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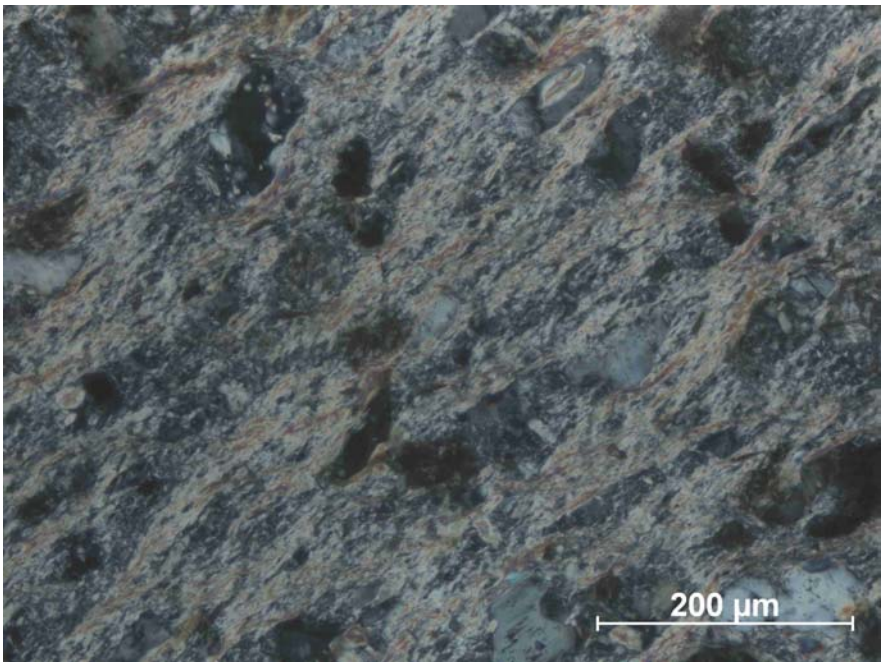
Petrographic descriptions of samples from the Cardigan, Llangranog, Fishguard, Llandovery and Brecon 1:50000 map sheets

Geology and Landscape Southern Britain Programme

Internal Report IR/07/027



BRITISH GEOLOGICAL SURVEY

GEOLOGY AND LANDSCAPE SOUTHERN BRITAIN PROGRAMME

INTERNAL REPORT IR/07/027

Petrographic descriptions of samples from the Cardigan, Llangranog, Fishguard, Llandovery and Brecon 1:50000 map sheets

J A McKervey

Keywords

Petrography, Brecon, Cardigan, Fishguard, Llandovery, Llangranog.

Front cover

Cross-polarised light photomicrograph of the sample FSJ64 with a well-defined (shear band) cleavage.

Bibliographical reference

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Contents

FIGURES

TABLES

1 Introduction

This report presents petrographic descriptions and accompanying photomicrographs of samples collected by Jeremy Davies (BGS) during the mapping of the Cardigan (193), Llangranog (194), Fishguard (210), Llandovery (212) and Brecon (213) 1:50000 map sheets. The details of the samples are given in Table 1 below.

Table 1: Sample details

Sample		Grid sq.	Grid ref.		1:50K map	Locality	Description/Stratigraphy
			E	N			
FSJ58	E74641	SN	1080	4580	Cardigan (193)	Drift cliffs, Ceibwr Bay	Erratic pebble from gravel
FSJ59	E74642	SN	1080	4580	Cardigan (193)	Drift cliffs, Ceibwr Bay	Erratic pebble from gravel
FSJ60	E74643	SN	1080	4580	Cardigan (193)	Drift cliffs, Ceibwr Bay	Erratic pebble from gravel
FSJ61	E74644	SN	1080	4580	Cardigan (193)	Drift cliffs, Ceibwr Bay	Erratic pebble from gravel
FSJ62	E74645	SN	1080	4580	Cardigan (193)	Drift cliffs, Ceibwr Bay	Erratic pebble from gravel
FSJ30	E74630	SN	7776	2144	Llandovery (212)	Crags, Carreg Yr Ogof	Dowlais Lmst Fm
FSJ31	E74631	SN	7776	2144	Llandovery (212)	Crags, Carreg Yr Ogof	Dowlais Lmst Fm
FSJ32	E74632	SN	7776	2144	Llandovery (212)	Crags, Carreg Yr Ogof	Dowlais Lmst Fm
FSJ33	E74648	SN	7800	2122	Llandovery (212)	Crags, Carreg Yr Ogof	Penderyen Oolite
FSJ35	E74633	SN	7694	3166	Llandovery (212)	Loose block, Llwynwormwood	Wormwood Fm
FSJ63	E74646	SN	4878	5206	Llangranog (194)	Cutting, Moyddin Fawr Farm	Tuffaceous sst, Devil's Bridge Fm
FSJ64	E74647	SN	4878	5206	Llangranog (194)	Cutting, Moyddin Fawr Farm	Tuffite bed, Devil's Bridge Fm
FSJ66	E74634	SM	9510	3764	Fishguard (210)	Cliffs west of Saddle Point	Clasts, Saddle Point Member
FSJ67	E74635	SM	9510	3764	Fishguard (210)	Cliffs west of Saddle Point	Clasts, Saddle Point Member
FSJ68	E74636	SM	9510	3764	Fishguard (210)	Cliffs west of Saddle Point	Clasts, Saddle Point Member
FSJ52	E74637	SM	9510	3764	Fishguard (210)	Cliffs west of Saddle Point	Clasts, Saddle Point Member
FSJ53	E74638	SM	9510	3764	Fishguard (210)	Cliffs west of Saddle Point	Clasts, Saddle Point Member
FSJ54	E74639	SM	9510	3764	Fishguard (210)	Cliffs west of Saddle Point	Clasts, Saddle Point Member
FSJ55	E74640	SN	1715	3126	Fishguard (210)	Quarried crags, Crugiau Dwy	Tuffite, Foel Twrch Fm
FSJ43	E74624	SN	8351	3892	Brecon (213)	Forestry cutting, Crychan Forest	Cefn Garreg Sandstone Fm
FSJ44	E74625	SN	8188	3766	Brecon (213)	Forestry cutting, Crychan Forest	?oolitic Fe-stone, Cefn Garreg Sandstone Fm
FSJ47	E74626	SN	8471	3962	Brecon (213)	Forestry quarry, Crychan Forest	Cwm Clyd Sandstone Fm
FSJ48	E74627	SN	8471	3962	Brecon (213)	Forestry quarry, Crychan Forest	Cwm Clyd Sandstone Fm
FSJ49	E74628	SN	8471	3962	Brecon (213)	Forestry quarry, Crychan Forest	Cwm Clyd Sandstone Fm
FSJ50	E74629	SN	8471	3962	Brecon (213)	Forestry quarry, Crychan Forest	Cwm Clyd Sandstone Fm

2 Summary

Individual petrographic descriptions are presented in Section 3 and an illustrated summary of the analysis for each map sheet is given in this section.

Cardigan (193): The five samples comprise acidic-intermediate igneous rocks now partially to completely altered. The sample FSJ59 retains the most evidence of its original character (a biotite-plagioclase-phyric felsite; Figure 1) whereas the four remaining samples also originated as feldspar-phyric rocks but are now classified as hydrothermal due to the pervasive alteration to sericite and quartz with lesser chlorite, epidote and opaque minerals, although the name hydrothermally-altered felsite would also apply The alteration assemblage is similar in all five rocks.

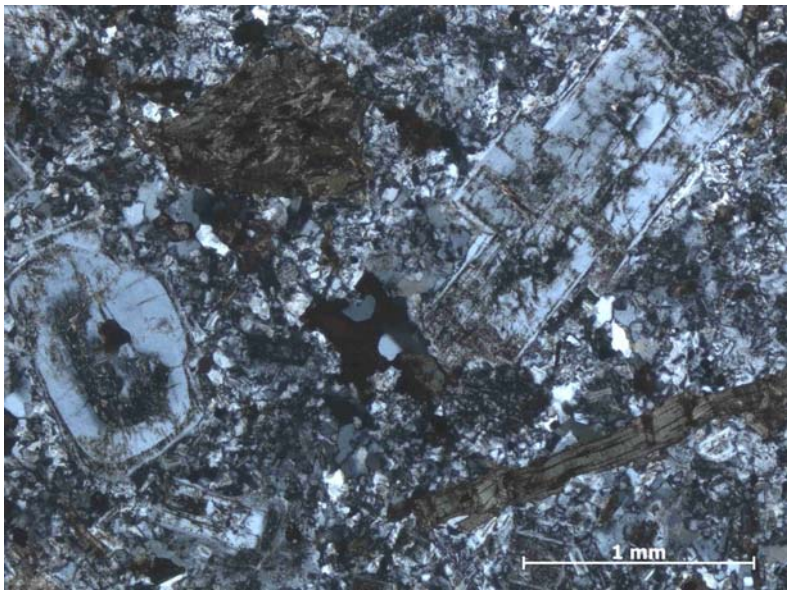


Figure 1: Cross-polarised light photomicrograph of the sample FSJ59 illustrating its plagioclase- and biotite-phyric texture.

Llangranog (194): The two samples originated as very-fine to fine-grained rocks and one of them (FSJ63) preserves banding and a mineral alignment texture interpreted as a flow-alignment of a compositionally-immature sedimentary rock (Figure 2). By contrast the second sample (FSJ64) is now porphyroclastic and mylonitic in texture and is dominated by foliated (shear band cleavage) sericitic mica (Figure 3).

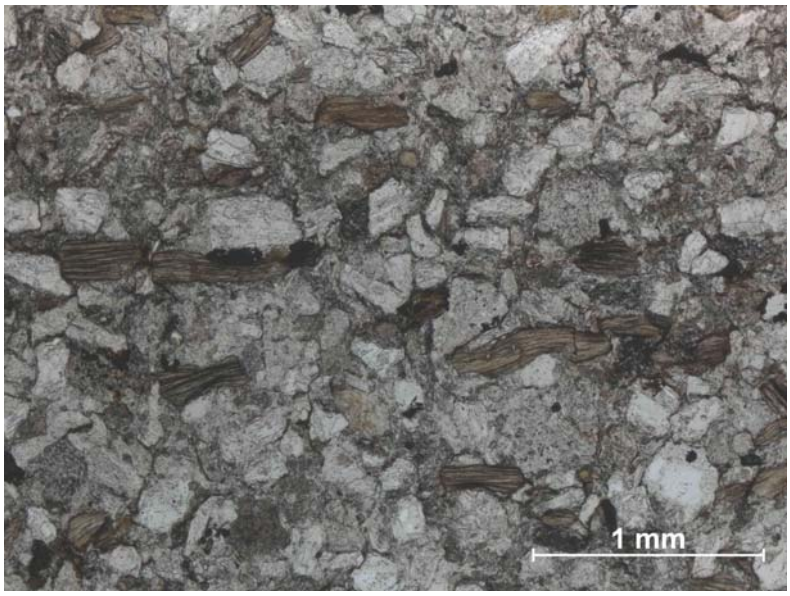
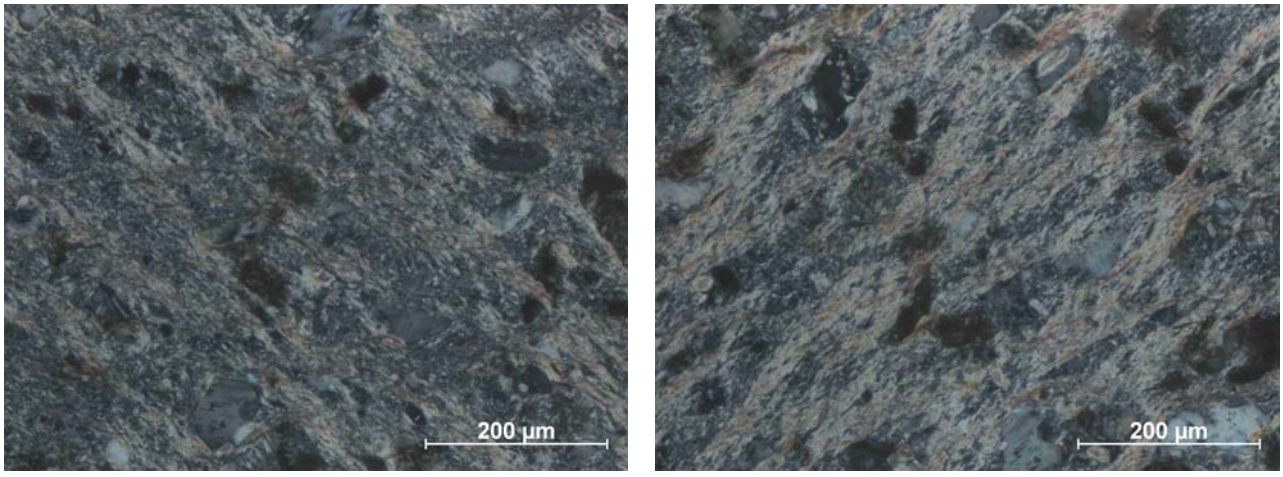


Figure 2: Plane-polarised light photomicrograph of the sample FSJ63 illustrating the alignment of biotite in this sample. The alignment is parallel to the compositional banding of the rock.



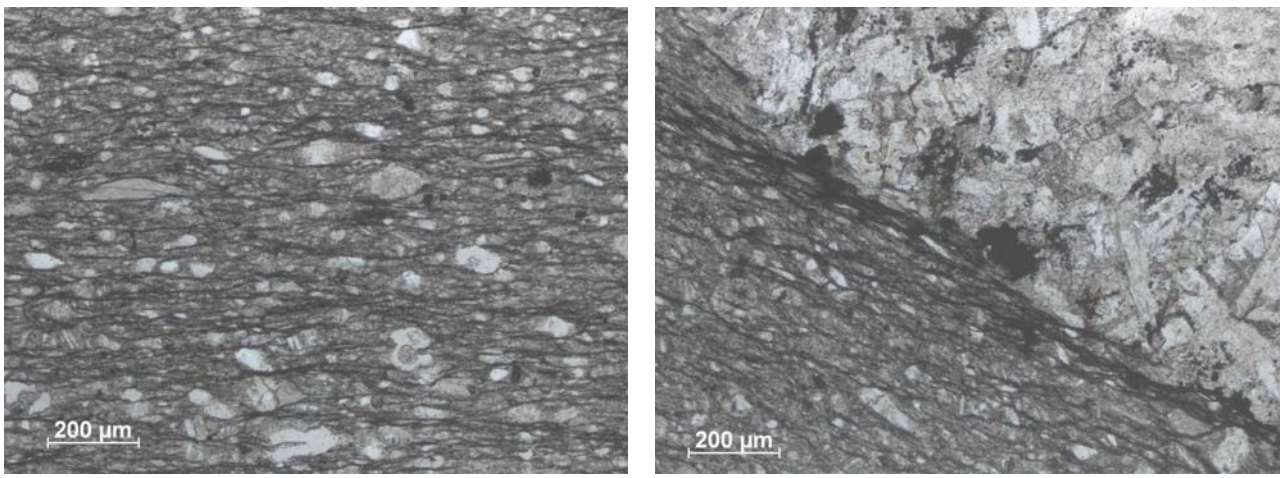
A B

Figure 3: Cross-polarised light photomicrographs of the sample FSJ64. A) A pervasive foliation defined by sericitic mica is evident (from the top left to bottom right), however when the microscope stage is rotated by 45° (3B) the foliation is orientated from the bottom left to the top right. Thus there are two foliations in the sample at low angles to each other and this is characteristic of a shear band cleavage.

Fishguard (210): Out of the seven samples four are heavily altered to secondary sericite, quartz, carbonate, opaque minerals and clay minerals and are now classified as hydrothermal-rocks (FSJ52, 53, 54 and 67). FS52 and 54 originated as plagioclase-bearing igneous rocks whereas FSJ53 and 67 show evidence of deformation prior to alteration. In general however the origin of all four rocks cannot be identified in any detail.

Two of the remaining samples are igneous: a K-feldspar-quartz-phyric felsite (FSJ55) and a vesiculated mafite (FSJ68).

The final sample (FSJ66) is heterogeneous and contains an unfoliated microgabbroic-rock with a sharp possibly intrusive contact with a protomylonite (Figure 4).



A B

Figure 4: Plane-polarised light photomicrographs of the two lithologies in the sample FSJ66. A) A fine-grained rock with prophyroclasts of quartz, feldspar and (chloritised) biotite, set in a deformed matrix is in sharp contact (B) with an undeformed microgabbroic-rock.

Llandovery (212): The five rocks comprise four samples of limestone and one of sandstone. The four limestones share many characteristics such as the presence of both ooids and bioclasts,

pervasive micritisation (that partially-to-completely obliterates the internal structure of the clasts) and a sparitic matrix (e.g. Figure 5A). The sample FSJ32 is recognisable as an ooid-limestone (Figure 5B), however the other three have substantial proportions of bioclasts as well as ooids. The sandstone (FSJ35) is a fine-grained quartz-wacke with a carbonate-bearing (10-20%) matrix.

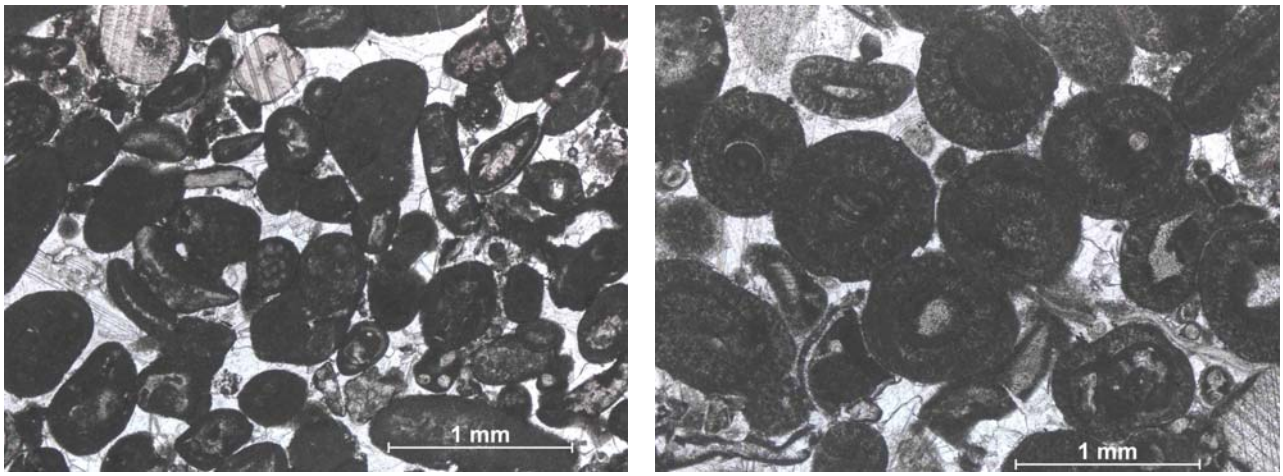


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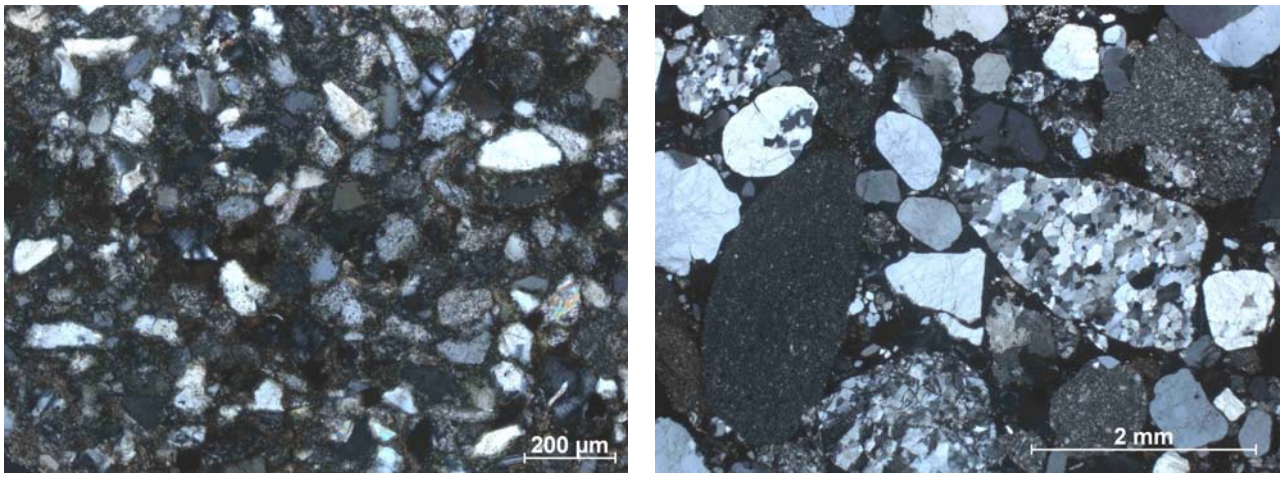
Figure 5: Plane-polarised light photomicrographs of carbonate samples from the the Llandovery sheet. A) Sample FSJ30 is characterised by the presence of micritised ooids and bioclasts in a sparitic matrix; B) Sample FSJ32 is dominated by micritised ooids.

Brecon (213): The samples are predominantly sedimentary in origin and consist of a quartz-wacke (FSJ43), a conglomerate (FSJ50) (Figure 6) and two ferruginous varieties of these two rock types (FSJ44 (ferruginous wacke) and FSJ47 (ferruginous conglomerate)). In addition a vesiculated mafite is present (FSJ49) and a felsite (FSJ48) with an intergrowth texture that may be similar to that found in aplitic rocks (micrographic texture).



A B

Figure 6: Cross-polarised light photomicrographs of a quartz-wacke (A, FSJ43) and a conglomerate (B, FSJ50).

3 Petrographic descriptions

Cardigan (193)

FSJ58: epidote-chlorite-quartz-sericite hydrothermal-rock

Originally this rock was a fine-grained, feldspar-phyric (10-20%, medium-grained) igneous rock. Now it is vuggy and dominated by secondary sericite (~70%) with lesser quartz (10%), opaque minerals (5-10%), chlorite (5-10%), epidote (2-3%) and partially altered relicts of feldspar that are not completely sericitised (2-3%).

FSJ59: biotite-plagioclase-phyric felsite

A fine-grained, porphyritic, partially-altered igneous rock. The rock contains ~20% of medium- to coarse-grained phenocrysts of plagioclase (90%, oscillatory zoned, subhedral to euhedral, partially sericitised) and biotite (10%, subhedral, partially chloritised) set in a fine-grained, partially altered groundmass composed predominantly of plagioclase and quartz (and ?k-feldspar) with lesser amounts of biotite, chlorite, opaque minerals and rare epidote.

FSJ60: brown-stained epidote-chlorite-sericite hydrothermal-rock

Originally a fine-grained, porphyritic (15-20%, plagioclase, subhedral) igneous rock now dominated by secondary brown-staining (30-40%) and sericite (30%) with lesser quartz (10-20%), chlorite (5%), opaque minerals (1-2%), epidote (1%) and partially-altered relict phenocrysts (15%).

FSJ61: epidote-chlorite-quartz-sericite hydrothermal-rock

Originally a fine- to very-fine-grained, porphyritic (20-25%, feldspar), foliated igneous rock now dominated by secondary sericite and quartz with lesser chlorite, epidote and opaque minerals.

FSJ62: epidote-chlorite-quartz-sericite hydrothermal-rock

Originally a fine-grained, porphyritic (10%, feldspar), igneous rock now dominated by secondary sericite and quartz with lesser chlorite, epidote and opaque minerals.

Llangranog (194)

FSJ63: sericitic, banded, ?tuffaceous mudstone

This is a banded (~2mm up to 1cm in thickness) rock in which individual bands are well-sorted to moderately well-sorted and contain very-fine- to fine-grained clastic fragments. The matrix to clast ratio varies from ~90:10 to ~50:50 and the clast-rich bands tend to be fine- to medium-grained whereas the matrix-rich bands are very-fine-grained. The rock contains plagioclase, ?K-feldspar, quartz, biotite (now chloritised), opaque minerals and a very-fine- to fine-grained groundmass; there is a widespread sericitisation of the feldspar. Some bands are sub-foliated; biotite, and to a lesser extent feldspar, is aligned parallel to the banding suggesting that the fabric is of depositional origin (flow alignment?). The sample was collected as a tuffaceous rock and therefore some of the clasts may be of volcanic origin.

FSJ64: micaeous, fine-grained protomylonite

This rock is fine-grained and porpyhroclastic (10-15%). The rock is dominated by fine-grained sericitic mica with two well-defined foliations at ~45° to each other, defining a shear band cleavage. The foliation wraps around the prophyroclasts and the rock now contains sericitic mica (~50%), plagioclase, biotite (now partially to completely chloritised), quartz and accessory ?zircon. Thin (<0.5mm) cross-cutting veins of quartz and white mica also occur.

Fishguard (210)

FSJ66: 1) plagioclase-phyric microgabbroic-rock; and 2) felsic protomlyonite

This is a heterogeneous sample containing two different lithologies. It is predominantly composed of a medium-grained, phenocrystic (<5%, plagioclase) rock dominated by plagioclase (partially altered to sericite or carbonate) and ?pyroxene (now entirely carbonated) with minor opaque minerals and secondary chlorite. This rock is in sharp contact with a porphyroclastic (10%: quartz, feldspar, mica (chloritised)) fine-grained micaeous rock with a shear band cleavage. The contact between the two lithologies is sharp and may be intrusive in origin.

FSJ67: carbonate-opaque minerals-quartz hydrothermal-rock

A fine- to medium-grained, foliated(?) rock now entirely altered to secondary quartz, carbonate, opaque minerals and other fine-grained alteration products.

FSJ68: carbonated,vesicular mafite

A fine-grained rock dominated by plagioclase (partially to completely altered to sericite) with vesicles (15%, now carbonate- or chlorite-infilled). Opaque minerals and an altered fine-grained groundmass are minor components.

FSJ52: plagioclase-bearing hydrothermal-rock

Originally a fine-grained, plagioclase-bearing igneous rock but now heavily altered to secondary mica, opaque minerals and carbonate with abundant irregular fractures.

FSJ53: foliated hydrothermal-rock

A heavily altered, fine-grained, foliated rock containing quartz, opaque minerals, sericite and ?amphibole (overall however the rock is too fine-grained and too altered to identify the original metamorphic rock type)

FSJ54: mafic hydrothermal-rock

A heavily altered fine- to medium-grained mafic rock. The rock is dominated by plagioclase (now partially to completely altered to sericite) and a very-fine-grained, heavily altered groundmass. Secondary carbonate, sericite and chlorite are present but the alteration products are generally too fine-grained to identify.

FSJ55: k-feldspar-quartz-phyric felsite

A fine-grained, phenocrystic (<5%; K-feldspar and quartz) rock dominated by a fine-grained quartz-rich groundmass which also contains some feldspar, opaque minerals and accessory ?zircon.

Llandovery (212)

FSJ30: micritised, matrix-supported (sparite) limestone

A micritic, matrix-supported rock composed of carbonate (calcite). The clasts (60%) are rounded, contain a variety of shapes and are predominantly composed of very-fine carbonate giving a turbid appearance (micritisation). Some internal structure is evident in some clasts indicating the present of ooids and bioclasts, however the majority are indistinct. The matrix is sparite.

FSJ31: micritised, matrix-supported (sparite) limestone

A micritic, matrix-supported rock composed of carbonate (calcite). The clasts (75%) range from medium- to coarse-grained and contain both ooids and bioclasts, however a pervasive micritisation has obliterated the internal structure of many of the clasts. The matrix is sparite.

FSJ32: micritised, matrix-supported (sparite) ooid-limestone

A micritic, matrix-supported rock composed of carbonate (calcite). The clasts (75%) are medium-grained, micritised and the majority are ooids, although some bioclasts are present (10%). The matrix is sparite.

FSJ33: micritised, matrix-supported (sparite) limestone

A micritic, matrix-supported rock composed of carbonate (calcite) with rare quartz. The clasts (70%) are fine-grained, sub-angular to sub-rounded and include both ooids and bioclasts; most of the internal structure has been obliterated by a pervasive micritisation. The matrix is sparite.

FSJ35: carbonate-bearing, fine-grained quartz-wacke

A fine-grained, matrix-supported rock composed of roughly equal proportions of clasts and matrix. The clasts are sub-angular to sub-rounded, fine-grained, well-sorted and predominantly composed of quartz with rare plagioclase, ?k-feldspar, biotite (now chloritised) and zircon. The clasts are supported by a compositionally heterogeneous matrix composed of cryptocrystalline ?clay minerals/mica (30-40%) and fine-grained carbonate (10-20%). Some irregular, net-textured carbonate replacement also occurs.

Brecon (213)

FSJ43: fine quartz-wacke

A fine-grained, matrix-supported and banded siliciclastic rock. The clasts (60%) are sub-angular to sub-rounded and comprise quartz (~55%), plagioclase, mica (some chloritised), opaque minerals and rock fragments. The matrix is cryptocrystalline to very-fine-grained, banded and micaeous.

FSJ44: poorly-foliated, ferruginous, fine-to-medium quartz-wacke

A texturally-heterogeneous, fine- to medium-grained, matrix-supported, poorly-sorted, banded and poorly-foliated siliciclastic rock. The matrix (50-60%) is cryptocrystalline to very-fine-grained and composed of mica, ?clay and opaque minerals; it is banded and poorly-foliated (one small area of the rock has a carbonate-bearing cement). The clasts are sub-angular to sub-rounded and predominantly composed of quartz with feldspar, rock fragments and mica (some chloritised) with substantial (~10%) replacement by opaque minerals. The replacement is usually irregular but in some cases a relict concentric structure is evident.

FSJ47: matrix-supported, ferruginous conglomerate

A fine- to coarse-grained, matrix-supported and poorly-sorted siliciclastic rock. The rock comprises 50% sub-rounded to rounded clasts, predominantly coarse-grained, composed of quartz, feldspar and rock fragments (sandstone, limestone, quartzite, granitic-rock, felsite, net-textured bioclasts); some of the rock fragments are partially replaced by opaque minerals (5%). The matrix is cryptocrystalline to very-fine-grained and composed of quartz, mica and opaque minerals with red-brown staining.

FSJ48: feldspar-phyric felsite

A fine- to medium-grained rock composed of euhedral phenocrysts of heavily altered feldspar (<5%) set in a fine-grained matrix of quartz and ?feldspar displaying a very-fine-grained intergrowth similar to a micrographic texture (giving the sample a ‘furry’ appearance in cross-polarised light).

FSJ49: altered, vesiculated mafite

A heavily altered fine-grained igneous rock. The rock is dominated by partially altered laths of plagioclase associated with secondary opaque minerals and containing ~20% rounded cavities (?vesicles) now partially occupied by opaque minerals. Also present are ~5% plagioclase

phenocrysts and some of the cavities may represent the relicts after other (?ferromagnesium) phenocryst phases.

FSJ50: clast-supported conglomerate

A mediun- to coarse-grained, clast-supported siliciclastic rock. The sub-rounded to sub-angular clasts comprise ~75% of the rock and contain quartz, feldspar and rock fragments (quartzite, granitic-rock, felsite, sandstone, mudstone and mica-schist). The matrix is cryptocrystalline to very-fine-grained and composed of quartz, mica, chlorite and opaque minerals.