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

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

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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

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<th>Sample</th>
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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-phryic felsite; Figure 1) whereas the four remaining samples also originated as feldspar-phryic 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.
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 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).

Figure 4: Plane-polarised light photomicrographs of the two lithologies in the sample FSJ66. A) A fine-grained rock with phryroclasts 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.

![Figure 5: Plane-polarised light photomicrographs of carbonate samples from 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.](image)

**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 aplite rocks (micrographic texture).

![Figure 6: Cross-polarised light photomicrographs of a quartz-wacke (A, FSJ43) and a conglomerate (B, FSJ50).](image)
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 porphyroclastic (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 porphyroclasts 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 protomylonite

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 micaceous 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 medium- 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.