

# THE PETROGRAPHY OF DARTMOOR AND ITS BORDERS.

## PART II.

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### A TYPICAL DARTMOOR FELSITE (FELSITE "A")— *continued.*

IN Part I. of the present paper (vol. xxxiv., p. 514) I have mentioned the occurrence of pebbles of this felsite on the beaches at the mouths of our Dartmoor rivers, and on *Slapton Sands*.

Recent events have directed my attention to the beach at *Hall Sands*, in *Start Bay*. I have there found Felsite A and its variants in quantity, the pebbles being much larger than at *Slapton*. So well is this rock represented on the beach, that within a few minutes a fairly complete set of specimens of its varieties can be readily collected.

Returning to the survey of the moorland localities of Felsite A:—Although no *in situ* exposures of this rock have rewarded further search between *Collard Tor* and *Dendles Green*, a hint has been found of its presence somewhere on this range of country, in the form of a block built into a hedge near *Coleland Bridge*, on the north side of the road leading to *Crownhill Down*. (CXVIII. S.E. 5. Long.  $4^{\circ} 1' 10''$ , lat.  $50^{\circ} 25' 40''$ .)

From *Dendles Green* eastward, it has been found necessary to make a new six-inch geological survey, the boundary of the granite as shown on the old edition of the official Survey being hopelessly misleading at many places. Errors of half a mile in position occur, and the junction of the granite and slate is made much too regular in outline. A very limited leisure has proved unequal to the task of carrying this survey further than *Pupper's Hill* since the publication of the first part of this paper.

From CXIX. N.W. 8', the last point mentioned in Part I., the granite boundary passes northward through *Highbush Waste*, turning south-easterly at *Broadall Lake*, cutting across the corner of *Hawns*, thence across *Dendles Wood*, and turning southerly in *Harrowthorn Plantation*, continues with a slight easterly trend to *Grange Plantation*; here it leaves sheet CXIX. N.W. Entering sheet CXIX. S.W., it passes a little westward of *Hall Cross*. Not until it reaches this last point has anything been found which has any apparent relation to Felsite A.

But from *Hall Cross* along the road southward, and also along the northern boundary of *Hanger Down*, we find in the hedges compact red felsites, too granular, however, to be more than slightly reminiscent of the rock whose localities we are tracing.

The granite boundary next turns westerly and passes close to *Stone*, past which it makes a sharp curve, and, proceeding considerably east of south, almost touches *Donore*; thence cutting across the southern extreme of *Hanger Down*, it assumes an easterly direction.

The hedge of *Hanger Down*, which lies east of this line of junction, gives some indication of the nature of the rocks in the vicinity. In this hedge, just 200 yards north of *Donore Moor Gate*, occurred the first clearly recognisable variant of Felsite A which is found on this section. CXIX. S.W. 13. Long.  $3^{\circ} 56' 38''$ , lat.  $50^{\circ} 24' 35\frac{1}{2}''$ . *Not in situ*.

I. The matrix of this rock is a compact red felsite, with a distinct shade of purple-brown. Quartz is plentifully distributed throughout the specimen; no large grains are present. Small compact crystalline blebs of purple fluorite are fairly frequent, but a lens is required to fully appreciate their number. In this rock fluorite takes the place of tourmaline, to a great extent. Small orthoclase crystals can be detected with the lens; one exceptionally large, 9 mm. by 4 mm., has been attacked by fluorite along its margin.

The rock weathers pink to buff, and becomes more granular. It is interesting as a felsitic variety of "Trowlesworthite."

II. No microscopic examination made.

CXIX. S.W. 14. Long.  $3^{\circ} 56' 34''$ , lat.  $50^{\circ} 24' 31\frac{1}{2}''$ . *Not in situ*.

A specimen derived from the same hedge 70 yards north of *Donore Moor Gate*.

I. The matrix is a light red felsite, exactly corresponding in texture to CXII. S.E. 10, *Legis Tor*, but brighter in

colour. Quartz is a prominent porphyritic mineral; its grains range from 2 mm. to 5 mm. average diameter, and a surface 4 cm. by 3 cm. shows 12 separate grains.

Schorl is present, infilling cavities left by the decomposition of felspars, but is not prominent.

Bright red crystals of orthoclase are frequent, and many reach 8 mm. by 4 mm.

The felsitic matrix is, however, by no means obscured by these porphyritic constituents of the rock.

II. No microscopic examination made.

At *Donore Gate* rocks similar in type to this last are common constituents of the hedge.

Following the hedge, this will presently be found to turn to the eastward, and its materials then become very mixed in character. Grey granite occurs, but blocks similar to CXIX. S.W. 14 are nowhere infrequent and soon become predominant again.

A junction specimen of slate and granite from the southern angle of *Hanger Down* (CXIX. S.W. 7. *Long.*  $3^{\circ} 56' 8\frac{1}{2}''$ , *lat.*  $50^{\circ} 24' 5''$ . *Pract. in situ*) shows that at that point the actual contact rock is not Felsite A. It is by no means unusual to find these variations in a very short distance.

The southern hedge of *Hanger Down*, and the eastern hedge between *Pithill* and *Wilkeys Moor*, yield variants of felsite in quantity.

The most typical specimen has, however, been found on the *Wilkeys Moor* road at:—

CXIX. S.W. 4. *Long.*  $3^{\circ} 55' 40\frac{1}{2}''$ , *lat.*  $50^{\circ} 24' 33''$ . *Not in situ*. This actual specimen lay 730 yards within the junction of the granites and slates. From *Pithill* to *Wilkeys Moor*, however, the ground is plentifully strewn with variants of Felsite A, and *Pithill Farm* itself stands on a tongue of slate projecting into the granite and not recognised by the Survey.

I. A fairly typical specimen of the felsite. *Colour*, slightly brighter than the average. *Texture*, slightly less vitreous than the extreme. *Specific gravity*, 2.601. A few small felspar crystals, a little schorl, small quartz blebs frequent, but all really require a lens for their determination.

II. With a sixth-inch objective the ground-mass can be resolved into granules with fair distinctness, but not to the limit in which the mineral constitution of the grains can be ascertained.

Neither quartz nor felspar yields perfect micro-porphyritic



crystals. These minerals are in places developed as a micro-pegmatite.

Some of the felspar is plagioclase, all is turbid. The tourmaline is in two forms, (1) olive-brown to olive-green prisms (the centres greener and the margins browner), which may possibly be an original constituent of the rock and has an independent habit, and (2) blue-green needles which penetrate felspars and quartz alike in the pegmatitic areas, under circumstances which make it doubtful whether some of this quartz is not of secondary origin.

The porphyritic quartz contains numerous fluid enclosures, with bubbles and cubic crystals (a selection of which is represented in the drawing on p. 516, *Trans. Devon. Assoc.*, vol. xxxiv., Part I. of present paper).

This rock brings me back to the discussion on the small colourless grains which occur in most specimens of Felsite A (see p. 516 *et seq.*, Part I.). It also modifies my views, yielding somewhat unusually large examples of these grains, which I can hardly doubt in this instance are garnet. After re-examining all available sections, I conclude, unless fresh evidence prove incompatible with this view, that the majority of these grains are garnet, none are quartz, and only coloured examples are tourmaline. I note that the coloured grains are more usually prismatic in habit, and the colourless are more rarely so, and the latter have a tendency toward six-sided forms.

At a later stage any errors which have arisen in Part I. on this matter will be corrected, but it is better to postpone such correction until the survey of Felsite A has been completed.

At *Pithill* the border of the granite turns southward for a short distance, then loops back to the *Erme*, runs parallel with its western bank in a southerly direction, and shortly crosses the river.

The junction of the granite and the sedimentary is exposed in the quarry on the road from *Ivybridge* to *Pithill*, and again in the bed of the *Erme*; in neither case is Felsite A present.

Eastward, after crossing the *Erme*, the boundary passes a little north of *Rutt*, and runs approximately parallel to the southern hedge of *Ugborough Moor* and a few hundred feet to the north of it. There are no *in situ* exposures, and perforce the hedge must be our museum.

Near the reservoir and drinking-place the hedge yields a warm buff felsite, which is of distinctly lithoidal texture;

it probably forms the extreme, which one should record as a variant of Felsite A, and, except as the result of a continuous survey, its true kinship with that felsite might not be suspected.

CXXV. N.E. 3. *Long.*  $3^{\circ} 53' 39\frac{1}{2}''$ , *lat.*  $50^{\circ} 23' 46\frac{1}{2}''$ . *Ugborough Moor*, near reservoir.

I. Colour and texture as above described.

Small felspar crystals and quartz blebs are just visible to the unaided eye. Prisms of schorl are evenly distributed through the mass, and have the appearance of original constituents.

II. Micro-pegmatitic. The felspar is cloudy and readily distinguishable from the quartz. The larger quartz shows good crystal faces, but the angles are rounded; fluid inclusions numerous, bubbles almost invariably present, cubic crystals frequent.

Some of the larger felspars are extremely turbid.

The tourmaline is olive-brown in colour, and is usually associated with idiomorphic quartz. The crystals of quartz and tourmaline exhibit mutual interference, and would appear to belong to the same stage of differentiation. The smaller acicular tourmaline, so frequently found associated with and penetrating quartz and partly replacing felspar, is entirely absent.

Varieties of this rock, either fresh or more or less decomposed, are prominent eastwards until *West Peek* and *Cuckoo Ball* are reached. They are represented in the "Census of Devonian Granites and Felsites" by the eleventh item on p. 189 (p. 7 of reprint); *Blackett*, (a), (b), and (c).

Eastward of *Cuckoo Ball* and the *Ludbrook* is a loop of slate resting on the granite, and entirely ignored in the Survey, the effect being an extreme error of half a mile in the position of the junction.

Associated with this incurve of the slate is an exposure *in situ* of Felsite A, blocks of which are very common in the bed of the *Ludbrook*.

CXIX. S.E. 7. *Long.*  $3^{\circ} 52' 55''$ , *lat.*  $50^{\circ} 24' 23''$ . *Ludbrook*, *in situ*.

I. Colour, Indian red; texture, vitreous; fracture, smooth and conchoidal; *specific gravity*, 2.624; *weathers* buff to pale cream. Some weathered surfaces exhibit the banded nature of the rock to perfection, the bands retaining their colour better than the general mass (see Plate IV., Fig. 1).

Rare and minute blebs of quartz are the sole porphyritic



constituent. Occasional dark, almost black bands, where more felspathic portions have been attacked by schorl (?).

In two or three specimens the felsite passes abruptly into a more porphyritic rock of similar colour, and along the plane of contact schorl is freely developed.

II. The section is banded in two shades of red; this is best seen with low powers or the naked eye. In ordinary lights the ground has the characteristic reticulation. The slide is crowded with minute blebs, specks, and microlites, mostly, with the exception of ferrite, indeterminate. The ferrite is generally distributed, but also forms aggregates around blebs of a colourless mineral. Granular tourmaline is present, of a dull deep green colour, so deep in shade that the grains are, many of them, practically opaque. Minute cracks have been filled with secondary quartz, in which a few needles of tourmaline have developed. There are a few very minute fluid enclosures in this quartz, but apparently no bubbles or cubic crystals.

On the other hand, the original quartz grains contain large fluid enclosures, with both bubbles and cubic crystals. One or two very small ill-defined felspar areas are discoverable. With polarised light the slide is dappled, but quite indiscriminate.

Eastward from the *Ludbrook*, at *Leigh Moor Gate*, we closely approach the junction of the sedimentary and igneous; and at *Leigh Moor Gate* I have obtained, but not *in situ*, an excellent junction specimen. CXIX. S.E. 4. Long.  $3^{\circ} 52' 31''$ , lat.  $50^{\circ} 24' 22''$ . *Leigh Moor Gate. Pract. in situ.*

I. The felsite is a rich bright red in colour, but in another specimen this is seen to grade off into a warm, light leaden shade, a not entirely unusual feature at junctions. Some of the felsite is a darker Indian red, and the two shades of red by their contrast mark out an involved flow structure. The sedimentary rock has been profoundly altered, and is now much indurated, very compact, and almost black. The felsite, for a great part, shows a sharp junction with it, but has also penetrated it irregularly, and in places the two are much involved. Very minute specks of quartz and small felspar crystals, about 1 mm. long, are the infrequent porphyritic constituents. The felsite might be taken as typical.

II. Two slides cut from this specimen agree in their general features. In each case the junction is sharp and well defined; in each case a narrow strip of felsite, next

PLATE IV.

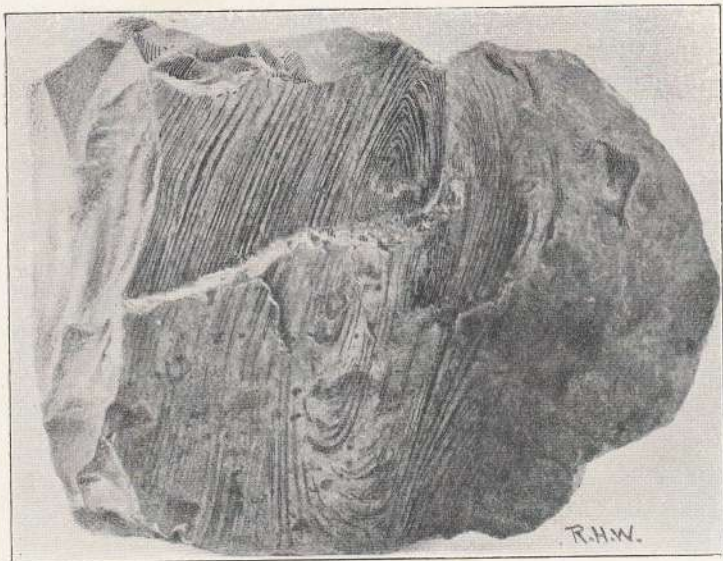


FIG. 1. CXIX. S.E. 7. Banded surface of Felsite "A."

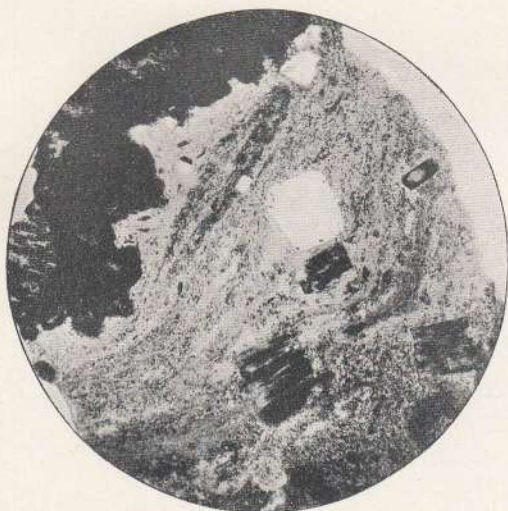
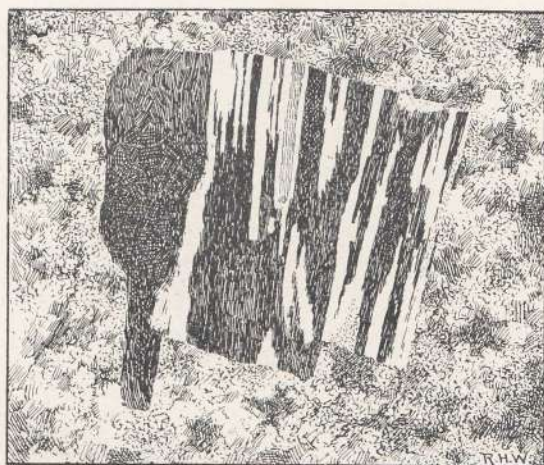


FIG. 2. CXIX. S.E. 4. Section of junction of Felsite "A" and Slate.  
× 9.

PLATE V.



0 ——— .5  
M.M. SCALE

CXIX. S.E. 4. Imperfect twin Lamellæ in Felspar Crystal.  
Polar.



the junction, is somewhat lighter than the mass. Well-marked banded structure is present in both. Plate IV., Fig. 2, is from a photograph of one of these sections, taken with a low magnification, in order to clearly indicate the lines of flow. Near the junction the micro-porphyritic crystals of quartz and felspar are fairly numerous. The felspar occurs in almost square sections, which in ordinary light appear finely striated, and present indefinite bands of contrasting shades of orange and orange-red. Associated with these are other felspars, of a dull brown-grey, with a clearer approach to good crystal outline. With crossed nicols the orange-coloured crystals show imperfect twin lamellæ (see Plate V.). These lamellæ correspond in position with the bands of light and dark shade seen in ordinary light, but are more numerous. The few grey crystals show no twinning. Three-quarters of one felspar consists of the orange variety, and the remaining quarter of the grey. The two varieties are associated to the extent that the grey almost always adjoins an orange crystal, but the latter greatly predominates.

Most of the quartz crystals present at least some perfect faces; inclusions of the ground-mass, and merging of the crystal into the ground-mass, are, however, frequent. Liquid inclusions, with bubbles and some cubic crystals, form bands across the quartz, and in one slide all these bands are parallel to the lines of flow and to the junction, these directions being coincident.

Tourmaline occurs in two forms, in comparatively large (microscopically) crystals of a rich brown shade, apparently an original mineral of the rock, and in grains and needles of a blue shade, either scattered through the mass or replacing felspars in part.

Of the minerals the quartz presents the most perfect form, the larger tourmaline the next more perfect, and the felspars the least definite. The ground-mass is indiscriminate.

The altered slate has lost all cleavage, but the structure is still marked by the development of tourmaline along the cleavage lines. This tourmaline is dark green, minutely granular and acicular. Eastward, along the side of *Ugborough Beacon*, we find red and drab felsites, chiefly red, closely corresponding in texture to CXXV. N.E. 3 (*Ugborough Moor*, near reservoir), but the prisms of schorl are not so frequent as in that rock. Near *Wrangaton Moor Gate* these felsites are strongly in evidence in the bed of a small stream.

At the turn of the enclosure hedge by *Peek Plantation* another border felsite has replaced Felsite A. This will hereafter be described under the name of "Felsite B," but for the present we are not greatly concerned with it.

The junction of the granite and sedimentary lies a little under a hundred yards outside *Peek Moor Gate*, whereas the Survey places it a few hundred inside in the enclosed lands, a divergence of no great importance.

But from this point the Survey shows the junction running almost due north, and crossing *Glazebrook* below *Owley Bridge*. In point of fact the line should be drawn westward a little within the enclosed lands, turning north at *Owley Corner*, where it lies within the moor, and crossing the *Glazebrook* at its bend at *Corringdon Wood*, half a mile in a straight line from the point at which the Survey makes it cross this stream. The error is inexplicable, since even the stones in the hedges would enable a more accurate line to be sketched.

*Corringdon Wood* is crossed diagonally, and the junction turns easterly again in *Corringdon Plantation*.

Meanwhile, at the point where it crosses the *Glazebrook*, a rock mingling the characters of Felsites A and B occurs.

Another loop of slate overlies the granite between *Corringdon Ball Plantation* and *Aish Ridge*, extending northerly, and the granite of *Aish Ridge* thrusts a narrow tongue southward into the slate.

For a short distance, from *Aish Ridge* to the *Avon*, there is no great difference between the Survey map and my own.

Since Felsite A now disappears entirely for some considerable distance, as far, at least, as I can at present discover, it is not necessary to give detail of the exact position of the boundary of the granite, although at a later stage, when Felsite B is discussed, this may become advisable.

The next exposure of Felsite A occurs at the point where the track, running northward from *Water Oak Corner*, crosses a leat running eastward from *Brock Hill Mire*. About one hundred feet eastward of this track, at the ford, lies the junction of the granite<sup>1</sup> and the slate. Felsite A is so common on the south side of the ford that it is undoubtedly *in situ* here. CXIII. S.E. 1. Long. 3° 51' 31", lat. 50° 28' 56½". *Brock Hill Mire Leat, Ford*.

<sup>1</sup> In writing of the position of the junction I use the word "granite" throughout very loosely to include any portion of the igneous boss of Dartmoor, whether granitic or felsitic. The context will always clearly show where I purposely adopt a closer discrimination.



I. *Colour*, Indian red. *Texture*, compact lithoidal to vitreous; fracture, conchoidal, broken surfaces slightly splintery. *Specific gravity*, 2.60. *Weathers* white; some weathered surfaces show honeycomb texture. A few quartz grains, a few small red feldspars, and a rare buff feldspar crystal are the porphyritic constituents. Little nests of schorl are not infrequent, and mostly appear to replace feldspars.

II. Closely resembles the type. Those feldspar microlites which show repeated twinning are of imperfect form, those which present fair outline are not twinned. The quartz grains are much rounded, and crowded with fluid enclosures, practically each of which has its bubble and cubic crystal. Numerous single grains and little radiating bunches of blue-green tourmaline are present.

In these few pages has been described the detailed occurrence of Felsite A for eight miles beyond the limit reached in Part I., thus completing the first twenty miles of the Survey. Even with the most careful observation, it is highly improbable that every locality where the rock occurs should be discovered, since in many instances it is likely to be hidden by surface deposits. One further fact has now been positively ascertained, that the felsite in question is in no way dependent for its presence at any given point on the mineral composition of the sedimentary rock adjacent to it.