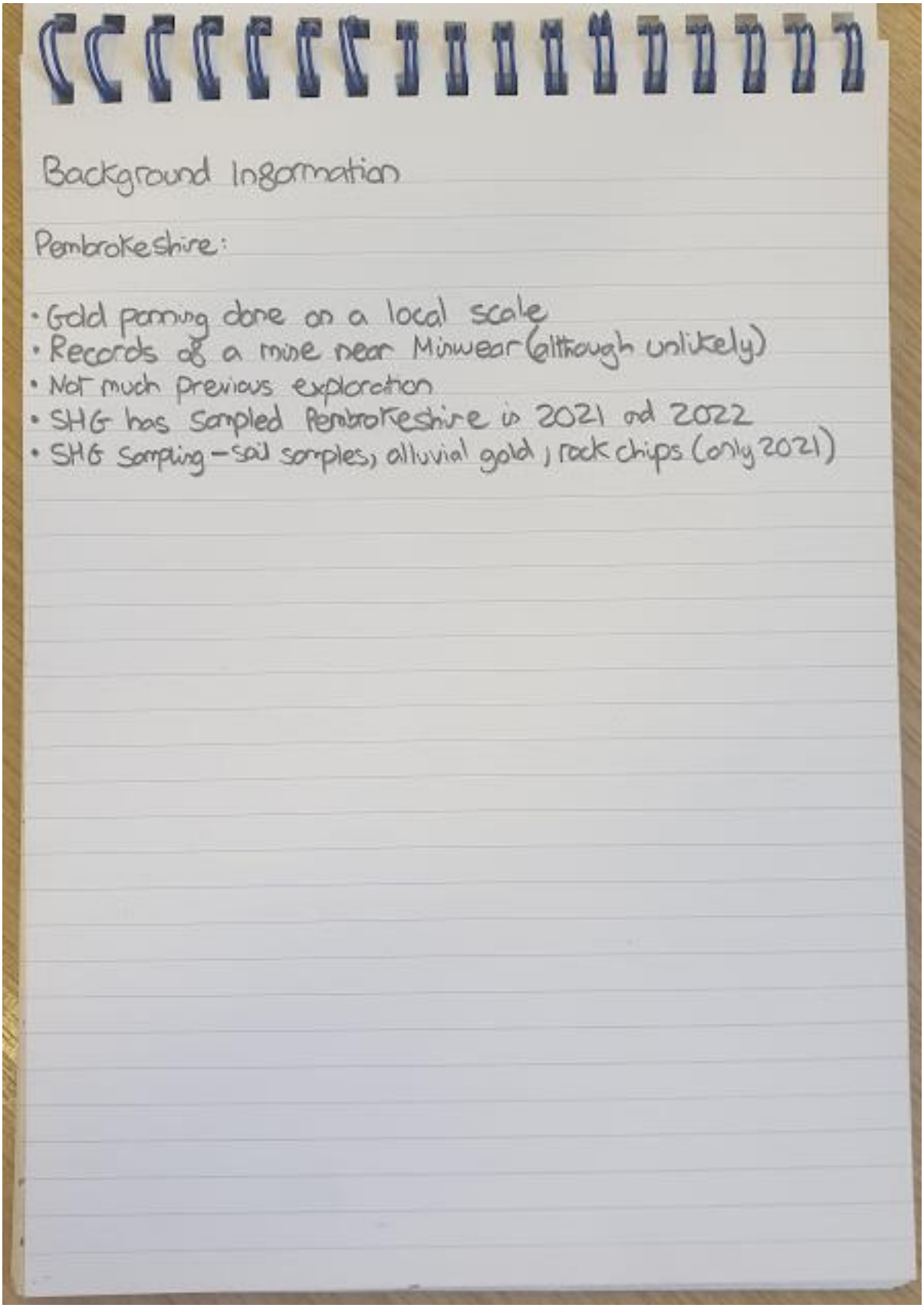
- Sam Helen Gold Ltd. (SHG) - Welsh Gold Exploration Company
- Founded ~November 2019 by Mike Armitage & Roger Murphy
- 4 directors?
- 2 offices - Haverfordwest, Pembrokeshire (Tristan + Alex)
  Lampeter, Carmarthenshire (Jasper + Charlie)
- License areas - Pembrokeshire + Carmarthenshire
- Focus is to explore for Gold potential in the areas
- Methods: Alluvial gold panning - proves the presence of gold
  Soil sampling - pXRF samples to map geochemistry (mainly Arsenic) then assay select samples
- Potential drilling in the future

Gold:

- Potential VMS, Orogenic, Porphyry or glacially trasported grains in river systems
- Gold is dense - accumulates (settles) in waterways when a sudden change in velocity occurs (gold trap) - Fast → slow water
- Pan sediment from traps using pans - gold settles in ridges in pan
- Arsenic is a heavy metal - used as an indicator for gold - pXRF soil samples to show local Arsenic levels - may indicate gold?

eg. Waterfall Trap





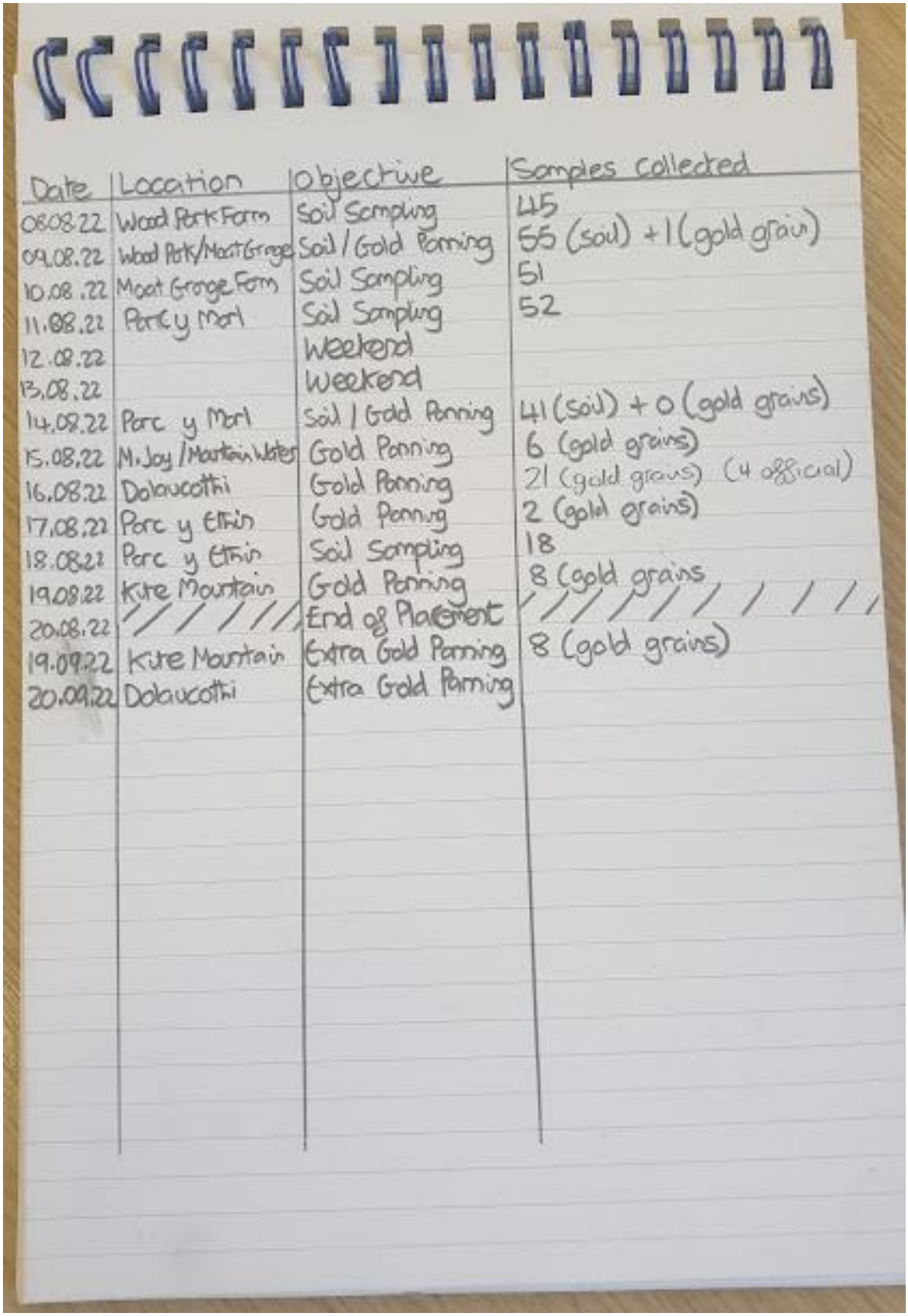
Background Information

Pembrokeshire:

- Gold panning done on a local scale
- Records of a mine near Minwear (although unlikely)
- Not much previous exploration
- SHG has sampled Pembrokeshire in 2021 and 2022
- SHG sampling - soil samples, alluvial gold, rock chips (only 2021)

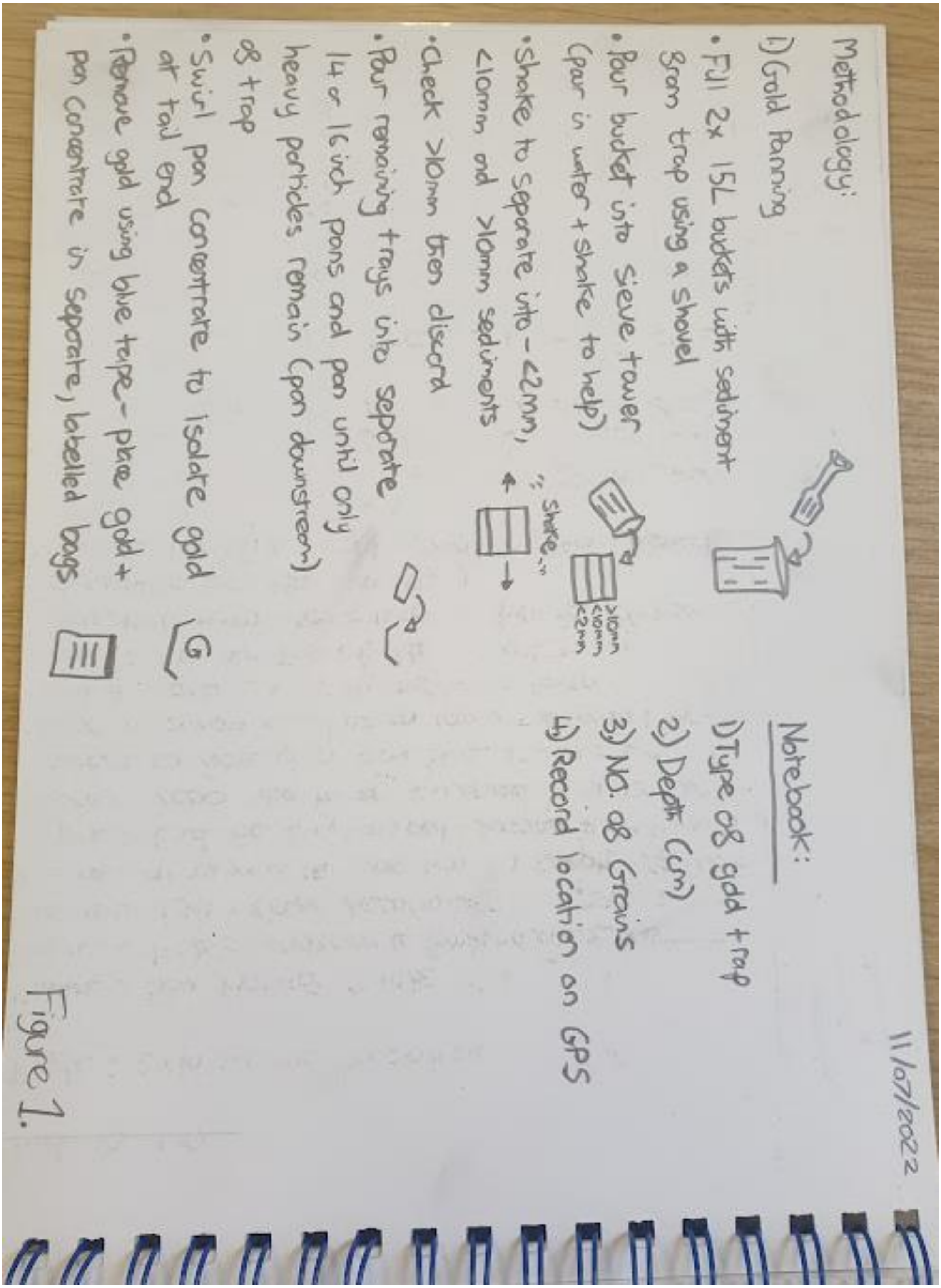
Timeline of Placement

Date	Location	Objective	Samples Collected
11.07.22	Western Wicklow	Introduction	NA
12.07.22	Mount Joy Farm	SRK Brief	27
13.07.22	Mount Joy Farm	Soil Sampling	70
14.07.22	Mount Joy Farm	Soil Sampling	71
15.07.22	Mount Joy Farm	Soil Sampling	32
16.07.22	Mount Joy Farm	Soil Sampling	70
17.07.22		Weekend	
18.07.22		Weekend	
19.07.22	Mount Joy Farm	Soil Sampling	63
20.07.22	Ddaucothi	Soil Sampling	40
21.07.22	Ddaucothi	Soil Sampling	46
22.07.22	Mount Joy Farm	Soil Sampling	78
23.07.22		Weekend	
24.07.22		Weekend	
25.07.22	Cox Farm	Soil Sampling	68
26.07.22	Gorre	Soil Sampling	71
27.07.22	Mount Joy Farm	Soil Sampling	82
28.07.22	Mount Joy Farm	Soil Sampling	74
29.07.22	Mount Joy Farm	Soil Sampling	60
30.07.22		Weekend	
31.07.22		Weekend	
1.08.22	M.Joy/M.Water	Soil + Gold Panning	68 (soil), 13 (gold grains)
2.08.22	Mount Joy Farm	Gold Panning	0 (gold grains)
3.08.22	Lower Lanbaro	Soil Sampling	52
4.08.22	Ddaucothi	Structural Mapping	NA
5.08.22	Wood Park Farm	Gold Panning	9 (gold grains)
6.08.22		Weekend	
7.08.22		Weekend	

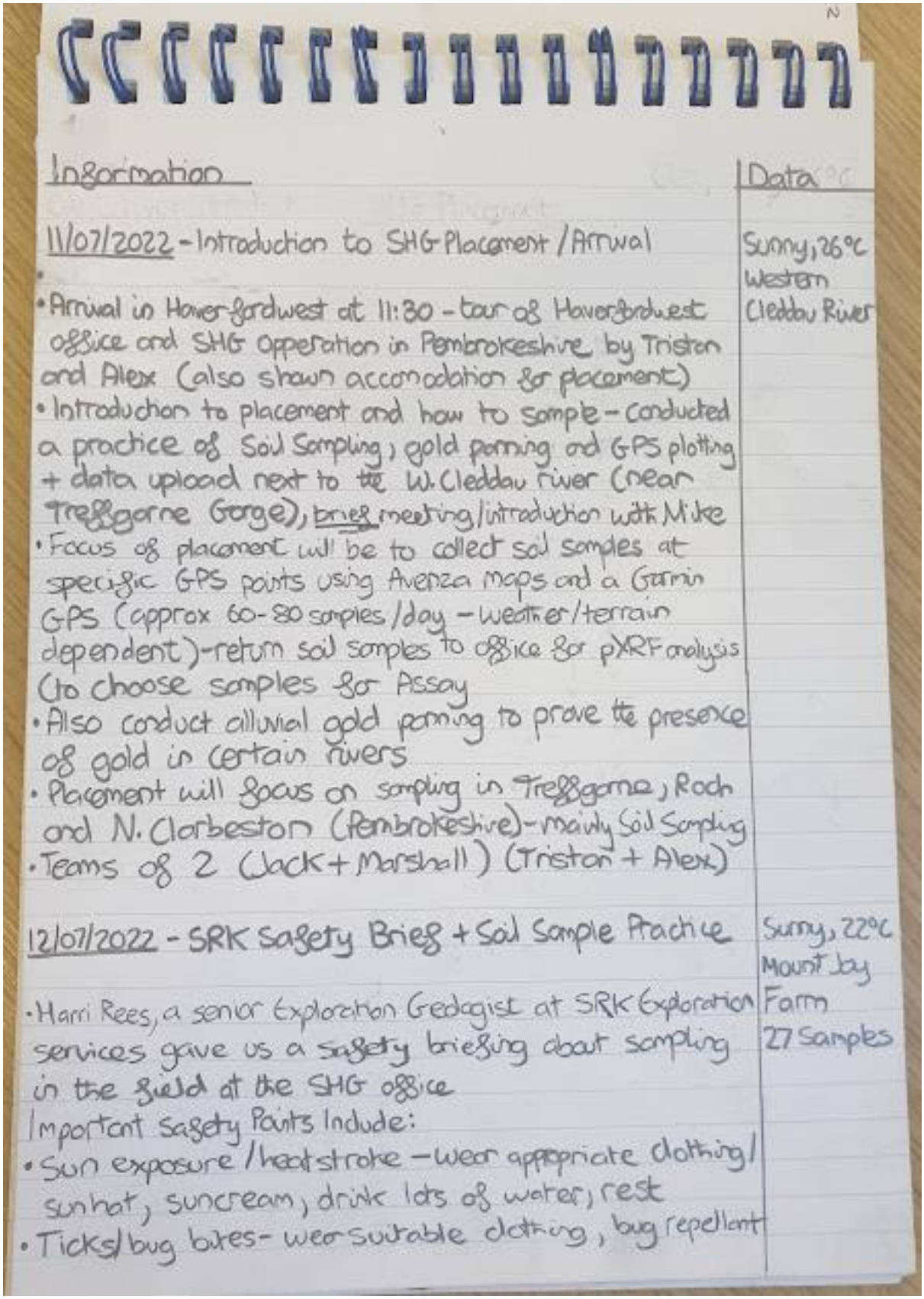


Date	Location	Objective	Samples collected
08.08.22	Wood Park Farm	Soil Sampling	45
09.08.22	Wood Park/Moat Grove	Soil / Gold Panning	55 (soil) + 1 (gold grain)
10.08.22	Moat Grove Farm	Soil Sampling	51
11.08.22	Parc y Merl	Soil Sampling	52
12.08.22		Weekend	
13.08.22		Weekend	
14.08.22	Parc y Merl	Soil / Gold Panning	41 (soil) + 0 (gold grains)
15.08.22	M. Joy / Mountain Water	Gold Panning	6 (gold grains)
16.08.22	Dolaucothi	Gold Panning	21 (gold grains) (4 official)
17.08.22	Parc y Ethin	Gold Panning	2 (gold grains)
18.08.22	Parc y Ethin	Soil Sampling	18
19.08.22	Kite Mountain	Gold Panning	8 (gold grains
20.08.22	///////	End of Placement	//////////
19.09.22	Kite Mountain	Extra Gold Panning	8 (gold grains)
20.09.22	Dolaucothi	Extra Gold Panning	

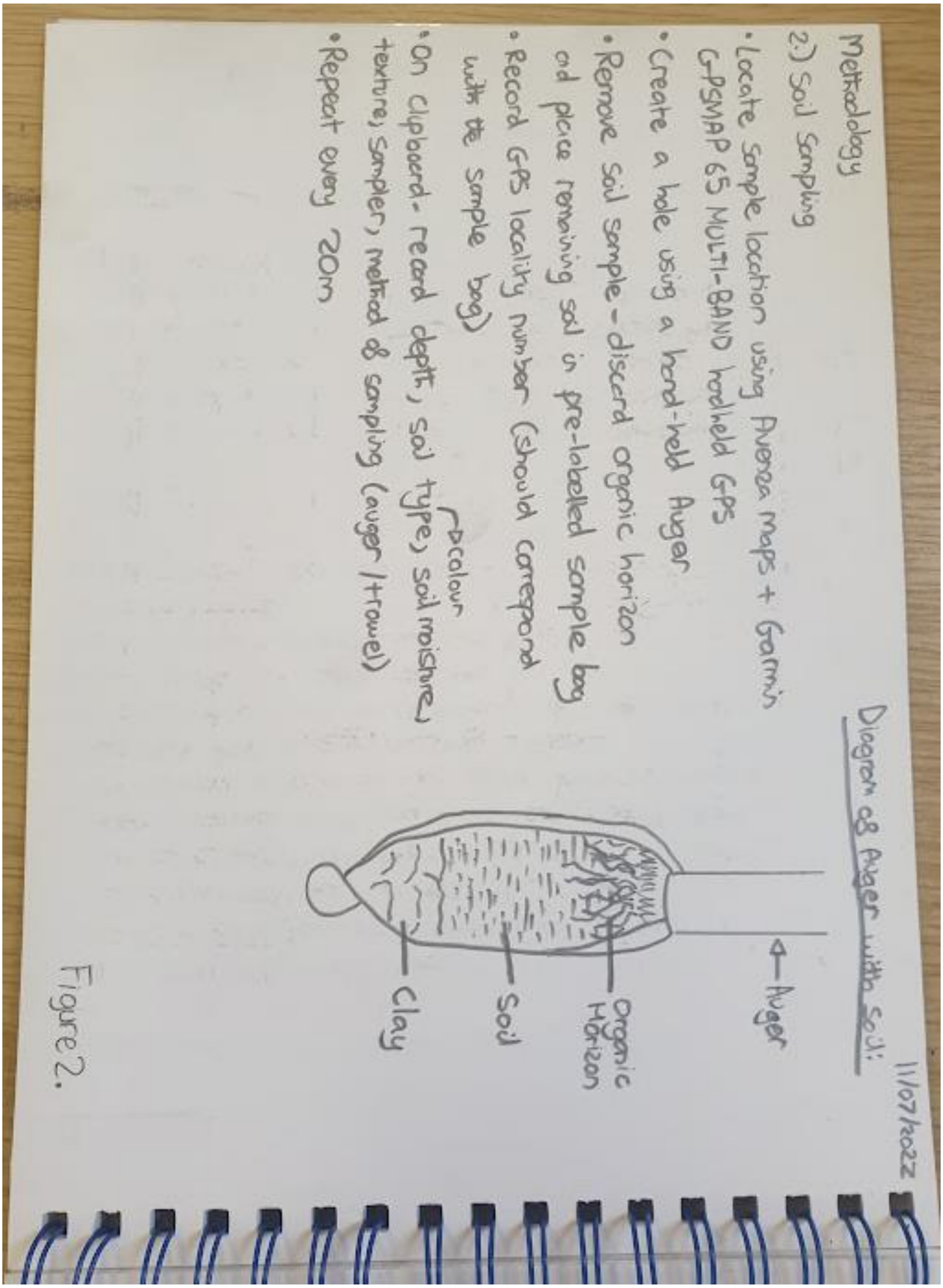
List of Figures.



Methodology:
1) Gold Panning
• Fill 2x 15L buckets with sediment from trap using a shovel
• Pour bucket into Sieve tower (pour in water + shake to help)
• Shake to separate into - <2mm, <10mm and >10mm sediments
>10mm
<10mm
<2mm
Shake
• Check >10mm then discard
• Pour remaining trays into separate 14 or 16 inch pans and pan until only heavy particles remain (pan downstream)
• Swirl pan concentrate to isolate gold at tail end
G
• Remove gold using blue tape - photo gold + of trap
• Pan concentrate in separate, labelled bags
Notebook:
1) Type of gold + trap
2) Depth (cm)
3) No. of Grains
4) Record location on GPS
11/07/2022
Figure 1.



Information	Data
11/07/2022 - Introduction to SHG Placement / Arrival	Sunny, 26°C Western Cleddau River
• Arrival in Haverfordwest at 11:30 - tour of Haverfordwest office and SHG operation in Pembrokeshire by Tristan and Alex (also shown accomodation for placement) • Introduction to placement and how to sample - conducted a practice of Soil Sampling, gold panning and GPS plotting + data upload next to the W. Cleddau river (near Treffgarne Gorge), brief meeting/introduction with Mike • Focus of placement will be to collect soil samples at specific GPS points using Avenza maps and a Garmin GPS (approx 60-80 samples/day - weather/terrain dependent) - return soil samples to office for pXRF analysis (to choose samples for Assay • Also conduct alluvial gold panning to prove the presence of gold in certain rivers • Placement will focus on sampling in Treffgarne, Roch and N. Clarbeston (Pembrokeshire) - mainly Soil Sampling • Teams of 2 (Jack + Marshall) (Tristan + Alex)	
12/07/2022 - SRK Safety Brief + Soil Sample Practice	Sunny, 22°C Mount Jay Farm 27 Samples
• Harri Rees, a senior Exploration Geologist at SRK Exploration services gave us a safety briefing about sampling in the field at the SHG office Important Safety Points Include: • Sun exposure / heatstroke - wear appropriate clothing / sunhat, suncream, drink lots of water, rest • Ticks / bug bites - wear suitable clothing, bug repellent	


Methodology

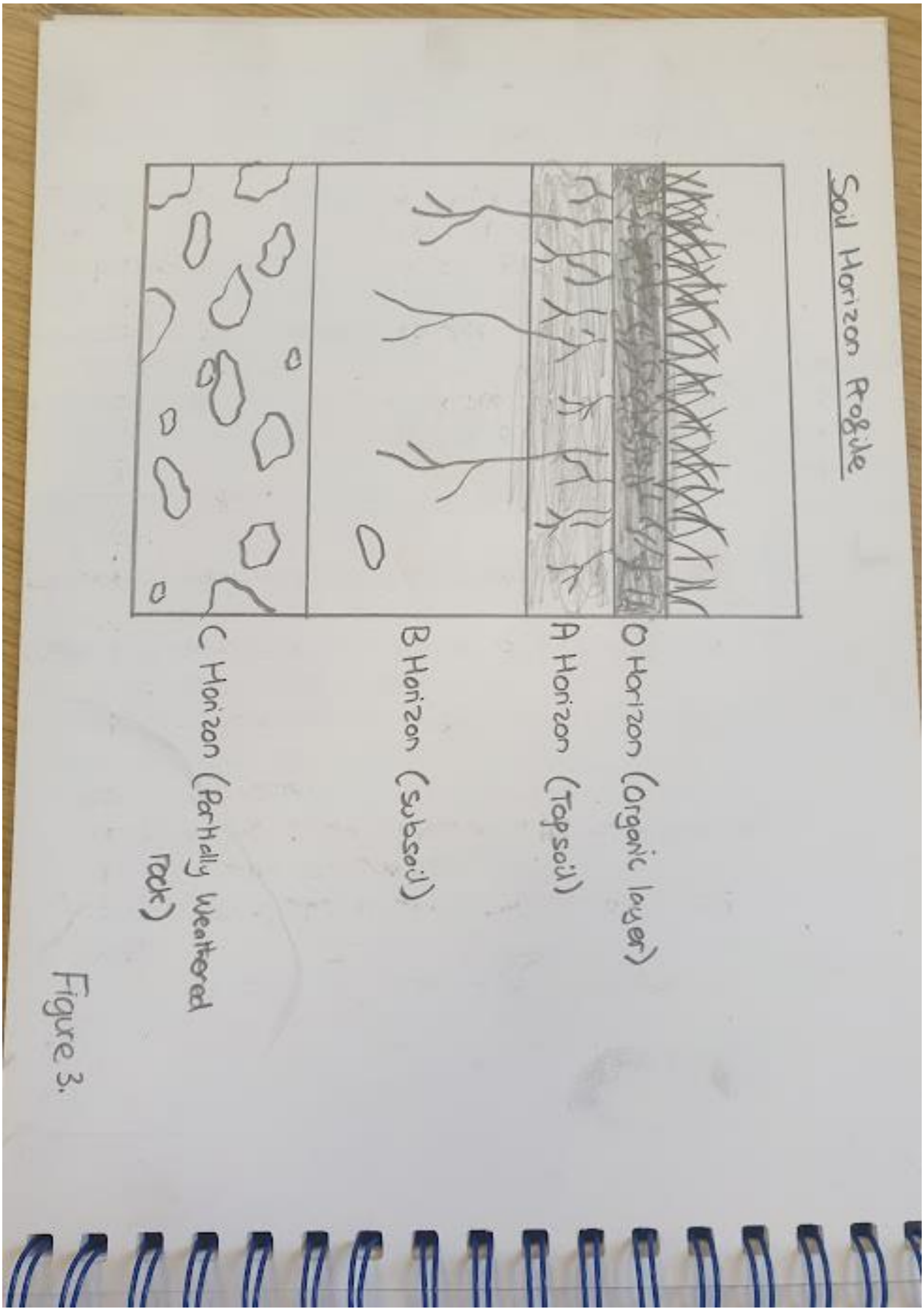
2.) Soil Sampling

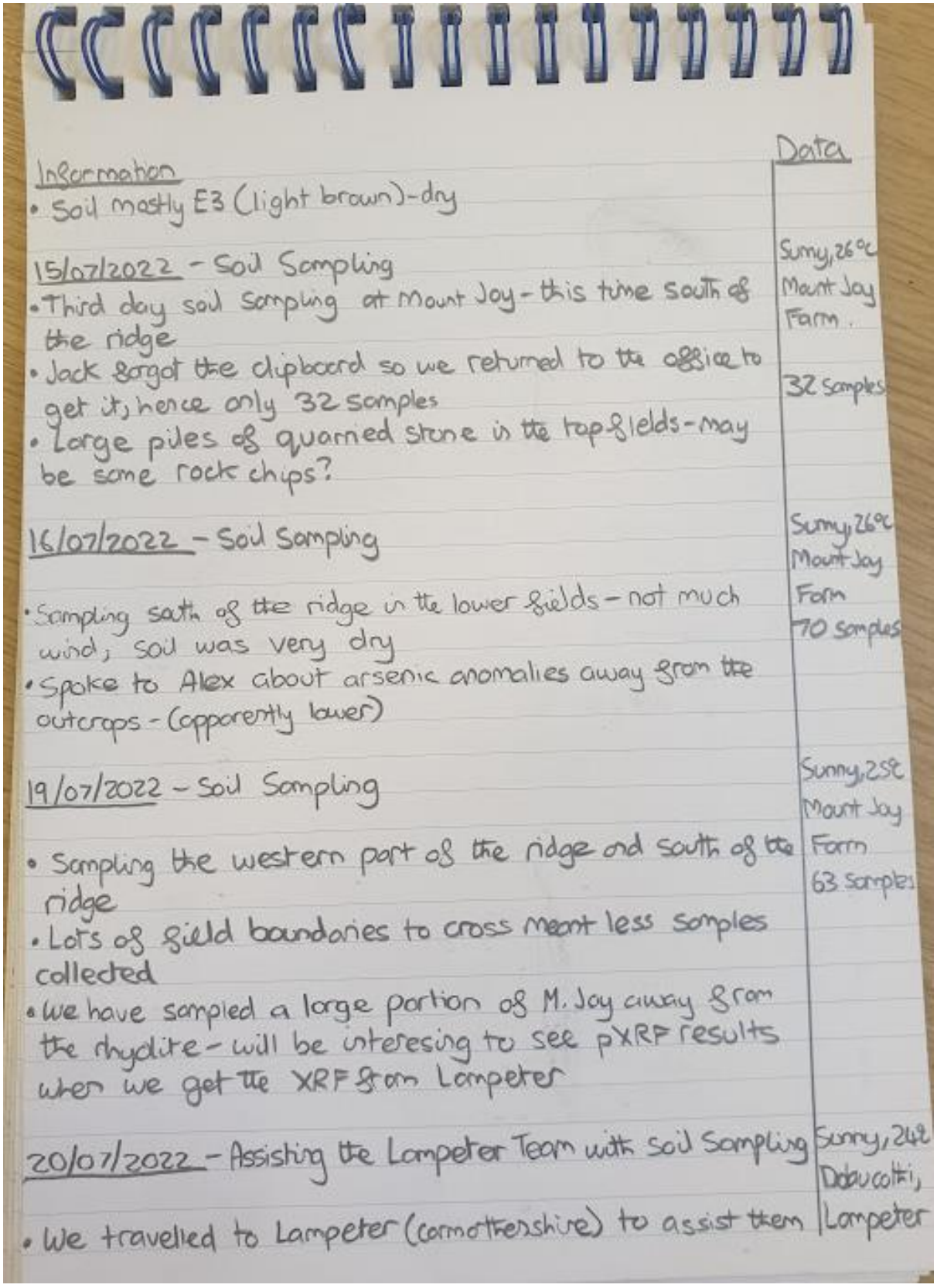
- Locate sample location using Avenza maps + Garmin GPSMAP 65 MULTI-BAND handheld GPS
- Create a hole using a hand-held Auger
- Remove Soil sample - discard organic horizon and place remaining soil in pre-labelled sample bag
- Record GPS locality number (should correspond with the sample bag)
- On clipboard - record depth, soil type, colour, soil moisture, texture, sampler, method of sampling (auger / trowel)
- Repeat every 20m

Diagram of Auger with Soil: 11/07/2022

Figure 2.

Information	Data
• Avoid animals (wild or farm)	
• Pack for adverse weather conditions, also avoid lightning	
• Remain on designated property (seek shelter)	
• Avoid river crossings / fast flowing waterways	
• Transport to field location – drive safely in safe conditions	
• Don't put yourself/others at risk whilst sampling	
• Communicate with your team – mobile phone / GPS	
We then travelled to M. Joy farm near Great Treffgorne Mountain (Extrusive outcrop) with Harri, Jasper, Charlie, Alex, Tristan and other Cardiff University students	
• We conducted practice soil sampling / GPS use in teams of 4 (2 students + 2 SHG Geologists)	
• Great Treffgorne Mountain – exposed Rhyolite (outcrop) - forms a ridge	
• Previous sampling – anomalous arsenic values near outcrop	*
13/07/2022 – First Full Day Sampling	Sunny, 25°C Mount Joy Farm
• First day soil sampling as a team of 2 (Jack + Marshall)	
• We conducted soil sampling at the northern boundary of M. Joy farm near the bottom of the rhyolite ridge	70 samples
• Tristan and Alex sampled together in a different field	
• We found a good sampling pace, happy with no. of samples collected	
14/07/2022 – Soil Sampling	Sunny, 24°C Mount Joy Farm
• Second day sampling the northern boundary and ridge near Great Treffgorne Mountain	
• Soil was dry in lower fields – made sampling harder	71 Samples


Soil Horizon Profile
O Horizon (Organic layer)
A Horizon (Topsoil)
B Horizon (Subsoil)
C Horizon (Partially Weathered rock)
Figure 3.



Information

- Soil mostly E3 (light brown)-dry

Data

15/07/2022 - Soil Sampling — Sunny, 26°C Mount Joy Farm.

- Third day soil sampling at Mount Joy - this time south of the ridge
- Jack forgot the clipboard so we returned to the office to get it, hence only 32 samples — 32 samples
- Large piles of quarried stone in the top fields - may be some rock chips?

16/07/2022 - Soil Sampling — Sunny, 26°C Mount Joy Farm 70 samples

- Sampling south of the ridge in the lower fields - not much wind, soil was very dry
- Spoke to Alex about arsenic anomalies away from the outcrops - (apparently lower)

19/07/2022 - Soil Sampling — Sunny, 25°C Mount Joy Farm 63 samples

- Sampling the western part of the ridge and south of the ridge
- Lots of field boundaries to cross meant less samples collected
- We have sampled a large portion of M. Joy away from the rhydlite - will be interesing to see pXRF results when we get the XRF from Lampeter

20/07/2022 - Assisting the Lampeter Team with soil Sampling — Sunny, 24°C Dolaucothi, Lampeter

- We travelled to Lampeter (carmarthenshire) to assist them

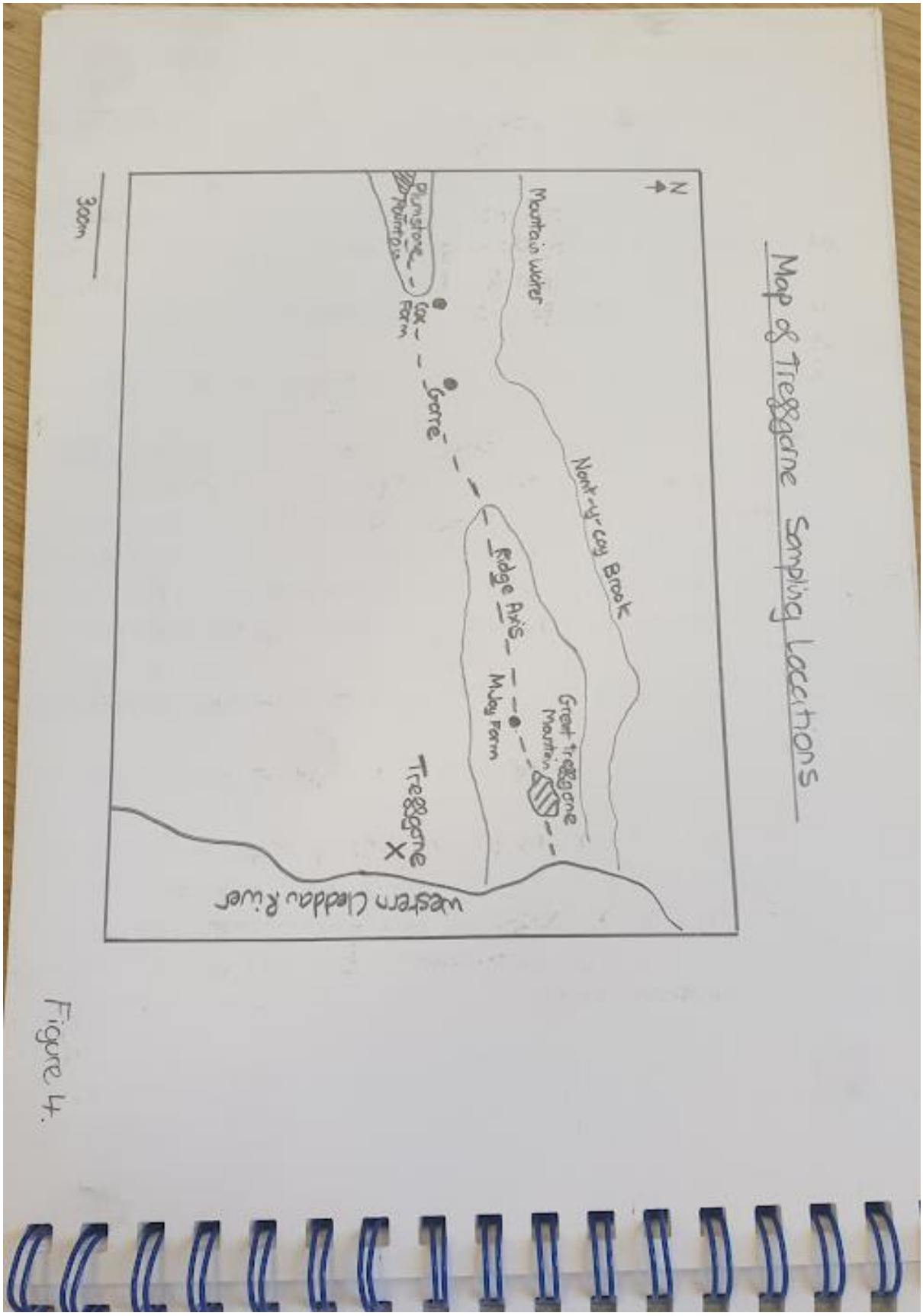
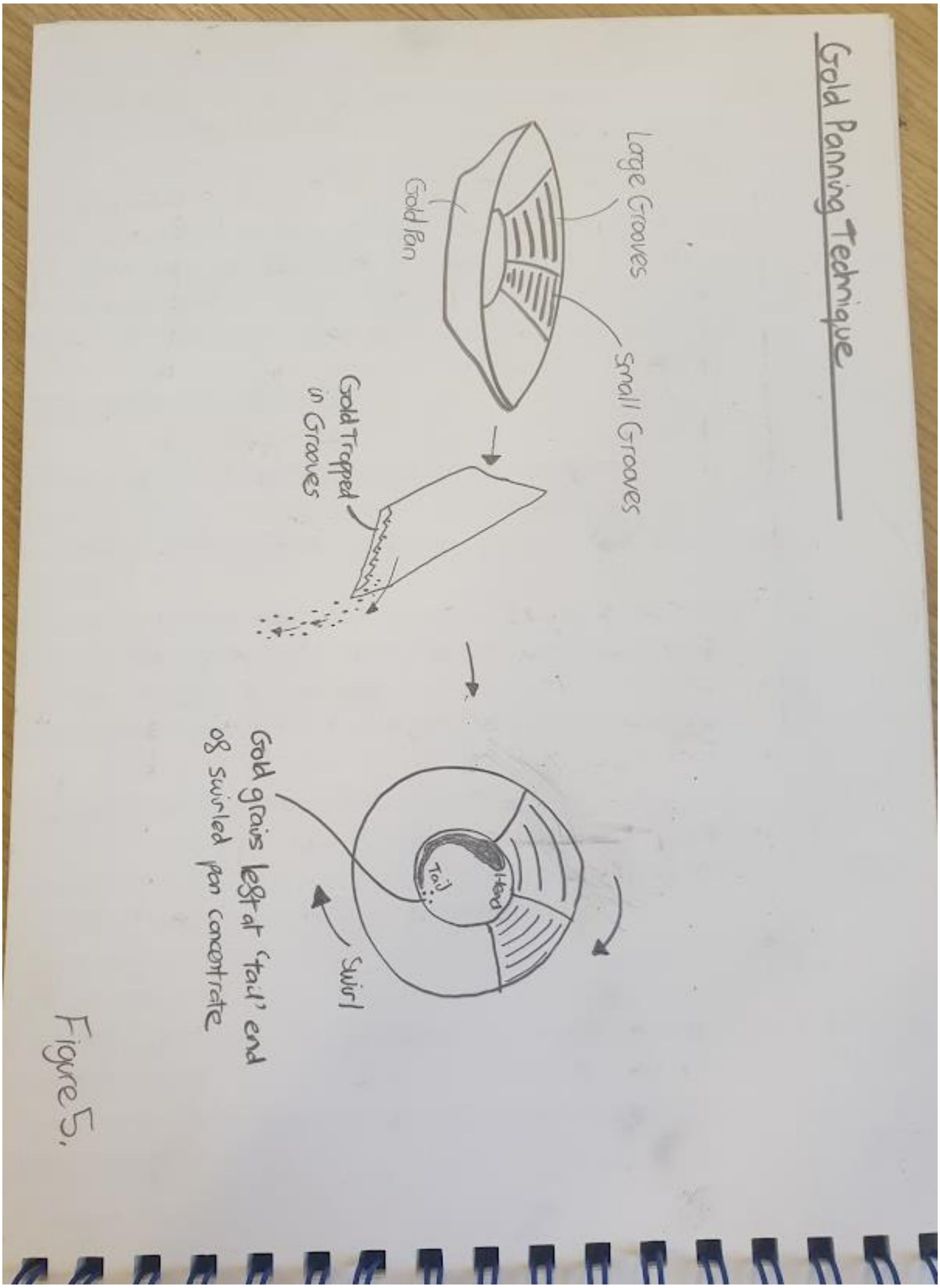
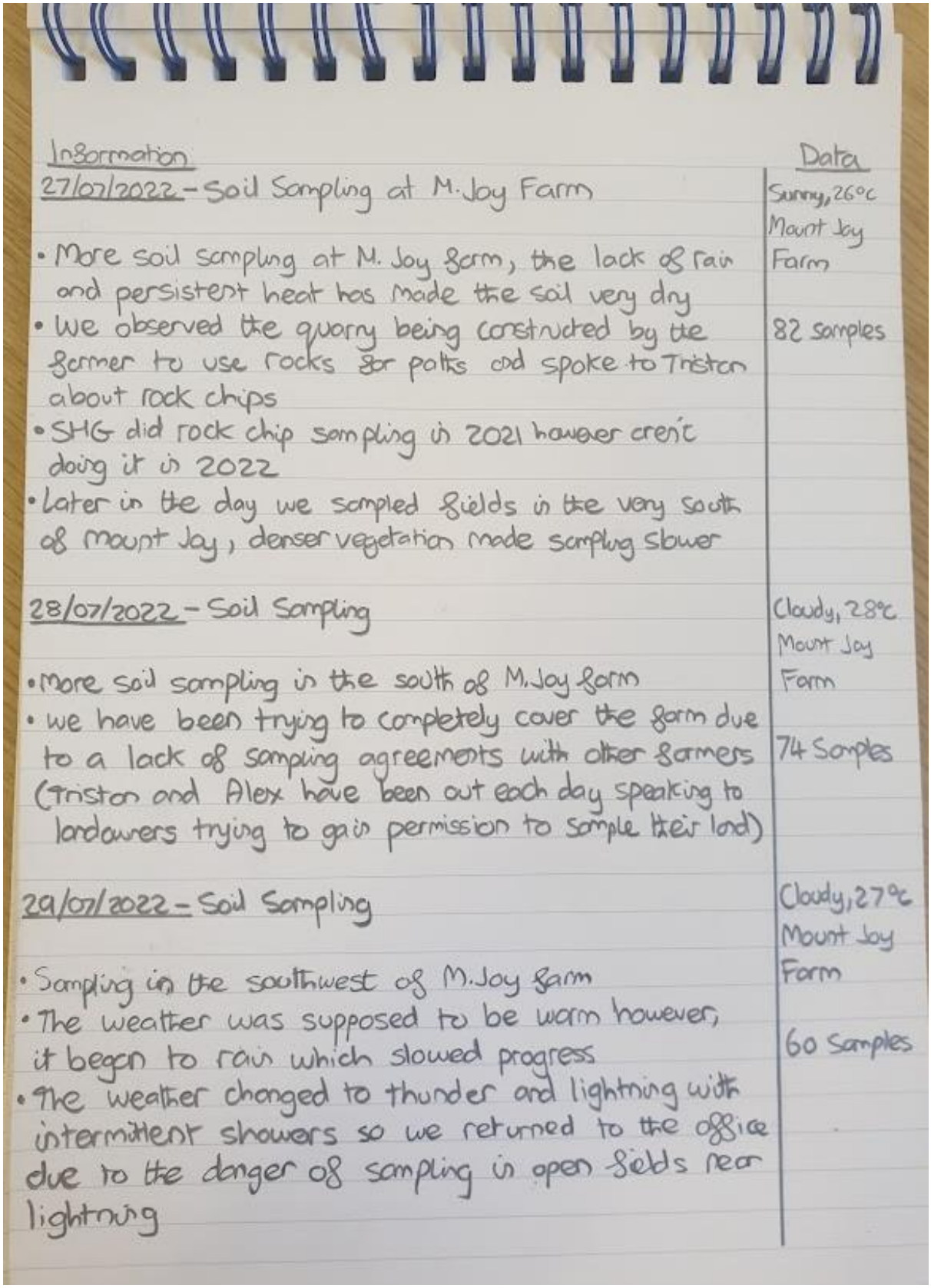

Map of Treggarne Sampling Locations
N
Mountain Water
Nant-y-coy Brook
Great Treggarne Mountain
Ridge Axis
Mijoy Farm
Treggarne
Western Cleddau River
Sarre
Cox Farm
Pumpstone Quarry
300m

Figure 4.

Information	Data
with soil sampling and also to collect the pXRF from the Lampeter office	
• We spent the morning in the office reviewing their operation in Carmarthenshire, then split into teams of 2 to sample	40 samples
• I conducted soil sampling with Joe Stone (Cardiff University Student) above Brunant Farm	
• Woodland and steep terrain limited the number of samples	
21/07/2022 - Soil Sampling in Dolaucothi	Sunny, 25°C Dolaucothi, Lampeter
• Second day sampling in Dolaucothi, today we sampled closer to the ancient Roman mine	
• We sampled the ridge roughly above the mine (Dolaucothi anticline) which was less densely forested so easier to sample	46 Samples
• Abundant quartz float observed - links to gold mineralisation	
• Once finished we returned to Haverfordwest with the pXRF to use on the Pembrokeshire samples	
22/07/2022 - Soil Sampling	Sunny, 26°C Mount Joy Farm
• Soil sampling in the lower fields south of the ridge, less field boundaries meant we were faster at sampling	
• Tristan and Alex stayed at the office to carry out pXRF analysis of our samples (nothing of interest found with arsenic levels)	78 samples
• We mapped the arsenic levels in the fields sampled around M. Joy, this showed lower levels (on average) with further distance from G. Treffgarne Mountain	
• I spoke to Tristan about the potential of using	


Gold Panning Technique
Large Grooves
Small Grooves
Gold Pan
Gold Trapped in Grooves
Head
Tail
Swirl
Gold grains left at 'tail' end of swirled pan concentrate
Figure 5.

Information	Data
pXRF data and arsenic anomalies to map potential for gold around Treffgarne, he has advised me to wait longer for more XRF data but thinks it is a possibility	
25/07/2022 - Soil sampling at Cox Farm	Cloudy, 20°C Cox Farm
• Today we sampled a new farm to the west of M. Jay, but still near the rhyolite ridge, as a team of 4 • We sampled the lower fields near the Nant-y-coy Brook • Fields were boggy so sampling was slow at first • We then split into two teams to cover more ground • Tristan and Alex were interested in a previous BGS borehole drilled into the rhyolite in the South of Cox Farm	68 samples
26/07/2022 - Soil Sampling at Gorre	Cloudy, 22°C Gorre
• Sampling at Gorre (the farm just East of Cox Farm) • Slightly larger fields and higher elevation made sampling faster • Later I spoke to Alex about his dissertation - he looked at Panned concentrates in Clarbeston (West Pembrokeshire - we may sample at some point), and indicator minerals associated with gold, this sounded like a very interesting topic for investigation, however, we haven't conducted any gold panning as of yet and is unlikely we will do it in a significant amount, so this isn't a likely direction for a dissertation question unfortunately	71 samples



Information	Data
27/07/2022 - Soil Sampling at M. Joy Farm	Sunny, 26°c Mount Joy Farm
• More soil sampling at M. Joy farm, the lack of rain and persistent heat has made the soil very dry • We observed the quarry being constructed by the farmer to use rocks for paths and spoke to Tristan about rock chips • SHG did rock chip sampling in 2021 however aren't doing it in 2022 • Later in the day we sampled fields in the very south of Mount Joy, denser vegetation made sampling slower	82 samples
28/07/2022 - Soil Sampling	Cloudy, 28°c Mount Joy Farm
• More soil sampling in the south of M. Joy farm • We have been trying to completely cover the farm due to a lack of sampling agreements with other farmers (Tristan and Alex have been out each day speaking to landowners trying to gain permission to sample their land)	74 Samples
29/07/2022 - Soil Sampling	Cloudy, 27°c Mount Joy Farm
• Sampling in the southwest of M. Joy farm • The weather was supposed to be warm however, it began to rain which slowed progress • The weather changed to thunder and lightning with intermittent showers so we returned to the office due to the danger of sampling in open fields near lightning	60 Samples

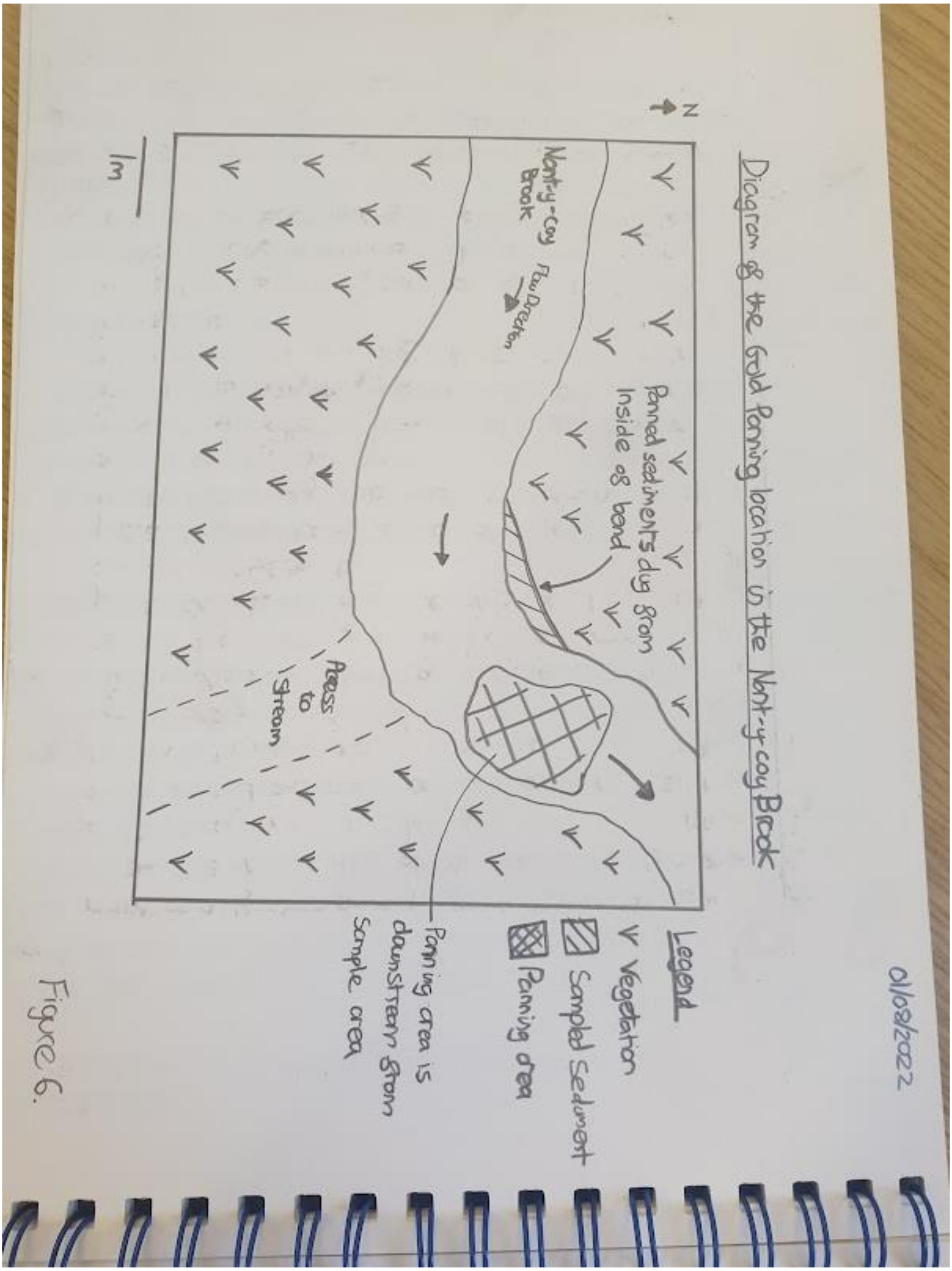
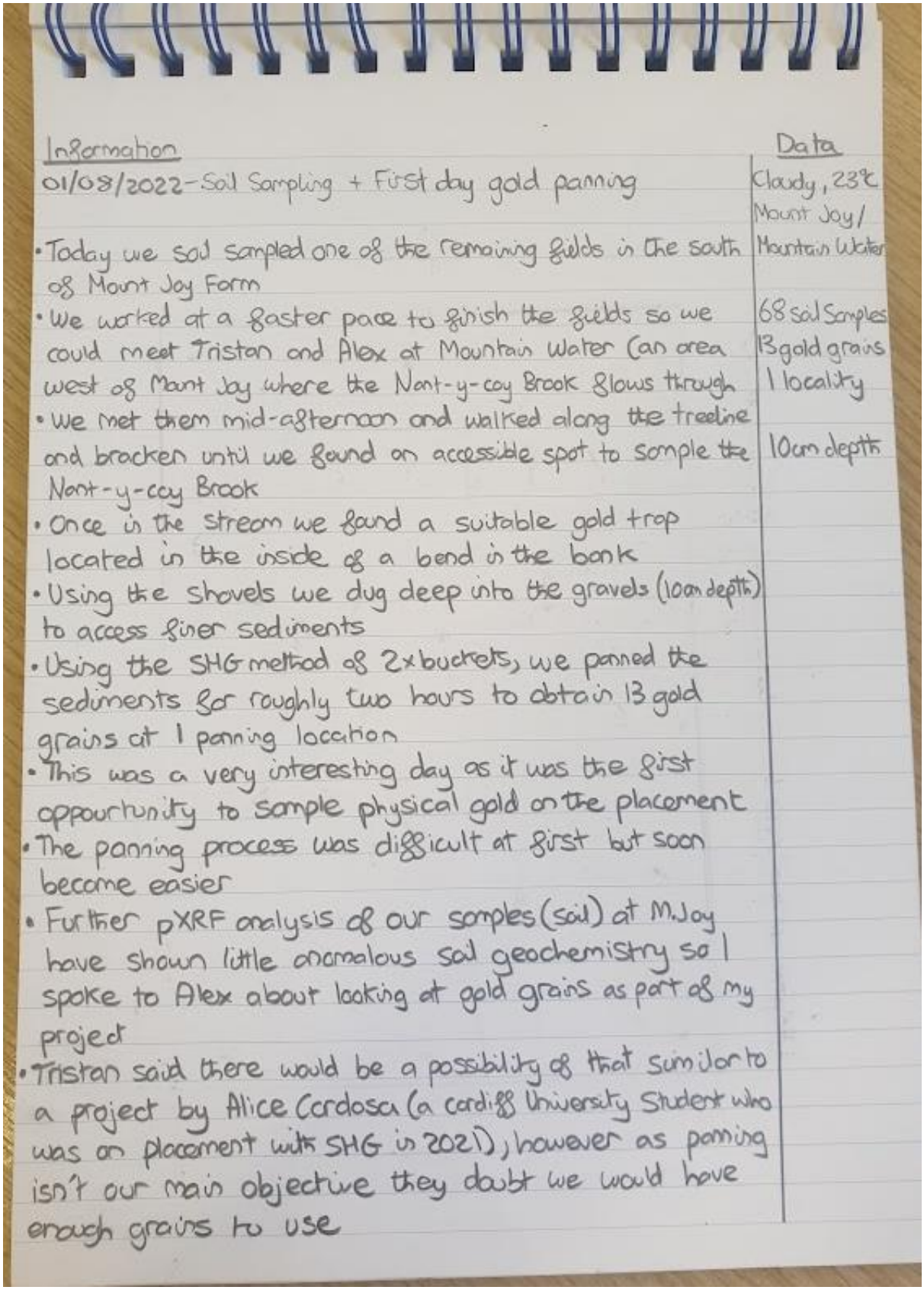
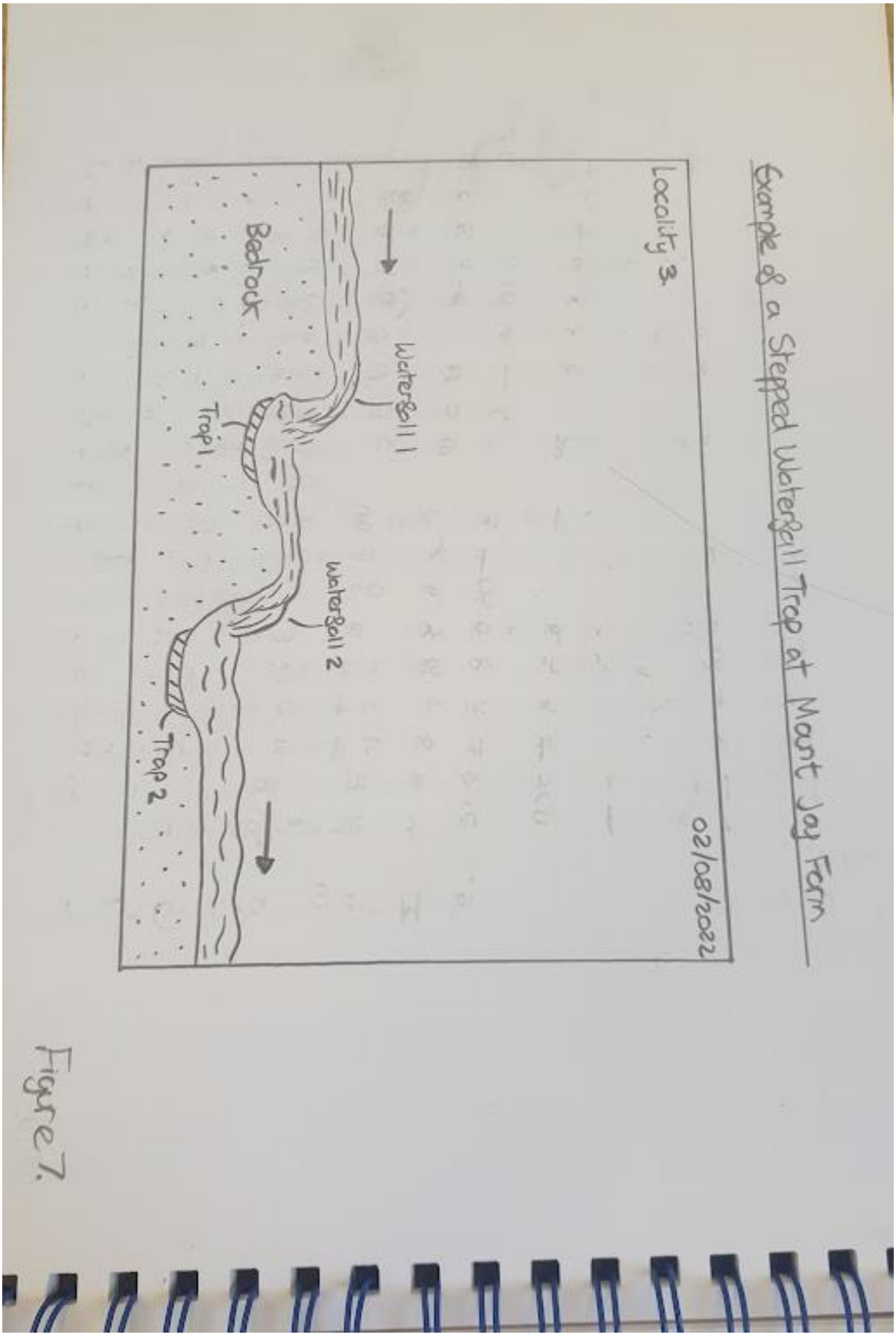
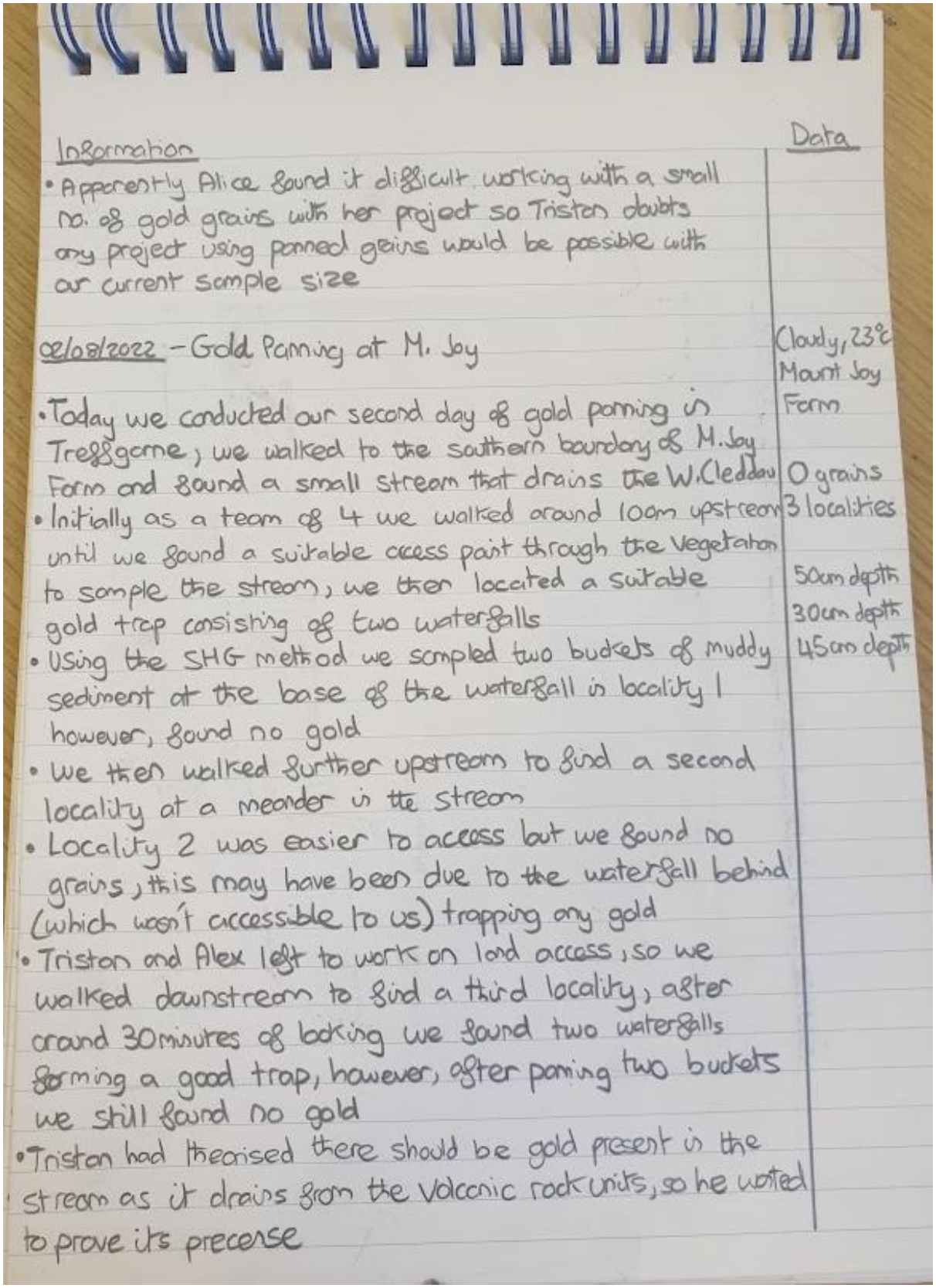


Diagram of the Gold Panning location in the Nant-y-coy Brook
01/08/2022
N
Panned sediments dug from inside of bend
Nant-y-coy Brook
Flow Direction
Access to Stream
1m
Legend
Vegetation
Sampled Sediment
Panning area
Panning area is downstream from sample area
Figure 6.



Information	Data
01/08/2022 - Soil Sampling + First day gold panning	Cloudy, 23°C
• Today we soil sampled one of the remaining fields in the south of Mount Joy Farm	Mount Joy / Mountain Water
• We worked at a faster pace to finish the fields so we could meet Tristan and Alex at Mountain Water Can area west of Mant Joy where the Nant-y-coy Brook flows through	68 soil Samples 13 gold grains 1 locality
• We met them mid-afternoon and walked along the treeline and bracken until we found an accessible spot to sample the Nant-y-coy Brook	10cm depth
• Once in the stream we found a suitable gold trap located in the inside of a bend in the bank	
• Using the shovels we dug deep into the gravels (10cm depth) to access finer sediments	
• Using the SHG method of 2x buckets, we panned the sediments for roughly two hours to obtain 13 gold grains at 1 panning location	
• This was a very interesting day as it was the first opportunity to sample physical gold on the placement	
• The panning process was difficult at first but soon become easier	
• Further pXRF analysis of our samples (soil) at M.Joy have shown little anomalous soil geochemistry so I spoke to Alex about looking at gold grains as part of my project	
• Tristan said there would be a possibility of that similar to a project by Alice Cordosa (a cardiff University Student who was on placement with SHG in 2021), however as panning isn't our main objective they doubt we would have enough grains to use	


Example of a Stepped Waterfall Trap at Mount Joy Farm
Locality 3.
02/08/2022
Waterfall 1
Trap 1
Bedrock
Waterfall 2
Trap 2
Figure 7.



Information

- Apparently Alice found it difficult working with a small no. of gold grains with her project so Tristan doubts any project using panned grains would be possible with our current sample size

Data

06/08/2022 - Gold Paming at M. Joy

Cloudy, 23°C
Mount Joy Farm

- Today we conducted our second day of gold paming in Treffgarne, we walked to the southern boundary of M. Joy Farm and found a small stream that drains the W. Cleddau
- Initially as a team of 4 we walked around 100m upstream until we found a suitable access point through the vegetation to sample the stream, we then located a suitable gold trap consisting of two waterfalls
- Using the SHG method we sampled two buckets of muddy sediment at the base of the waterfall in locality 1 however, found no gold
- We then walked further upstream to find a second locality at a meander in the stream
- Locality 2 was easier to access but we found no grains, this may have been due to the waterfall behind (which wasn't accessible to us) trapping any gold
- Tristan and Alex left to work on land access, so we walked downstream to find a third locality, after around 30minutes of looking we found two waterfalls forming a good trap, however, after paming two buckets we still found no gold
- Tristan had theorised there should be gold present in the stream as it drains from the volcanic rock units, so he wanted to prove its presense

0 grains
3 localities

50cm depth
30cm depth
45cm depth

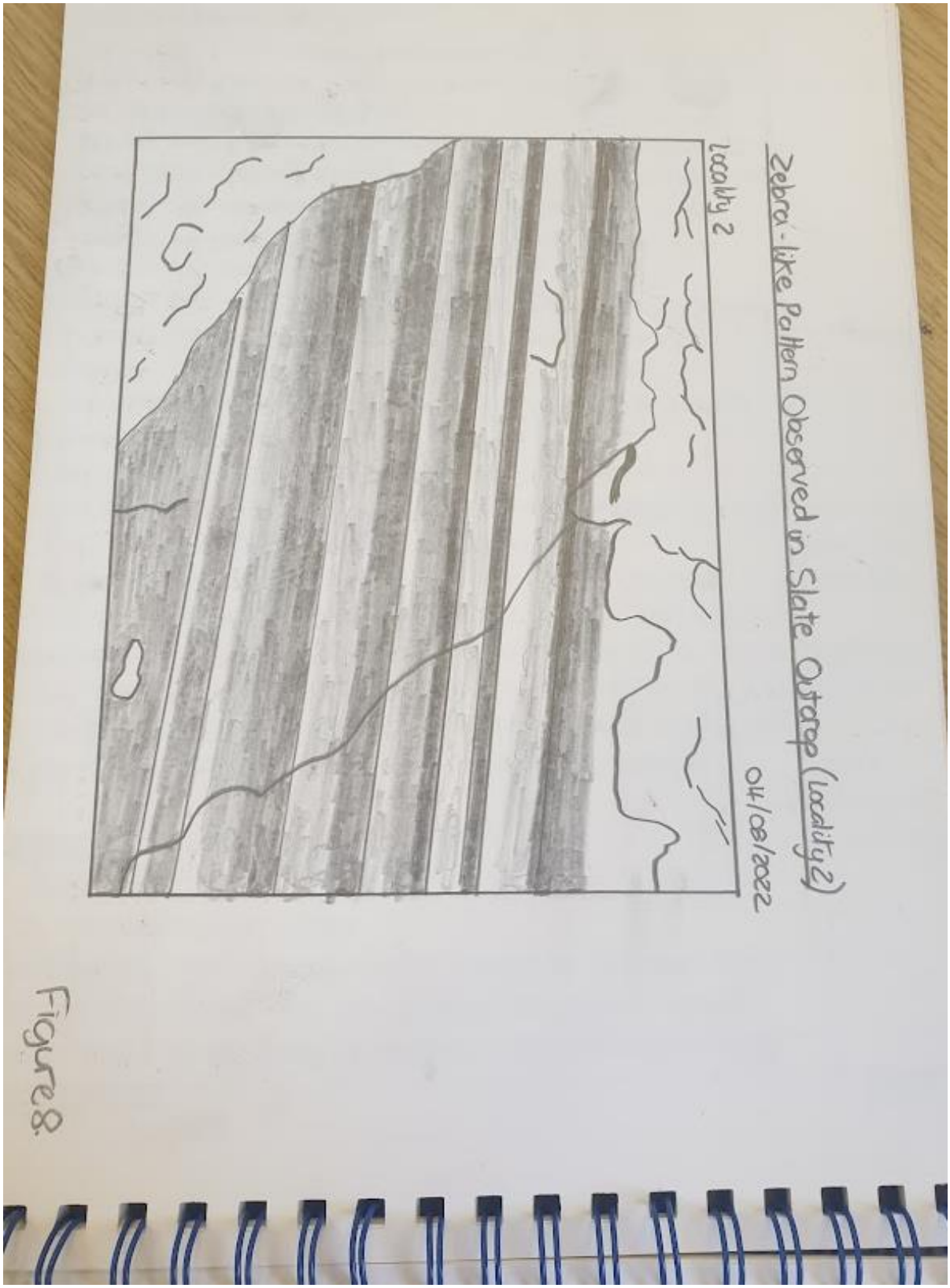
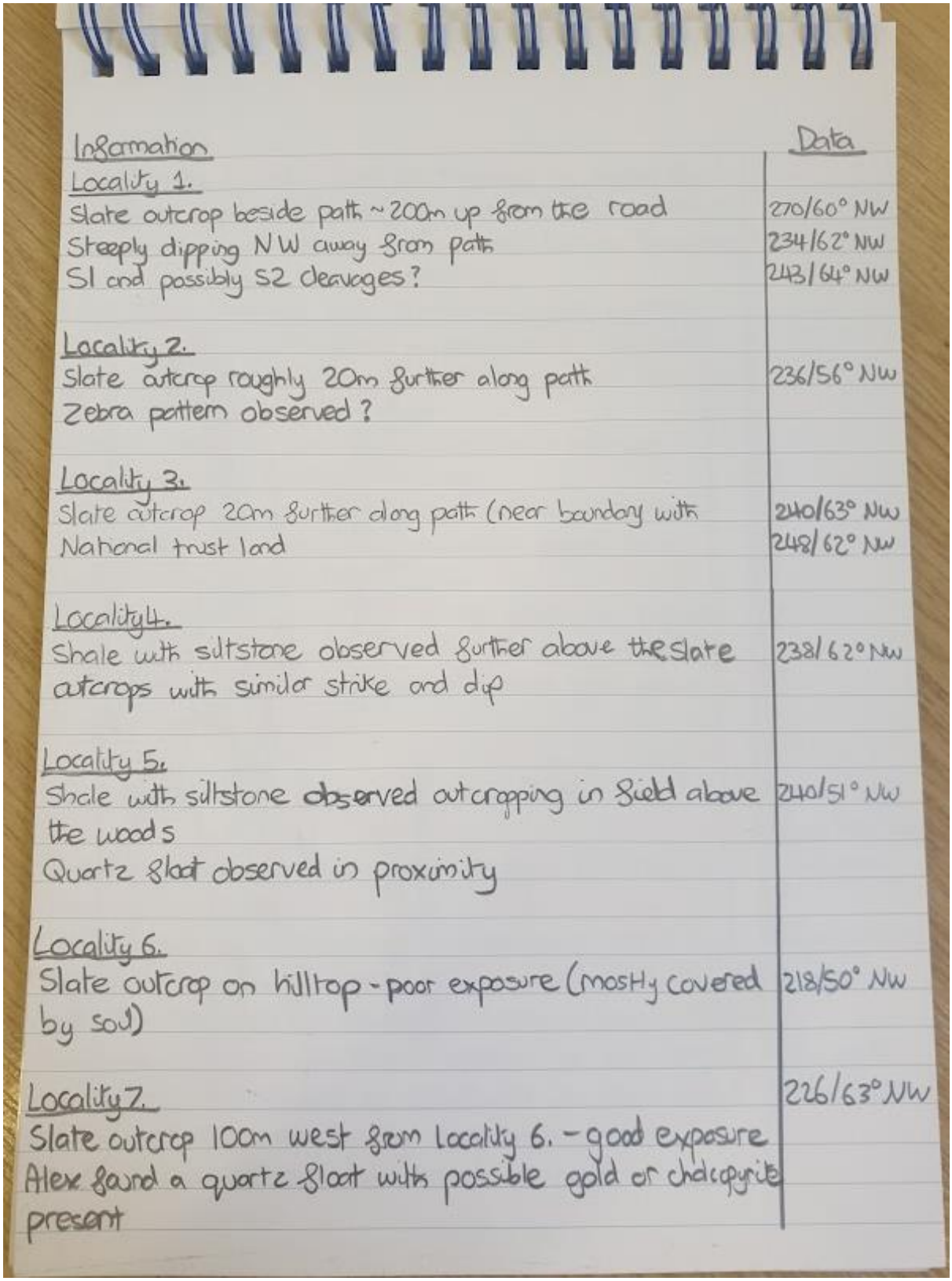
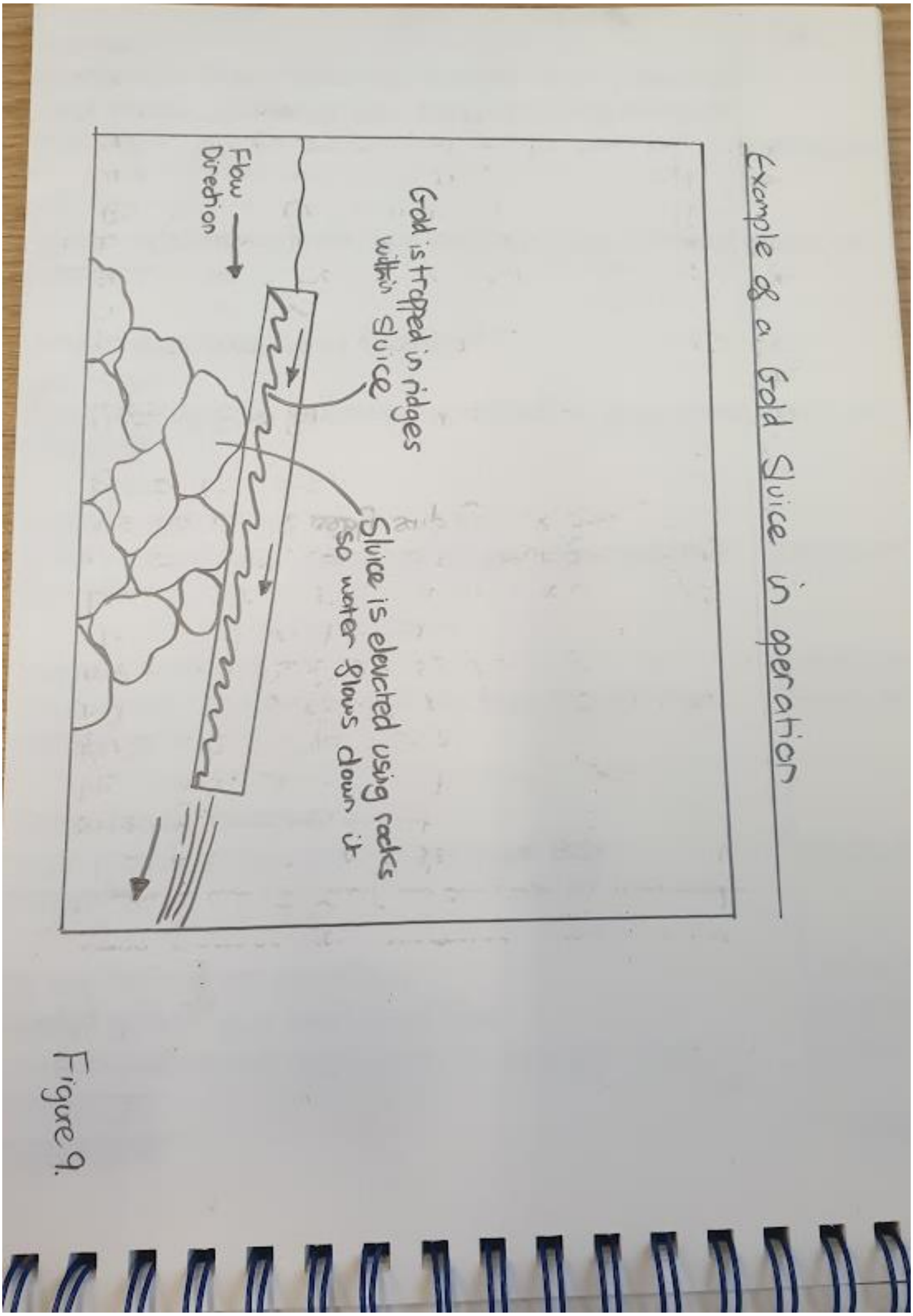

Zebra-like Pattern Observed in Slate Outcrop (Locality 2)
Locality 2
04/08/2022

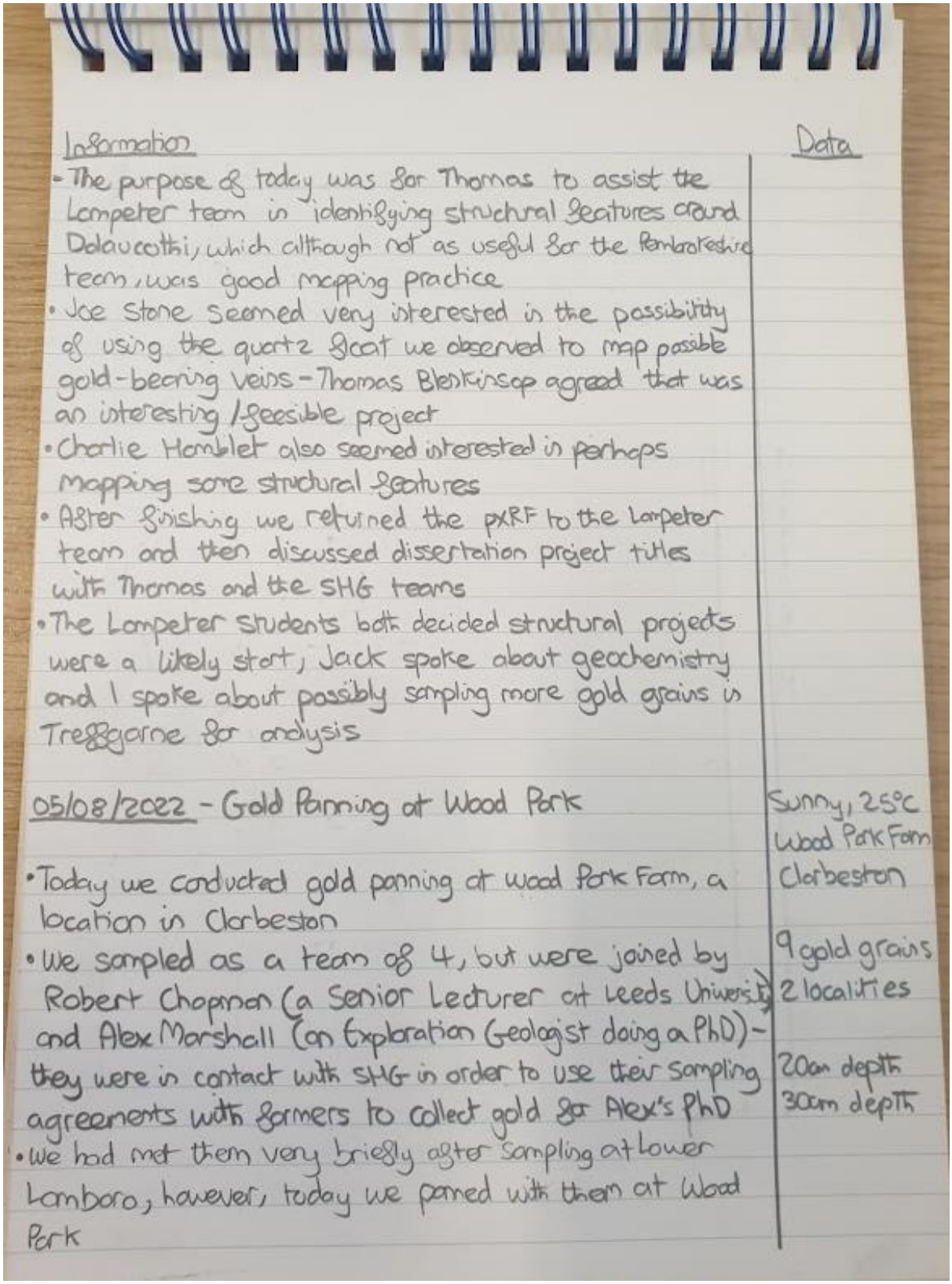
Figure 8.

Information	Data
• The lack of grains found doesn't mean no gold is present in the stream/area, it may just reflect poor choices of panning locations or less gold in the stream	
03/08/2022 – Soil Sampling at Lower Lamboro	Sunny, 25°C Lower Lamboro
• Today we sampled a farm in a new area of Pembrokeshire, Clarbeston - which has been sampled by SHG in 2021	Clarbeston
• The clarbeston area is around 6km east of Treffgorne and likely has a different gold source to Treffgorne (rumoured to be orogenic or glaciofluvial)	52 samples
• We sampled the farm in teams of 2, however, made slow progress due to farm animals and crops obstructing some sampling locations	
• The fields were just south of the South Wales Main Line and were mostly boggy	
• Lower Lamboro sits south of Clarbeston road in the area panned by SHG in 2021 so should hopefully show interesting soil geochemistry	
• Brief meeting with Robert Chapman and Alex Marshall	
04/08/2022 – Structural Mapping with Prof. Thomas Blenkinsop	Cloudy, 22°C Ddaucothi
• Today we travelled back to Lampeter for a structural mapping day around the Ddaucothi mine and Brunant Farm with Cardiff University Professor Thomas Blenkinsop, (and to also return the pXRF to the Lampeter team)	Lampeter
• We met the group in the Ddaucothi mine visitor car park and walked up the hill through the woodland trail	
• The first locality observed was a slate outcrop beside a path, dipping between 60 and 64° in a NW direction	240/060° NW

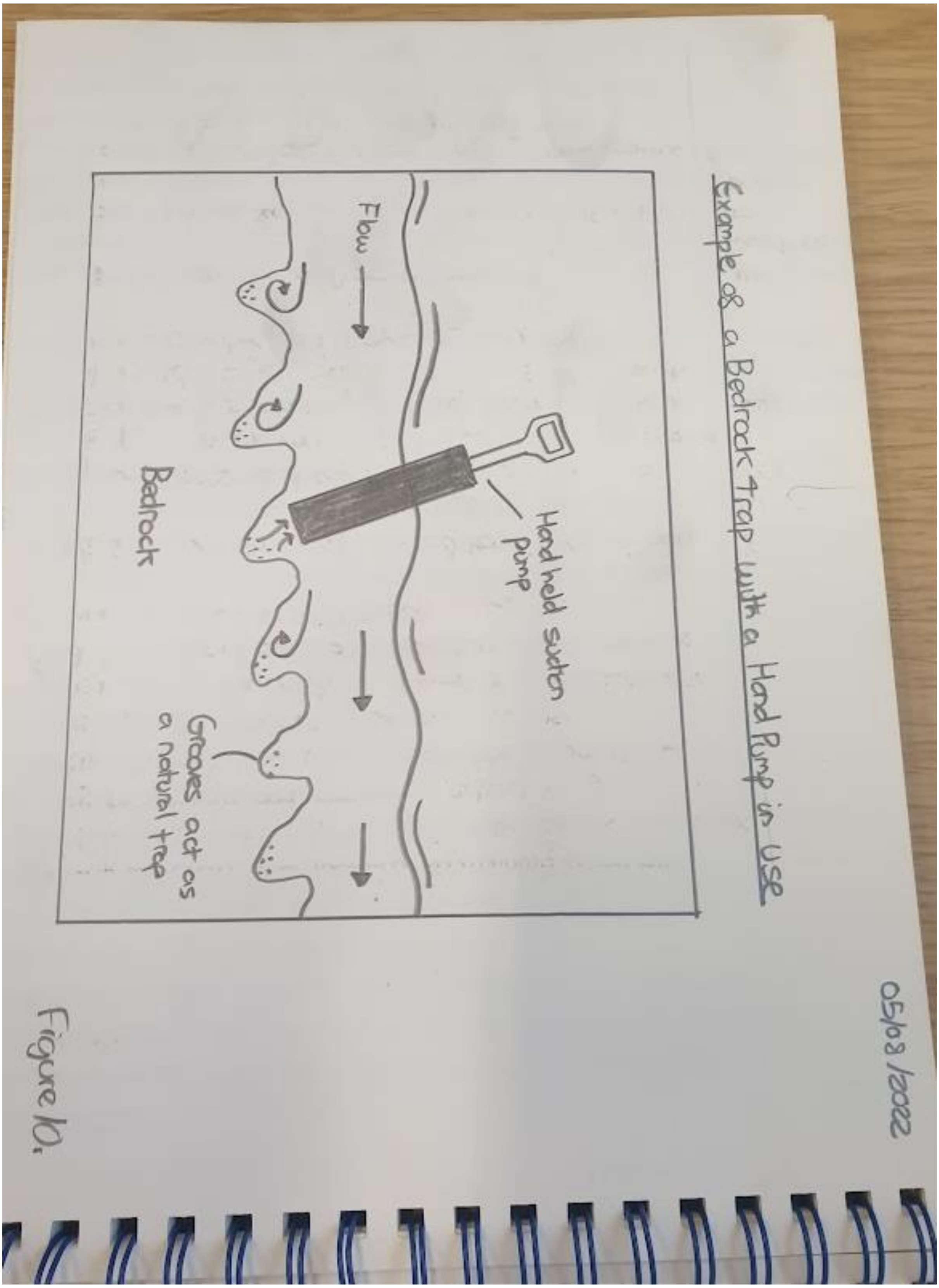


Information	Data
Locality 1.	
Slate outcrop beside path ~200m up from the road	270/60° NW
Steeply dipping NW away from path	234/62° NW
S1 and possibly S2 cleavages?	243/64° NW
Locality 2.	
Slate outcrop roughly 20m further along path	236/56° NW
Zebra pattern observed?	
Locality 3.	
Slate outcrop 20m further along path (near boundary with	240/63° NW
National trust land	248/62° NW
Locality 4.	
Shale with siltstone observed further above the slate	238/62° NW
outcrops with similar strike and dip	
Locality 5.	
Shale with siltstone observed outcropping in field above	240/51° NW
the woods	
Quartz float observed in proximity	
Locality 6.	
Slate outcrop on hilltop - poor exposure (mostly covered	218/50° NW
by soil)	
Locality 7.	226/63° NW
Slate outcrop 100m west from Locality 6. - good exposure	
Alex found a quartz float with possible gold or chalcopyrite	
present	

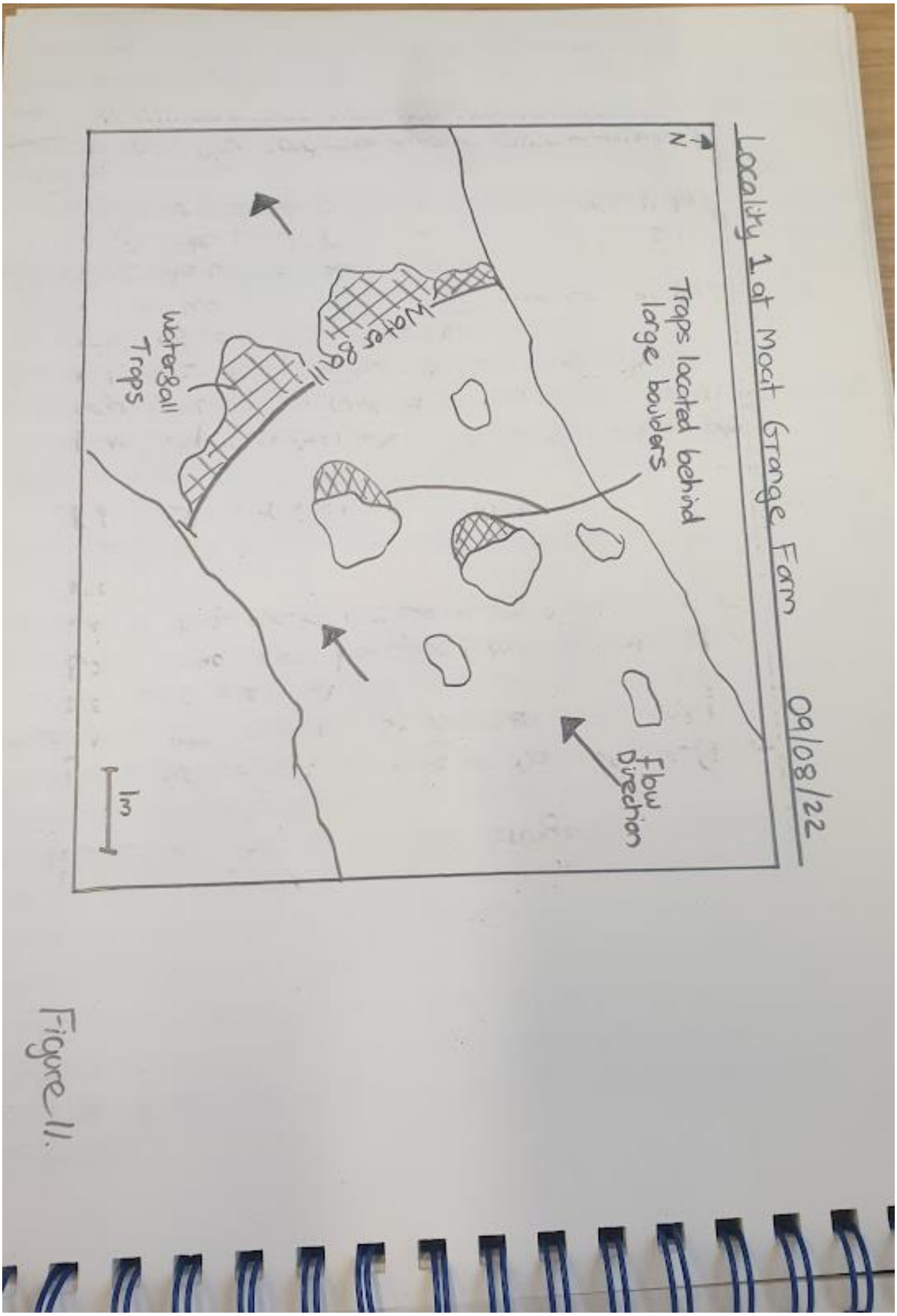

Example of a Gold Sluice in operation
Gold is trapped in ridges within sluice
Sluice is elevated using rocks so water flows down it
Flow Direction
Figure 9.

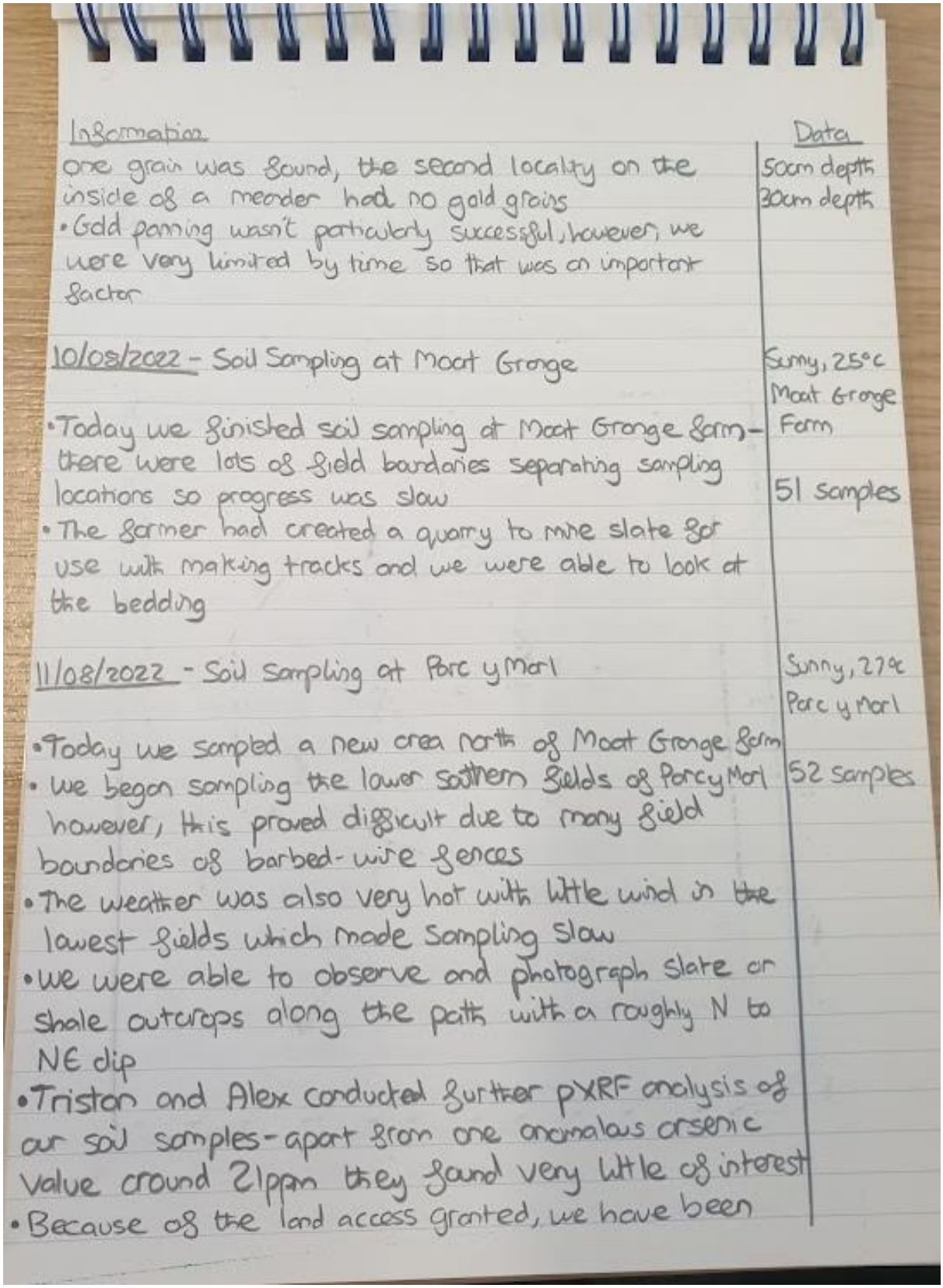


Information	Data
• The purpose of today was for Thomas to assist the Lampeter team in identifying structural features around Dolaucothi, which although not as useful for the Pembrokeshire team, was good mapping practice • Joe Stone seemed very interested in the possibility of using the quartz float we observed to map possible gold-bearing veins - Thomas Blenkinsop agreed that was an interesting / feasible project • Charlie Hamblet also seemed interested in perhaps mapping some structural features • After finishing we returned the pXRF to the Lampeter team and then discussed dissertation project titles with Thomas and the SHG teams • The Lampeter students both decided structural projects were a likely start, Jack spoke about geochemistry and I spoke about possibly sampling more gold grains in Treffgarne for analysis	
05/08/2022 - Gold Panning at Wood Park	Sunny, 25°C Wood Park Farm Clarbeston
• Today we conducted gold panning at Wood Park Farm, a location in Clarbeston • We sampled as a team of 4, but were joined by Robert Chapman (a Senior Lecturer at Leeds University) and Alex Marshall (an Exploration Geologist doing a PhD) - they were in contact with SHG in order to use their sampling agreements with farmers to collect gold for Alex's PhD • We had met them very briefly after sampling at Lower Lamboro, however, today we panned with them at Wood Park	9 gold grains 2 localities 20cm depth 30cm depth

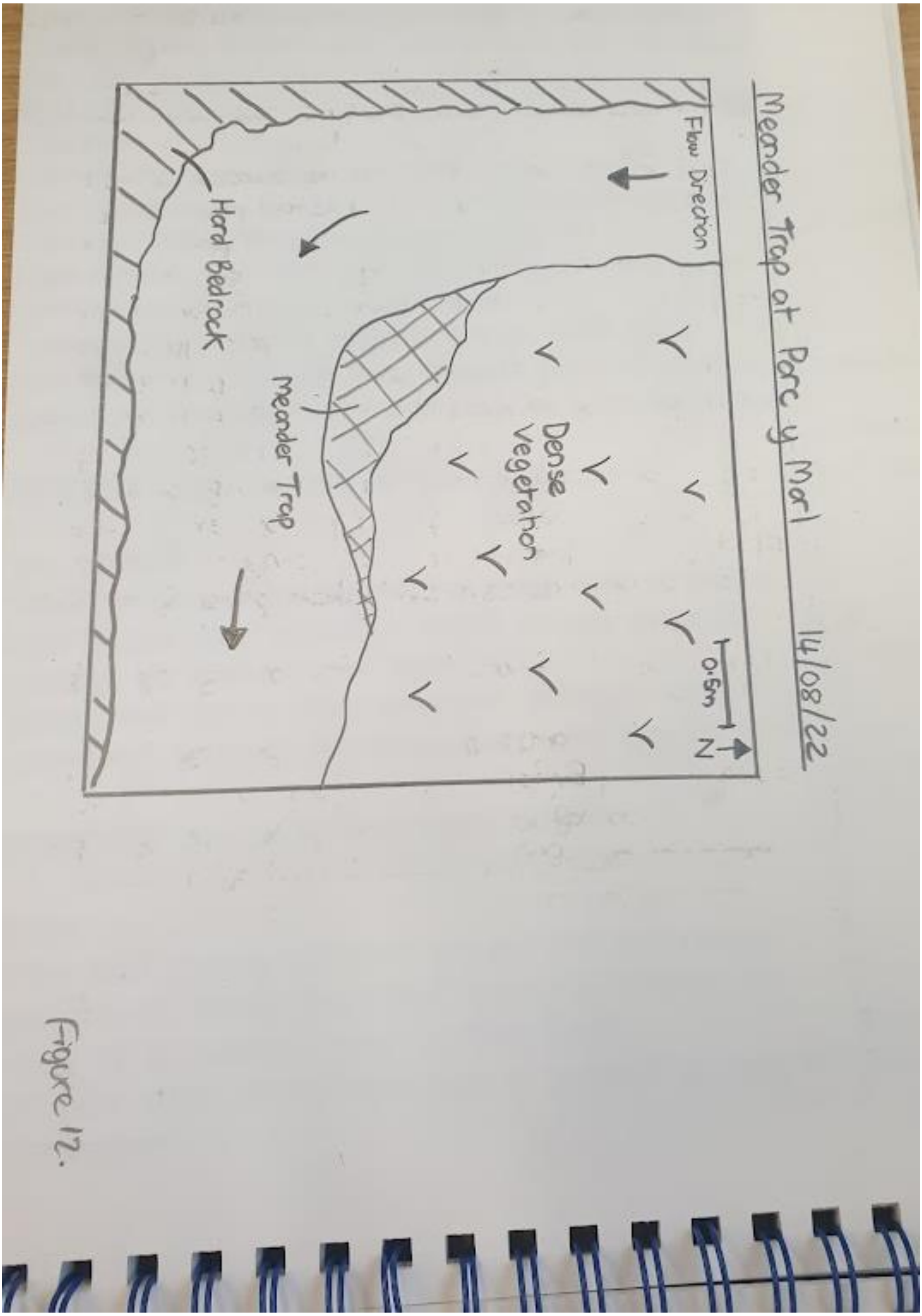

Example of a Bedrock Trap with a Hand Pump in Use
Flow
Hand held suction pump
Bedrock
Grooves act as a natural trap
05/08/2022
Figure 10.

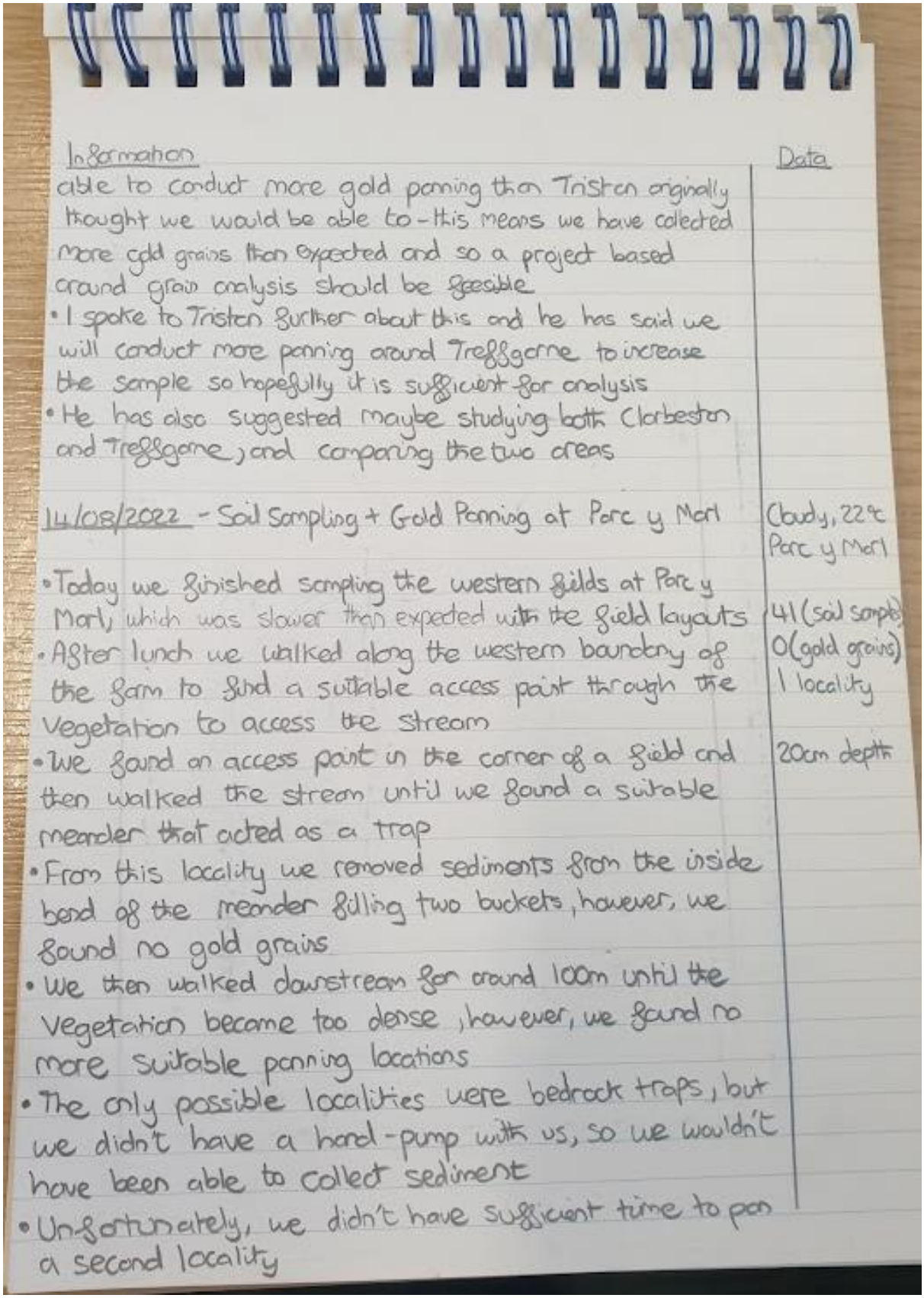
Information	Data
• Robert had brought a gold sluice which appeared far more effiicient at collecting gold grains - they were able to sample a much greater amount than we were able to • Robert also found a very large grain (~2mm in length) which he kindly allowed SHG to keep • We sampled from one locality containing a small waterfall trap and a meander with bedrock (bedrock is easy to sample and creates a natural trap) • For the bedrock we used Robert's suction pumps to access the finer material which proved useful • The day was successful however, only 9 grains were found by SHG (Robert and Alex found many more) as we had to leave at 14:00 for an office delivery	
08/08/2022 - Soil Sampling at Wood Park Farm • Today was our second day soil sampling in Darbeston • We sampled the southern part of Wood Park, which proved overgrown and wet, making sampling slower than usual • We also used larger spacing between sampling points so overall collected less samples than usual	Sunny, 25°c Wood Park Farm 45 samples
09/08/2022 - Wood Park & Moat Grange • We carried on soil sampling at Wood Park Farm to finish the remaining locations • Lots of field boundaries made sampling slower, however, we finished early and then travelled to Moat Grange Farm to conduct gold panning • We chose a locality near a waterfall trap, however, only	Sunny, 25°c Wood Park Farm and Moat Grange Farm 55 (soil samples) 1 (gold grain) 2 Localities


Locality 1 at Moat Grange Farm
09/08/22
N
Traps located behind large boulders
Waterfall
Waterfall Traps
Flow Direction
1m
Figure 11.



Information	Data
one grain was found, the second locality on the inside of a meander had no gold grains • Gold panning wasn't particularly successful, however, we were very limited by time so that was an important factor	50cm depth 30cm depth
10/08/2022 - Soil Sampling at Moat Grange • Today we finished soil sampling at Moat Grange farm - there were lots of field boundaries separating sampling locations so progress was slow • The farmer had created a quarry to mine slate for use with making tracks and we were able to look at the bedding	Sunny, 25°c Moat Grange Farm 51 samples
11/08/2022 - Soil Sampling at Parc y Mor • Today we sampled a new area north of Moat Grange farm • We began sampling the lower southern fields of Parcy Mor however, this proved difficult due to many field boundaries of barbed-wire fences • The weather was also very hot with little wind in the lowest fields which made sampling slow • We were able to observe and photograph slate or shale outcrops along the path with a roughly N to NE dip • Tristan and Alex conducted further pXRF analysis of our soil samples - apart from one anomalous arsenic value around 21ppm they found very little of interest • Because of the land access granted, we have been	Sunny, 27°c Parc y Mor 52 samples


Meander Trap at Parc y Marl
14/08/22
Flow Direction
Hard Bedrock
Meander Trap
Dense Vegetation
0.5m
N
Figure 12.



Information	Data
able to conduct more gold panning than Tristen originally thought we would be able to - this means we have collected more gold grains than expected and so a project based around grain analysis should be feasible • I spoke to Tristen further about this and he has said we will conduct more panning around Treffgarne to increase the sample so hopefully it is sufficient for analysis • He has also suggested maybe studying both Clarbeston and Treffgarne, and comparing the two areas	
14/08/2022 - Soil Sampling + Gold Panning at Parc y Marl	Cloudy, 22°c Parc y Marl
• Today we finished sampling the western fields at Parc y Marl, which was slower than expected with the field layouts • After lunch we walked along the western boundary of the farm to find a suitable access point through the vegetation to access the stream • We found an access point in the corner of a field and then walked the stream until we found a suitable meander that acted as a trap • From this locality we removed sediments from the inside bend of the meander filling two buckets, however, we found no gold grains • We then walked downstream for around 100m until the vegetation became too dense, however, we found no more suitable panning locations • The only possible localities were bedrock traps, but we didn't have a hand-pump with us, so we wouldn't have been able to collect sediment • Unfortunately, we didn't have sufficient time to pan a second locality	41 (soil samples) 0 (gold grains) 1 locality 20cm depth

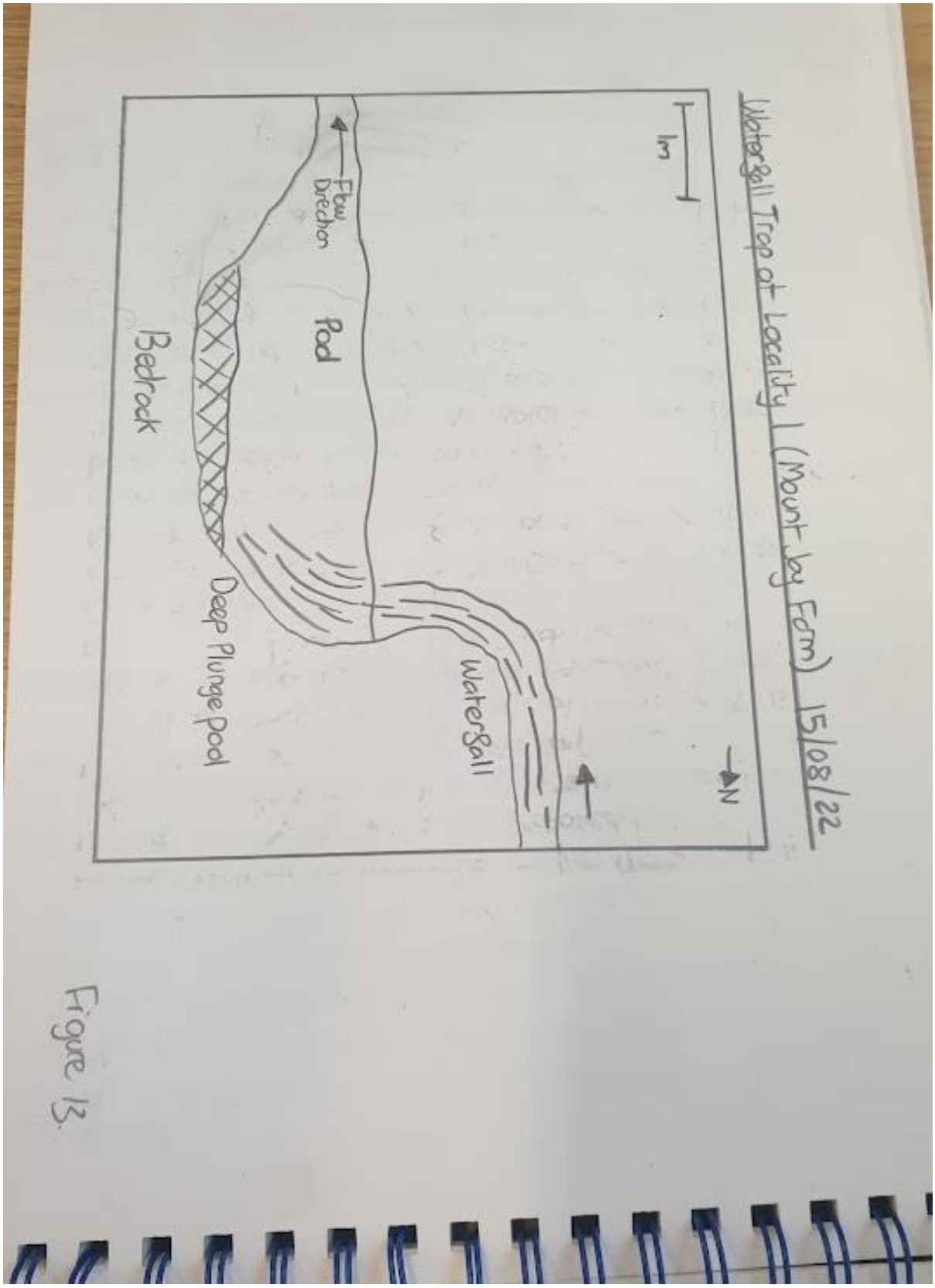
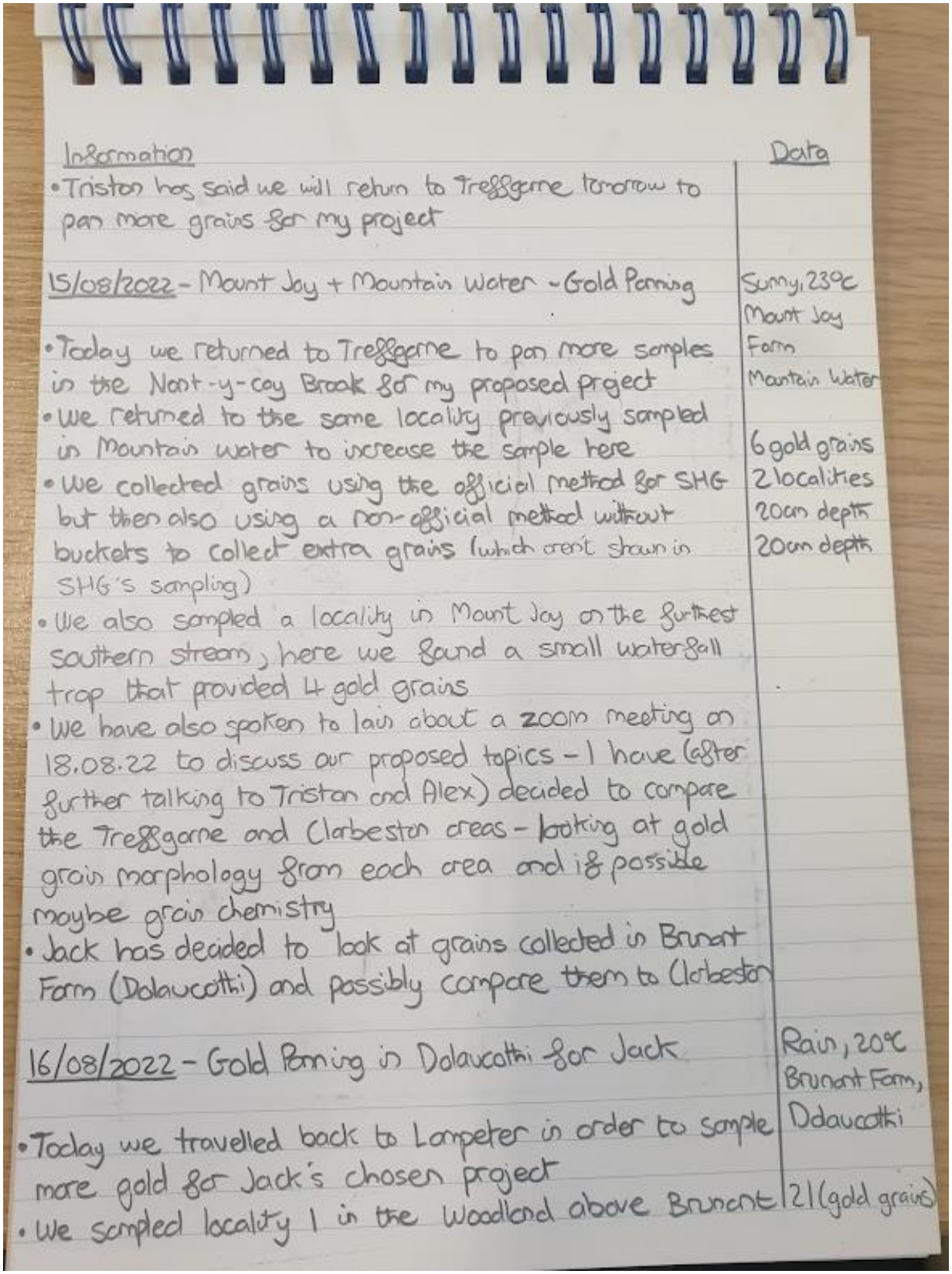
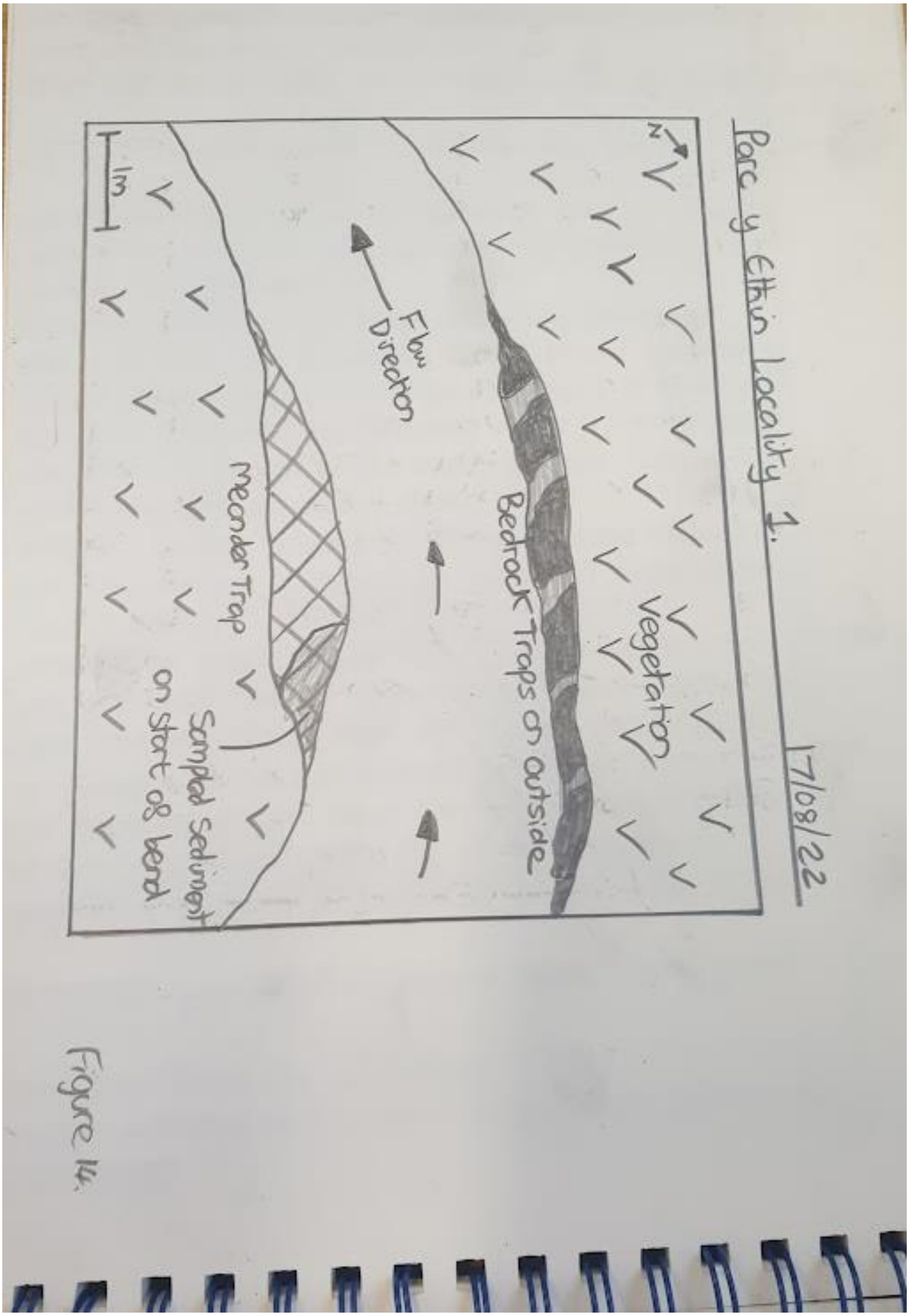

Waterfall Trap at Locality 1 (Mount Joy Form) 15/08/22
1m
N
Flow Direction
Pool
Bedrock
Deep Plunge Pool
Waterfall

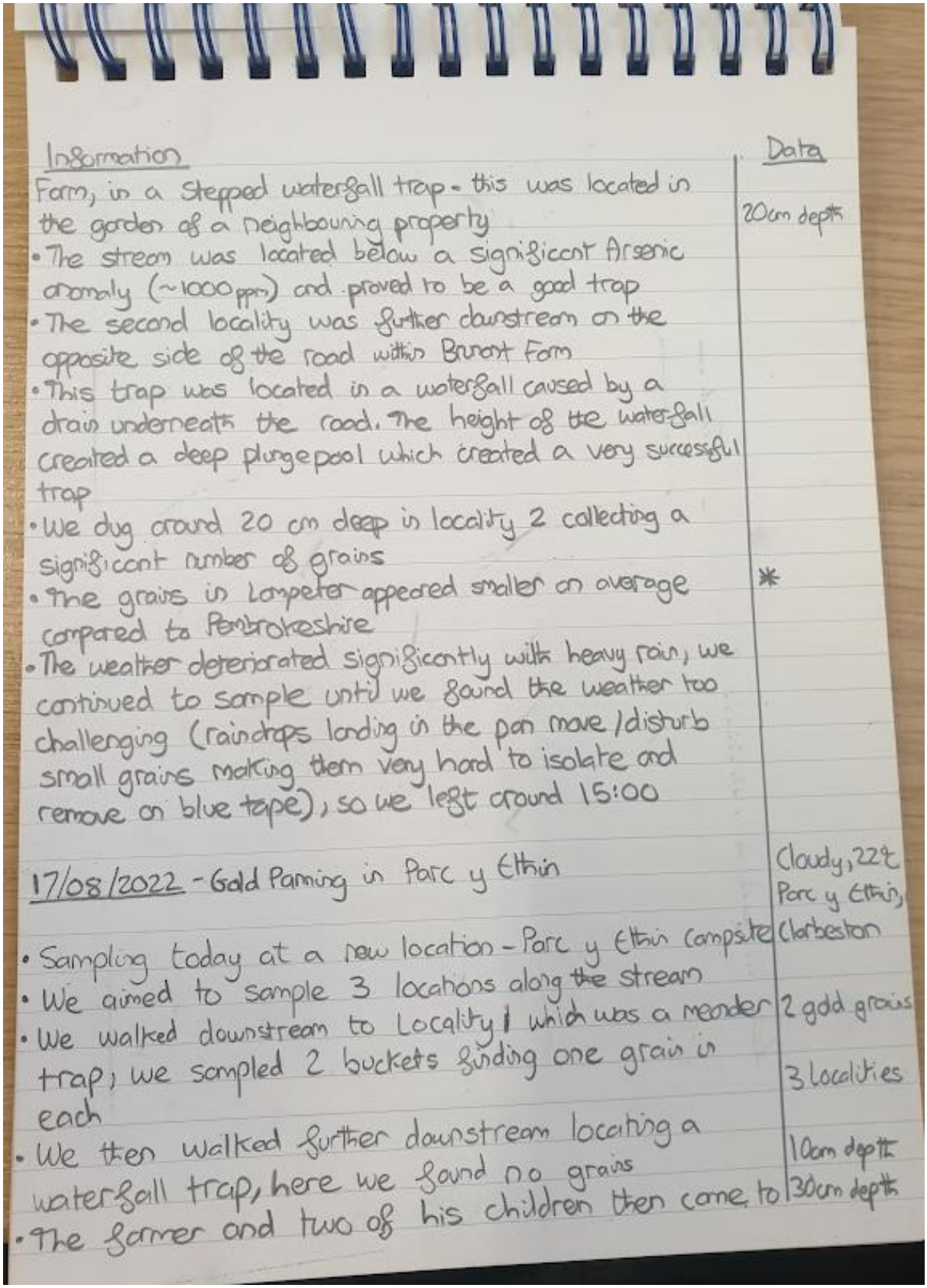
Figure 13.



Information	Data
• Triston has said we will return to Treffgarne tomorrow to pan more grains for my project	
15/08/2022 - Mount Joy + Mountain Water - Gold Panning	Sunny, 23°C Mount Joy Farm Mountain Water
• Today we returned to Treffgarne to pan more samples in the Nant-y-coy Brook for my proposed project • We returned to the same locality previously sampled in Mountain water to increase the sample here • We collected grains using the official method for SHG but then also using a non-official method without buckets to collect extra grains (which aren't shown in SHG's sampling) • We also sampled a locality in Mount Joy on the furthest southern stream, here we found a small waterfall trap that provided 4 gold grains • We have also spoken to Iain about a zoom meeting on 18.08.22 to discuss our proposed topics - I have (after further talking to Tristan and Alex) decided to compare the Treffgarne and Clarbeston areas - looking at gold grain morphology from each area and if & possible maybe grain chemistry • Jack has decided to look at grains collected in Brunant Farm (Ddaucoithi) and possibly compare them to Clarbeston	6 gold grains 2 localities 20cm depth 20cm depth
16/08/2022 - Gold Panning in Ddaucoithi for Jack	Rain, 20°C Brunant Farm, Ddaucoithi
• Today we travelled back to Lampeter in order to sample more gold for Jack's chosen project • We sampled locality 1 in the woodland above Brunant	21 (gold grains)



Parc y Ethin Locality 1.
17/08/22
N
Vegetation
Bedrock Traps on outside
Flow Direction
Meander Trap
Sampled sediment on start of bend
1m
Figure 14.



Information

Farm, is a stepped waterfall trap - this was located in the garden of a neighbouring property

- The stream was located below a significant Arsenic anomaly (~1000ppm) and proved to be a good trap
- The second locality was further downstream on the opposite side of the road within Burrow Farm
- This trap was located in a waterfall caused by a drain underneath the road. The height of the waterfall created a deep plunge pool which created a very successful trap
- We dug around 20 cm deep in locality 2 collecting a significant number of grains
- The grains in Carmarthen appeared smaller on average compared to Pembrokeshire
- The weather deteriorated significantly with heavy rain, we continued to sample until we found the weather too challenging (raindrops landing in the pan move/disturb small grains making them very hard to isolate and remove on blue tape), so we left around 15:00

Data

20cm depth

*

17/08/2022 - Gold Panning in Parc y Ethin

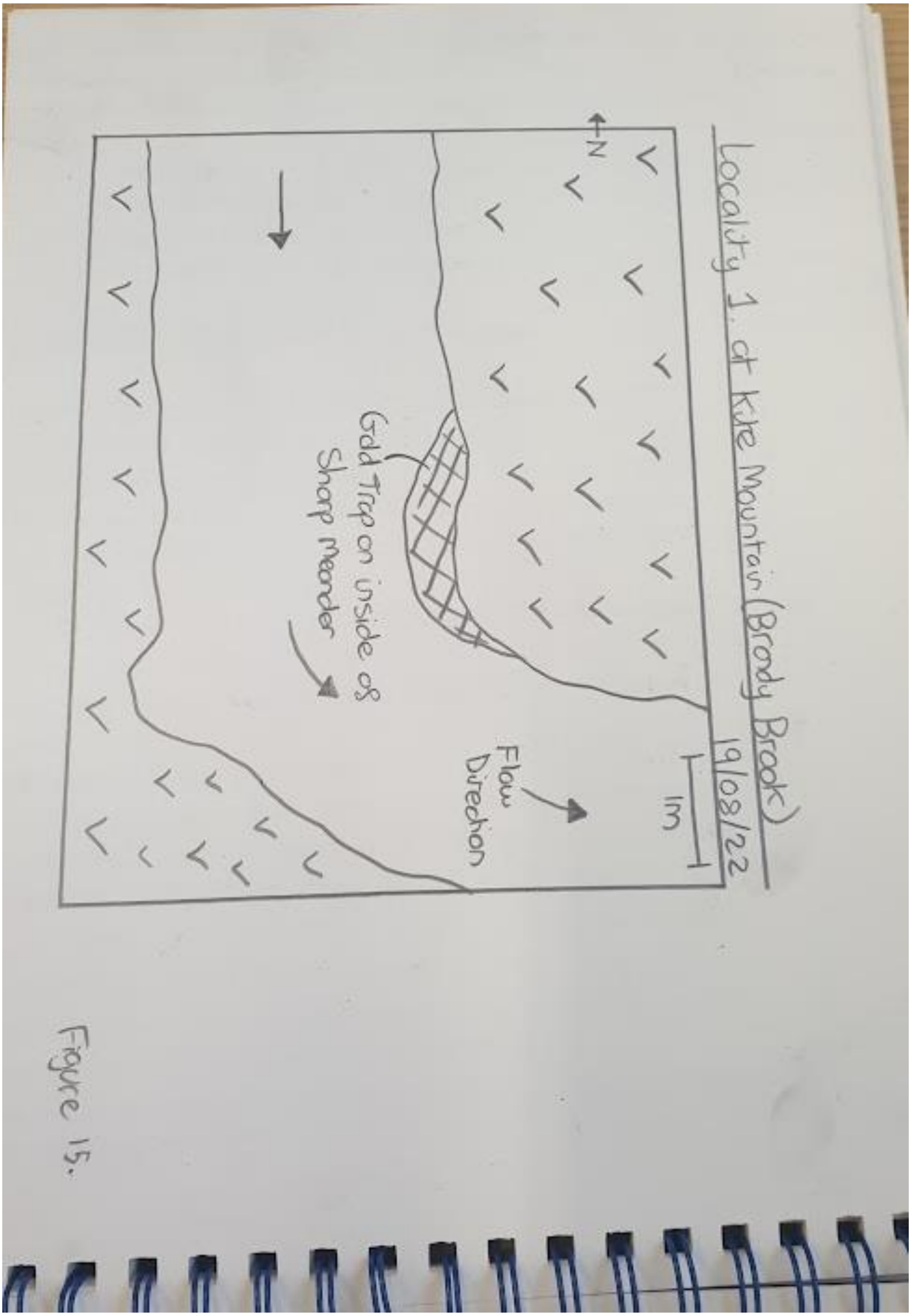
- Sampling today at a new location - Parc y Ethin campsite
- We aimed to sample 3 locations along the stream
- We walked downstream to Locality 1 which was a meander trap, we sampled 2 buckets finding one grain in each
- We then walked further downstream locating a waterfall trap, here we found no grains
- The farmer and two of his children then came to

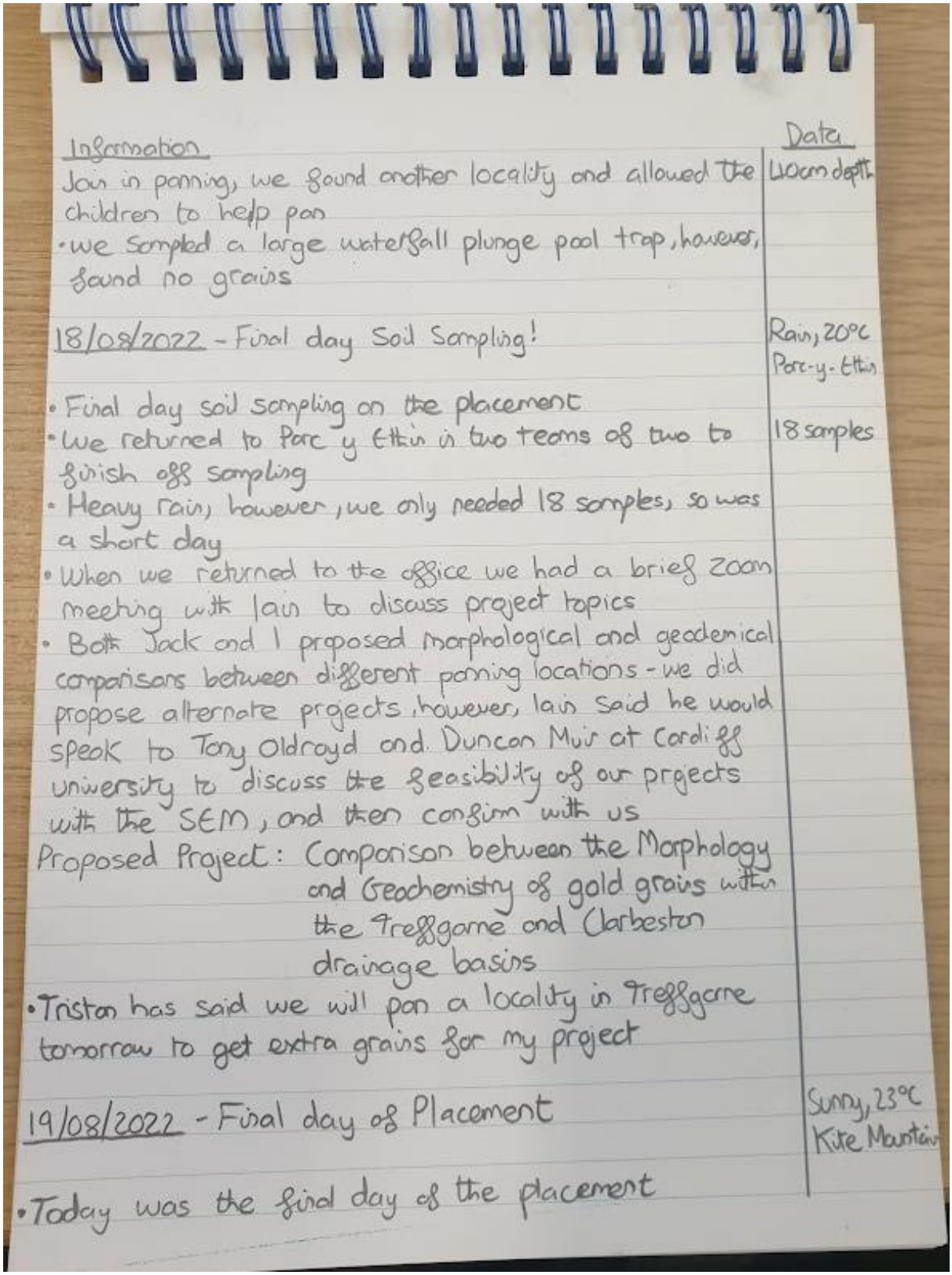
Cloudy, 22°C
Parc y Ethin, Clarbeston

2 gold grains

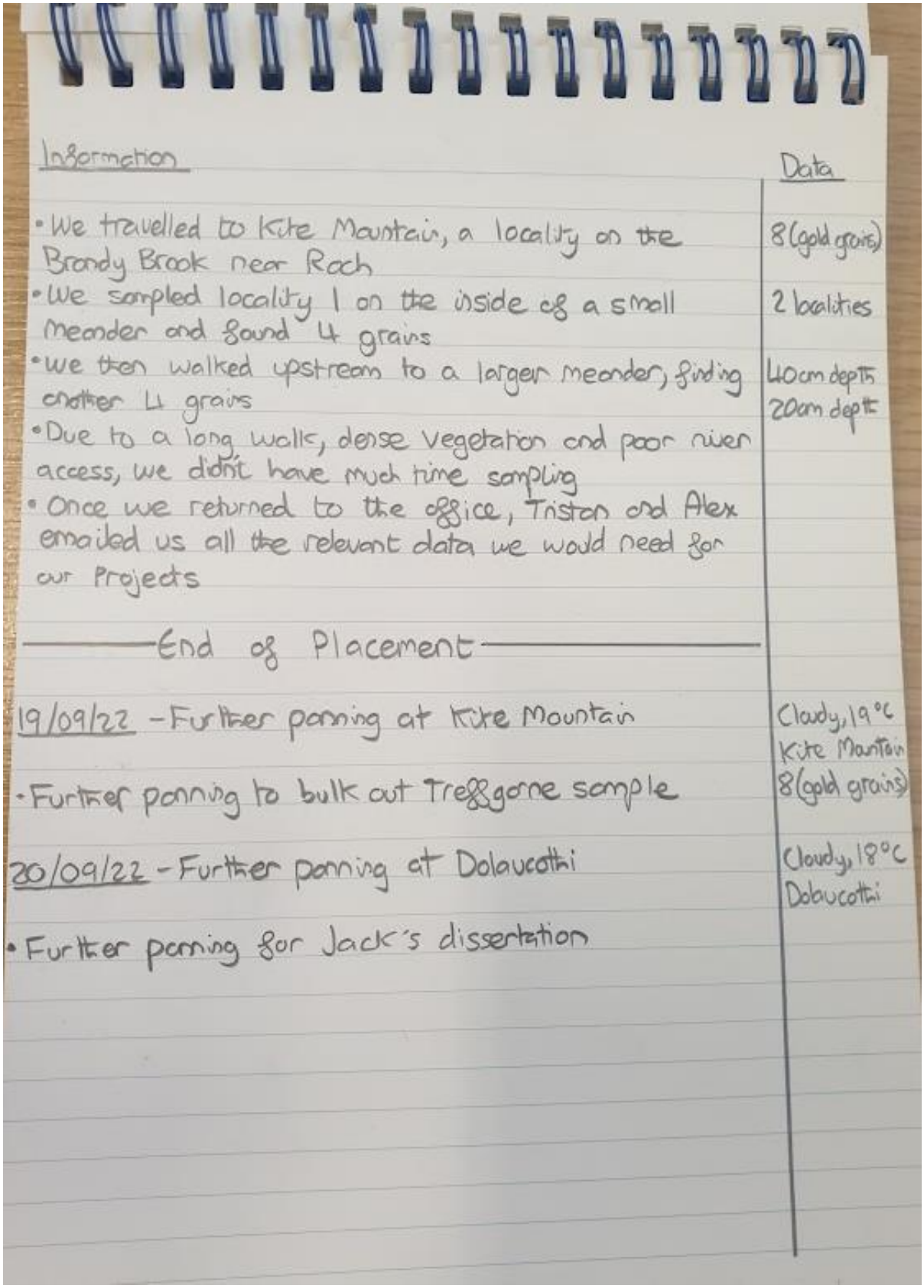
3 localities

10cm depth
30cm depth

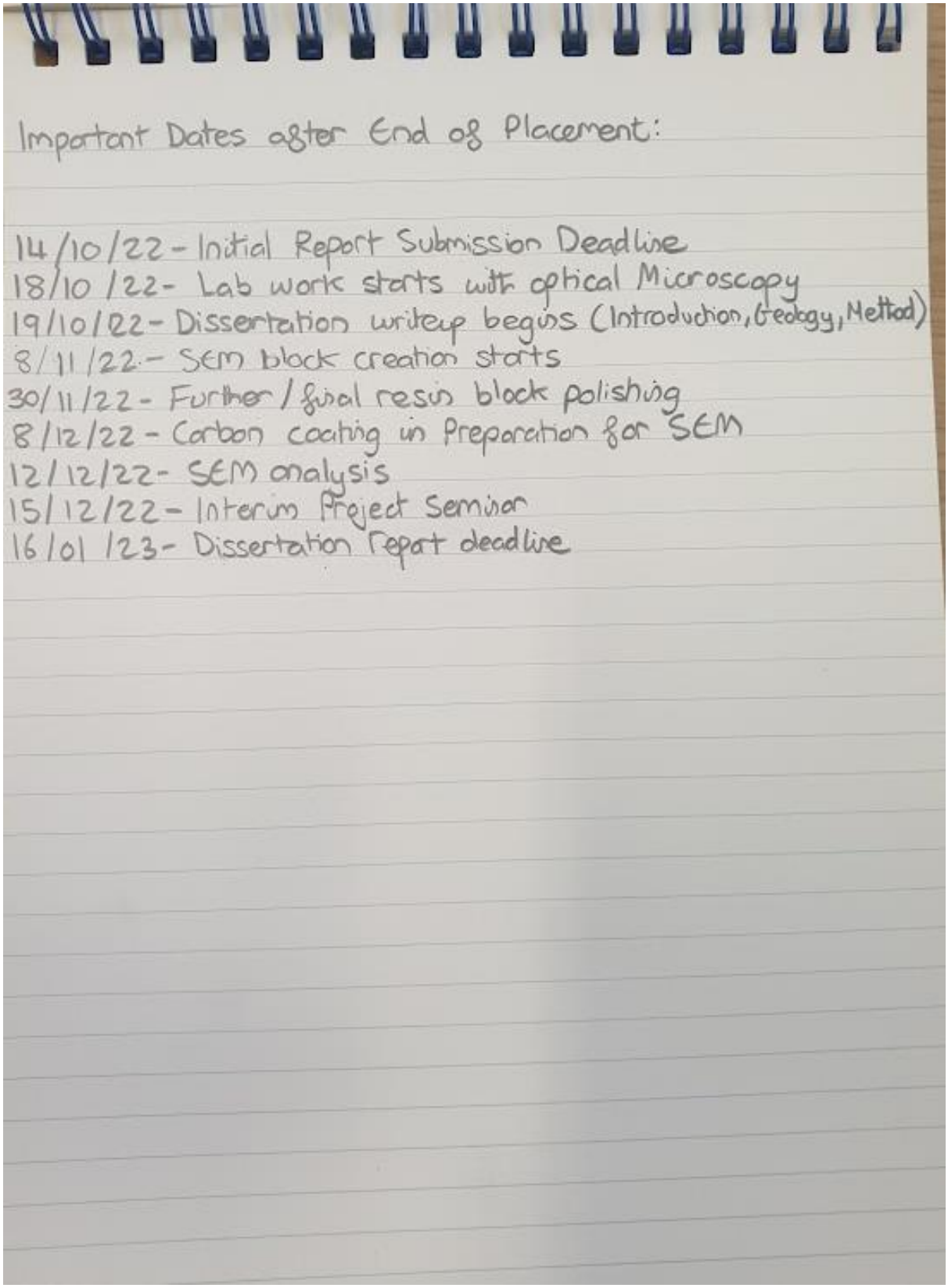

Locality 1. at Kite Mountain (Brody Brook)
19/08/22
1m
N
Flow Direction
Gold Trap on inside of Sharp meander
Figure 15.



Information	Data
Jan in panning, we found another locality and allowed the children to help pan • we sampled a large waterfall plunge pool trap, however, found no grains	40cm depth
18/08/2022 - Final day Soil Sampling! • Final day soil sampling on the placement • We returned to Parc y Ethin in two teams of two to finish off sampling • Heavy rain, however, we only needed 18 samples, so was a short day • When we returned to the office we had a brief Zoom meeting with Iain to discuss project topics • Both Jack and I proposed morphological and geochemical comparisons between different panning locations - we did propose alternate projects, however, Iain said he would speak to Tony Oldroyd and Duncan Muir at Cardiff university to discuss the feasibility of our projects with the SEM, and then confirm with us Proposed Project: Comparison between the Morphology and Geochemistry of gold grains within the Treffgarne and Clarbeston drainage basins • Tristan has said we will pan a locality in Treffgarne tomorrow to get extra grains for my project	Rain, 20°C Parc-y-Ethin 18 samples
19/08/2022 - Final day of Placement • Today was the final day of the placement	Sunny, 23°C Kite Mountain



Information	Data
• We travelled to Kite Mountain, a locality on the Brandy Brook near Roch	8 (gold grains)
• We sampled locality 1 on the inside of a small meander and found 4 grains	2 localities
• we then walked upstream to a larger meander, finding another 4 grains	40cm depth
• Due to a long walk, dense vegetation and poor river access, we didn't have much time sampling	20cm depth
• Once we returned to the office, Tristan and Alex emailed us all the relevant data we would need for our Projects	
——— End of Placement ———	
19/09/22 - Further panning at Kite Mountain	Cloudy, 19°C Kite Mountain
• Further panning to bulk out Treggorne sample	8 (gold grains)
20/09/22 - Further panning at Dolaucothi	Cloudy, 18°C Dolaucothi
• Further panning for Jack's dissertation	



Important Dates after End of Placement:

14/10/22 - Initial Report Submission Deadline
18/10/22 - Lab work starts with optical Microscopy
19/10/22 - Dissertation writeup begins (Introduction, Geology, Method)
8/11/22 - SEM block creation starts
30/11/22 - Further / final resin block polishing
8/12/22 - Carbon coating in Preparation for SEM
12/12/22 - SEM analysis
15/12/22 - Interim Project Seminar
16/01/23 - Dissertation Repot deadline