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A BRIEF ASSESSMENT OF THE SOCK CREEK AND CHESTER-PINNACLES PROSPECTS, TASMANIA

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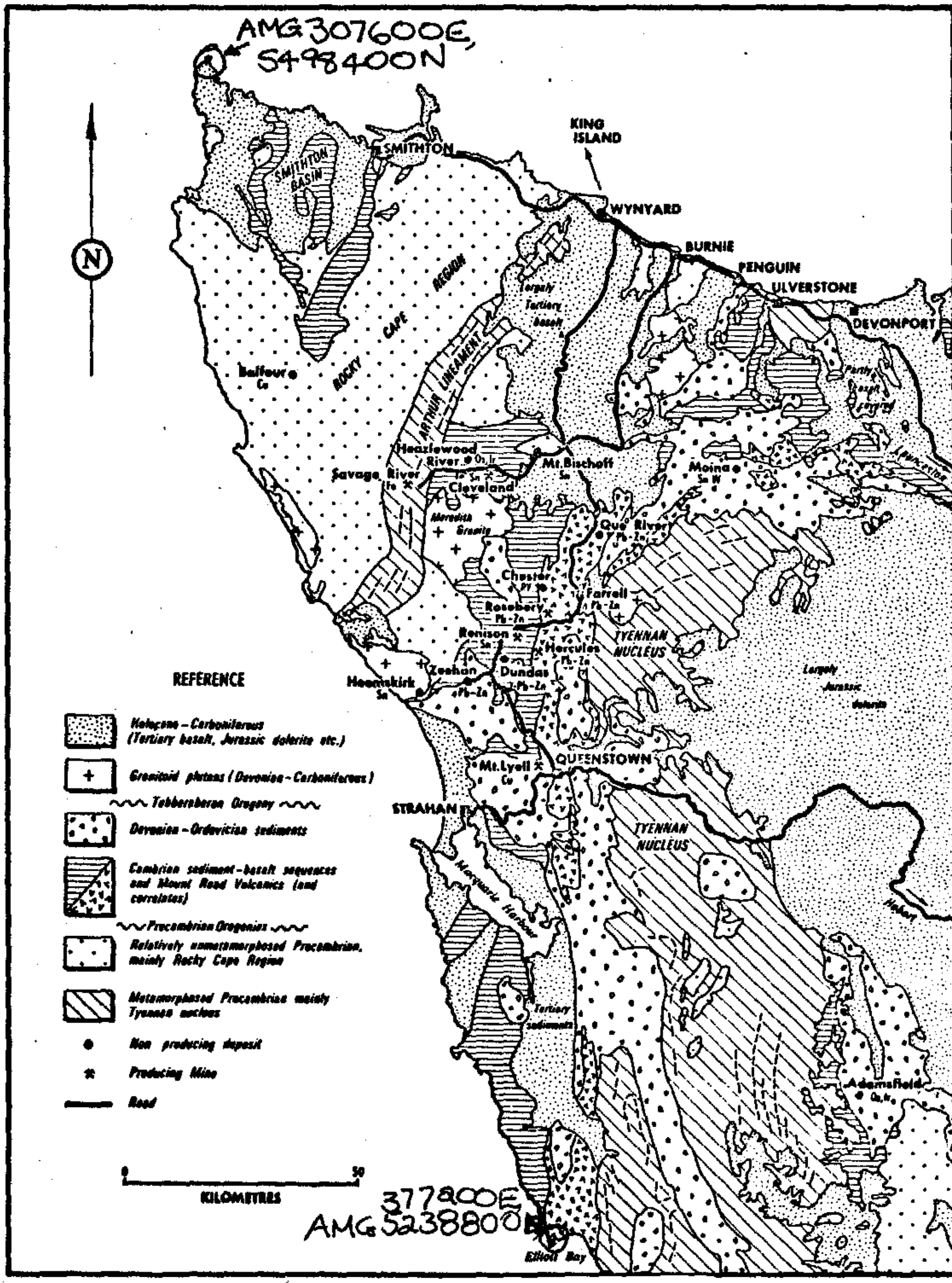

FIGURE 1; REGIONAL GEOLOGY, NORTHWEST TASMANIA.

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1.0 INTRODUCTION

The Sock Creek and Chester-Pinnacles prospects are areas of mineralisation associated with the thick regional sequence of Mt. Read Volcanics, lying between the Rosebery and Que River Pb, Zn, Cu deposits in northwest Tasmania, (see Figure 1, and refer to Solomon and Green, 1976). At the request of Mr. David Orr of Australian Anglo American, approximately nine days were spent (5 - 13th January, 1977), on these two prospect areas on core logging and/or fieldwork. The aim of this work was an assessment (insomuch as is possible within the time available) of the possibility of an occurrence of a massive base metal sulphide deposit of the volcanogenic type.

Both the Rosebery and the Que River deposits are good examples of the volcanogenic massive base metal sulphide type of deposit, and these two deposits provide the "model" for the type of exploration target sought in the Sock Creek and Chester-Pinnacles areas. It is an empirical observation that many of the

Canadian volcanogenic massive base metal sulphide deposits (Hopwood, 1976) and several Australian volcanogenic massive sulphide deposits (Captain's Flat, Woodlawn, N.S.W.; Golden Grove, Teutonic Bore, W.A.) are associated with a combination of pyrite rich stratigraphic units ($\pm$ black shales), and a characteristic quartz-eye porphyry./ This association has been noted by the author on a recent brief visit to Rosebery (the mine unit termed the hanging wall pyroclastics is considered equivalent to the quartz-eye rock). An obvious* equivalent to the quartz-eye rock has not been observed in association with the Que River deposit. Sections of pyrite rich stratigraphy are associated with black shales in both the Rosebery and Que River deposits.

Because specific characteristics of volcanic rocks are often difficult to describe verbally, in this report a series of captioned colour photographs are used as a substitute for lengthy verbal descriptions.

* Subnote: A waxy sericite schist similar to the sericite matrix of the quartz-eye rock occurs in the centre of the ore zone at Que River; this is similar to rocks at the Pinnacles deposit described below. At Que River, this waxy sericite schist matrix contains a few sparsely scattered quartz-eyes but is not regarded as a "good" or typical example of the quartz-eye rock.

SECTION A:

2.0 SOCK CREEK PROSPECT.

Figure 2 gives a geological map of the Sock Creek prospect (Comstaff mapping), showing the sites of diamond drillholes SK1 to SK14. Holes which scored mineralisation are SK1, SK2, SK3, SK5 and SK11. SK10, drilled below the intersection of SK2 contained weak mineralisation only. All holes which scored mineralisation were logged (Appendix A); the no-score drillholes SK4 and SK6, which are outside the limits of the mineralised zone, were logged in order to understand the mode of control of mineralisation and mechanism of ore cut-off within the prospect. The logging is plotted on Geological Sections from 750N to 1150N, (Figures 3A to 3F), together with an interpretation of the geological relationships within the prospect.

As illustrated in these sections the geological relationships inferred for this prospect imply the intrusion of a quartz-felspar porphyry along a fault zone. The sediments are thought to have been wet at the time of intrusion, causing alteration of the porphyry and extensive net-vein fracturing on the contacts of the porphyry as discussed in Section 2.5 below.

2.1 Black Argillites.

The quartz-porphyry rocks at Sock Creek are inferred to intrude a series of pyritic black argillites and grey siltstones. These are finely laminated (Plate 1); the siltstones are often pyritic (5-10%), containing extremely fine disseminated pyrite, which sometimes segregates into nodules as shown in Plate 2. The argillites often contain small-scale soft-sediment deformation structures, suggesting that the sediments had a high water content during their deformational history. A fine cleavage is developed in the argillites; this cleavage is often observed in core at a high angle to the bedding, suggesting proximity to a major fold hinge (Figure 3C). The bedding is often disrupted by numerous small displacements on the cleavage (Plate 1); this disruption is probably related to the major fault zone thought to extend north-south through the length of the prospect (Figure 2).

2.2 Quartz-Felspar Porphyry.

As indicated in Figures 2 and 3, the argillites at Sock Creek are inferred to be intruded by a quartz-felspar porphyry. There are a series of styles of alteration of the quartz-felspar porphyry which gives the impression of rapid variation of composition in core.

Because similar quartz and felspar porphyritic textures can be recognised "through" the overprinted alteration assemblages of the matrix, this compositional variation is interpreted here as an irregular alteration phenomenon, rather than a "stratigraphic" sequence of different acid volcanic units.

2.3 Alteration.

The styles of alteration of the porphyry are as follows:

1) Silicification.

2) Carbonate, siderite and/or iron oxide alteration.

3) Yellow-green sericitic alteration, associated with possible (yellow-green) epidote alteration of felspars.

4) Chloritisation of felspars.

5) Felspathisation of sediments.

The alteration appears to be most intense at contacts of the porphyry with metasediment, and is closely associated with net-vein fracturing. Samples of unaltered porphyry, at considerable distance from the contact are illustrated in Plates 3 and 4.

2.31. Silicification: The most common style of alteration is silicification. Silicification is particularly common as a net-vein fracture filling and as a fine dense matrix alteration in the porphyry. Silicification appears in some cases to be associated with sericitisation and/or carbonate alteration. This causes alteration of the matrix which is often associated with a "loss" of felspar phenocrysts (Plates 5 and 6). Silicification of the porphyry is also notably associated with sediment-porphyry contacts as discussed below (Section 2.5).

2.32 Carbonate-Iron Oxide Alteration: Carbonate is common as a net-vein fracture filling material. Veins are often zoned with carbonate on the margins and silica in the cores (Plate 7). Locally carbonate veinlets have been observed to transect quartz veinlets. Diffuse carbonate alteration of matrices of the quartz porphyry occurs, causing bleaching of the normal blue-green coloured matrix (Plates 3 and 4). Associated with the carbonate alteration is disseminated iron oxide staining giving the matrix an overall reddish colour (Plates 6 and 7). The iron oxide staining appears to be preferentially associated with zones of mineralisation.

2.33 Sericite-Epidote Alteration: Associated with silicification, is the development of waxy yellow-green sericite alteration of the quartz-felspar porphyry matrix, as illustrated in Plate 6. In some cases felspars are accentuated by becoming bone-white in colour (albitised ?). In more extremely altered examples felspars are altered to yellow-green sericite-epidote (?) or obliterated so that they merge with the groundmass. This results in a yellow-green sericitic or siliceous matrix containing round remnants of quartz phenocrysts, with diffuse margins.

2.34 Chlorite "Fleck" Alteration: In some areas felspars appear to be pseudomorphed by chlorite. Initially chloritic alteration develops around the rims of felspars, in association with yellow-green silica-sericite alteration of the matrix. In more altered examples, original laths of felspar appear to have been completely chloritised, as illustrated in Plates 3 and 6. This results in a green-yellow silica-sericite matrix containing remnant round quartz phenocrysts, with dark green chlorite flecks scattered throughout.

The "felspathic" alteration is a more complex alteration phenomena, which affects sediments at the porphyry contact, and will be discussed in Section 2.5 below.

2.4 <u>Net Vein Fracturing</u>.

2.41 Preamble, Fracturing Mechanism: Figure 4 illustrates a style of brecciation referred to (Hopwood, 1974) as net-vein fracturing. This characteristic style of breccia is thought to be produced by a mechanism of hydraulic fracturing (Phillips, 1972). Incompressible pore-fluids when shock-loaded induce enlargement and propagation of fractures within the host rocks, causing in-situ fracturing and brecciation, resulting in breccia styles as illustrated in Figure 4. The mechanism of hydraulic fracturing has been demonstrated experimentally by Hubbert and Willis, 1957. Characteristics of the breccia are:

1) an irregular angular array of fragments which often appear to fit together like pieces of a jig-saw puzzle,

2) a single fragment population (except for the effects of alteration),

3) angular apex-ended fractures, which terminate within fragments or within the adjacent wall-rocks which are host to the fractured area.

Table 1 lists the host (and fragment) compositions, together with compositions of fracture filling of net-vein fractured breccias known to the author (Hopwood, 1974).

TABLE 1: NET VEIN FRACTURED BRECCIAS

Host Composition	Fracture Filling Composition
Trachyte	Calcite
Albitite	Quartz
Quartzite	Chlorite
Dolomite	Mud
Limestone	Sandstone
Andesite	Chalcopyrite
Quartz-Porphyry	Galena
High Grade Gneiss	Sphalerite
Amphibolite	Chalcocite

The requirements for net-vein fracturing are:

1) the host rock is saturated with pore fluid,

2) shock-loading of the pore fluid,

3) pressure less than 2 Kb ($<$ 8 Km depth), to ensure low confining pressure, brittle-fracture conditions.

Shock loading of the pore fluid may be achieved by:

(a) dissipation of energy associated with a fault zone,

(b) explosive release of CO_2 due to reaction of acid groundwaters with a carbonate host rock,

(c) rapid explosive boiling of connate pore water in wet sediments.

2.42 Net-Vein Fracturing at Sock Creek: Plates 8, 9 and 10 show the development of net-vein fracturing in quartz porphyry at Sock Creek. The fracture filling in this case is quartz, and zoned veins of mineralisation-quartz. Plate 8 illustrates the development of net-vein fracturing in quartz porphyry, with mineralisation as the fracture filling. Plates 12 and 13 illustrate net-vein fracturing in argillites at the contact of the quartz porphyry, with fracture fillings of quartz, carbonate or sphalerite (-galena). The characteristics of the breccias are:

1) Development of angular fragments, defined by interconnecting fractures.

2) An in-situ derived clast population the same as the host composition.

3) Fractures which terminate internally in fragments, and within the host rock.

2.43 Control of Alteration: Net-vein fracturing appears to have exercised some control on the patterns of alteration within the porphyry, as illustrat in Plates 9 and 10. Areas of silicification and carbonate-iron oxide alteration can be bound by net-vein fractures. Preferential silicification of zones of dens net-vein fracturing can result in the development of pseudo-breccias containing remnant unaltered "fragments" of porphyry within a siliceous matrix, as illustrated in Plate 11.

2.44 The Fault Zone: The north-south fault zone throughout the Sock Creek prospect (Figure 2) is recognised in drilling as intervals of core loss or gouge in argillite, and as a zone of dense silicification of argillitic rock types (see drill logs, Appendix A, SK5/155.5 m, and SK2/198.4 m). This inferred fault correlates well throughout the geological sections, and with the surface position of the fault as inferred by Comstaff mapping.

2.5 <u>Sediment-Porphyry Contact Effects</u>.

The contacts of the quartz-felspar porphyry with the black argillites are complex. There are three processes which appear to be specifically related to porphyry-sediment contacts:

1) Net vein fracturing.

2) Silicification of the porphyry.

3) The development of hybrid, contaminated porphyry phases, and/or the development of felspathic alteration.

2.51 Distribution of Net-Vein Fracturing: Dense net-vuin fracturing is developed within the porphyry on the contact of the porphyry with sediment (as described above). Net-vein fracturing is also developed within argillites near the contact of the porphyry, as illustrated in Plates 12 and 13. The development of net-vein fracturing on the porphyry contact is possibly due to shock loading of pore fluids. This is due to column-pressure effects induced by the rapid generation of large volumes of steam caused by the contact of the porphyry with wet sediments (see Sections 2.1 and 2.41).

2.52 Contact Silicification: Silicification of the porphyry at sediment contacts is illustrated in Plates 14 and 15. Sediment inclusions in the porphyry are extremely irregular in shape, with highly irregular contacts. Net-vein fracturing of the porphyry is common on the contacts of the inclusions, together with the formation of a rim of silicification. In some cases there is infilling of the net-vein fractures by black argillite (wet sediment ?).

Pepperite?

2.53 Felspathic Alteration: Near to the contact zone of the porphyry body and the sediments, unusual hybrid porphyry phases or areas termed "felspathic alteration" are developed. These are illustrated in Plate 16. This type of alteration is coarsely felspathic, often with round quartz grains, densely packed. Locally both the quartz and felspar appear to be porphyroblastic as they form isolated coarse grains within the argillite. This rock type is an alteration product rather than a "sediment or tuff" because it is demonstrably transgressive to fine bedding in the argillite (Plate 16). The felspathic alteration is commonly irregularly "mixed" with black argillite as illustrated in Plates 17, 18 and 19.

2.54 Porphyry Phases on Contact: The "inter-mixing" of porphyry and sediment is associated with the development of hybrid porphyry phases resembling the felspathic alteration, or possibly representing a transitional contact phase of the porphyry contaminated by sediment. This phase is illustrated in Plate 18. Contrast between the contaminated phase, which has a darker matrix than normal contact porphyry phases and the felspathic alteration is illustrated in Plate 19.

2.55 Contact Effects Vs Agglomerate Sequence Interpretation: The alternation of layers or lenses in drill core of:

(i) dark-matrix contaminated porphyry,

(ii) silicified brecciated porphyry (Plate 15),

(iii) inclusions or intervals or argillite (Plate 14),

(iv) porphyry containing small fragments of argillite (Plate 18), and

(v) the development of pseudo-breccias in porphyry by silicification controlled by net-vein fracturing,

could be interpreted as an agglomeratic sequence. Rocks regarded as fine tuffaceous or volcanolithic detrital (Plate 20) have been logged in SK6/47 m, and SK1/19.4 m, and the sequence to the east is regarded as a normal volcanic sequence, as indicated on the Sections (Figure 3). However in the case of (i) to (v) above, the observation of the close association of net-vein fracturing and alteration on sediment-porphyry contacts, combined with the structural and textural evidence, suggest cumulatively that (i) to (v) above are probably the contact effects of the intrusion of porphyry into wet sediments rather than being an agglomeratic sequence.

2.6 Mineralisation.

The sequence of plates from 13, 16, 18, 21, to 22 illustrates a section across a porphyry-sediment contact. These relationships at this contact are summarised in Figure 4.

2.61 Structural Control of Mineralisation:

The mineralisation forms within a zone of net-vein fracturing developed about the porphyry-sediment contact zone. The mineralisation is strongly developed within the porphyry near black argillite contacts (Plate 21).

Mineralisation is also developed within the black argillite at the contact, (Plate 13). Although the zone of net-vein fracturing continues, the mineralisation falls off with distance from the sediment-porphyry contact as illustrated in Plate 22. Outside the zone of mineralisation this results in a net-vein fracture filling of barren quartz (and some carbonate). With increased distance from the contact, the net-vein fracturing in the porphyry decreases. The net-vein fracturing also continues as a thin zone within the sediment extending along the porphyry-sediment contact, and passes from the zone of mineralisation to barren quartz net-vein fracture filling.

2.62 Zoning of Veins: The mineralised fractures are zoned, usually passing from (i) yellow or iron-poor sphalerite at the cores of veins, (ii) through zones of more iron-rich dark sphalerite, to (iii) quartz rich margins of veins as illustrated in Plate 23. In areas near the margins of the mineralisation, chalcopyrite or galena is associated with the sphalerite, as shown in Plates 13 and 24.

Plate 25 shows the zone of net-vein fracturing from drillhole SK10, below the zone of rich mineralisation developed in drillhole SK2 as shown diagrammatically in the Section 900N of Figure 3C. The zone of net-vein fracturing is developed; but the zone of mineralised net-vein fractures is diminished, and passes off into barren quartz fracture filling on either side (Plate 25). This gives a "telescoped" version of the relationships of drillhole SK2.

2.63 Faulting and Mineralisation: Faulting appears to have continued after mineralisation; this is indicated by observations such as that of Plate 26 which shows displacement of a mineralised veinlet by micro-faulting. A similar relationship is given in Plate 13.

2.64 Geological Controls on Mineralisation: The controls on mineralisation at Sock Creek appear to be a combination of the following:

(1) the quartz-porphyry,

(2) the black argillites,

(3) the major north-south fault zone through the centre of the prospect.

In keeping with generalised concepts of ore genesis expressed in Hopwood, 1974, p. 260, it is considered tha requirements for mineralisation are as follows:

A) a sulphur source,

B) a metal source,

C) a concentrating mechanism.

In the case of Sock Creek it is considered that the quartz-felspar porphyry has intruded as an elongate body along the major active north-south fault zone.

The sediments although relatively deeply buried ($\sim$ 0.5 to 2 Km) are considered to have been wet, with a high connate water pressure, especially in sandy or silty layers. Extensive net-vein fracturing of the contact has occurred due to rapid boiling of the water at the porphyry contact causing impulse loading of the pore fluids. The pyritic black argillites have acted as a sulphur source; the connate waters of such sequences are often metal rich brines (Carpenter, 1973) and these connate waters are inferred to be a likely metal source. The porphyry has acted as a thermal source causing circulation of connate waters, with the zone of net-vein fracturing acting as the structural trap. The system has been relatively sulphur poor, as suggested by the yellow sphalerite. The dispersed iron oxide alteration associated with the mineralisation is possibly due to displacement of Fe^{++} from pyrite, by Zn^{++}.

Not so! A function of the Fe^{++} content!

He means that Fe has a lower S affinity than Zn.

SECTION B:

3.0 CHESTER-PINNACLES AREA

3.1 Introduction.

The regional setting of the Chester area within the Mt. Read Volcanics, is indicated on Figure 1. The Pinnacles area is some 3 or 4 Km north of Chester, approximately along strike and within similar rock types. The visit to this area was organised by Gerhard Krummei of Preussag (Australian Anglo American's joint venture partner in the Comstaff Project). Approximately five days were spent on the Pinnacles prospect; only half a day was spent on Chester. Consequently most of the comments below refer to the Pinnacles prospect, which was considered in greater detail.

3.2 Geological Outline of the Pinnacles Prospect.

As shown on the geological sketch map (Figure 5), in general terms the geology of the Pinnacles prospect comprises a complex set of volcanics (acid, basic, detrital equivalents, black shales, and cherts) intruded by a large inhomogeneous composite porphyry body (rock types Tsc, Pq, Psa of Figure 5, Table 2). This

TABLE 2 Summary of Rock Types, Figure 5 Pinnacles Area.

Symbol	Name	Brief Field Description
A. Volcanic Host Sequence		
Tf	Fine acid tuff or volcanics	White fine grained massive rock type (Plate 65)
Vbp	Porphyritic basic volcanics	Dark green often heavily chloritic rock type, porphyritic in felspar (probably plagioclase), (Plates 27, 28)
Dp	Porphyritic dacite	Intermediate, rock type, porphyritic in felspar
Abl	Laminated black argillites	Finely laminated black argillite/siltstone often pyritic (similar to Plates 1,2)
Tba	Bedded tuff argillite	Comprises sequence of Vbp with argillitic layers, or Abl alternating with coarse volcanolithic or felspathic "gritty" layers
c	Chert	Fine grained white, grey or black chert or silicified argillite
c/a	Chert/argillite	Mixed sequence of chert and argillitic rocks
Tqe	"Quartz-eye" rock	Tuffaceous rock type with glassy quartz-eyes - see petrographic description, Sample P5, Appendix B
B. Composite Intrusive Body		
Pq	Quartz porphyry	Massive quartz-felspar porphyry with obvious quartz phenocrysts (Sample P11, Appendix B)
Psa	Pseudo agglomerate	Acid matrix rock type, porphyritic in felspar, containing numerous irregular patches of dark green matrix material, which is also porphyritic in felspar, (Plates 39 and 36)
Tsc	Sericitic "tuff" with chert nodules	This rock type consists of a sericite schist matrix containing round nodules (1-3 cm) and "lumps" (3-10 cm) of chert, as illustrated in Plates 35, 36 and 37

composite body has been considered by earlier workers as an agglomerate/lapilli tuff sequence, but contact relationships, and alteration effects at the contacts, suggest that this body is intrusive, a point which will be discussed further below (Section 3.6).

3.3 The Volcanic Sequence.

This comprises a group of bedded rock types which form a series of relatively thin units correlable from Trench 28S to Trench 26S (Krummei mapping, and Figure 5), and from surface to underground (see Geological Section 16S, Figure 6A). These bedded units are fine grained acid tuffs or volcanics (Tf), porphyritic basic volcanics (Vbp, Plates 27, 28), porphyritic dacite (Dp), finely laminated black argillites (Abl), interbedded bedded volcanic/argillite sequences (Tba), and chert (c, Plate 33). These rock types are summarised in Table 2. The "cherts" may possibly be silicified argillites rather than "normal" bedded diagenetic cherts (see Berner, 1971, p. 161). This is because these "cherts" are developed enclosing zones of pyrite within the argillite as illustrated in Plate 34.

3.4 Folding Within the Pinnacles Area.

The units of the volcanic sequence are deformed:

(1) by large scale regional first phase folds F_1, and

(2) by local complex polyclinal kink style folds (F_2).

Large scale F_1 folds are defined by systematic changes in vergence sense, as indicated by the sense of assymetry of the bedding/cleavage, or S_0/S_1 intersection. The inferred positions of major anticlinal and synclinal F_1 hinges defined by these changes of vergence are indicated on Figure 5. Small scale F_1 folds in argillites are often quite tight; examples are illustrated in Plate 32. On a broader scale, F_1 structures developed on the west side of the area appear to be much tighter, and argillites are locally much more intensely deformed, than on the eastern side of the area. On the eastern side of the area cleavage intersects with bedding relatively commonly at a high angle (70^o to 40^o), indicating a general lack of appression of F_1 folds in this eastern region, when compared with those of the west of the map (see Plate 32 and Figures 8A, 8B, 8C, and 8H). In the deformation process there is an implication of an interplay between normal (solid-state) deformation processes and wet-sediment (liquefaction) deformation effects. Plates 31 and 32 illustrate responses which are traditionally considered normal solid-state tectonic responses. Plates 29 and 30 illustrate observations which indicate that some siltstone layers contained considerable connate water at the time of deformation, giving a soft-sediment response (cf. relationships at Sock Creek, Section 2.1). These soft-sediment effects appear to be more obvious on the contacts of the composite porphyry intrusive as discussed in Section 3.6 below.

There is a secondary deformation effect within the area. This is manifested in polyclinal or kink style folds with characteristically variable axes and axial planes, here termed F_2. The F_2 folds are distinguished by this local axial plane variability, and divergence with respect to "normal" F_1 or S_1 orientations, (Figures 8D, 8E). In general, zones of polyclinal folds are often associated with cross-faulting.

3.5 Composite Porphyry Body.

Three rock types make up what appears to be a composite body of intrusive porphyry. This body has reaction effects with the sediments on its contacts, and contacts which are apparently transgressive with respect to sedimentary units within the host volcanic sequence. The rock types comprising this body are:

(1) Pq, quartz porphyry,

(2) Tsc, sericite schist ("tuff") with cherty nodules,

(3) Psa, pseudo-agglomerate.

The characteristics of these rock types are summarised in Table 2.

The quartz porphyry occurs as occasional lenses within the Tsc rock type. It consists of a fine quartzofelspathic groundmass containing bipyramidial quartz phenocrysts and glomerophyric felspar. A petrographic description is given in Appendix B, Sample P11.

The Tsc rock type consists of a sericite schist matrix containing round nodules and irregular masses of chert, as illustrated in Plates 35, 36 and 37. These cherty nodules or masses appear to be developed about inclusions of pyrite within the sericite matrix as shown in Plates 37, 38 and 40.

The pseudo-agglomerate, Psa, is a sericitic quartz porphyry matrix containing irregular patches of dense chlorite. Both the chlorite patches and the matrix contain numerous phenocrysts (or porphyroblasts?) of felspar, as illustrated in Plate 39. The irregular chloritic patches, inclusions, fragments (or fiami ?) can occur singly or in dense "swarms", as illustrated in Plate 39. As discussed below, these chloritic patches are thought (in this work) to be altered inclusions or rafts of inclusions of argillite, derived by intrusion of the porphyry body into the volcanic sequence.

Some areas of the quartz-felspar porphyry phase are heavily net-vein fractures, with zones of dense silicifications forming pseudo-breccias, as illustrated in Plate 41.

As shown in Figure 5 different phases of the composite porphyry body appear to form separate zones or lenses, with Tsc rock types generally on the contacts, and Psa forming a lens or zone passing through the body. The quartz porphyry phase occurs as small isolated lenses within the Tsc phase.

3.6 Complex Contact Relationships.

Contact relationships between the volcanic sediments, and the composite porphyry body are complex, and appear to be transitional.

Figure 8, and Plates 42 to 58 inclusive illustrate these transitional contact relationships. The sequence of rock types and changes, passing from sediment to the composite porphyry, are summarised as follows:

1. The intruded host rocks are laminated black argillite, with interlaminae of felspathic "tuff" or siltstone (Plates 51, 53, 57).

2. Intrusion by thin apophyses of quartz porphyry (0.1 to 0.5 mm wide in core), associated with bleaching of argillite, and the development of patchy felspathic alteration (Plates 51, 52, 53); often the intrusive phase is extremely "poddy", or lenticular as

illustrated in Plates 46, 47, 51, 55, 57.

3. The argillite is irregularly bleached at the contacts; with gradual incorporation of the argillite, the apophyses of porphyry join. The argillitic remnants become more siliceous or cherty, as in Plate 48. Alternatively, the argillites are converted to chlorite schists, which develop porphyroblasts of felspar, Plate 45. These inclusions resemble material of the pseudo-agglomerate of Plate 39.

4. Original felspathic siltstones are subject to patchy felspathic alteration and are porphyritised (Plates 55, 56).

5. At the contact with the Tsc phase there is wholesale silicification (Plates 48, 49, 50, 52, 54), contamination of the porphyry by sediment (Plates 42, 43,51, 52) and development of felspathic alteration.

6. Passing into Tsc, the "chert" nodules and zones are presumably the remains of inclusions of sediment, within a sericitised former felspathic matrix.

7. Lenses of normal quartz felspar porphyry (Petrography Sample P11, Appendix B) occur as small bodies within Tsc. In some areas fragments of black shale occur within the porphyry (Plate 56).

These reaction relationships between sediment and porphyry at the contact, combined with its irregular apophysis-like detail at the contact, and transgressive nature towards mapped units of the volcanic stratigraphy imply that the composite Tsc/Psa/Pq body is intrusive, rather than being an agglomeratic pile.

3.7 Mineralisation.

As illustrated in Figure 5 and in Figure 7H, there are four known zones of mineralisation, within the volcanic sequence:

Zone A. Brown's workings.

Zone B. Thomas's Tunnel and its extension to drillhole CP 12 (Appendix C).

Zone C. An outcropping zone of massive mineralisation to the west of drillhole CP 7.

Zone D. South Trenches.

There are broad geochemical anomalies extending from Zone A to B, and from Zone C to the west of D. Soil geochemical anomalies comprise areas of 200 to 1250 ppm Pb, 200 to 1000 ppm Zn, 60 to 130 ppm Cu, and 650 to 1450 ppm Ba. There is also a broad zone comprising multiple continuous I.P anomalies, covering the same general area.

Brown's workings had not been relocated at the time of writing; some zones of silicification associated with pyrite are evident in the area (Plates 33 and 34). Thomas's Tunnel contained a series of significant rock types, which (apart from banded massive sphalerite-galena) are usually associated with major volcanogenic massive sulphide deposits as follows:

1. quartz-eye rock (cf. Hopwood, 1976),
2. pyritic black shales,
3. barytes bearing sericite schist (cf. Rosebery)
4. chert or silicification.

The quartz-eye rock and the chlorite schist are described in the petrography Appendix B as Samples P5 and P3 respectively. Banded sphalerite-galena ore, associated with barytes occurs in the southern trenches, (Zone C) and west of Thomas's Tunnel (Zone D); these are illustrated in Plates 59, 60, 61, 62 and are similar to banded sphalerite/galena ore from the Que River deposit in Plate 63. These zones of massive sulphide mineralisation comprise thin lenses, usually up to 2 m wide, which are discontinuous. It is a significant point that these lenses of mineralisation appear to be related stratigraphically, and structurally are distributed about a tight syncline as indicated on the main map Figure 5, on Figure 7H and on the Geological Section Line 16S, Figure 6A.

3.8 Structure of the Mineralised Zone.

Geological observations which support this inferred synclinal structure are as follows:

1. There is a well defined parasitic fold with a syncline-west sense in the main tunnel immediately east

of the cross cut in Thomas's Tunnel. This F_1 fold plunges 15N.

2. There are parasitic folds with opposed vergence senses, indicating a synclinal core, on either side of Zone D of the mineralisation in the Trench TR2 of the Southern Trenches.

3. The complex structure on Section Line 18S on either side of drillhole CP 12 is generally dipping 30^o to 50^o north; cleavage is generally vertical (when observed), suggesting that this area is a major F_1 hinge area (disrupted by intrusion of apophyses of porphyry, Plates 42 to 48).

4. On Section Line 16S, Figure 6A, a synclinal hinge appears to be a reasonable inference on a stratigraphic basis. Rock type correlations can be made from Thomas's Tunnel, together with surface outcrops south of drill site CP 7 to drillholes CP 7 and CP 14. The unit Vbp forms the core of the syncline as shown on Figure 6A. There are good rock type correlations of coarse tuff/black argillite sequences (Plate 51) from Thomas's Tunnel to CP 7, and from lower sections of CP 7 to CP 14. A quartz-eye tuff very similar to Tqe in Thomas's Tunnel and drillhole CP 7, is also exposed in the trench ~ 50 m west of CP 12.

On the basis of these combined sets of observations the inference of a syncline, as illustrated in Figures 6A, and 7H appears reasonable. This syncline appears to have been intruded by multiple thin apophyses of quartz porphyry (0.1 to 0.5 mm wide), as shown in core in Plates 51, 56 and by zones of Tsc. Plunges of parasitic F_1 folds and bedding/cleavage (S_0/S_1) intersections about the syncline suggest that the plunge of the major syncline is approximately 15^o to 50^o north.

4.0 BRIEF NOTES ON THE CHESTER AREA

Plates 66 to 68 illustrate rock types and relationships from the Chester area, a few km south of the Pinnacles area, discussed above. The Chester Mine is an open cut operation producing pyrite. This deposit comprises a stratigraphic unit of massive pyrite which is folded as illustrated in Figure 7F. Plates 67 and 68 are from localities (1) and (3) respectively of Figure 7F, and illustrate changes in vergence sense of bedding cleavage relationships. These changes indicate a large anticline within the pyrite rich stratigraphic units of the Chester Mine. This anticline is plunging approximately 15^o to the north, as indicated by the consistent plunge of parasitic F_1 folds.

Other rock types occur in the area: agglomerates (or pseudo-agglomerate ?), as in Plate 66 and flow rhyolites, Plate 65, make up the volcanic stratigraphy. Rock types similar to those at the Pinnacles are associated; the Tsc rock and other altered porphyritic rock types occur in the area. Unfortunately insufficient time was available in the Chester area to be able to determine specific interrelations between the pyrite-rich stratigraphy and these other volcanic rock types. Insufficient is known of the geology of the deposit to comment on its exploration potential, except to mention that the "gross" environment appears favourable.

5.0 SUMMARY AND RECOMMENDATIONS

There are rock type associations which are common to all four areas: Sock Creek, Chester-Pinnacles, Que River and Rosebery. In these areas there is an implied relationship of porphyry bodies apparently intruded into wet sediments.

5.1 The Sock Creek deposit is contrasted with those of the Que River, Rosebery, and Chester-Pinnacles areas by virtue of the style of mineralisation. The siting of the mineralisation at Sock Creek is almost certainly controlled by the net-vein fracture system, and extension of mineralisation is limited by this phenomenon. It is considered that the area is not classically volcanogenic, and in using this model as a basis for exploration, it is considered that there is little potential for large tonnages at Sock Creek. For this reason it is felt that exploration activity should be concentrated on the Pinnacles area, as described below.

5.2 The Pinnacles Area, as discussed above, has geological characteristics associated with mineralisation in other volcanogenic environments, and is considered to have potential for the occurrence of a larger deposit. In this context, significant points of comparison with other areas, which enhance the exploration potential of the Pinnacles area are:

1. Fine grained banded sphalerite/galena mineralisation similar to the ore of the Que River and Rosebery deposits.

2. An association of quartz-eye rock (Tqe, Sample P5, Appendix B) and pyritic black argillites similar to that at Rosebery and other major volcanogenic deposits.

3. Wet sediment tectonics are similar to soft-sediment structures developed with the pyritic argillites at Rosebery.

4. Chloritic alteration, silicification, and barytes-sericite schists associated with the Pinnacles deposit are alteration styles typically associated with volcanogenic deposits, and specifically with Rosebery.

Because of a lack of detailed mapping and the need to specifically correlate data in detail from surface outcrops to drill core, the structure of the Pinnacles zone of mineralisation (Zones A to D Figures 5 and 7H) is difficult to "fix" positively. It is well known that the relationships between mineralisation, structure and stratigraphy of these deposits are often capricious (cf. Hopwood, 1974, Brathwaite, 1972, and Roberts, 1975) and difficult to predict in the specific terms required for drilling. Because of this, and the characteristic small surface expression of these volcanogenic deposits (e.g. the Horne Mine, Quebec, 68 mT, has a surface outcrop only 350 ft diameter), I feel that this area has not been sufficiently tested to the stage where it can be confidently written off. To be able to write off the area totally a series of holes would have to be drilled at least 50 m apart between Sections 15S and 23S, targeted for both limbs and/or the keel of the inferred syncline plunging from Zone D, Figure 5. These holes would need to be drilled from the west and extended and terminated within the Tsc sequence to the east of the mineralised zone. Such a heavy drill program would need to be supported by large scale surface mapping and logging (at least 1:500 scale) so that detailed rock type, stratigraphic and structural data can be specifically correlated from surface to drill holes, so that an adequately detailed and specific concept of the geology is developed.

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APPENDIX A: SOCK CREEK DRILL LOGS

DDH SK1

Depth From	To	Description	Structure and Alteration
0	13.72	White to pale orange fine grained (aphanitic) rock type.	Weathered.
13.72	19.35	Light orange to buff porphyritic fragmental, rock fragments. Porphyry in felspar, minor argillaceous interlayers.	
19.35	27.7	Greenish grey fine grained argillite, locally coarser detritus, probably tuffaceous? Oxidised wiihin weathering zone; local leaching.	
27.7	41.5	Fine grained grey dense siliceous rock type. Felspar with diffuse margins.	Localised N (Si, Ch(?) at 28 m). Dense pervasive silicification.
41.5	43.5	Black shale, highly foliated, finely pyritic, fine carbonate veinlets.	
43.5	51.8	Mottled grey green-brown siderite. Altered massive porphyry. Fine grained silicified matrix with round quartz and yellow green (epidote?) felspar. Irregular brown carbonate alteration. (Photo contrast between round quartz, 46.8 m, and felspar porphyry, and zoned vein, 45.9 m, photo ref. AC1/10A.	Minor local N. Silicified veining. Zoned.
51.8	57.0	Pale pink, grey-green mixed interval. Fine grained rhyolitic matrix, heavily altered yellow green epidote ?, pink diffuse FeO alteration, Photo 52.6, 53.9, 56.8 m zoned veins, photo ref. AC1/2. Photo 52.7, 53.6, 56.8, mineralisation, net veining, zoned veins, marmatite, honeyblende, photo ref. AC1/4.	Heavy N*. Zoned veins. Silicified margin, sphalerite cores, dark sphalerite marginally light sphalerite.
57.0	62.4	Pink fine grained rhyolitic matrix; quartz felspar porphyry; round quartz embayed pinkfelspar, diffuse margin; at contact below N controls alteration. (Photos N, 61.2, 61.8, 62.4 m. N Si minor sphalerite, apparent control of alteration Siderite, epidosite v. FeO by N boundary, Photo ref. AC1/5).	Heavy N* (Si, very minor sulphide). Silicified?

DDH SK1 (cont.)

Depth From	To	Description	Structure and Alteration
62.4	75.0	Mottled pink, grey quartz-felspar porphyry, very altered giving overall mottled coarse irregular texture. Photo of quartz and carbonate, zoned veinlets; and sphalerite-silica zoned veinlets, 64.9, 66, 72.8m, photo ref. AC1/6. Photo zoned light to dark coloured sphalerite, silic. margin, 69.3, 76.6, 89.2m, Photo ref. AC1/7. Photo 67.3 m, photo ref. AC1/8, dense alteration 66.7, 62.8 m, photo ref. AC1/9.	Pervasive N(Si CO_2 sphalerite-silica zoned mineralisation, silicification at 69.3, 69.1, 67.3 m. Patchy alteration of silicification, carbonate, FeO?, apparently controlled by N.
75.0	89.6	Unaltered is fine grained grey pink mixed interval; heavy N*. Carbonate alteration. Quartz-felspar porphyry, zoned sulphide veins. Unaltered interval 77.5-80.5 m is pink, brown carbonate.	N*(Si minor sphalerite, zoned light-dark sphalerite and silica.
89.6	111.3	Alternating pink, grey with yellow green epidote. Quartz-felspar porphyry. Last 6 m retains similar texture but increases in fine chloritic flecks.	Alteration pink FeO, local areas of epidote altered felspar, patchy. Carbonate alteration over last 3 m, dense silicification?
111.3	115.5	Black argillite with irregular patchy areas of epidotised felspar, silica, zoned veinlet of possible honey sphalerite? 115.2 m.	
115.5	131.9	Hybrid phase appears to be transitional contact phase of massive porphyry sediment. "Fragments" appear to be unaltered interarea between zones of fracturing. (Photo 117.3, 119.5, 121.6, 128.2 m, photo ref. AC1/10,11).	Local N.
131.9	175.56	Alternating grey green and pink carbonate. Massive quartz-felspar porphyry. Occasional stringer veins of quartz-calcite. Local N with quartz-calcite filling. Photo 171.2 (ref. AC1/12)	Heavy N* first 2 m (silicified zoned vein) then local N.

152042

DDH SK2

Depth From	To	Description	Structure and Alteration
0	47.4	Laminated black shale siltstones, argillite, locally fine pyritic layers between 26 m (up to 26 m rock is oxidised) and 47.4 m. (Photo ref. AC1/13). Pyrite very fine, dense 5-10%. (Photo 27.3, 27.6 m, photo ref. AC1/14). At 39.7 m graded bed top up hole. ∢ S_o = 15°.	Disrupted by minor close spaced faults (Photo). Tends to resemble fracture cleavage (29.8, 33.3 m). ∢ S_o 65 ∢ S_1 65 at 30 m ∢ S_o 40 ∢ S_1 75 at 47.8 m
47.4	80.3	Black argillite with fine siltstone layers, very minor 1-2 cm laminae of fine dense pyritic argillite (5-10%). Overall massive local very fine veinlets, possibly N. Scale of density of fracturing relates to rock type. Local sphalerite-galena fracture filling at 56.2 m. Fine spotting of argillite. Coarse granular quartz-felspar segregations, local layers ? fragments ? or alteration ? Carbonate stringers parallel to close spaced fractures. ∢ S_1 = 90° (Photo N quartz-felspar segregations and carbonate veins 56.2, 58.8, 61.3 m. Photo ref. AC1/15).	
80.3	89.7	Contact zone between massive quartz felspar porphyry and sediments. Complex mixed interval comprising fine argillite and acid rhyolitic rock types. Rhyolite-rich rock type contains angular fragments; however zone of alteration is transgressive to S_o in argillites with apparent porphyroblastic felspar. Photo 81.3, 82.1, 83, 85 m. Photo of fragments, note black argillite fragment. Photo ref. AC1/16. Photo transgressive alteration (quartz felspar chlorite) and hybrid quartz felspar chlorite/sediment contact phase at 86.5, 88.2, 88.8 m. Photo ref. AC1/19.	Some N. Zoned light to dark sphalerite and quartz at 87.4 m.
89.7	103.6	Heavily N* and altered quartz felspar porphyry, matrix is fine grained massive with local remnants of round quartz and pink felspar. (Photo N, zoned sphalerite fracture filling, and wallrock lamination of fracture, photo ref. AC1/21)	N* zoned yellow to dark sphalerite, siliceous margin. Chalcopyrite in cores of thick fractures.

152043

DDH SK2 (cont.)

Depth From	To	Description	Structure and Alteration
		Barren quartz in fractures contains galena (at 100, 101 m). (Photo N and silicification leaving remnant intersertal areas resembling fragments. Note open cavities at 99.7, 102.1 m. Photo ref. AC1/22).	Galena in the more quartz rich barren veins. Alteration is silicification, pink diffuse FeO; minor epidote?
103.6	142	Massive quartz felspar porphyry, crustiform extension veinlets, local N with sphalerite zoned with siliceous margin. Patchy alteration comprising pink FeO, diffuse buff epidote? Carbonate, quartz veinlets. Zone of silicification associated with zone of mineralisation. (Photo of contrast between pink, yellow green spotted epidote altered porphyry, 116.9, 119.2, 127 m. Photo ref. AC1/23).	N
142	170.6	Grey green or pale green porphyry, sparse scattered quartz. Chlorite flecked, zone of silicification associated with N and very minor sphalerite. Felspars are yellow green and finer than usual phases.	
170.6	189.7	Mixed interval of alternating units of black shale with fine quartz-carbonate stringers, laminated quartz veins, with brecciated sericitic margins, remnant volcanic or porphyritic texture visible in terms of remnant round quartz. Zone may represent intertonguing or interbedded sediment with porphyritic or volcanics. Sediment is heavily brecciated and leached.	
189.7	194.2	Interfoliated zone of heavily deformed sediment? Interfoliated laminated finely siliceous material. Transgressive late quartz-calcite veins. Possibly = fault zone along with previous interval.	
194.2	219.5	Dense fine grained grey rock type, siliceous, fine internal breccia structure, pink siliceous and/or carbonate patches	

DDH SK2 (cont.)

Depth From	To	Description	Structure and Alteration
		throughout, white quartz veining, hackly broken texture, non porphyritic, contains local zones of possible fragmentals or silicified fault zone material. Whole zone could be a silicified fault zone material or non porphyritic volcanic.	

END OF HOLE

DDH SK3

Depth From	To	Description	Structure and Alteration
0	25.3	Laminated black argillite, siltstone, leached, weathered, oxide stained joints. $\angle S_o = 25^o$ at 9 m.	
25.3	56.8	Grey, black laminated siltstone, argillite. Relatively abundant pyritic siltstone interlayers 1-2 cm. $\angle S_o$ variable, but predominantly $10-20^o$.	
56.8	68.6	Black argillite, tends to be massive with very fine quartz-carbonate stringers. Locally fine N. Stringer zone of quartz-felspar material. Heavily sericitised. Tongues or apophysis of quartz-felspar material, possibly derived from porphyry because of irregular distribution rather than interlamination.	
68.6	91.5	Massive black argillite, very fine stringers, N locally. Local stringers parallel to S_1 of quartz, $\angle S_o = 20^o$ at 82.1 m. $\angle S_1 = 80^o$. At 82.1 m, fine grained detrital layer, very similar to quartz-felspar stringers in above interval, contrasting in that quartz-felspar stringers are heavily altered to sericite and epidote, while this layer is unaltered and conformable to S_o.	
91.5	97.7	Fine grained granular quartz-felspar rock type. Heavy N* with zoned veins sphalerite. Laminated Si. Material appears to be marginal phase of quartz-felspar porphyry and contains some remnants of rounded quartz and altered felspars.	Heavy N* silicification.
97.7	125.3	Predominantly pink massive quartz-felspar porphyry. 3 m zone of extension veining and small amount sulphide and silicification from 100.7 m. Very rare laminated stringer veins of quartz with minor sphalerite. Towards end numerous isolated quartz-carbonate stringer veins.	Diffuse FeO.

END OF HOLE

040

DDH SK4

Depth From	To	Description	Structure and Alteration
0	30.2	Weathered interval, comprising alternating intervals 1-3 m of 1) weathered black argillite, FeO stained (pyritic?) 2) heavily kaolinised quartz-porphyry apophysis or beds? Quartz felspar recognisable by remnant quartz phenocrysts.	
30.2	46.6	Alternating units black argillite, grey siltstone, locally pyritic (fine dispersed pyrite). 4 cm detrital coarser lithic layer at 31.8 m. ∢S_0 at 33.2 m = 55°. ∢S_1 = 90°.	
46.6	58.2	Alternating black argillite siltstone (units 1-4 cm). Fine stringer micro veinlets of carbonate-quartz. Local soft sediment slumping within siltstone layers. (Photo of slumping and pyrite nodule from earlier interval (43 m), photo ref. AC2/2A).	
58.2	70.0	Coarse quartz porphyry rock type containing round quartz phenocrysts or clasts, containing interlayers of sediment 2-10 cm. They are black shale with numerous "detrital" angular fragments. Sediment intervals have highly irregular contact with porphyritic rock type with notable silicification of contacted area (Photo 59.5, 67.5, 124.9 m of irregular contacts of black argillite inclusions in quartz porphyry, cofe on right (124.9 m) isolated inclusions in a thick porphyry interval, see description below. Photo ref. AC2/4A).	
70.0	82.1	Extremely heavily and finely N. black argillite. (Tongue of sediment between two porphyry intervals?). Photo 73.9 m, 76 m, photo ref. AC2/5A.	N*
82.1	122	Quartz porphyry, remnant round quartz phenocrysts, epidote alteration. Pink felspar. Extremely heavily veined by quartz carbonate. Local zone of well developed N, especially near the sediment contact. Alteration is carbonate, silicification.	

41

15204?

DDH SK4 (cont.)

Depth From	To	Description	Structure and Alteration
122	149.05	Quartz-felspar porphyry, yellow green and pink epidote alteration of felspar. Interval is contrasted by occurrence of small intervals 5-10 cm of black argillite, which are associated with N on contacts and silicification. Possible to interpret as interbeds, but silicification and similar occurrences also suggest they are wet sediment inclusions in the porphyry. Sediment interval associated with chloritisation of porphyry and with local development of felspars (alteration). Phase similar to SK10, 246.0, 84.2 m. Porphyry is heavily veined by quartz-carbonate associated with local zones of concentrated N. N is strongly developed on contact of sediment intervals.	N

END OF HOLE

42

DDH SK5

Depth From	Depth To	Description	Structure and Alteration
0	21.03	Upper weathered zone. Massive quartz-felspar porphyry consists of relatively abundant round quartz clasts and abundant felspar. Differs from massive porphyries in lower SK2 (160 m) in density and abundance of quartz phenocrysts or clasts. Relatively less matrix.	
21.03	68.3	Quartz-felspar porphyry. Relatively coarse granular clasts and/or phenocrysts of quartz-felspar. Variations in grainsize and abundance of phenocrysts gives an apparent coarse layering. Local zones of quartz and carbonate stringer veins. Photo 23.7 m (coarse) and 55.7 m (fine). Photo ref. AC1/24. Local areas of FeO alteration within overall grey green colour.	
68.3	121.0	Heavily altered massive quartz-felspar porphyry. Alteration is carbonate FeO diffuse and silicification. Zone of dense N* with silicified infilling. Round quartz phenocrysts are remnant within alteration matrix. Remnant quartz phenocrysts predominate, felspar phenocrysts are present but subordinate. Local stringer zone of quartz and carbonate.	N*
121.0	132.6	Massive quartz-felspar porphyry. Fine buff leucocratic matrix with rounded quartz and numerous felspars (pink) phenocrysts/ Photo 3 types of zoned veins 1) chalco-quartz, 2) sphalerite-galena-quartz, 3) light to dark sphalerite-quartz. Photo ref. AC1/25.	N* with zoned veins passing from chalcopyrite-quartz-sphalerite-galena quartz, or quartz carbonate
132.6	148.2	Transitional contact of massive quartz-felspar porphyry. Sulphide veins of quartz, light to dark sphalerite, passing to heavily sericitised marginal zones with remnant porphyry textures. Local short interval of massive quartz-felspar porphyry, with N and quartz-sulphide vein.	
148.2	155.5	Massive black argillite with stringer veins of white barren quartz.	

DDH SK5 (cont.)

Depth From	To	Description	Structure and Alteration
155.5	163.08	Heavily silicified argillitic shear zone material, alternating with detrital volcanolithic tuffs. Silicified sheared material may be fine rhyolitic rock type, similar to interval at end of SK2 (198.4 m).	
163.08	169.16	Silicified shear zone material or fine silicified rhyolitic rock type. Cf. SK2, 198.4 m, especially similar quartz carbonate veining.	

END OF HOLE

DDH SK6

Depth From	To	Description
0	11.4	Weathered quartz-felspar porphyry.
11.4	28.9	Quartz-felspar porphyry, fresh, unaltered. Felspars in greater abundance than rounded quartz phenocrysts. Unaltered grey green matrix. Last 1 m of contact contains both argillite and quartz porphyry. (possible error in lay-out of core).
28.9	34.3	Fine grained grey argillite. $\measuredangle S_o = 0$.
34.3	47	Fine grained very siliceous massive rock type, similar to interval SK2: 214.7 m. Internal breccia structures, pink and grey siliceous areas. Last 2 m fine grained heavily leached argillite.
47	84.4	Grey-greenish coloured fine grained sandy detrital rock type, possibly fine grained tuff. Local patches of silicification and carbonate alteration. 2 m at 49.4 m is silicified argillite or very fine grained sericitised rhyolite. Interval heavily and finely N with quartz carbonate infillings. Local interval with amygdaludal texture.
84.4	93.4	Cf. SK1 at 38 m. Last 1 m of interval very deformed argillitic material, probably crush zone in a fault. Fine grained siliceous rock type, locally foliated. Either foliated rhyolite+ or heavily silicified and altered argillitic material?
93.4	126	Quartz-felspar porphyry. Remnant round quartz phenocrysts, white and pink felspars. Matrix sericite-carbonate altered. Local N, 3 m at 120 m. Becomes increasingly sericitic towards end of interval. Transitional contact into:-
126	150	Quartz-felspar porphyry. Round quartz phenocrysts. Felspars oxidised, either to carbonate or FeO. Matrix is carbonate-sericite altered. Stringer veins of quartz and carbonate.

END OF HOLE

DDH SK10

Depth From	To	Description	Structure and Alteration
0	9.75	Weathered black argillite ∢S_o=75° 6.8 m. Iron oxide stained, heavily leached.	
9.75	38.3	Alternating black argillite and siltstone. Black siltstone lamellae are relatively abundant. At 20.3 m, ∢S_o=35°, ∢ S_1=80°. 0.5 m of heavily altered quartz felspar material with round quartz phenocrysts or clasts; possible massive quartz-felspar stringer or detrital interlayer at 37.8 m.	
38.3	60.4	Black argillite tends to be massive, minor 1-2 cm pyritic siltstone interlayers. Abundant quartz calcite micro-veinlets. Clastic layer 0.3 m widely dispersed lithic or felspathic detritus at 61.2 m.	
60.4	83.8	Massive fine even grained quartzofelspathic rock type, locally laminated, bedded? possibly detrital. Local fine stringer veins of quartz-carbonate, very minor quartz-sphalerite-galena patch, 70.2 m. S_o at 73.3 m = 35°. Rock becomes coarser grained felspathic towards end of interval, with apparent fragmental material at 83.6 m. (Photos of 1) laminated fine rock type and apparent fragmental material, photo ref. AC1/27. 2) Contrast coarse and fine (73.5, 82.2, 84 m) with silicification on contact, photo ref. AC1/28. 3) Also quartz felspar alteration or heavily altered porphyry apophysis on contact, photo ref. AC1/28).	
83.8	87,2	Metasediment tongue, laminated argillite. ∢ S_o at 86.2 m = 10°. Local stringers of coarsely porphyritic felspar, possible local apophysis of quartz felspar porphyry. (Photo porphyry felspar within sediment above, photo ref. AC1/29).	
87.2	105.5	Heavily altered quartz felspar porphyry. Round quartz, remnant felspar, locally round epidote altered. Patches of silicification, FeO and carbonate. Very inhomogeneous	Zones of N with carbonate and silica fracture filling.

052

DDH SK10 (cont.)

Depth From	To	Description	Structure and Alteration
		interval. Pseudo-breccia texture developed because of irregular silicification. (Photo of pseudo-breccia and N veins, 88.5, 91.6, 95.1, 95.3 m. Photo ref. AC1/30,31).	
105.5	121.0	Massive quartz-felspar porphyry, felspar remnants prominent (relatively). Stringer veins of quartz-carbonate contain very minor yellow sphalerite at 108.3 to 108.6 m. FeO diffuse alteration. Thin stringers of vein quartz, sphalerite shales, galena?. .03 m minor mineralisation at 116.0 m. 0.2 m very minor mineralisation at 118.5 m.	
121.0	132.8	Massive quartz-felspar porphyries; felspar phenocrysts predominant. Altered pink diffuse FeO matrix and unaltered grey-green matrix alternate. Local zones N and barren quartz-calcite veins.	
132.8	144	Massive quartz-felspar porphyry. Abundant felspar phenocrysts. Round quartz. Matrix heavily altered. Chlorite-epidote patches give pseudo-breccia appearance. Also local zone of carbonate alteration.	
144	155.2	Heavily altered quartz-felspar porphyry. N with barren quartz-carbonate veins, occasional light to dark sphalerite cores, with chalcopyrite. (Photo of N and sphalerite-chalcopyrite mineralisation, 144, 146, 147.6, 148.2, photo ref. AC1/32). Matrix alteration is diffuse FeO carbonate and fine epidote sericite.	N
155.2	204.2	Massive quartz-felspar porphyry with alteration patches; zone of diffuse FeO alteration. Quartz in round phenocrysts predominate, very few felspars, chlorite flecks throughout. Stringer veinlets of quartz and minor carbonate occasionally zoned throughout felspar. Minor zone of N.	N

47

15203

DDH SK10 (cont)

Depth From	To	Description
204.2	205.8	Dense fine grained phase; grey porphyritic rock type, highly silicified? Remnants of original porphyritic texture.
205.8	233.8	Massive quartz-felspar porphyry. Round quartz phenocrysts predominate; minor pink felspar. Diffuse FeO, patchy alteration in matrix.
233.8	236.3	Massive quartz-felspar porphyry. Greater proportion of felspar phenocrysts. Patchy diffuse FeO in matrix. 0.2 m alteration zone of sericite at beginning of interval. 0.5 m of heavy silicification at 236.3 m and end of interval.
236.3	248.25	Interfoliated heavily altered quartz-felspar material. Densely porphyritic in felspar (interbedded with sediment). Possible quartz-felspar apophysis in soft sediment. Possibly same as 84.2 m in SK10. (Photo, 245.7, 246.5, 247.4, 248 m, photo ref. AC1/33).

END OF HOLE

DDH SK11

Depth From	To	Description	Structure and Alteration
0	9.1	Oxidised weathered quartz-felspar porphyry; equivalent to below.	
9.1	20.0	Alternating yellow, green, pink heavily altered quartz-felspar porphyry. Round quartz phenocrysts. Epidote altered felspars. Zoned stringer veins of carbonate-quartz.	Heavy matrix alteration epidote-chlorite, carbonate and some diffuse FeO.
20.0	41.4	Quartz porphyry with round quartz phenocrysts and chlorite flecks (note chlorite flecks may be felspar pseudomorphs sericitised and reacted with metasomatic FeO to form chlorite (cf FeO alteration), note loss of felspars in this phase). Interval is heavily veined with carbonate-quartz veins. Local areas of extensive N*. Zoned veins: quartz core, carbonate rim. Areas of this weak mineralisation associated with quartz-carbonate vein. 0.2 m zoned galena to yellow sphalerite at 26.8 m.	N* local zoned veins; quartz core with carbonate rim.
41.4	47.5	Altered quartz-porphyry, large round remnant quartz phenocrysts. Heavily altered epidote-sericite matrix. Felspars not obvious. Local areas of chlorite flecks after felspar (?).	Local zones of silicification.
47.5	59.0	Photo SK1 - 160 m with 56.2 m in SK11. Photo of comparison of quartz-felspar porphyry with chloritic flecked porphyry, photo ref. AC1/34. Quartz porphyry, large remnant round phenocrysts of quartz. Chlorite flecks: chloritised pseudomorphs after felspar? Net vein fractured boundary against next interval.	N* throughout. Heavy predominantly carbonate infillings with exsolved quartz on margins. Reverse also occurs. Quartz core with carbonate rim.
59.0	65.7	Equivalent is SK11(1) from 62.4 m. Mixed interval comprising angular composite fragments of siliceous and carbonate altered material. In some areas positive remnant porphyritic textures are recognisable, (Photo 62.5 m, SK11 N veined, fragment of silicified porphyry, Photo ref. AC1/36,37) but in most cases fragments are fine grained and massive with little remnant texture. Fragments have internal silica-carbonate	

DDH SK11 (cont.)

Depth From	To	Description	Structure and Alteration
		boundaries suggesting original zoned veins. In some cases suggesting alteration prior to fracturing, in others post-dating fractures. In SK11(1) from 62.4 m N boundary (carbonate altered) passes into detrital rock type comprising dark argillite matrix containing numerous angular fragments of siliceous or cherty composition. Interval in SK11(1) is contrasted with SK11(2) in proportion of matrix material. There is subsequent disruption of some sections of earlier carbonate veinlets on fractures with a consistent displacement sense suggesting displacement of faulting. Interpretation is of intrusion of quartz felspar porphyry into wet sedimentary material with extensive silicification and carbonate alteration on contact. Alternate interpretation of agglomerate is possible but not preferred due to weight of data supporting N concept.	N extensive within fragments and on major fragment boundary contacts.
65.7	67.5	Poor recovery clay, black argillite, fault pug. Some siliceous material.	
67.5	90.0	First 1.5 m of interval comprises rock type finely porphyritic in felspar with remnant round quartz. Material is similar to alteration (porphyritic) in SK10, 246 m and 84.2 m. Heavily altered quartz porphyry remnant round quartz phenocrysts. Occasional areas of remnant felspars, pink or epidote altered (not always present) appear to be supplanted by chloritic flecks. Matrix alteration is patchy, varying from pink diffuse FeO to sericite and epidote (?). Locally alteration is controlled by N boundaries giving pseudo-breccias. Areas of N tend to degenerate to stringer veins of quartz-calcite: Mineralisation 5 m from 73.8 m, associated with N zoned light to dark sphalerite (light in core). Silicification of fragments, also some silicification of fracture walls. (Photo 76 m, 76.6 m silicification and mineralisation, photo ref. AC20A).	

DDH SK11 (cont.)

Depth From	To	Description
		2.5 m mineralisation from 86.2 m. Zoned vein galena, dark sphalerite, minor light sphalerite, silicified margins. Minor fault post-dating mineralisation at 89.6 m (Photo ref. AC2/1A).
90.0	101.0	Quartz-felspar porphyry, alternating sections of chlorite flecking and pink diffuse FeO stained round quartz phenocryst remnants. Felspars are pink, yellow, green epidote altered and replaced by chlorite ? Stringer veins of quartz-carbonate. Local N veining.

END OF HOLE

APPENDIX B - PETROGRAPHY

Sample P3: Chlorite Schist, Thomas's Tunnel.

Handspecimen: The rock type consists of waxy dark green almost black chlorite, containing irregular patches and mottles of white siliceous or carbonate altered material. Scattered throughout are fine porphyroblasts or phenocrysts of felspar. Overall the rock has the appearance of the chloritic patches or inclusions of the Psa rock type (Plate 39).

Thin Section: The matrix consists of a densely schistose texture of chlorite spicules (0.1 to 0.01 mm), with irregular patches and granules of carbonate and lesser irregular grains of quartz. Original felspar laths, presumably former plagioclase have been reduced to sericite-calcite-quartz-albite. Dense chlorite concentrates about felspar pseudomorphs. Small patches and granules of siderite, and opaques, probably limonite, occur within the matrix.

Composition: Groundmass: chlorite 40%, calcite 30%, sericite 15%, quartz 15%.

Pseudomorphs of Felspar: sericite 35%, calcite 15%, quartz 20%, albite 30%.

Comment: The rock is probably a heavily chloritised porphyry or porphyritic volcanic rock. It may also represent porphyritised sediment similar to inclusions in porphyry discussed in text Section 3.5.

Sample P5: Quartz-Eye Rock from Thomas's Tunnel.

Handspecimen: The sample is a fine grit-textured greywacke like rock type, with numerous angular rock fragments, and fine felspar clasts (?); scattered throughout are numerous fine (1 mm) glassy quartz eyes (phenocrysts, clasts or whatever). In looking at the thin section with a handlens the quartz eyes are much more abundant and appear overprinted on the clastic texture. Quartz eyes are located within the matrix, within clasts, and overprinted over clast boundaries.

Thin Section: The texture of this rock is very complex. The rock contains angular clasts or fragments of:

1. isotropic volcanic glass,
2. fine granular acid volcanic matrix, containing altered albite phenocrysts,
3. altered felted volcanic matrix, without phenocrysts,
4. fine granular quartz rich slate or siltstone,
5. clasts or phenocrysts of plagioclase An_{15-20}.

The groundmass is very fine granular quartz sericite-chlorite, which is locally schistose.

Throughout the rock are numerous glassy quartz eyes 1 to 2 mm in diameter. They are most commonly rounded, occasionally bipyramidial in shape. They occur throughout the matrix and in all clast varieties, including the siltstone fragments. Some quartz-eyes incorporate groundmass micas regionally. There are some overgrowths

Sample P5 continued ...

or rim textures developed.

Composition: Volcanic fragments 25%, volcanic glass 15%, shale or siltstone 15%, felspars 10%, quartz-eyes 15%, matrix 20%.

Comment: The rock type is classically what most petrologists would term a crystal tuff. It is a good example of the quartz-eye rock of Hopwood, 1976.

Sample P11: Quartz Felspar Porphyry, Locality 16S, 13.3W.

Handspecimen: The rock type consists of a massive yellow green quartzofelspathic groundmass containing glassy quartz phenocrysts (1 to 10 mm) and glomerophyric aggregates of felspar euhedra.

Thin Section: The groundmass consists of finely granular indeterminate felted grains of quartz-sericite($\pm$ chlorite ?). The matrix contains large (1 to 5 mm) glomerophyric aggregates of felspar subhedra, An_{5-10}, and large bipyramidial quartz grains. The matrix contains occasional sericite-chlorite pseudomorphs of a former prismatic mineral, possibly biotite or even former more calcic (now unstable) plagioclase. The groundmass alteration is more densely chloritic (?) around felspar or quartz phenocrysts.

Composition: Groundmass 48%, quartz phenocrysts 20%, albite phenocrysts 30%, prismatic pseudomorphs 2%.

Comment: The rock is a normal quartz felspar porphyry, not a "quartz-eye" rock.

APPENDIX C: PINNACLES PROSPECT DRILL LOGS

DDH CP7

Depth From	To	Description
0	10.7	Weathered zone. From mapping Vb.
10.7	36.2	Unweathered Vb retains apparent fragmental texture. Dark green chloritic in appearance. Porphyritic in K-felspar. Photos of Vb (16.7, 18.7 m) fragmental texture. Photo ref. AC4/31A.
36.2	63.7	Porphyritic rock type leucocratic - appears kaolinised similar to material in Thomas's Tunnel at 30 m (collapse). Fine net vein fracturing. N.B. Occasional inclusions and/or fragments of argillitic material (overprinted K-felspar). Photo at 58.7 m. Photo ref. AC4/32A.
63.7	70.5	Vaguely schistose - heavily kaolinised or sericitised. Sporadically mineralised with finely disseminated sphalerite and galena in flecks and thin laminae. Photo at 70.25 m, Photo ref. AC4/33A.
70.5	92.6	Altered porphyritic rock type - altered sericitic matrix. Tsc; porphyritic in felspar contains rounded chert nodules. Foliation locally highly crenulated. Photos at 71.1, 82.3, 83.2 m. Photo ref. AC4/34A.
92.6	98.5	Interlaminated fine detrital rock type - possibly tuffaceous. Siltstone with notable zones of fine bedded pyrite. Stringers of sphalerite, chalcopyrite, galena locally.
988.5	122.0	Interlaminated coarse felspathic? gritty tuffaceous rock type. Fragments of laminated black argillite. Soft sediment deformation similar to transition of trench east of CP12. 0.3 m intersection of quartz felspar porphyry at 99.2 m. Photo of contrast between porphyry and tuffaceous interlayers and soft sediment structure, photo ref. AC4/35A.
122.0	130.6	Interlaminated argillites and fragmental detrital rock units. Fragmental rock units comprise angular fragments of siliceous or silicified volcanic material in a dark argillaceous matrix. Black shale layers are finely laminated. Leucocratic material, appears sericitised. There has been porphyritisation of material implied by over-printing of felspars on both matrix and fragments. Photo 107.1, 125.3, 127.1 m. Photo ref. AC4/36A.
130.6	140.3	Brecciated material similar to above, interfoliated with thin tongues of quartz-eye bearing porphyry - massive. Notable silicification and overprinted K-felspar alteration.

DDH CP7 (cont.)

Depth From	Depth To	Description
		Photo of quartz-eye porphyry, silicification felspathic alteration and net-vein fracturing. Photos 131.4, 130.8, 135.4, 130.4 m. Photo ref. AC5/0A. Notable flecks of sphalerite in fracture zones.
140.3	156.5	Layered coarse leucocratic detrital rock - tuff? - with locally overprinted felspar alteration and local fragmental zones. Cf. 122 m above.
156.5	164.5	Fine grained gritty quartzofelspathic rock type with notable fine quartz-eyes (Tqe). Sample at 159.45 m. Alternating with fine grained dark laminated siltstones $\angle S_0$ 164.5 = 20° graded bed top down hole = East. 0.1 m of quartz porphyry massive (Pqe) at 163.7 m.
164.5	197.5	Now interval is laminated black shale, siltstone locally silicified with patchy alteration. Pyrite nodules, soft sediment deformation structures (Photo 170.1, 171.7 m). Also local net vein fracturing containing sphalerite (Photo 187.3 m). Photo ref. AC5/2A.
197.5	200.7	Transitional porphyry contact. Porphyritisation of leucocratic layers. Zones of zoned sphalerite veinlets in adjacent sediments. Photo 196.4, 196.1, 199.5 m. Photo ref. AC5/3A. N.B. 3 m missing from 196 m.

END OF HOLE

DDH CP9

Depth From	To	Description
0	13	No core.
13	54.9	Laminated black shales with siltstones - siltstones light coloured, local fine pyritic siltstone layers. Very occasional overprinting of feldspathic alteration. Argillites are heavily net vein fractured with stringer veins of calcite quartz. Loss of core of brecciation 2 m from 37.4 m indicates possible fault zone. 0.3 m from 39.0 m is quartz feldspar porphyry. ∢ S^0 varies between 70 and 90 approximately throughout length of interval.
54.9	62.6	Alternating 0.5 - 1 cm layers of pyritic black argillite and fine grey-white siltstone heavily pyritic, subject to "soft-sediment" style of deformation stringers and dissemination of sphalerite, chalcopyrite and galena, between 54.9 and 59.5 m. Interval becomes increasingly silicified towards the end. Photo of transitional contact between sediment and Tsc, Photo ref. AC5/5A. N.B. Partial interfoliated silicification 61 m, contact silicification 62.4 m, silicification of breccia fragments 63.9 m and irregular zones of sphalerite 67.4 m.
62.6	71.3	Tsc locally forms porphyry sericitised porphyry matrix containing angular fragments of chert (silicified argillite ?).
71.3	92.4	Alternating cherty argillites and leucocratic gritty siltstone. Rocks are presumably silicified argillites. Bedding conformable zone of sphalerite 1 m from 79 m. Discontinuous zones of sphalerite in net vein fractures and stringers throughout the zone of silicification.
92.4	110.7	Irregularly mottled cherty sericitic rock remnant foliation. ∢ S 70-90, occasional darker stringers may contain fine grained sphalerite or galena. (Zone is transitional Tsc).
110.7	119.4	Waxy yellow Se overprinted by felspathic alteration, tendency to segregate cherty patches, similar to Tsc. Minor irregular patches and stringers of sphalerite and galena. Photo of felspathic alteration 115.3 m, galena, 116.0 m, and silicified sericite texture 103.4 m.

DDH CP9 (cont.)

Depth From	To	Description
119.4	143.9	First 4 m of interval is fine grained silicification followed by Tsc with local patches of dense silicification throughout. Local carbonate veinlets and stringers of carbonate containing galena and sphalerite at 137.3, 136.5, 139.0, 140.0 m.
143.9	144.8	Fault gouge plus core loss.
144.8	158.4	Silicified Tsc with very occasional carbonate stringers containing galena and sphalerite at 157, 157.8 m. A 0.1 m interval of porphyry with large round quartz eyes at 158.2 m.

END OF HOLE

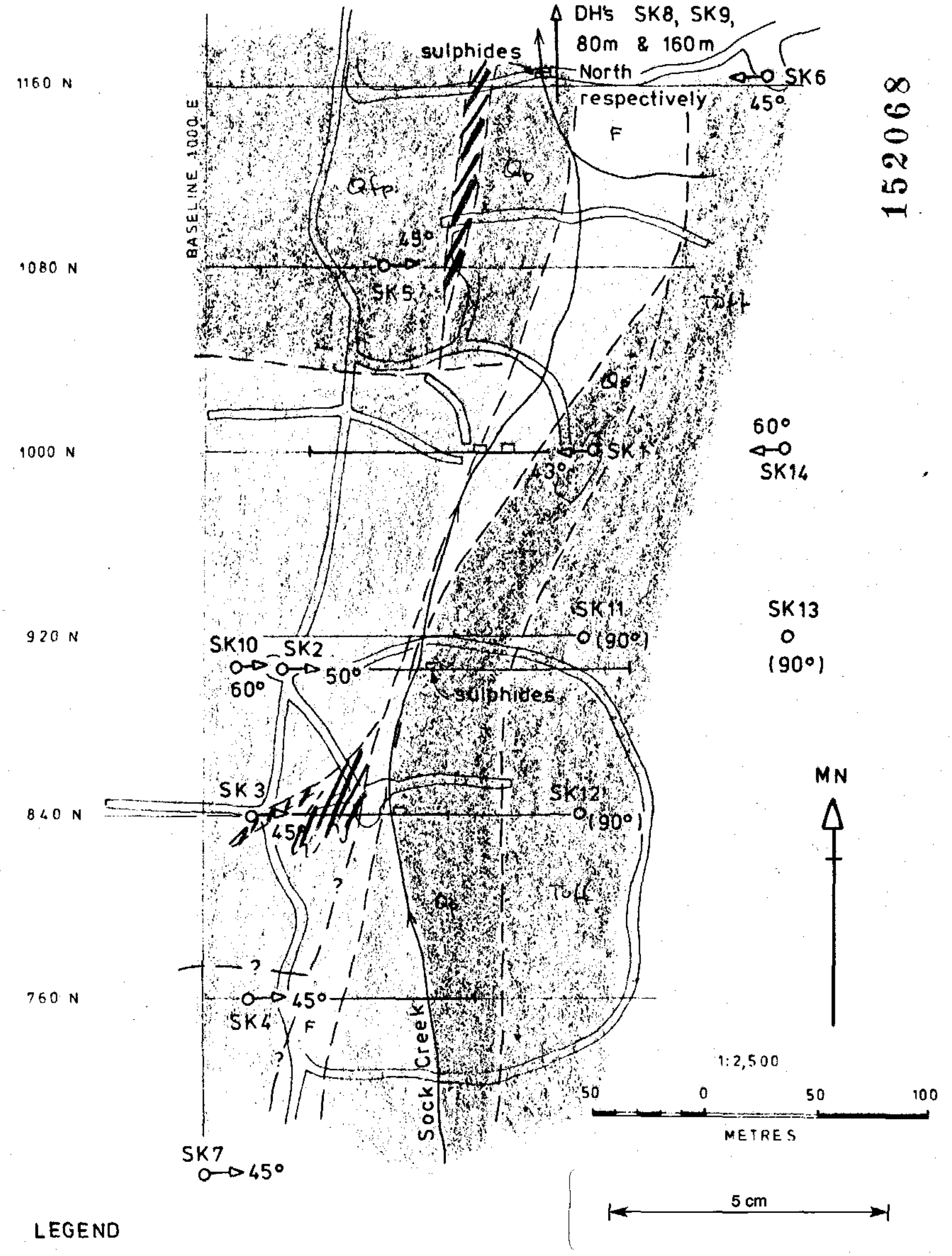
DDH CP14

Depth From	To	Description
0	16.4	Weathered Vb.
16.4	47.8	Vb porphyritic in K-felspar, locally fragmental; similar to first two intervals of CP7.
47.8	51.8	Kaolinised and/or sericitised Vb still retains porphyritic texture.
51.8	90.6	Sericite schist and/or kaolinite zone (Tsc) round chert nodules. Porphyritic in K-felspar and notable occasional quartz-eyes.
90.6	125.7	(Tsc) Volcanic - porphyritic in felspar, recrystallised quartz phenocrysts. Inhomogeneous with zones and nodules of silicification (chert nodules) and patches of chloritisation.
125.7	145.4	First 2.5 m heavily leached zone silicified with cavernous quartz, passes to pyritic argillites, heavily brecciated with fine net vein fracturing, carbonate silica. 5 m of porphyroidal rock type, felspar round quartz phenocryst, alteration (hybrid rock type) from 133.5 m. Fractured pyritic black shale continues after this interval.
145.4	159.6	Pyritic black argillites alternating with fine volcanolithic felspathic tuff. Cf. DH CP7, 98.5 m onwards.
159.6	175	Tsc sericite schist with chert nodules.
175	179.4	Black argillite fragmental units with cherty patches. Cf. Tsc. Some overprinted felspathic alteration locally pyritic.
179.4	196.9	Tsc, local cherty nodules, becomes foliated towards fault contact.
196.9	200.2	Kaolin fault gouge.
200.2	201.8	Gouge zone containing sulphides (sphalerite from assay).
201.8	214.4	Silicified black argillite and fine leucocratic tuff or siltstone. 0.2 m of breccia comprising angular sedimentary fragments in fine porphyry matrix, 206.7 m. Quartz carbonate stringer veins throughout.

DDH CP14 (cont.)

Depth From	To	Description
214.4	219.8	Heavily brecciated black shale, some siltstone, resembles broad fault zone.
219.8	245.3	Alternating laminated grey siltstone.

END OF HOLE



LEGEND

Ab	Pyritic Black Argillite
Qfp	Quartz-Felspar Porphyry
	Transitional Contact Breccia
Qp	Silicified Porphyry
F	Fault Zone
SK3	Diamond Drill Hole
	Inferred Geological Boundary
	Road / Costean

FIGURE 2:

SOCK CREEK PROSPECT - GEOLOGICAL PLAN

From AUSTRALIAN ANGLO AMERICAN LTD.

LEGEND SOCK CREEK PROSPECT Figures 2, and 3A to 3F.

Rock Units

Black Argillites (Arg.)

Green tuff or Volcano-clastic Rocks

Quartz Porphyry

Quartz felspar porphyry

Phenocrysts

[q or qtz] quartz

[fels] felspar

[chl] chloritic flecks

[q >fels] quartz and felspar phenocrysts, quartz more abundant

Alteration (indicated in brackets)

(Si) silicification

(Si*) heavy silicification

(Ca) Carbonate

(Fe) Iron Oxide

(qf or fels) quartzofelspathic or felspathic alteration

(ep) epidote

(Se) sericite

Structure

S_o trace of bedding

S_1 trace of cleavage

N net-vein fracturing

N* heavy net-vein fracturing

N(Si) silica fracture filling

V vein or stringer veins

Mineralisation

Py pyrite

Sp sphalerite

Gn galena

Cp chalcopyrite

069

152070

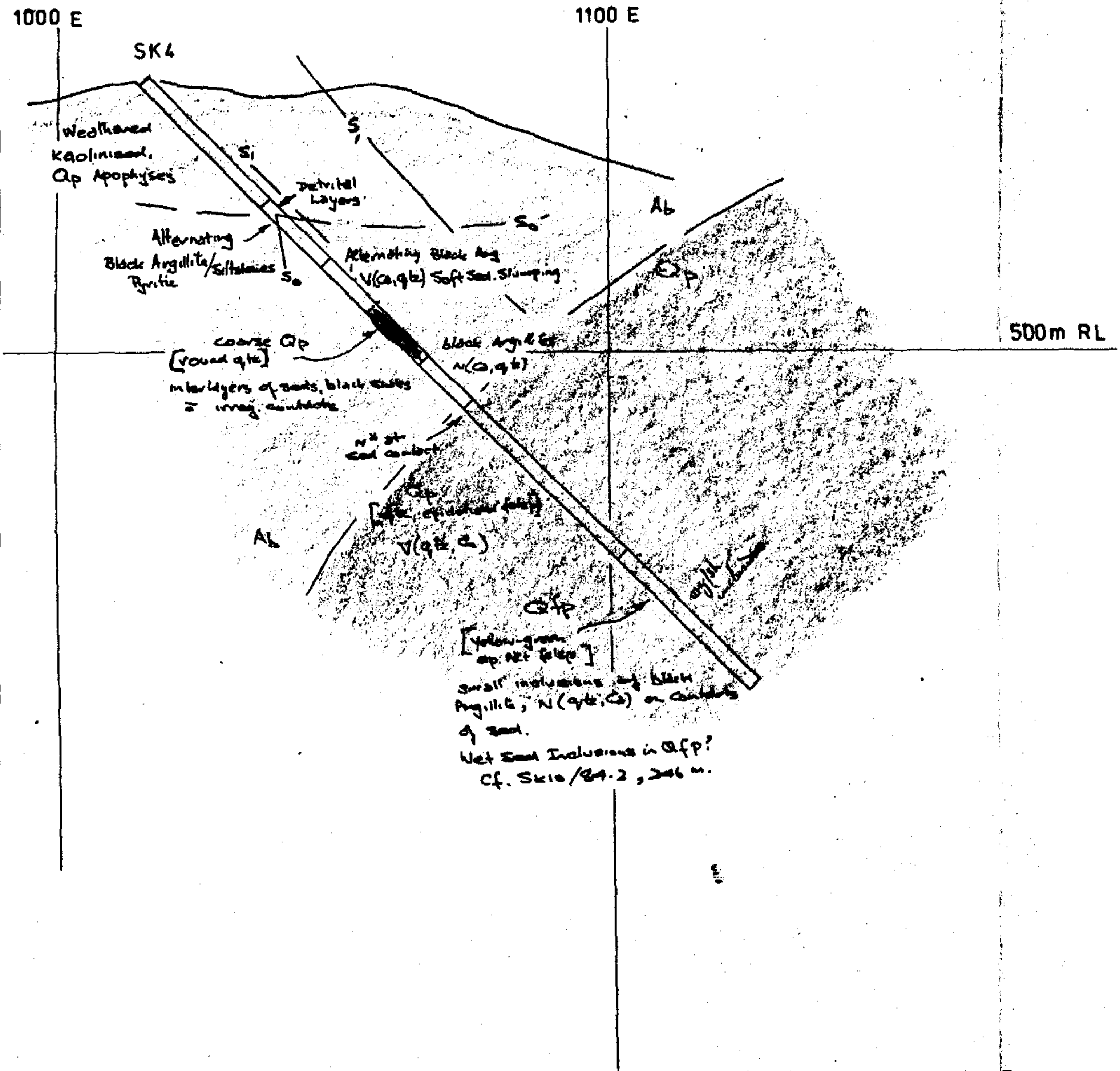


FIGURE 3A:
SOCK CREEK SECTION 750 N

SCALE 1:1000

5 cm

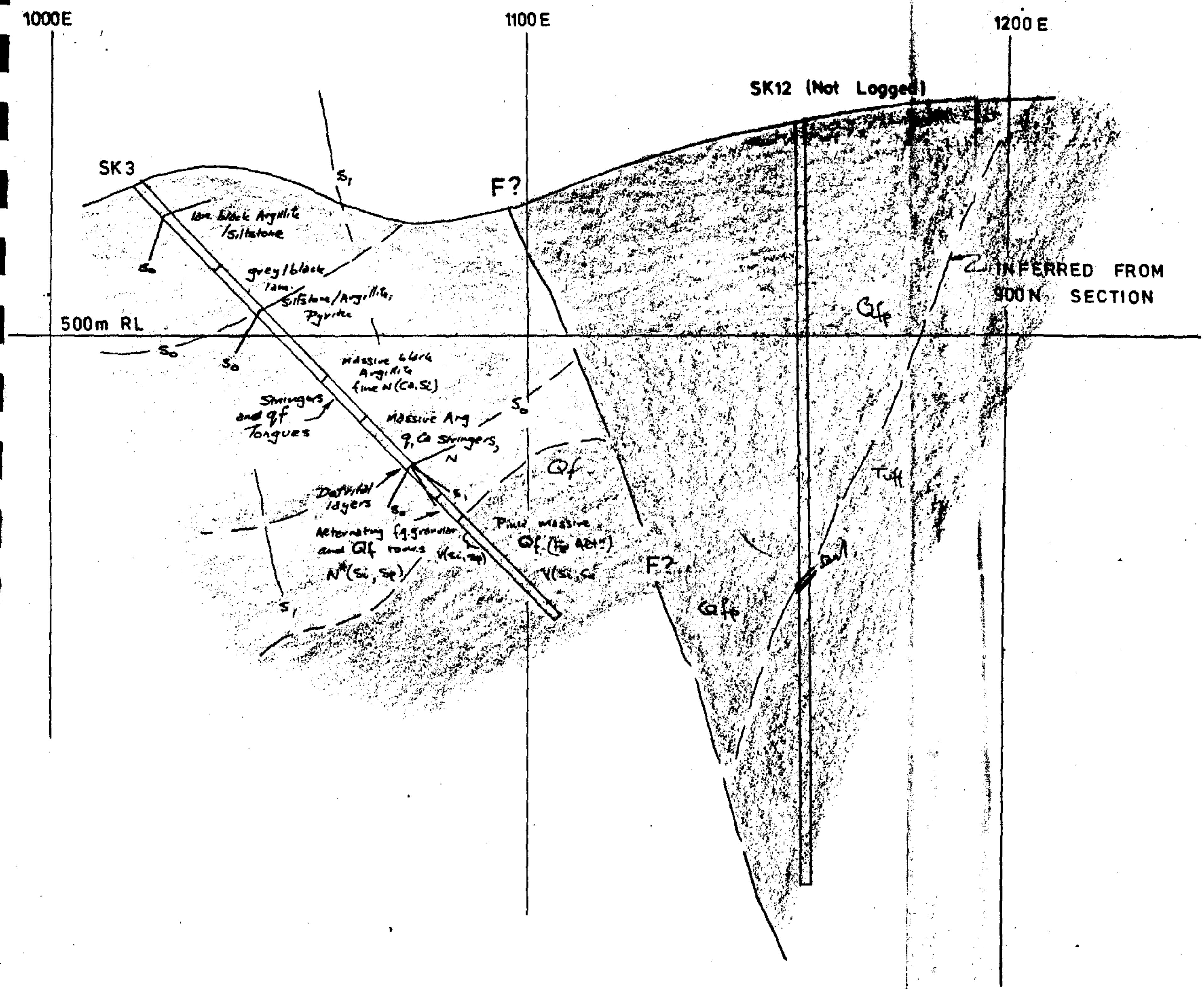


FIGURE 3B:

SOCK CREEK SECTION 850 N

SCALE 1:1000

5 cm

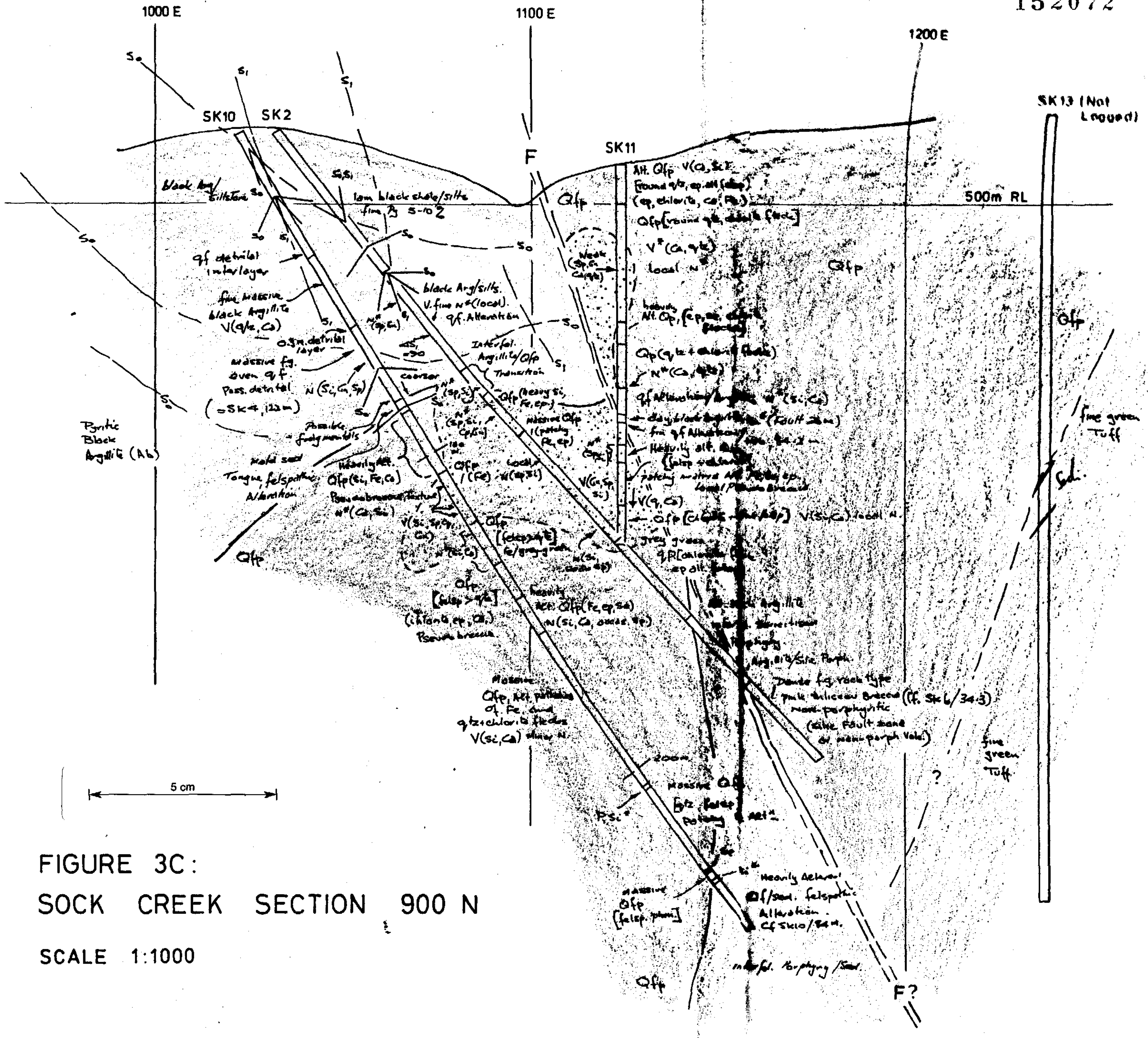


FIGURE 3C:
SOCK CREEK SECTION 900 N

SCALE 1:1000

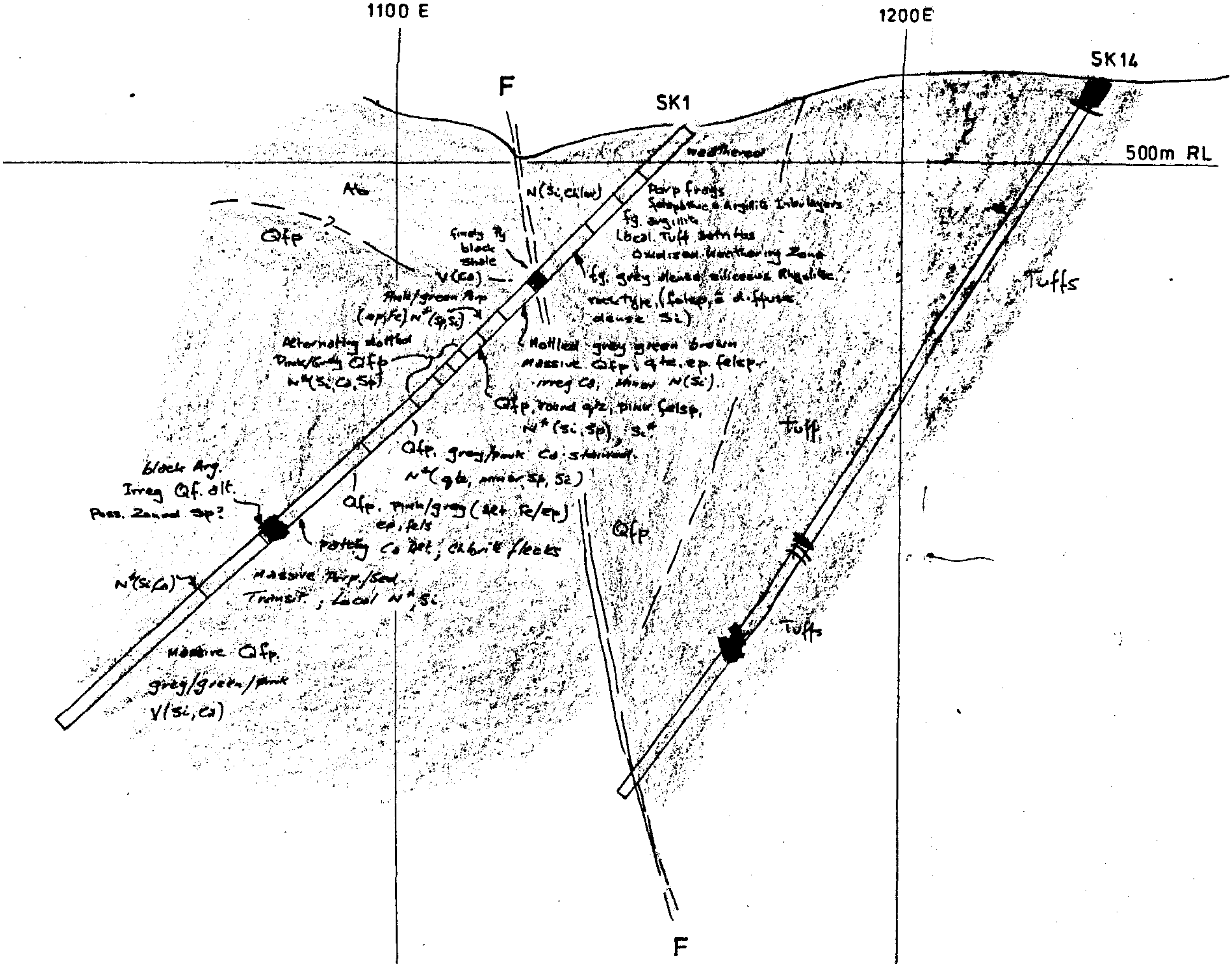


FIGURE 3D:
SOCK CREEK SECTION 1000 N

SCALE 1:1000

5 cm

073

152074

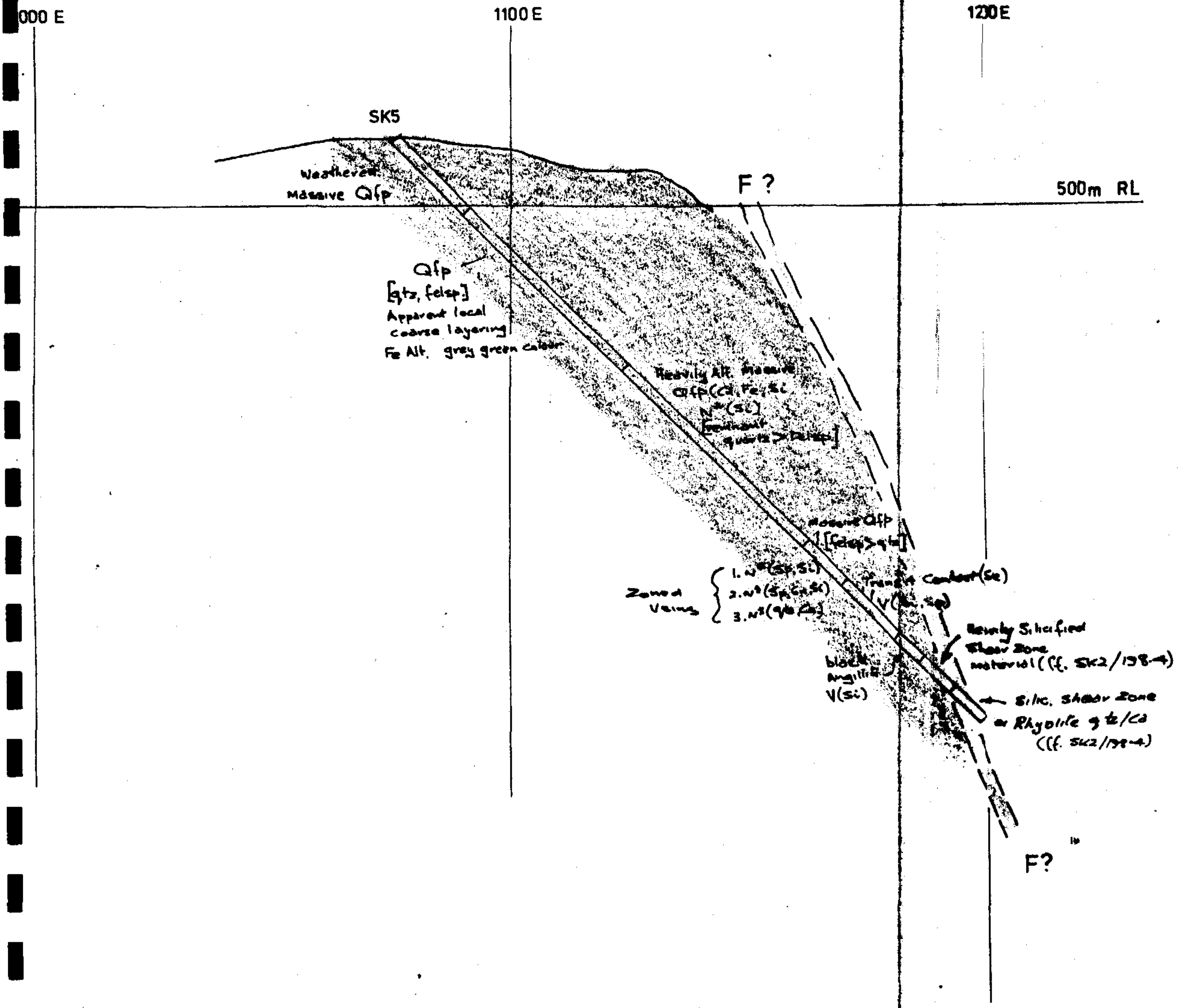


FIGURE 3E:
SOCK CREEK SECTION 1100 N

SCALE 1:1000

5 cm

152075

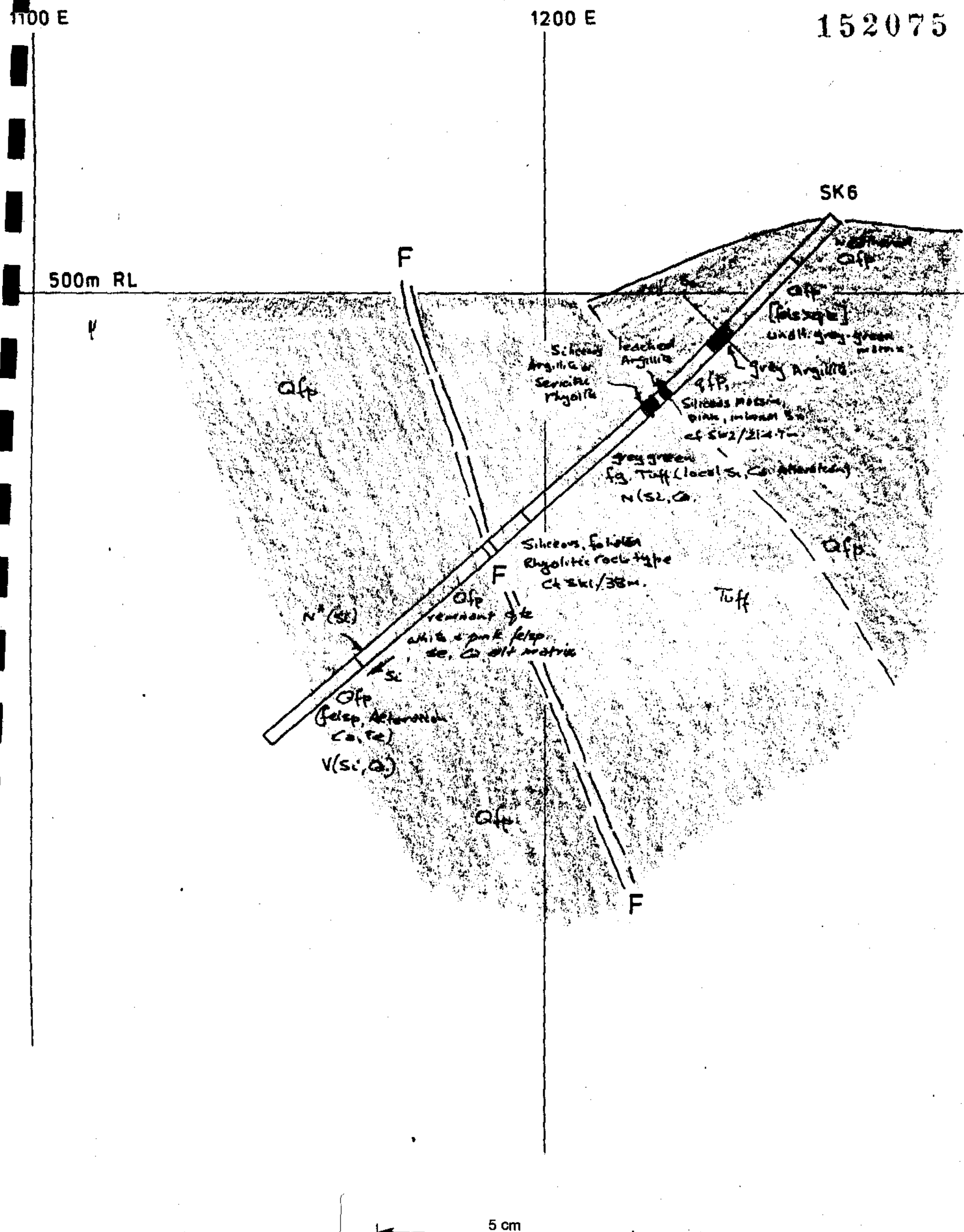
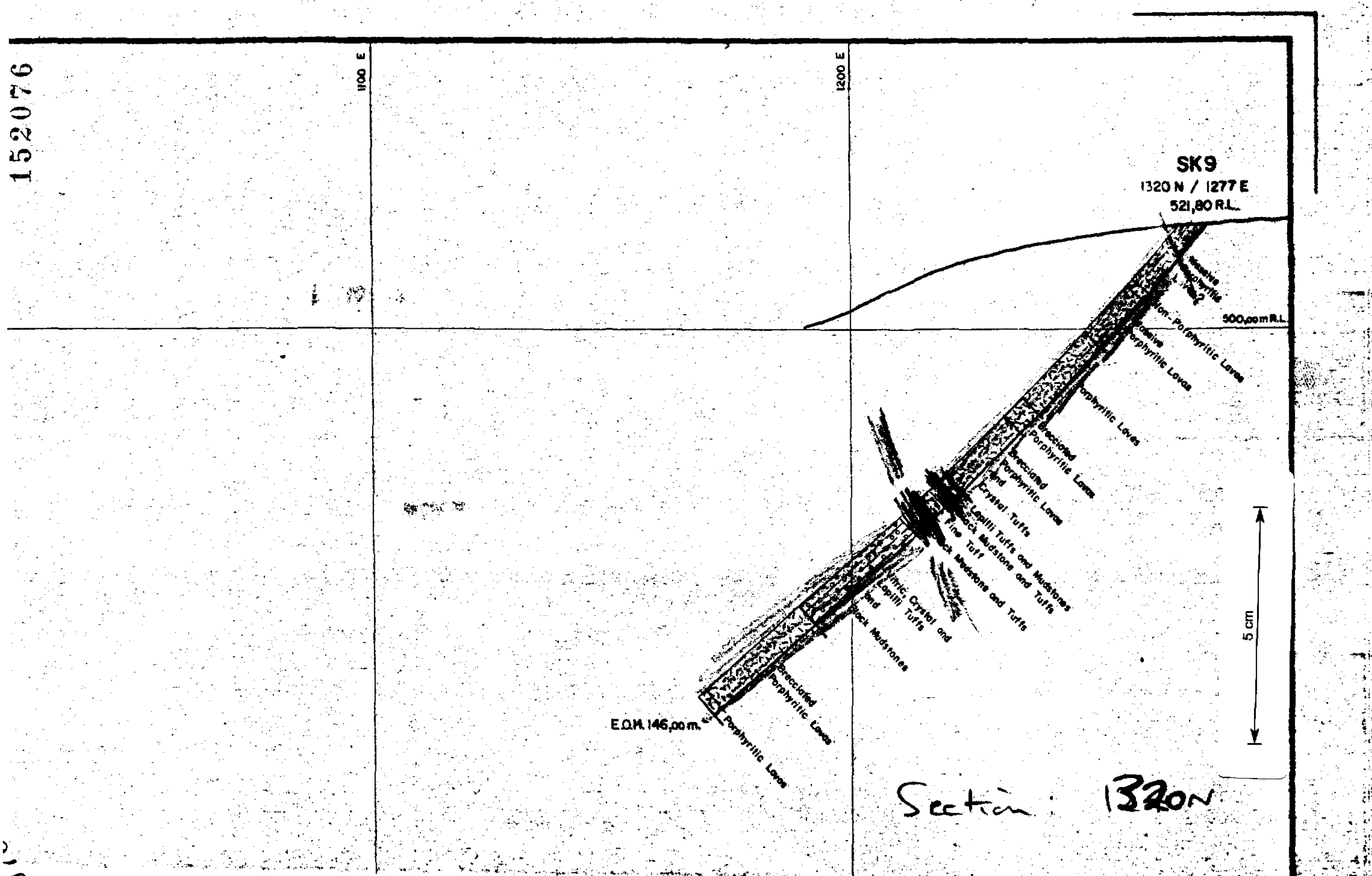
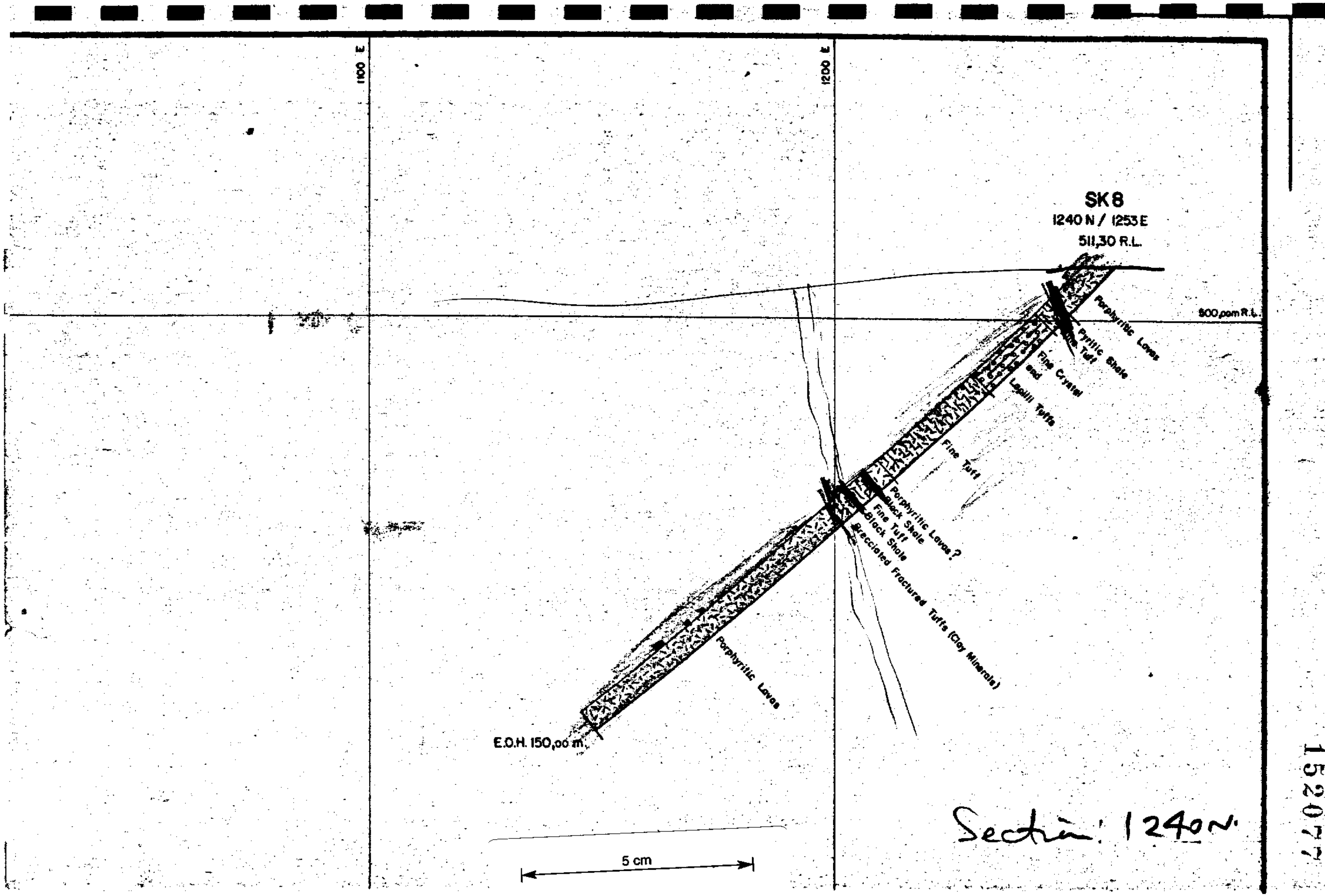


FIGURE 3F:

SOCK CREEK SECTION 1150 N

SCALE 1:1000


152076
1100 E
1200 E
SK9
1320 N / 1277 E
521,80 R.L.
500,00m R.L.
Non-Porphyritic Lavas
Porphyritic Lavas
Porphyritic Lavas
Brecciated
Porphyritic Lavas
Brecciated
Porphyritic Lavas
Crystal Tuffs
Lapilli Tuffs and Mudstones
Mudstone and Tuffs
Fine Tuff
Mudstone and Tuffs
Vitric, Crystal and
Lapilli Tuffs
Mudstones
Brecciated
Porphyritic Lavas
Porphyritic Lavas
E.O.H. 146,00 m.
5 cm
Section: 1320N


1100 E
1200 E
SK8
1240 N / 1253 E
511,30 R.L.
500,00m R.L.
Porphyritic Lavas
Pyritic Shale
Fine Tuff
Fine Crystal and Lapilli Tuffs
Fine Tuff
Porphyritic Lavas?
Black Shale
Fine Tuff
Black Shale
Brecciated Fractured Tuffs (Clay Minerals)
Porphyritic Lavas
E.O.H. 150,00 m.
5 cm
Section: 1240N

152077

152078

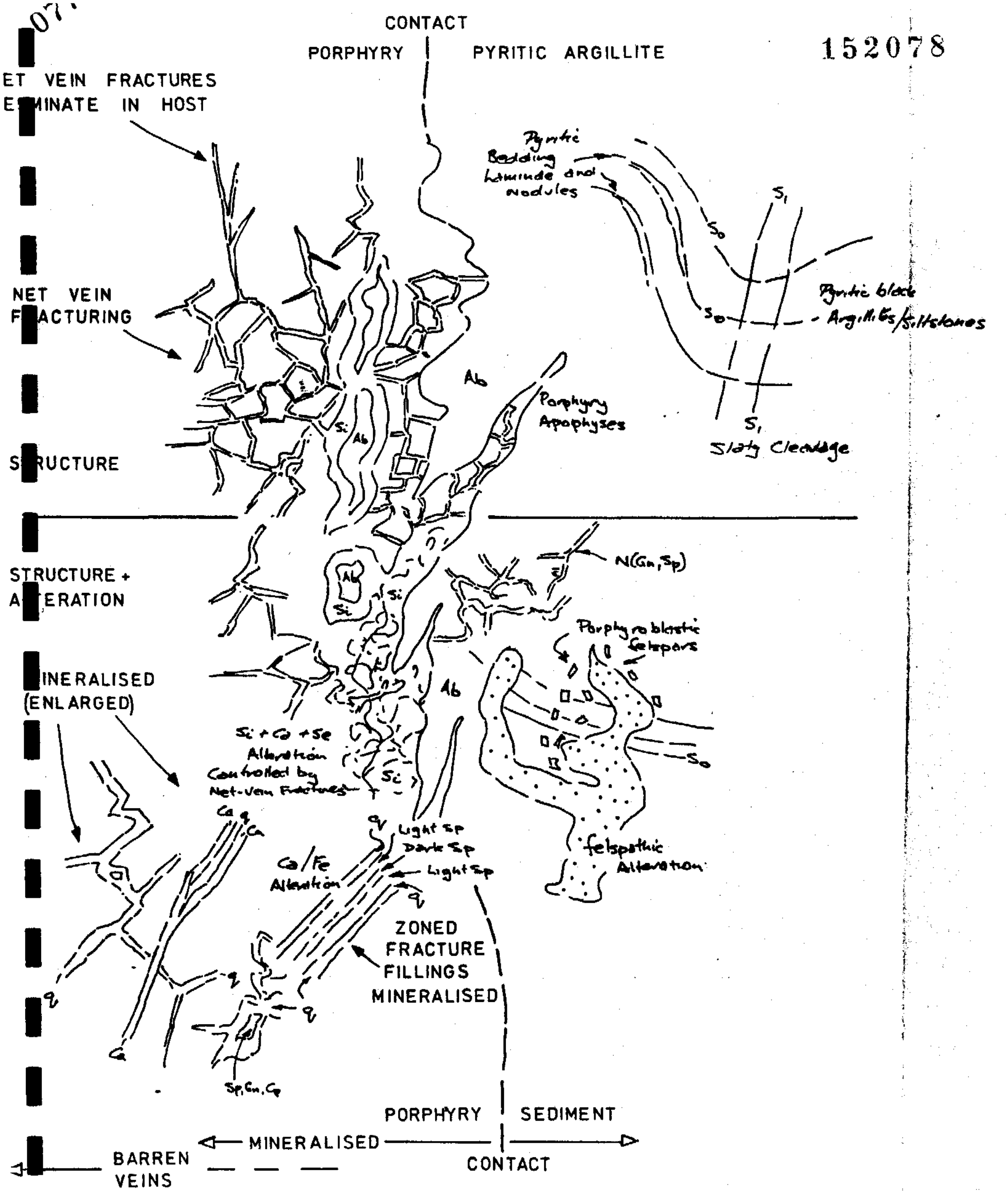


FIGURE 4:

RELATIONSHIPS AT SEDIMENT/PORPHYRY CONTACTS.

078

152079

LEGEND PINNACLES AREA Figure 5.

Rock Types

Vbp	porphyritic basic volcanic
Pdp	porphyritic dacite
Tf	Fine acid tuffs or volcanics
Tbl	laminated black argillite
Tba	interbedded volcanics and argillite
C	chert
	quartz-eye rock
Se	sericite schist or fault gouge

geological contact

geochemical anomaly

road or trench

drillhole with mineralisation, number indicates interval on Table 3

Composite Porphyry Body

sericite schist with chert nodules

pseudoagglomerate

quartz porphyry

Structure

70 bedding S_0

60 cleavage S_1

15 F_1 *fold plunge*

SYN / AN vergence sense of bedding/cleavage intersection

inferred anticline

inferred syncline

CP7 Drillhole Comstaff Program

PP31 Drillhole E.Z. Program

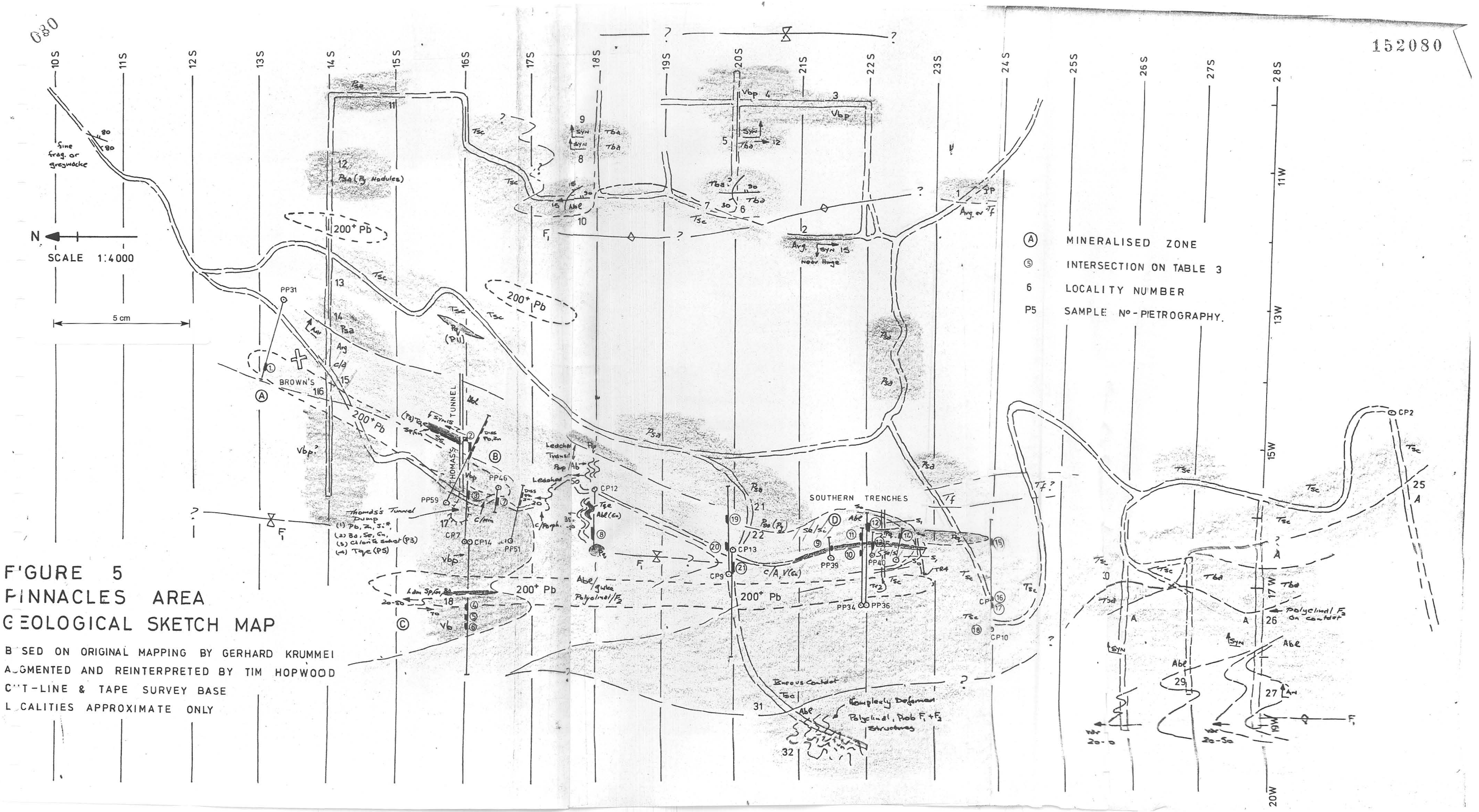


FIGURE 5
PINNACLES AREA
GEOLOGICAL SKETCH MAP

BASED ON ORIGINAL MAPPING BY GERHARD KRUMMEI
AUGMENTED AND REINTERPRETED BY TIM HOPWOOD
CUT-LINE & TAPE SURVEY BASE
LOCALITIES APPROXIMATE ONLY

TABLE 3 Pinnacles Prospect Assay Values of Drillhole Intersections.

*	Interval m.	Zn %	Pb %	Cu %	Ag g/T
1	6.5	3.3		0.9	
2	1	1.8	0.17	Tr	
3	3	1.0	0.34	0.1	
4	4	1.41	0.03	0.01	
5	11	1.27	0.22	0.01	
6	5	1.12	0.06	0.01	
7	4.4	7.1	1.9	0.74	31
8	20.7	1.32	0.1	Tr	1
9	1.8	2.4	-	0.2	19
10	2.6	2.35		0.2	6.2
11	6.5	6.9	2.9	0.67	15.6
12	8.1	3.2	0.3	0.3	3.1
13	5.9	8.0	3.7	0.7	34.1
14	4.7	3.6	1.2	0.3	18.7
15	2	1.4	.25	0.02	
16	1	1.4	.15	0.03	
17	1	1.1	.04	0.02	
18	2.7	3.17	1.12		12
19	4	2.01	1.09	0.01	
20	8	2.99	.04	.08	
21	11.7	2.24	0.17	0.12	5

* Numbers indicate intersection on Figure 5.

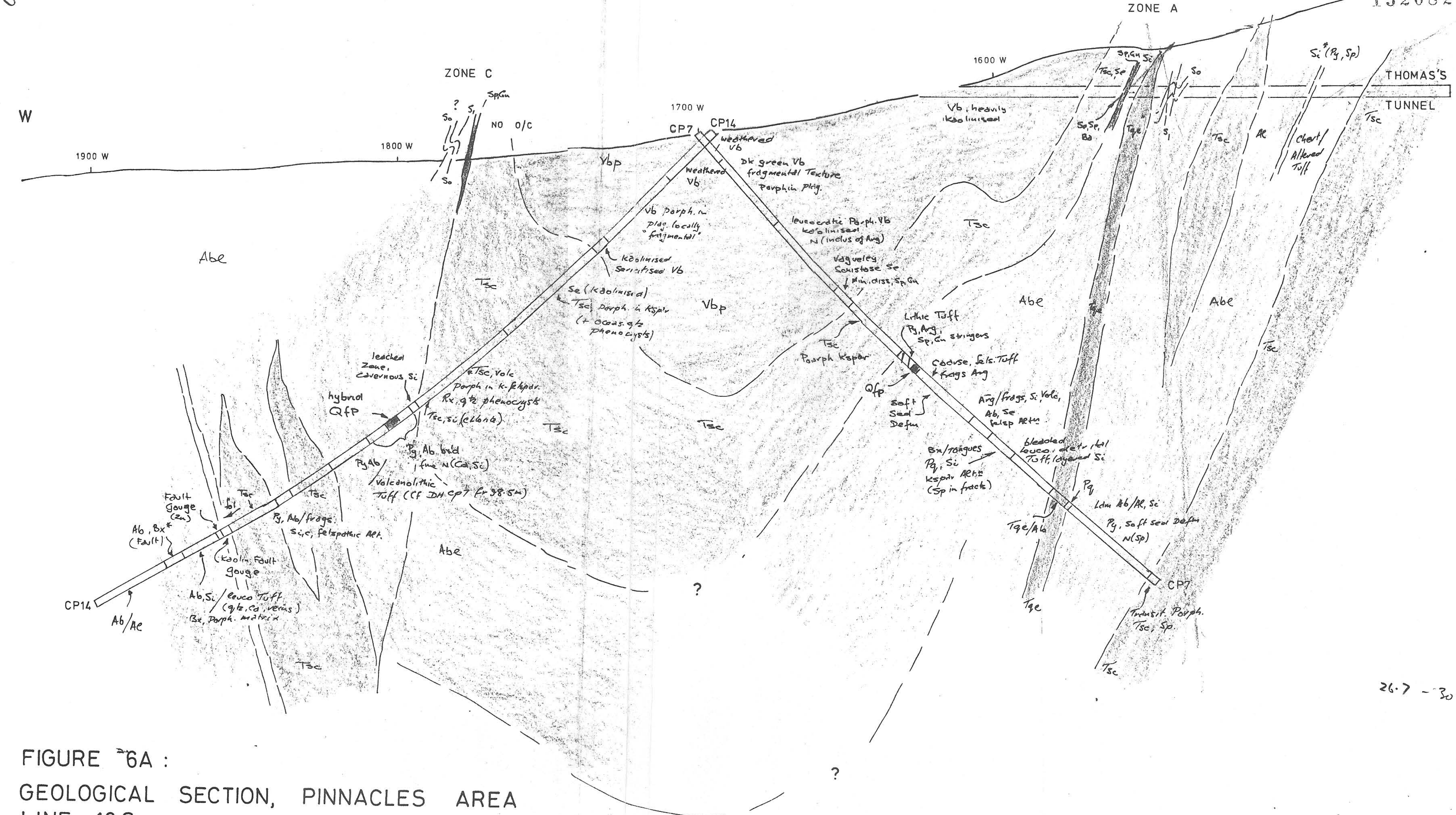


FIGURE 6A :

GEOLOGICAL SECTION, PINNACLES AREA
LINE 16 S

5 cm

SCALE 1:1000

082

152083

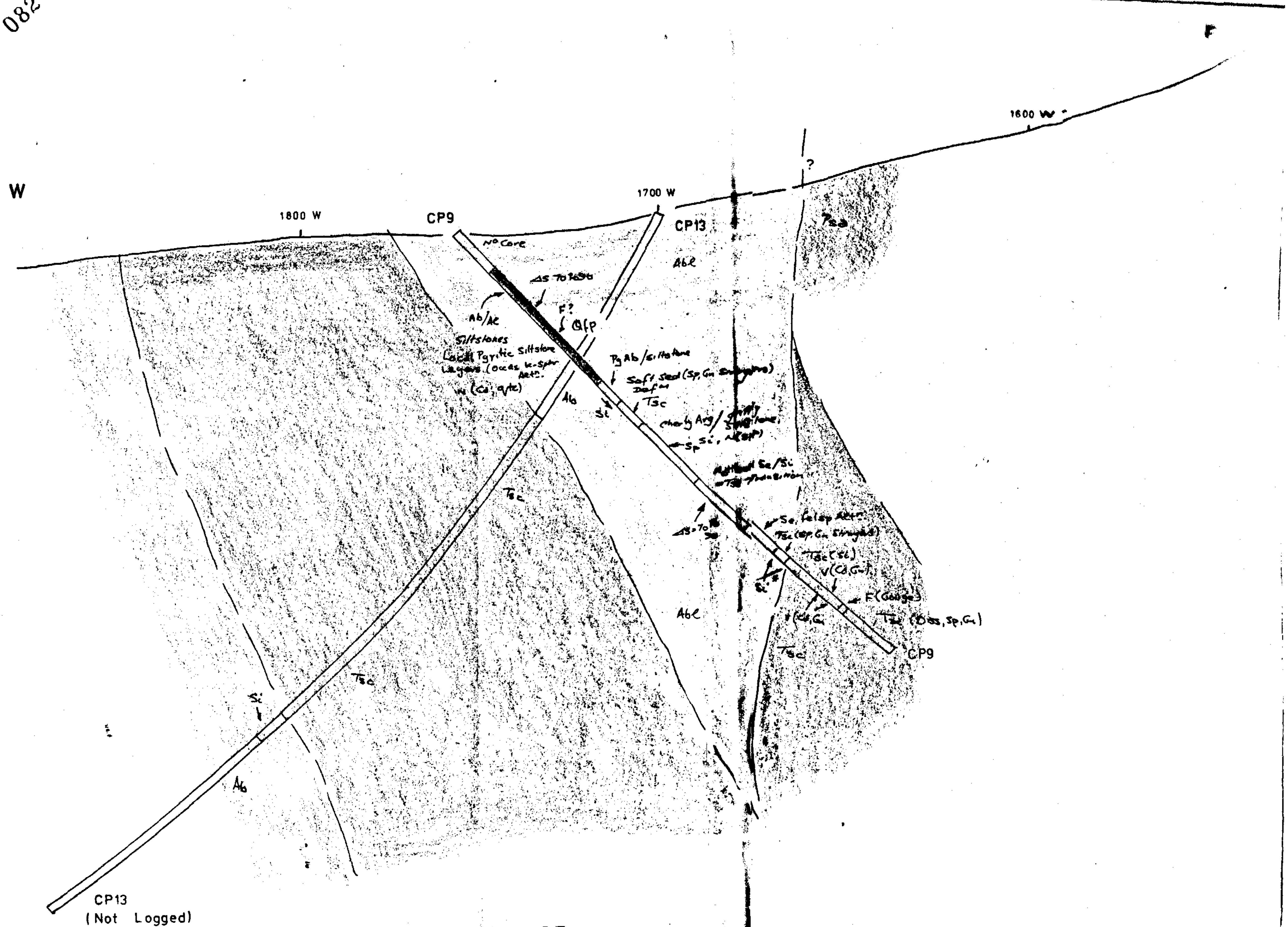
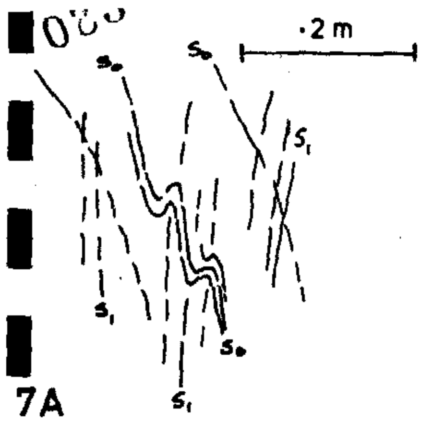


FIGURE 6B :
GEOLOGICAL SECTION, PINNACLES AREA
LINE 20S

5 cm

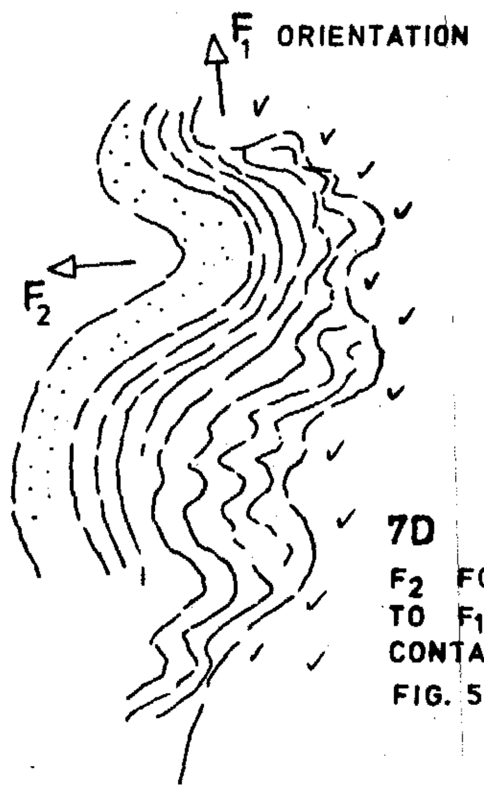
SCALE 1:1000



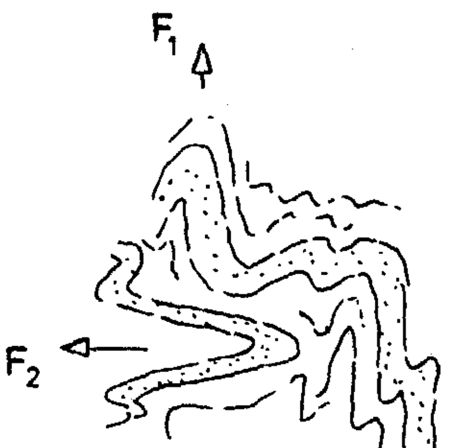
7A
8·0S, 10·7W FIG. 5
F_1 PARASITIC

7B
28S, 19·2W FIG. 5
F_1 PARASITIC

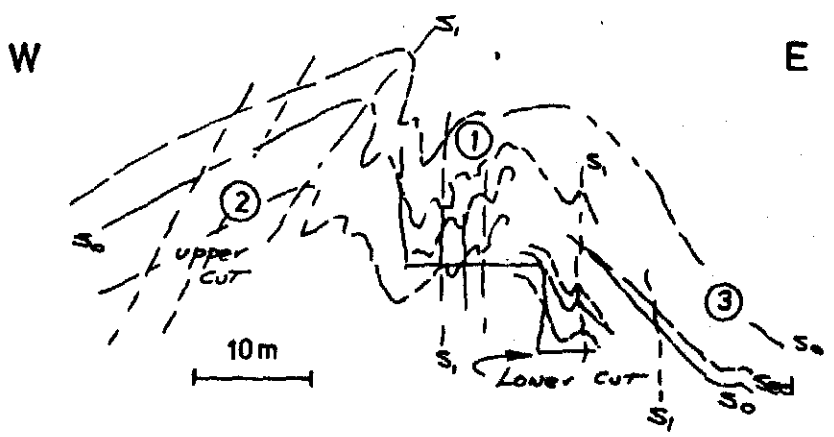
7C 28S, 17·3W FIG.5
F_1 IN Tba



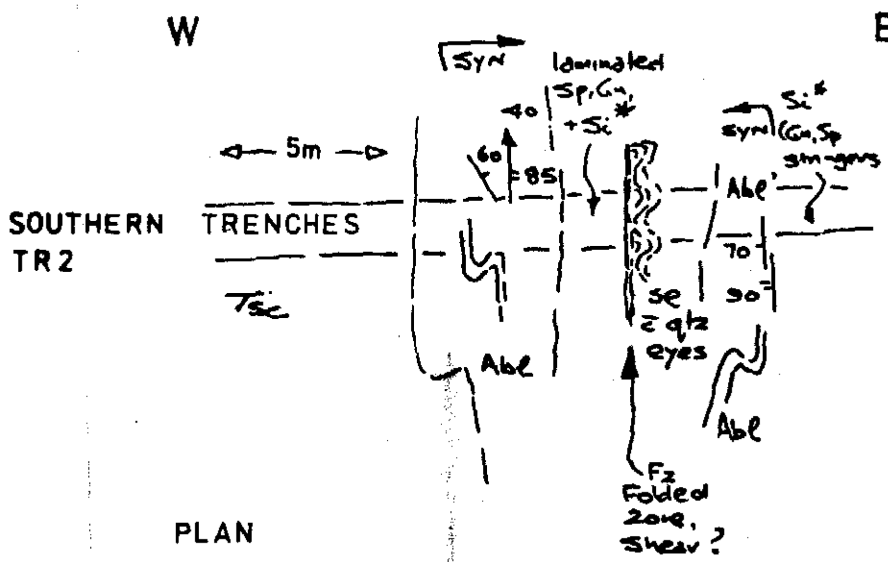
7D
F_2 FOLDS DIVERGENT TO F_1 ON Vb / Abl CONTACT 28S, 17·4W FIG. 5



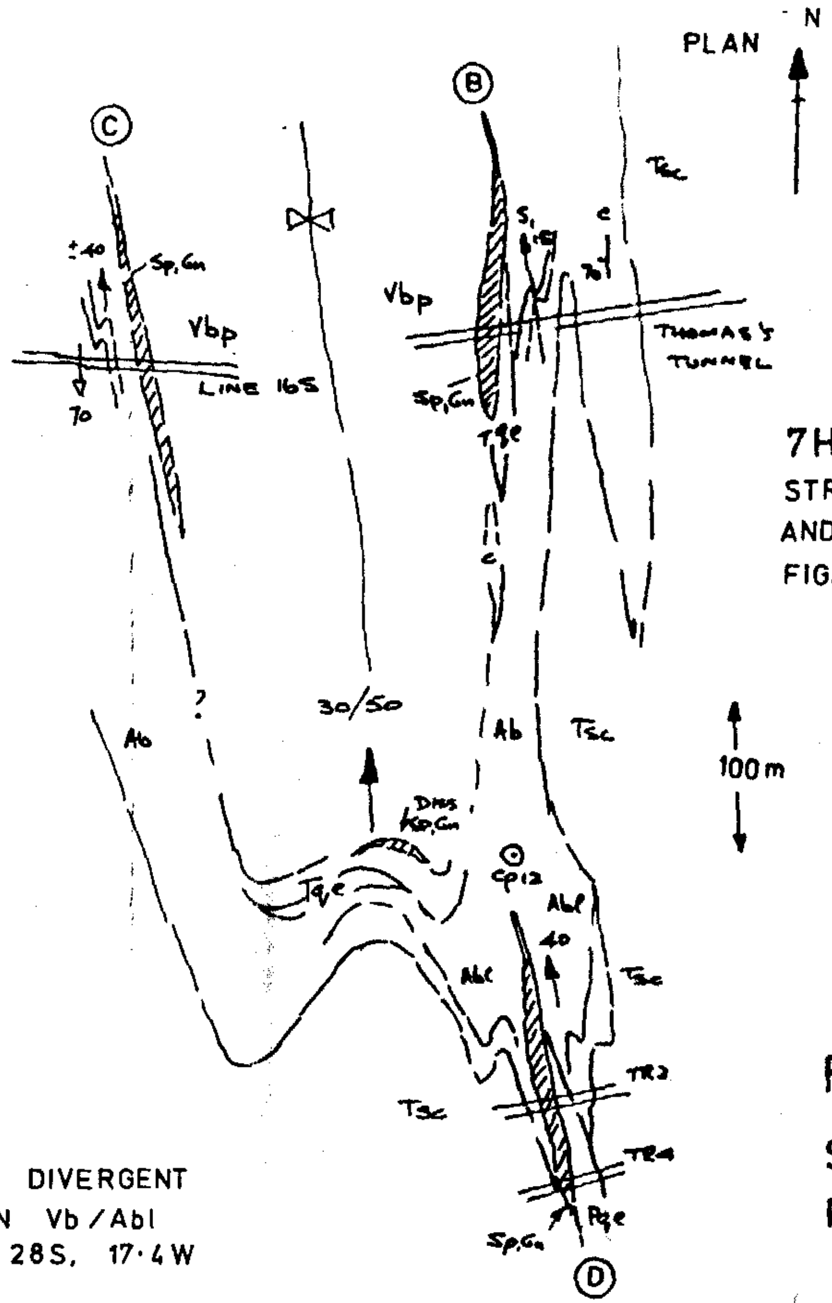
7E
F_2 F_1 DIVERGENCE
26S, 18·5W FIG. 5



7F F_1 FOLDS IN PYRITIC UNITS, CROSS SECTION OF CHESTER MINE, SEE PLATES 67 AND 68



7G
SYNCLINAL F_1 HINGE IN CUT TR2 INFERRED FROM S_0/S_1 VERGENCE SENSE



7H
STRATIGRAPHY, MINERALISATION AND INFERRED F_1 SYNCLINE, FIG. 5

FIGURE 7 :
STRUCTURAL RELATIONSHIPS, PINNACLES AREA.

5 cm

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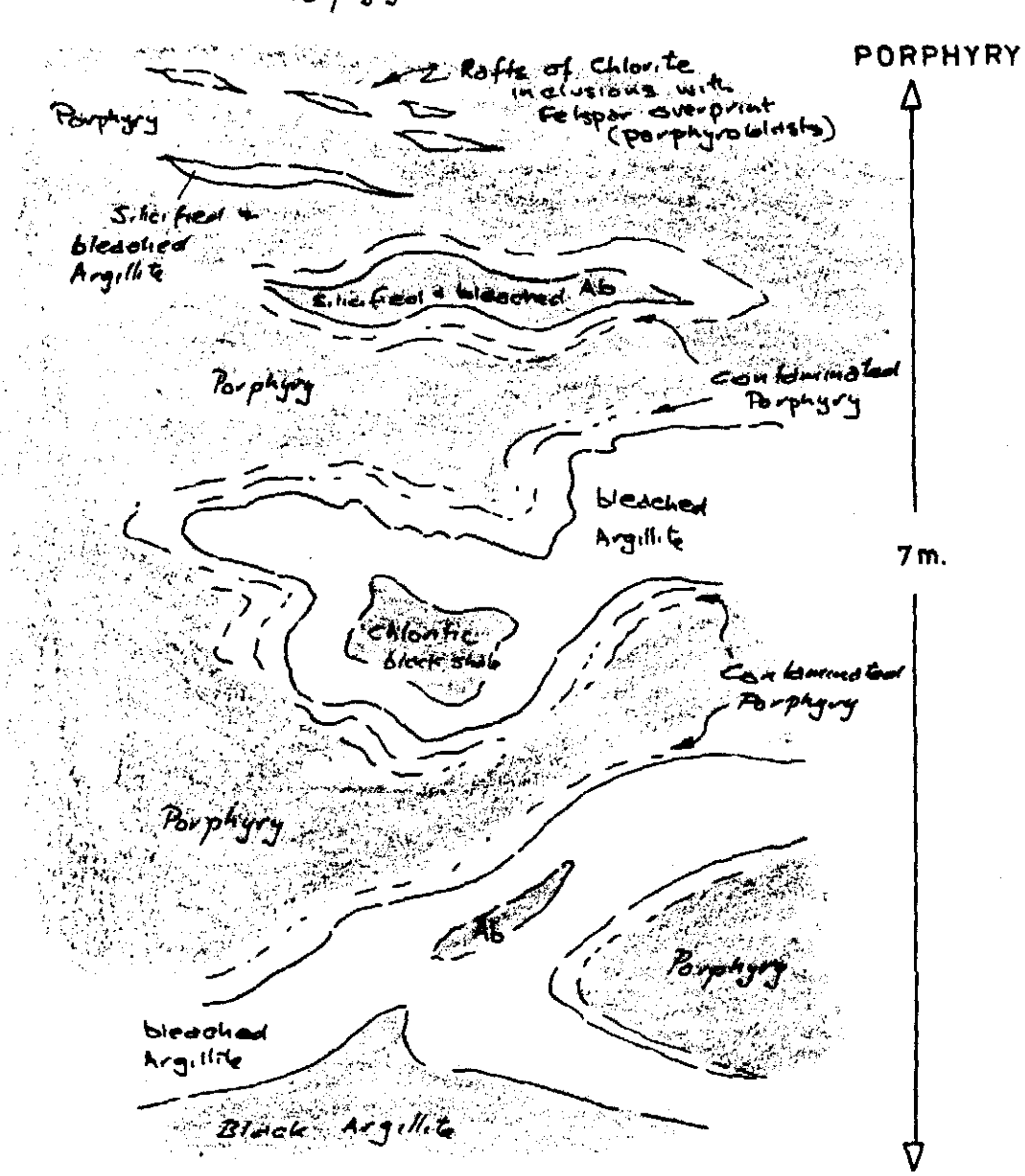
8A

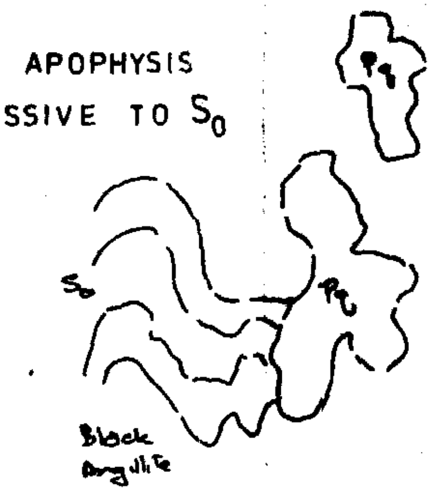
TRANSITIONAL CONTACT BETWEEN BLACK ARGILLITE AND PORPHYRY

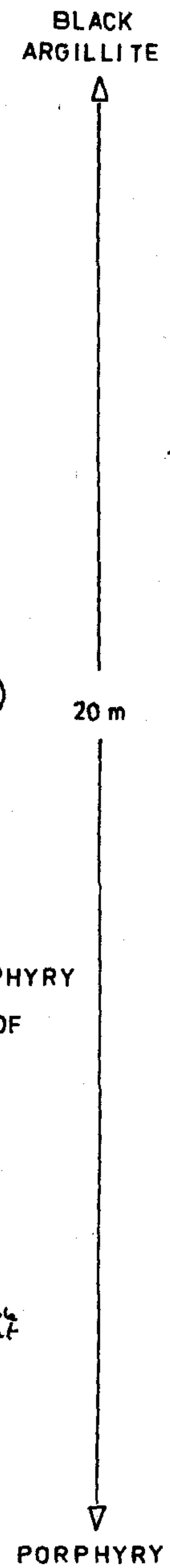


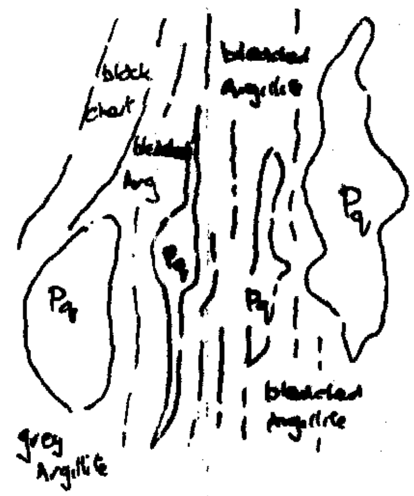
ILLUSTRATED IN PLATE 43

8C

PORPHYRY APOPHYSIS TRANSGRESSIVE TO S_0





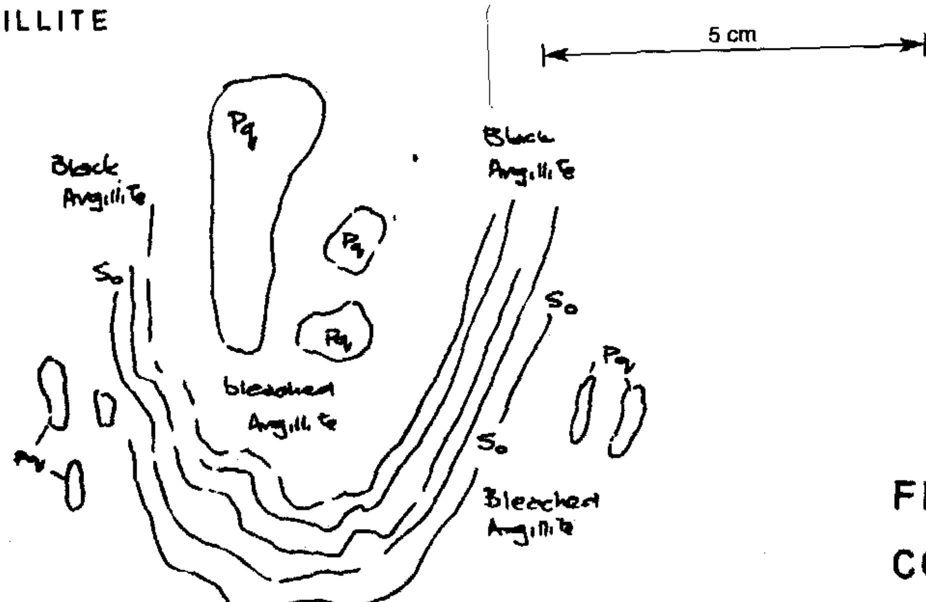


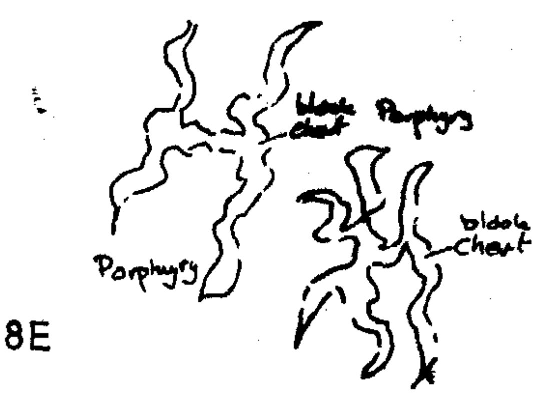
8D

INCREASE IN SIZE OF PORPHYRY APOPHYSES. BLEACHING OF ARGILLITE

8B

APOPHYSES OF PORPHYRY IN BLACK ARGILLITE





8E

COALESCENCE OF PORPHYRY, SILICIFIED BLACK ARGILLITE REMNANTS.

FIGURE 8 PINNACLES AREA. CONTACT RELATIONSHIPS BETWEEN

085

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Plate 1

Plate 1: This shows finely laminated black argillite and grey siltstone, which are considered to be host rocks for the quartz-felspar porphyry intrusive body at Sock Creek. The siltstone layers often contain extremely fine, disseminated pyrite (5-10%). A cleavage (S_1) is developed in the argillites, which is often transgressive to bedding (S_o) at a high angle, suggesting the proximity of a major fold hinge. In this example the bedding has been displaced on the cleavage by microfaulting, possibly related to the major fault zone passing north-south centrally through the prospect.

Locality: SK2/27.3 m and 27.6 m.

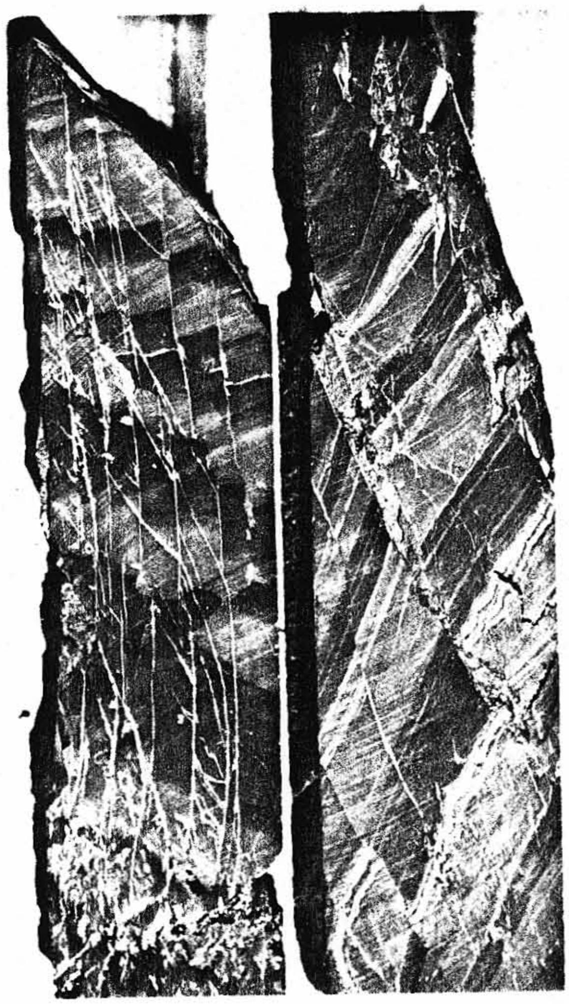

Plate 2

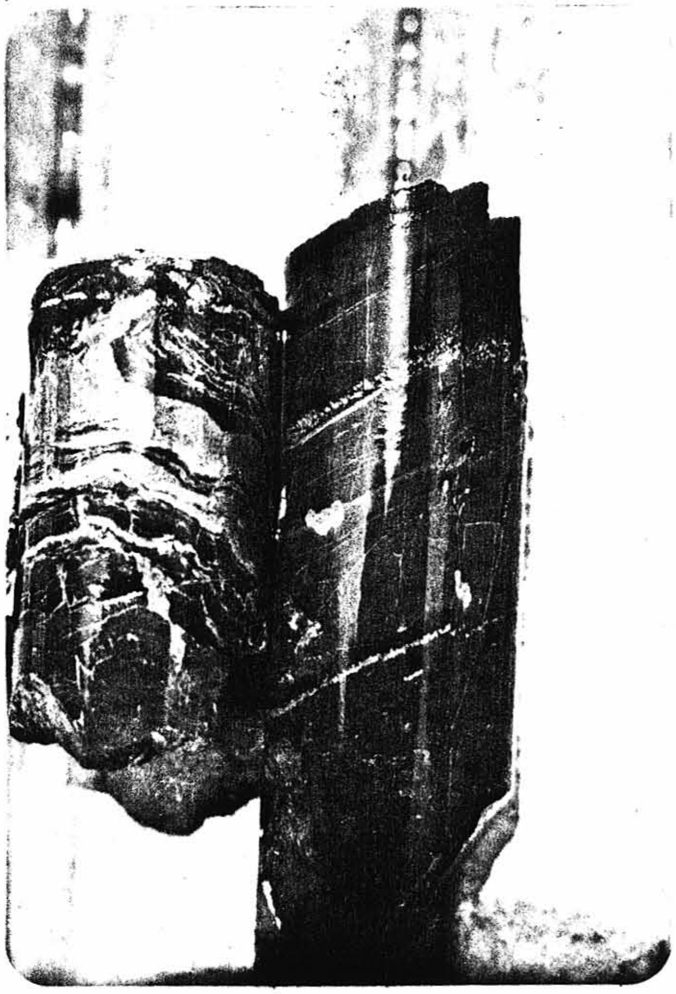

Plate 2: The drill core on the left (SK4/46.6 m) illustrates soft-sediment deformation structures (broadly referred to as "slumping"). The coarser grained more sandy or silty layers appear to have been unconsolidated during deformation, as indicated by "pull-apart" structures in argillitic layers, and infilling by liquified sandy material. Also see contrasted properties of argillitic and sandy material illustrated in Plates 29 and 30 from the Pinnacles prospect. The core on the right (SK4/43 m) shows laminated black argillite/siltstone containing pyrite nodules, and thin bedding-conformable laminae of recrystallised pyrite.

Plate 3

Plate 3: The core on the left (SK1/160 m) is relatively unaltered quartz-felspar porphyry. The matrix is dark grey and finely quartzofelspathic, containing numerous subhedra of felspar and round quartz phenocrysts. The core on the right (SK11/56.2 m) illustrates chloritisation of the felspars. The matrix has been bleached by silicification and/or dense fine carbonate alteration (note multiple carbonate-quartz stringer veinlets). This process leaves round remnant quartz phenocrysts with diffuse margins. Original felspars appear to have been replaced by chlorite (suggesting iron rich acid groundwaters). This replacement is suggested by the lath-shaped chlorite pseudomorphs after felspar and the observation of partial marginal chloritisation felspars from other samples.

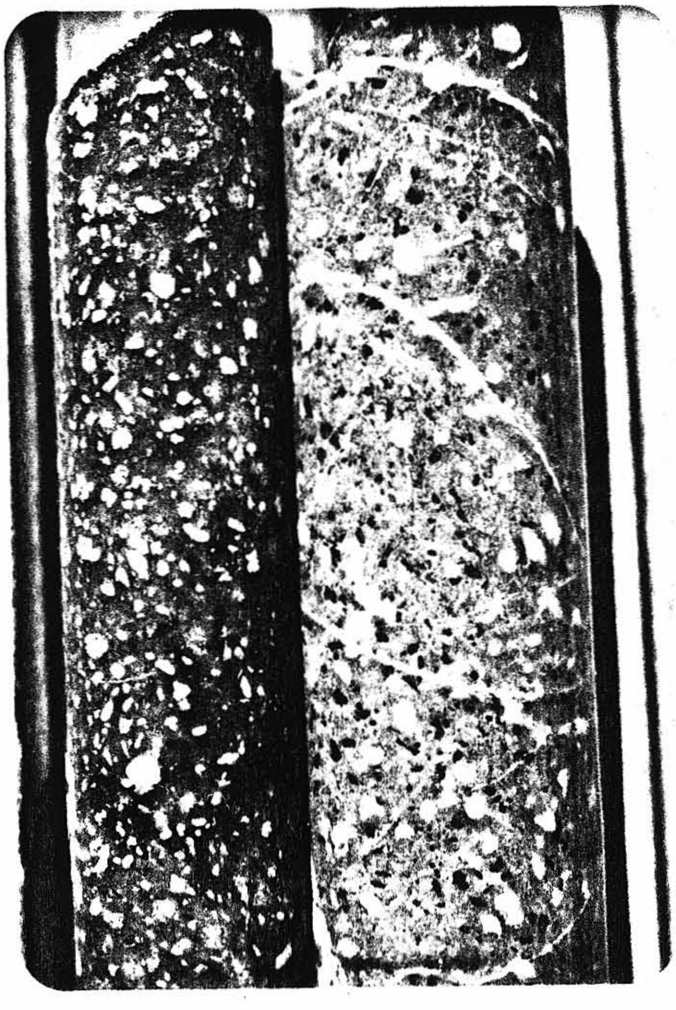

Plate 4

Plate 4: The core on the left (SK1/171.2 m) is "unaltered" quartz-felspar porphyry with a dark green-grey matrix. The core on the right (SK1/164.4 m) shows bleaching of the matrix caused by carbonate alteration; the patch of alteration is associated with a veinlet of quartz carbonate (iron oxide). Patchy remnants of unaltered (greenish) groundmass can be seen; the quartz-felspar porphyry texture can be traced from the unaltered to altered matrices.

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Plate 5

Plate 5: This plate illustrates the heavily altered matrix of quartz and quartz-felspar porphyries. The matrix in the core on the left is subject to dense fine silicification $\pm$ carbonate (iron oxide flecks may be sideritic replacements of felspars). The core on the right has been altered by silica-carbonate, with some iron oxide alteration (associated with siderite ?). In comparing the two samples there is an apparent loss of felspar. Ghosted remnants can be seen in core.

Locality: Core is from SK1/46.8 m.

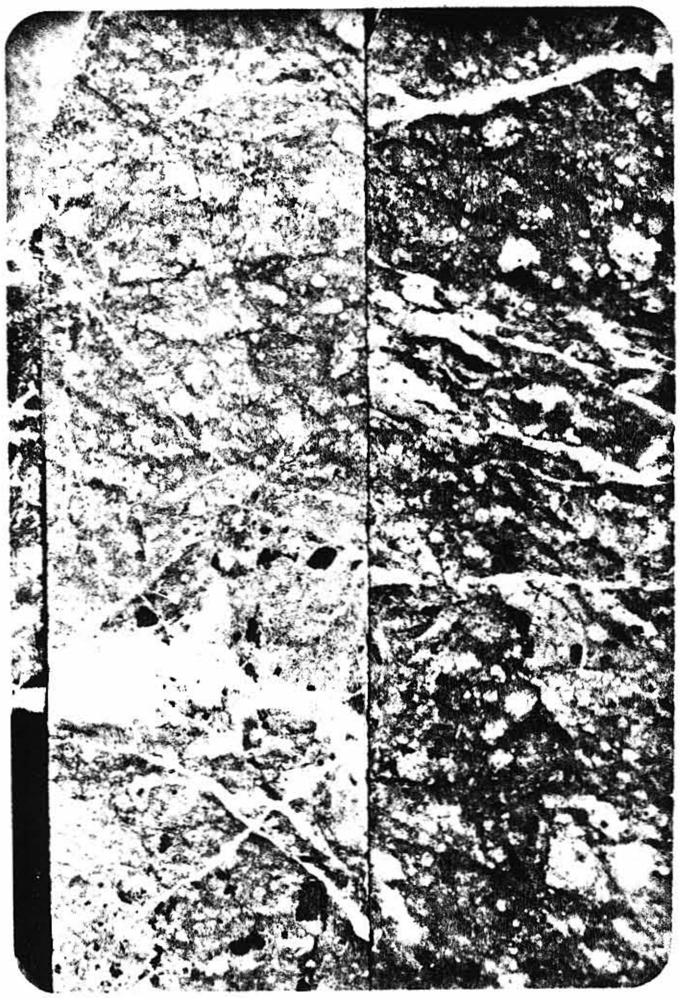

Plate 6

Plate 6: This plate illustrates the contrast in the effects of carbonate-iron oxide alteration compared with silica-sericite alteration of the groundmass of the quartz-felspar porphyry. The core on the left (SK2/116.9 m) shows the red-coloured dense fine carbonate-iron oxide (sideritic ?) alteration of the porphyry matrix. Note the remnant pink felspars and round quartz phenocrysts within the altered matrix. The central core (SK2/119.2 m) shows yellow-green sericite-silica alteration. Note the yellow-green alteration of felspars which may indicate epidote. Chlorite alteration flecks occur both in this core and the core on the right. The matrix alteration of the core on the right (SK2/127 m) is more siliceous. Note the remnant round quartz phenocrysts in both the central and right hand core; and the loss of felspar phenocrysts from the right hand core. Note also the siliceous veinlet in the centre of the core on the right, containing a core of mineralisation (sphalerite).

091

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Plate 7

Plate 7: This plate illustrates carbonate veinlets and carbonate alteration of the matrix of the quartz-porphyry. The core on the left shows a white quartz veinlet at the top, and a yellowish carbonate split vein at the centre. The associated matrix alteration is patchy reddish carbonate-iron oxide, leaving remnant round quartz-phenocrysts. The central core contains a zoned vein with a carbonate rim, and a silica core zone. The core on the right contains irregular veinlets, with silica rims and mineralisation in the core zone. There is patchy silica and carbonate alteration of the matrix of the two pieces of core on the right.

Locality: SK1/64.9, 66.0, 72.8 m.

Plate 8

Plate 8: This plate illustrates net-vein fracturing in quartz-porphyry. The matrix is carbonate (iron-oxide) altered quartz porphyry, with ghosted remnant felspars. The irregular angular array of fractures, interconnecting as shown, with variable angles of fracture-conjunction and with fractures terminating within host porphyry are characteristic of net-vein fracturing. The fracture filling is quartz (white), with some zoned veins comprising sphalerite cores and quartz margins.

Locality: Core from SK1/52.6, 53.9 and 56.8 m.

Plate 9

Plate 9: This plate shows control of alteration by net-vein fracturing. The irregular array of quartz filled fractures is net-vein fracturing developed within a quartz porphyry host rock. There is variable alteration of the host porphyry with boundaries between different types of alteration, marked by individual net-vein fractures. For example in the upper central core there is a boundary between silicification and carbonate alteration bound by a net-vein fracture boundary. Note the remnant round quartz phenocrysts, and loss of felspars. Some of the net-vein fractures contain small discontinuous inner zones of dark sphalerite.

Locality: Core from SK1/61.2, 61.8 and 62.4 m.

Plate 10

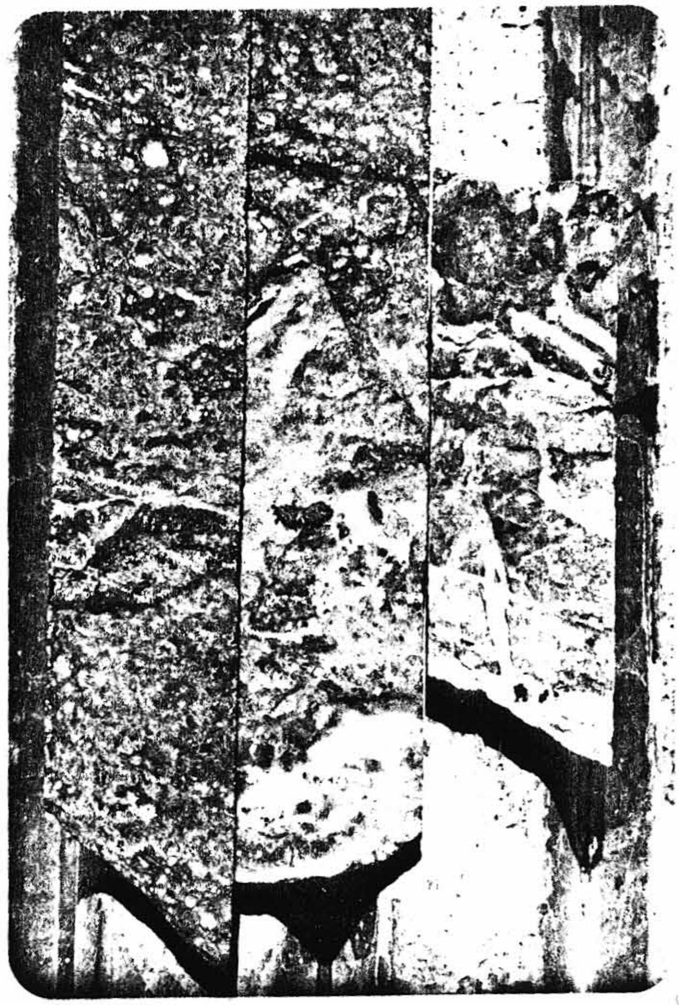

Plate 10: This plate illustrates the control of net-vein fracturing on the distribution of alteration and the development of a pseudo-breccia. The core on the right (SK1/62.8 m) shows control of areas of siliceous and carbonate alteration by net-vein fracturing. The two pieces of core on the left (SK1/66.7 m) show the development of areas of dense silicification controlled by net vein fracturing leaving remnant angular "fragments" of iron-oxide altered quartz porphyry. A veinlet of zoned mineralisation occurs, with a core zone of light-coloured yellow sphalerite and a marginal zone of dark sphalerite.

Plate 11

Plate 11: This plate illustrates an extension of the process of net-vein fracturing and control of areas of alteration by net-vein fracturing resulting in a pseudo-breccia. The grey areas are areas of dense net-vein fracturing and heavy silicification. The areas of iron-oxide stained porphyry are angular remnants between the zones of net-vein fracturing. These have the appearance of "fragments" within a siliceous matrix.

Locality: Core from SK1/117.3, 119.5, 121.6, 128.2 m.

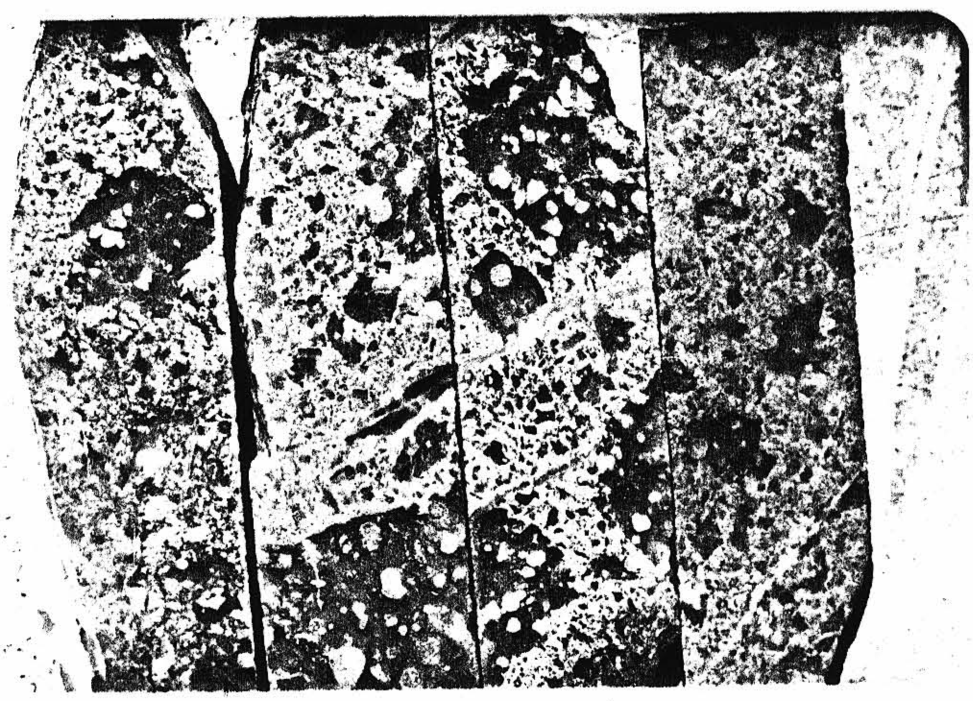

Plate 12

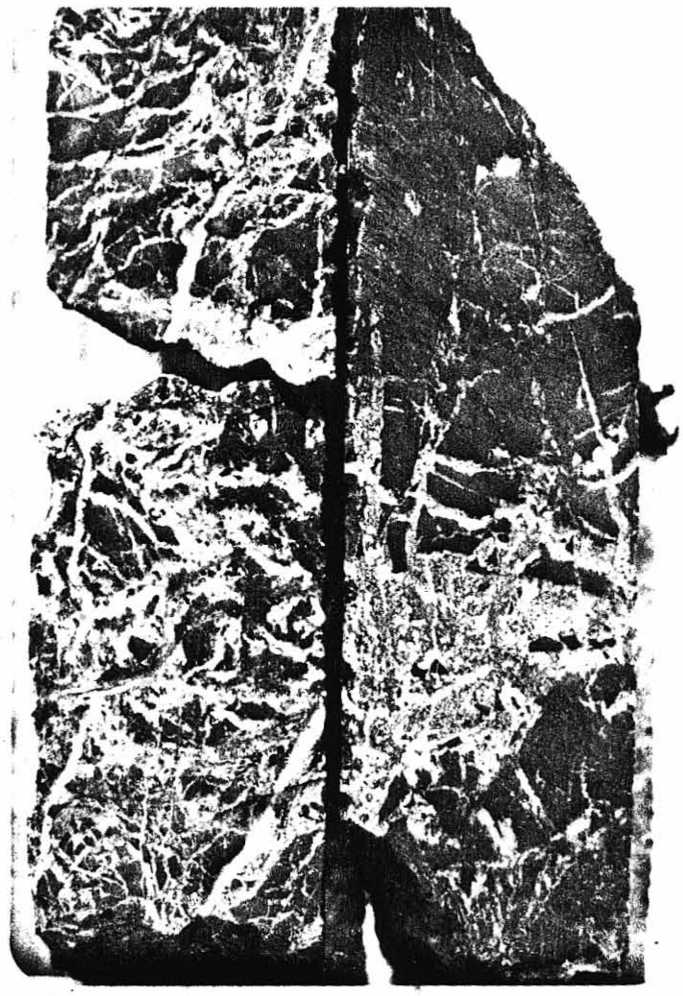

Plate 12: This plate illustrates net-vein fracturing in black argillite, forming dense irregular fracture arrays. Note the termination of fractures within the margin of the host-rock of the fracture chamber of the core on the right. The fracture filling is quartz and carbonate. This interval in drillhole SK4/73.9 and 76 m is probably the barren southern structural extension of the net-vein fractured zone which contains the mineralisation of drillhole SK3. Compare drill section 760N (Figure 3A) and section 850N (Figure 3B).

Plate 13

Plate 13: This plate illustrates contrasted effects of three processes operating on the argillites at the contacts of the quartz-felspar porphyry bodies. The central core (SK2/58.8 m) illustrates dense fine net-vein fracturing containing quartz, galena (metal-grey) and sphalerite (brown, at lower end of core). Note the tendency for net-vein fractures to follow earlier tectonic fractures (microfaulting, upper end of core). The core on the left (SK2/56.2 m) shows carbonate stringer veins, with a local tendency towards a net-vein fracturing style, following earlier S_1 cleavage or microfaults parallel to S_1 (cf. Plate 1). In the core on the right (SK2/61.3 m) the yellow, coarsely quartzofelspathic material is "felspathic" alteration or hybrid quartz-felspar porphyry illustrated in detail in Plate 16. This material is partly controlled by the microfault running vertically within the core. This microfault also displaces a small zone of segregation of sphalerite, rimmed by quartz.

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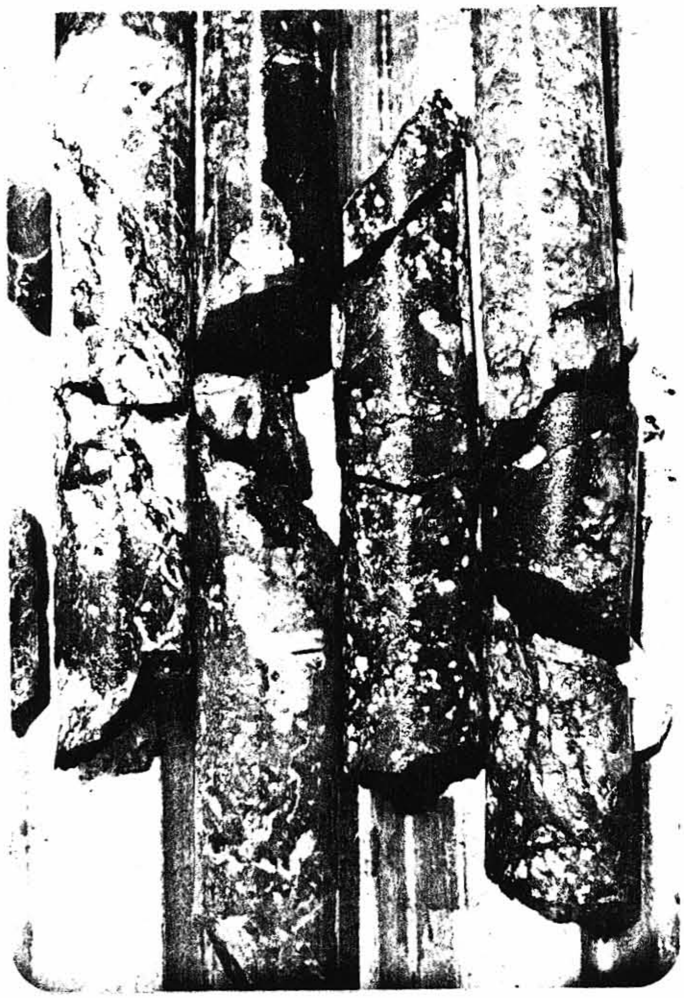
Plate 14



<u>Plate 14</u>: This plate illustrates the effects of the inclusion of fragments of wet sediment on the porphyry. Short (5-10 cm) intervals of sediment occur within the porphyry. These black argillite intervals have highly irregular contacts with the porphyry, and there is notable silicification of the porphyry on argillite contacts. The two pieces of core on the left (SK4/59.5, 67.5 m), illustrate this silicification; note the white silica on the contact contrasted with the greenish colour of the more "normal" porphyry. Note the irregular shapes of black argillite inclusions and the net vein fracturing developed on porphyry contacts with the argillite, (core on the left). The core on the right (SK4/124.9 m) shows an irregular (net veined) sediment contact, with a wide zone of silicification.

Plate 15

Plate 15: This plate illustrates silicification on contacts of the porphyry with sediment. The original porphyry appears to have been converted into a dense cherty siliceous material, in which the original quartz and felspar phenocrystal texture of the porphyry is recognisable (in core). There has been extensive net vein fracturing of the silicified porphyry at the contacts with infilling of the net-vein system by black argillitic soft sediment. The intense silicification dies off away from the contact. The sediment in the core on the right is a layer or lens within the porphyry body.

Locality: Drillhole SK11/62.5 m.

Plate 16

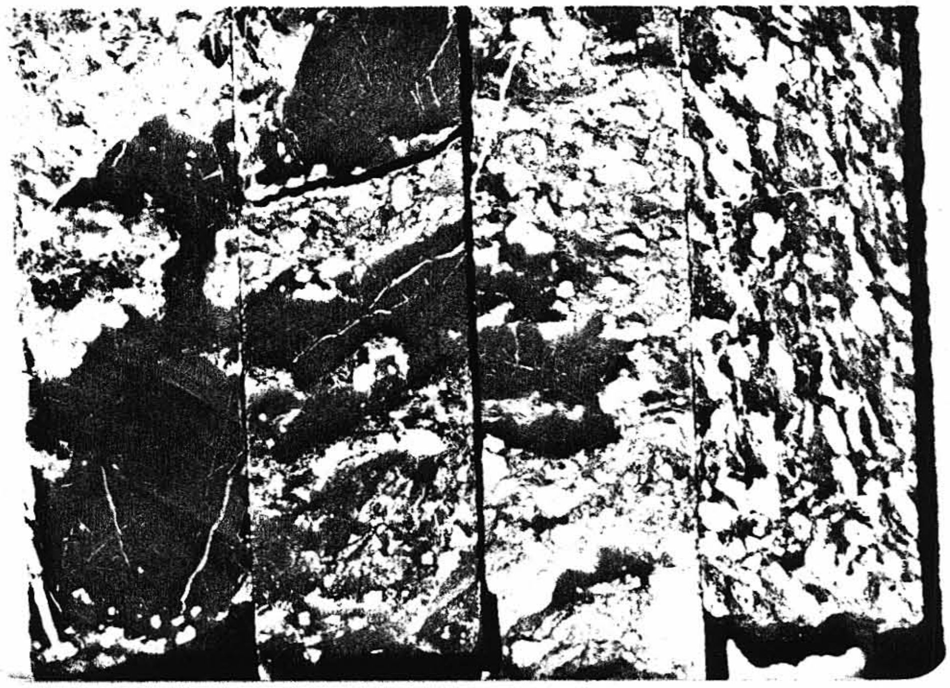


Plate 16: This plate illustrates the "felspathic" alteration, characteristically developed on contact zones of the porphyry with the sediment. The "felspathic" alteration consists of dense packed coarse felspar and round quartz. The core on the left shows the yellow quartz-felspar of the "felspathic" alteration with an irregular contact transgressive to fine laminate bedding (dipping $\sim 30^{o}$ to the right) in the black argillite. The two central pieces of core and the lower end of the core on the left illustrate isolated porphyryblastic grains of quartz and felspar within black argillite. The core on the right illustrates the development of a foliated phase of the felspathic alteration, possibly associated with movements on the major north-south fault through the prospect (see Figures 2 and 3).

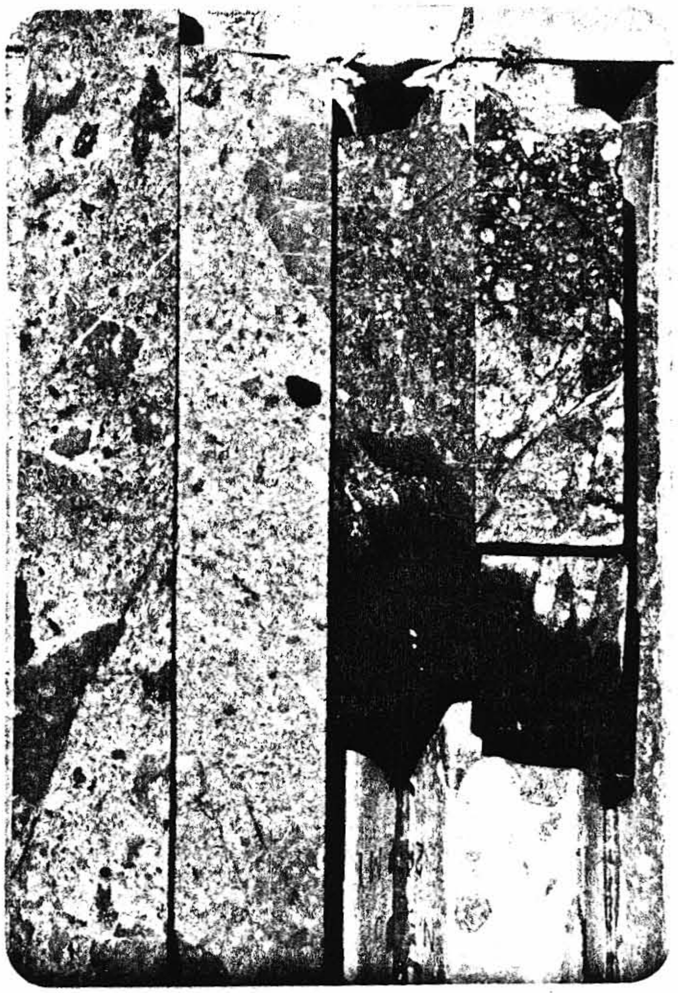
Locality: Samples from drillhole SK2/86.5, 88.2 and 88.8 m.

Plate 17

Plate 17: This plate shows the nature of the transitional contact zone of quartz porphyry with black argillite. The core on the right (SK10/245.7 m) is the contact phase of the quartz porphyry with a silica-carbonate altered matrix, containing remnant round quartz phenocrysts. The three pieces of core on the left show intermixed (wet?) sediment and porphyry phases, and felspathic alteration. Note local fine net vein fracturing, and quartz-filled stringer veins.

Locality: Samples from drillhole SK10/246.5, 247.4 and 248 m.

Plate 18



<u>Plate 18</u>: This plate illustrates contact effects of porphyry and sediment. The two pieces of core on the left (SK2/81.3, 82.1 m), show the development of a pseudo-breccia similar to that of Plate 11, by silicification along dense net-vein fracturing, leaving porphyry remnants. The porphyry texture can be recognised in both the silicified "matrix" and porphyry remnants, comprising the "fragments." The central-left core also contains a black shale inclusion. The two cores on the right (SK2/83, 85 m) illustrate transitional contact phases of the porphyry with black argillite. Note the development of the dark-matrix of the porphyry phase (contaminated ?) on the contacts, and the irregular nature of the contacts with the sediment. Refer to agglomerate vs. contact phase discussion, text Section 2.55.

Plate 19

Plate 19: This plate compares "felspathic" alteration (two pieces of core on the right, SK10/73.5, 82.2 m), with the dark-matrix contact phase of the porphyry (two pieces of core on the left SK10/84 m). The dark matrix contact phase (left) is similar to that of Plate 18. The felspathic alteration (right) is the same as that illustrated in Plate 16. Note the apparent layering of the dark phase, transgressing the core on the right, resembling bedding of a tuffaceous sequence (refer to discussion, text Section 2.55).

Plate 20

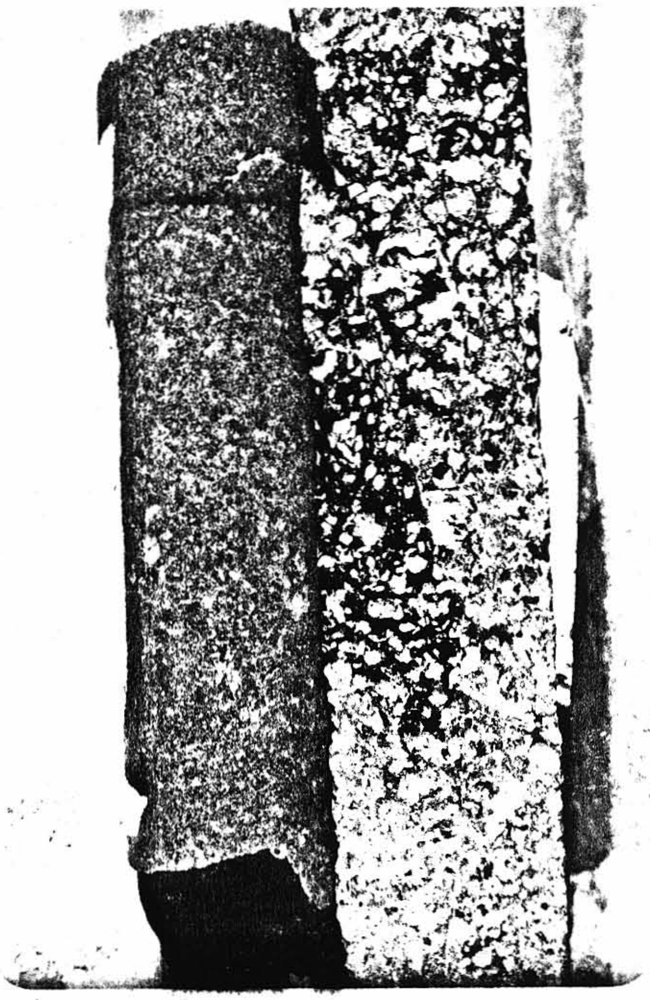


Plate 20: The core on the left (SK5/55.7 m) is dark grey-green tuffaceous detrital (volcanolithic tuff) rock type. This unit characterises the stratigraphy of the eastern drillholes. This comprises intervals of drillholes SK6/47 m and SK1/19.4 m, and is considered part of a normal volcanic sequence. This sequence is contrasted with the argillitic sequence on the western side of the prospect and intruded by the porphyry. This plate illustrates the contrast of this fine grained green tuff, with a coarser grained rock type (core on the right, SK5/83.7 m) which may be coarse tuff or alternatively may be contaminated dark matrix contact phase or porphyry intrusive.

Plate 21

Plate 21: This plate, from left to right shows the fall-off in mineralisation from the porphyry contact, with depth into the porphyry. This plate together with 13, 16, 18 (21) and 22, in sequence illustrate a section through the sediment-porphyry contact. The mineralisation on the left (SK2/89.7 m) is zoned light to dark sphalerite, sited in dense net-vein fractures, which contain relatively little quartz gangue. The porphyry alteration is carbonate-iron oxide. The central core is zoned sphalerite-galena, with siliceous gangue on the margins of the mineralisation. The core on the right (SK2/103.6 m) is densely net-vein fractured, but the fracture fillings are predominantly quartz, with substantially less mineralisation (dark sphalerite and galena).

Plate 22

Plate 22: This plate shows the margins of the structurally controlled zone of mineralisation, within the porphyry. At the margins, the zone of mineralisation passes off into net-vein fracturing containing barren vein quartz, with occasional local carbonate strings. In the core on the right the quartz filled net-vein fracturing is so dense that a pseudo-breccia is developed, with "fragments" of remnant porphyry, in a vein quartz matrix.

Locality: Core from SK2/99.7 and 102.1 m.

Plate 23

Plate 23: This plate illustrates zoned veins of mineralisation. The core on the left shows a veinlet passing from yellow (iron-poor) sphalerite through dark (iron-rich) sphalerite, to quartz on the vein margins. The alteration is carbonate-iron oxide. The mineralisation on the right is sited in a complex net-vein fracture system, and is zoned from yellow sphalerite cores to dark sphalerite rims. Surrounding the mineralisation is dense silicification.

Locality: Core from SK1/69.3, 76.6 and 89.2 m.

Plate 24

Plate 24: This shows three varieties of mineralisation. The core on the right shows mineralisation zoned from yellow to dark sphalerite. The central core is zoned from a core of yellow sphalerite, through dark sphalerite, through galena (steely grey) to quartz (carbonate). The core on the left is zoned from patchy chalcopyrite in the core, through dark sphalerite, to quartz. Chalcopyrite and galena appear to form in the outer marginal zones of the mineralisation.

Locality: Core from SK5/121.6 to 148.2 m.

Plate 25

Plate 25: This core from drillhole SK10 illustrates the net-vein fractured interval of porphyry below the zone of mineralisation in drillhole SK2. The relative positions of SK2 and SK10 are shown on the Section 900N, of Figure 4C. The net-vein fracturing continues to depth, but the fracture filling is predominantly barren vein quartz. The spot of mineralisation on the core on the left is zoned chalcopyrite-sphalerite. The mineralisation of the core second from the left is zoned yellow to dark sphalerite, with quartz-margins.

Locality: Core is from SK10/144, 146, 147.6 and 148.2 m.

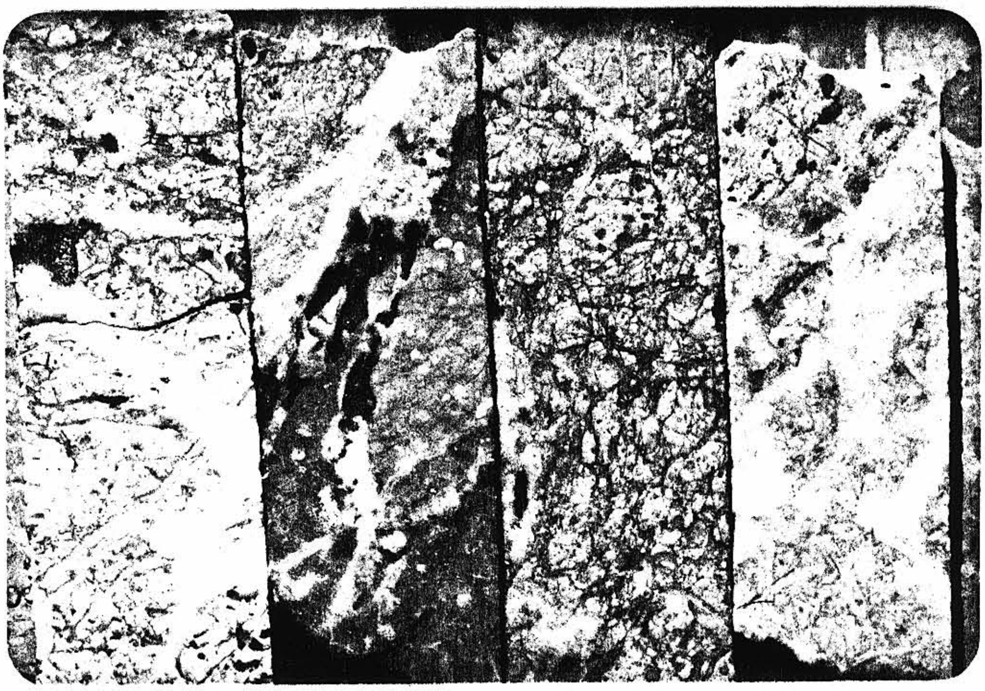


Plate 26

Plate 26: This plate illustrates a zoned vein of mineralisation (light to dark sphalerite to quartz), which has been transected by micro-faulting. The fault runs parallel to the core and displaces the vein dextrally. Note that the silica vein margin continues up the fault, even though the mineralisation is truncated.

Locality: From drillhole SK11/89.6 m.

Plate 27

Plate 27: This plate shows porphyritic basic volcanics in outcrop. This is the outcrop equivalent of drill core illustrated in Plate 28. This outcrop occupies the core of the syncline (Figure 7F) in the northwest corner of the map of Figure 5. This particular outcrop is adjacent to outcropping galena-sphalerite mineralisation (Plate 59), and the rock type is notably chloritic.

The locality (east of (18) in Figure 5) of this outcrop is approximately line 16.0S, 16.5W, west of the drill site of DDH CP7, CP14, and east of the mineralisation Zone C, of Plate 59. Outcrops of a similar rock type occur on the east side of the intrusive Tsc/Psa body, at localities (3) and (4) (1000W, 21060S, and 1000W, 20S costean respectively).

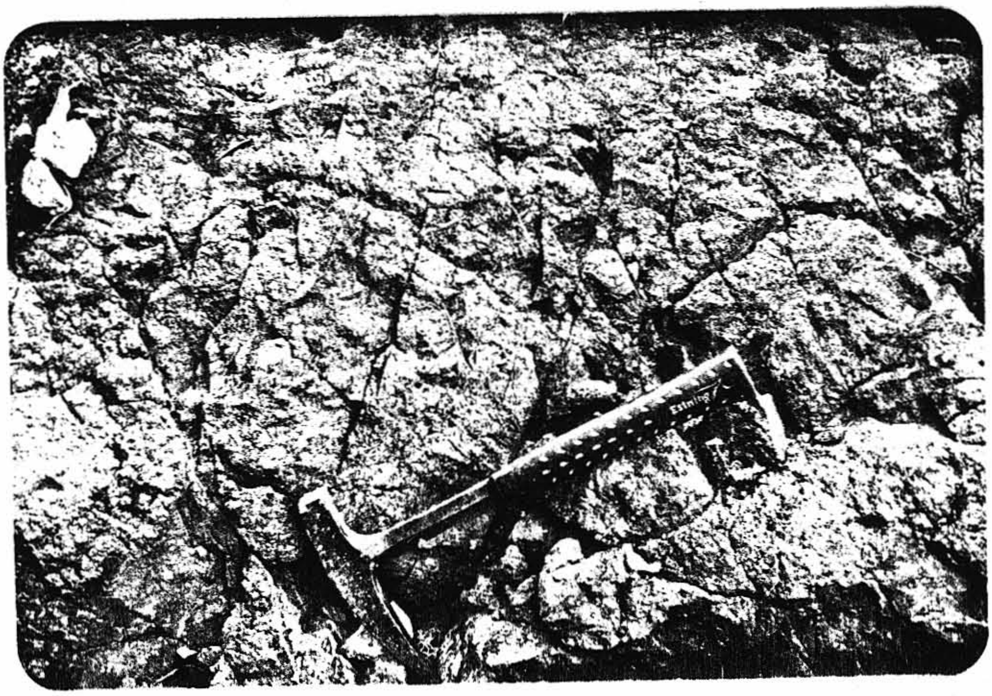


Plate 28

Plate 28: This plate illustrates Vbp in core from DDH CP7/18.7 m. This is the core equivalent of the rock type of Plate 27 in outcrop. The rock type appears to be fragmental. This may be genuinely so, or may be due to fracture alteration of the matrix leaving pseudo-breccia remnants (see discussion of a similar phenomenon, text Section 2.43).

Plate 29

Plate 29: This plate illustrates a leucocratic siltstone layer within black argillites (see Plates 51 and 57). The thin black argillite layers within the siltstone have been deformed by what appear to be soft-sediment or wet-sediment deformation structures, suggesting that these siltstone layers were wet at the time of deformation (also refer to discussion Section 2.1 and Plate 2 of the Sock Creek prospect). This outcrop is within the transitional contact zone of the porphyry body and sediments discussed in Section 3.6.

Locality: Line 18S, approximately 25 m east of CP12.

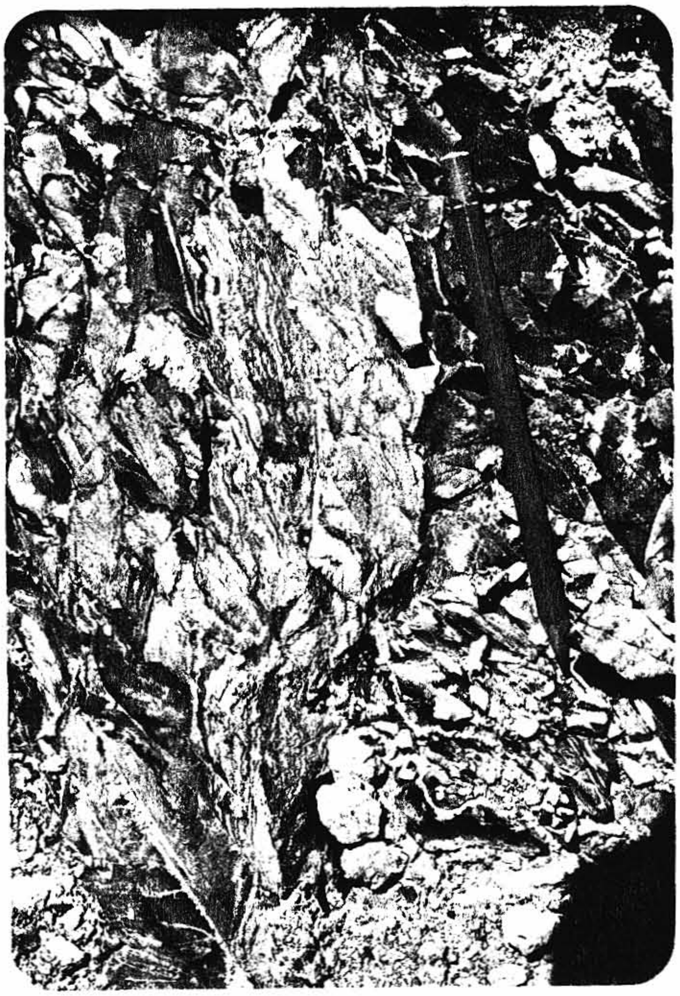


Plate 30

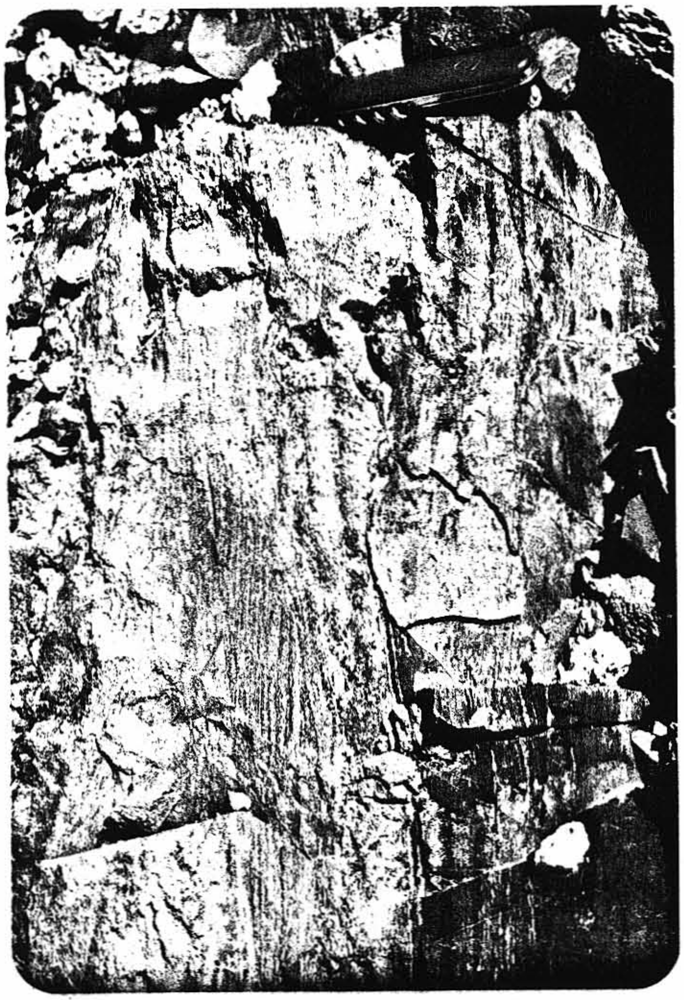


Plate 30: This is a contact between light coloured felspathic siltstone or "tuff", and black argillite. Immediately below the penknife there is an irregular embayment of the siltstone by the argillite indicating soft or wet-sediment conditions at the time of deformation.

Locality: 31 m west of CP12, Line 18S.

Plate 31

<u>Plate 31</u>: This plate illustrates bedded tuffaceous (?) siltstone (light coloured) and laminated black argillite. Small zones of microfaulting occur with displacements parallel to the pencil which indicates that some units have been consolidated (with brittle fracture properties) at the time of deformation. This is in contrast with the wet-sediment tectonic conditions suggested by Plates 29 and 30.

Locality: Line 18S, approximately 30 m east of CP12.

Plate 32

Plate 32: This plate illustrates the tight F_1 folding of argillites in Trenches 26S, 27S and 28S on the southwest corner of the map area, Figure 5. The tightly folded surface is bedding S_o. Often, but not visible in this plate, an axial plane cleavage, S_1 is developed.

Locality: Trench 28S, 18.8W.

Plate 33

Plate 33: This plate illustrates an irregular interpenetration of chert and argillite, c/a. The argillite is probably pyritic. The exposure is in a large boulder, out of situ, near Brown's workings, locality (16), approximately 14S, 14.6W on Figure 5. The foliation parallel to the knife may be bedding (S_0) but is more probably cleavage (S_1). Note the differential flattening of the cleavage in the argillite, relative to the chert, above the penknife.

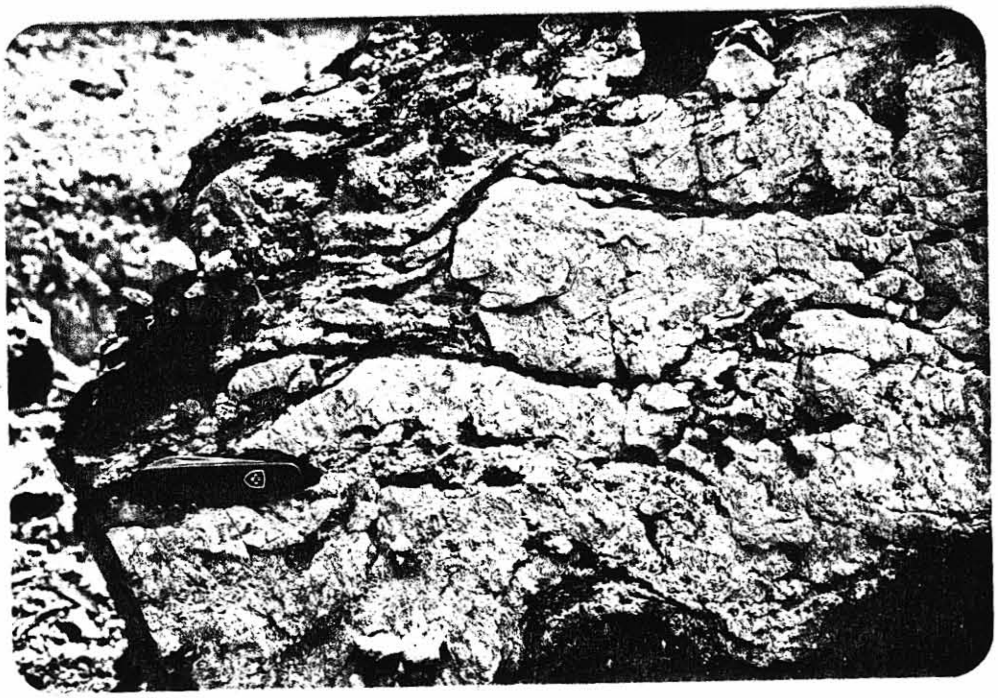


Plate 34

Plate 34: This plate illustrates the development of chert or silicification about a layer or lens of pyrite, within sediment. According to Berner, 1971, p. 161 the precipitation of silica in solution in groundwaters is dependent upon Eh change. Such an Eh change can be induced by the presence of pyrite. This pyrite was presumably present within the original argillites (see Plates 1 and 2). Circulation of siliceous groundwaters, particularly in association with mineralisation is considered to have deposited the irregular siliceous or cherty patches of this plate and that of Plate 33.

Locality: (15) of Figure 5, approximately 14S, 14.3W.

Plate 35

Plate 35: This plate illustrates the Tsc phase of the large composite intrusive body. The rock type consists essentially of a schistose sericite schist matrix containing ovoid-shaped bodies of chert (grey in the plate) as illustrated. These round chert bodies are also shown in Plate 36. In some cases these cherty nodules contain a core of pyrite, and are considered to be a phenomenon which is possibly due to flow of silica bearing groundwaters, with pyrite causing the precipitation of the silica to form the chert nodules.

Locality: Trench 2 of the south trenches.

Plate 36

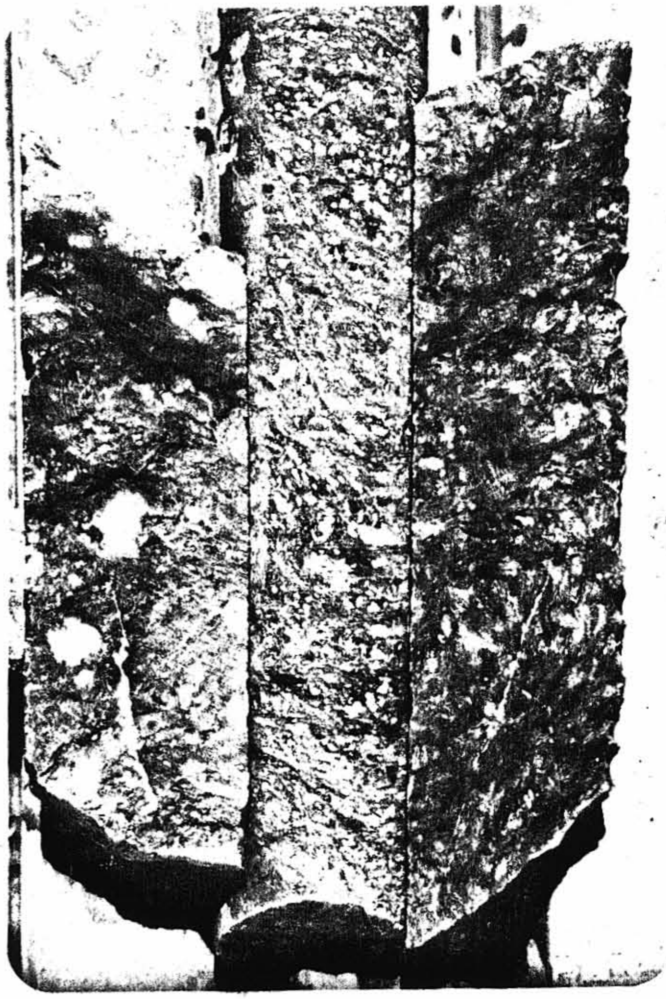


Plate 36: This plate illustrates two varieties of the main composite porphyry body. The core to the left and to the right are Tsc (sericitic "tuff" with chert nodules); the core on the left shows the characteristic round chert nodules in sericite schist; the core on the right gives an example of heavily crenulated sericite schist (possibly due to the development of a local zone of cross-faulting). The central core is representative of the Psa rock type (pseudo-agglomerate), containing large ragged fragments or patches of dense chlorite schist, within a sericite schist matrix containing dispersed phenocrysts (or porphyroblasts ?) of felspar scattered throughout both the sericitic and chloritic matrices.

Locality: Core is from DDH CP7/71.1, 82.3 and 83.2 m.

Plate 37

Plate 37: This plate shows the development of irregular chert nodules or masses within sericite schist. This is characteristic of the Tsc phase of the composite porphyry intrusion. The chert nodules are developed about small (dark) inclusions of pyrite-chlorite, indicated by the knife blade.

Locality: Approximately 19.6S, 11.6W, Figure 5.

Plate 38

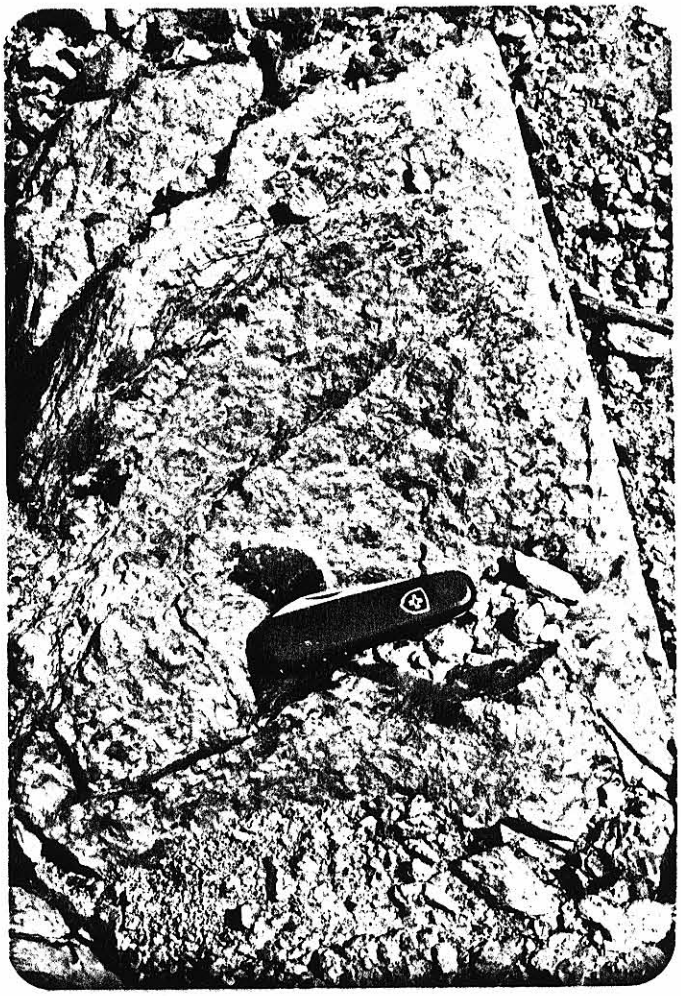


Plate 38: This plate shows the development of a large siliceous or cherty nodule, about a zone of disseminated pyrite. The nodule is within a sericite schist matrix of Tsc.

Locality: Approximately 14S, 13.3W, Figure 5.

Plate 39

Plate 39: This shows irregular chloritic patches, fragments or inclusions which are characteristic of the rock type termed Psa (= pseudo-agglomerate). This is material illustrated in core in Plate 36 (central core); scattered throughout the chloritic material and throughout the sericite matrix are felspar phenocrysts and/or porphyroblasts. See discussion text Section 3.6.

Locality: Approximately Line 20S, 16.0W, Figure 5.

Plate 40

Plate 40: This plate shows a chlorite-pyrite inclusion, within Tsc. This inclusion was found near to the outcrop illustrated in Plate 39. The chlorite-pyrite inclusion is surrounded by siliceous cherty material, similar to the chert nodules of Tsc. For discussion refer to text Section 3.6.

Locality: Near to drill site CP9.

Plate 41

Plate 41: This plate shows the development of extensive net-vein fracturing developed with quartz-felspar porphyry of the composite body. There has been extensive silicification of the net-vein fractured zone, leaving porphyry remnants, producing a pseudo-breccia as illustrated. This is similar to that developed at the Sock Creek Prospect, Plates 11 and 22.

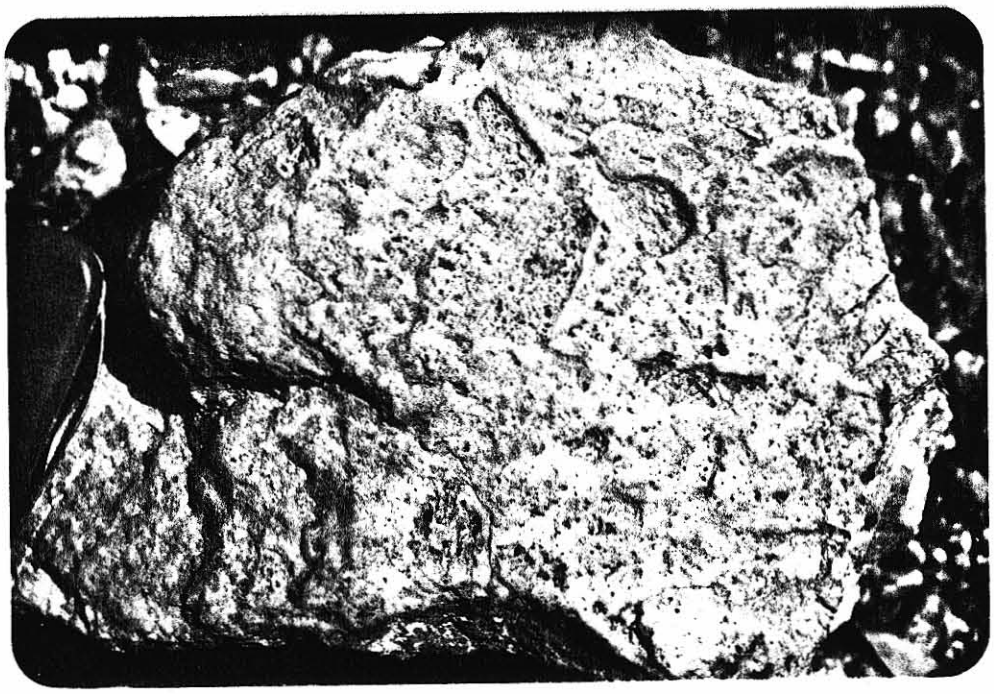


Plate 42

Plate 42: This plate illustrates a transitional irregular contact between sediment and quartz felspar porphyry. Between the sediment in the centre-lower of the plate, and the quartz-felspar porphyry, there is a transitional phase or porphyritised sediment or contaminated porphyry. Because of the irregularity of this contact, and the implied sediment-porphyry reaction relationship, this contact is considered intrusive.

Locality: Main road to Pinnacles prospect, 1 Km west of Chester East turnoff.

Plate 43

Plate 43: This plate shows an irregular and transitional contact between the Tsc phase of the porphyry body at the top of the plate, and black shale at the bottom of the plate. The leucocratic porphyry forms a series of apophyses into the black shale. There is progressive bleaching of the black shale at contacted areas, and transitionally (upwards) into the porphyry. Details of this outcrop are given in Plates 44 and 45, and relationships are summarised in Figure 8A.

Locality: 21S, 19.20W, Figure 5.

Plate 44

Plate 44: This shows details of the lower contacts of the Tsc (altered quartz porphyry) apophysis in the lower half of Plate 43. The black shale, which is dark away from the contact becomes bleached chloritic, and shredded as it passes into the quartz-felspar porphyry. The metasediment often contains small felspar phenocrysts (or porphyro-blasts), similar to those of Plate 39, near to the porphyry contact.

Locality: 21S, 19.20W, Figure 5.

Plate 45

Plate 45: This plate illustrates remnant former inclusions of argillite (now heavily chloritised) within the porphyry (Tsc-phase) near the upper contact of Plate 43. The argillite contains felspar phenocrysts or porphyroblasts and is similar to material illustrated in Plate 39. The process of incorporation of original argillite, through bleaching to chloritisation, to felspar growth can be recognised in this contact exposure, as illustrated in Figure 8A.

Locality: 21S, 19.20W, Figure 5.

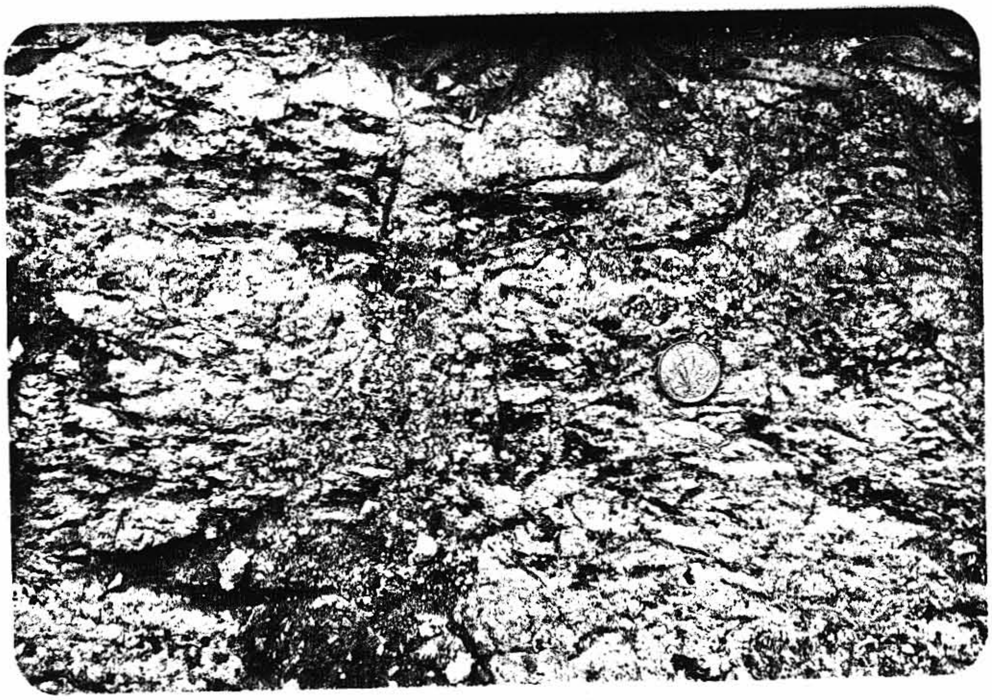


Plate 46

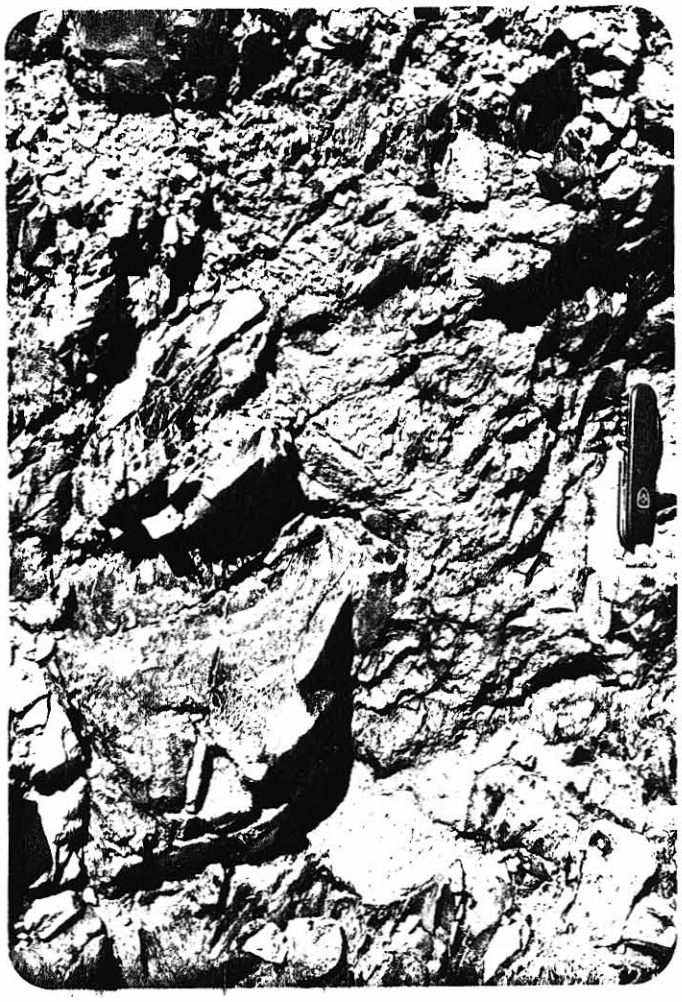


Plate 46: This plate gives details of the complex intrusion of quartz porphyry into black argillitic rocks at the contact zones. This plate, together with Plates 47, 48, 49 illustrate the transitional nature of the contact zone in the trench west of CP12. The black argillite has been folded, prior to intrusion, with fold axes plunging approximately 40°N. In this plate, irregular apophyses of quartz porphyry can be seen transgressive to bedding within the argillites. Note the irregular bleaching of the argillite. This plate presents the detail of the much wider view presented in Plate 47.

Locality: Approximately 40 m east of CP12, Line 18S, Figure 5. Refer to Figures 8B to 8E.

Plate 47

Plate 47: This plate illustrates the complex manner of intrusion of the quartz felspar porphyry into the black argillite. The detail of the area in the upper right is given in Plate 46. Note the patchy apophyses of porphyry, and the irregular bleaching of black argillite at the contact.

Locality: 40 m east of CP12, Line 18S.
Refer to Figures 8B to 8E.

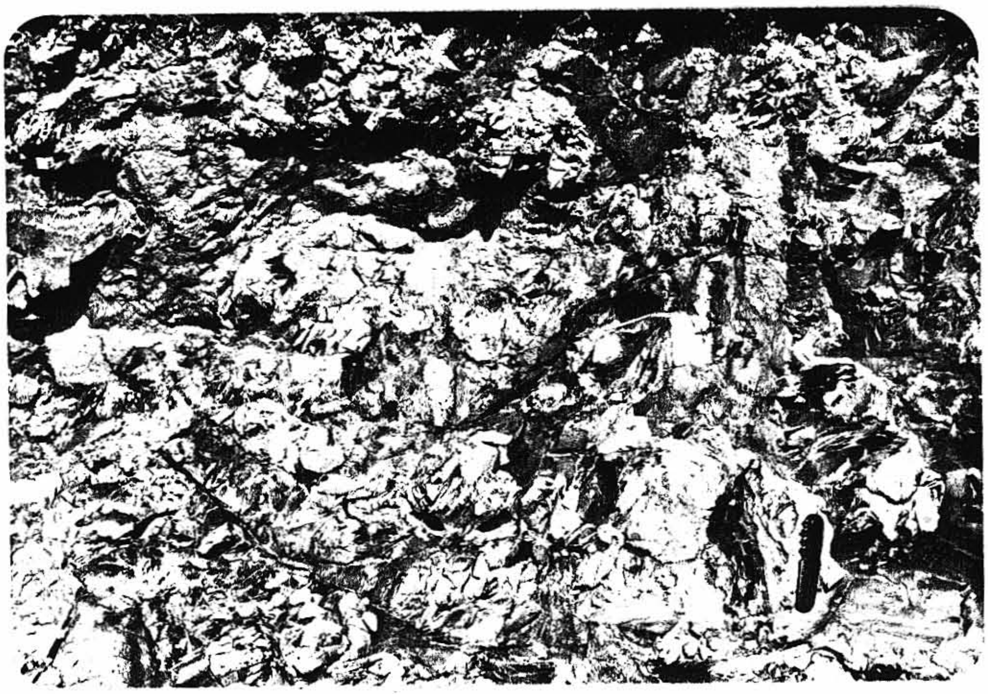


Plate 48

Plate 48: This plate illustrates the transitional nature of porphyry-sediment contacts, at a point deeper within the porphyry body. Coalescence of the irregular scattered porphyry apophyses of Plate 47, results in discontinuous remnants of meta-sediment within a porphyry matrix as illustrated. These metasediment inclusions are silicified and converted to material similar to chert. Leucocratic "tuff" layers of the original argillite/siltstone sequence are "porphyritised."

Locality: 45 m east of CP12, Line 18S.
Refer to Figures 8B to 8E.

Plate 49

Plate 49: This illustrates an original black argillite layer within the porphyry of the above contact sequence (Plates 46 to 48). The white coloured layers are bleached, or partly "porphyritised." The black argillite remnant is bleached around its outer margin, silicified in the core. There is a small fault above-right the penknife which has been exploited by fluids associated with the alteration process.

Locality: 50 m east of CP12, Line 18S.
Refer to Figures 8B to 8E.

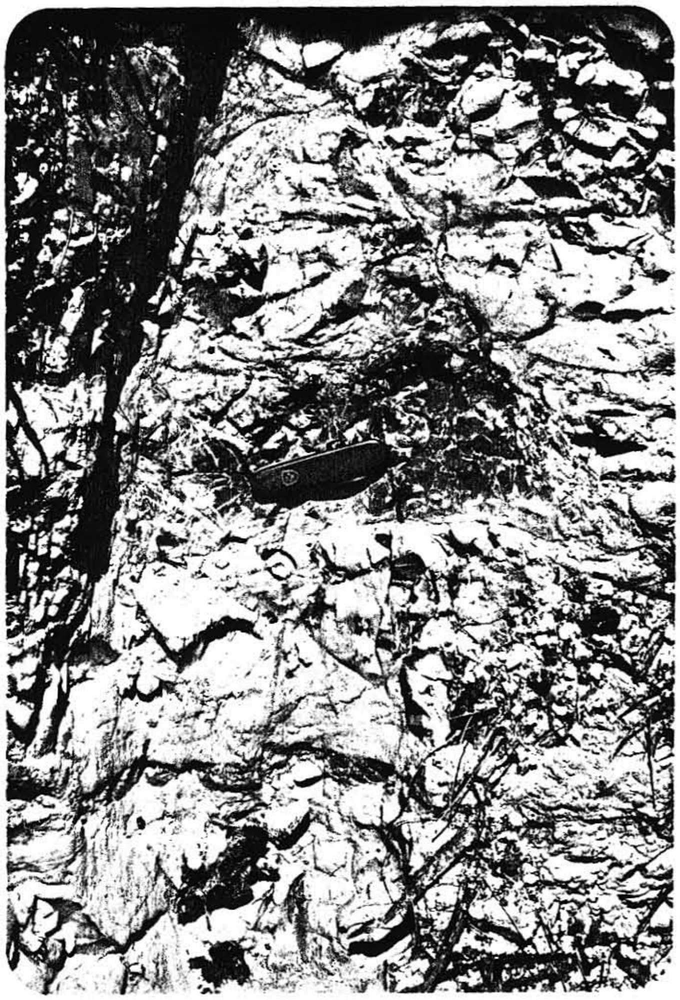


Plate 50

Plate 50: This plate shows bleached chert inclusions within porphyry. Because there is a reaction rim effect in the silicification process, the end of the inclusion beneath the penknife gives an apparent tight fold hinge. Ghosted remnants of metasediment within the porphyry can be recognised within the porphyry, between the chert inclusions.

Locality: 17S, 12 west, on road to Thomas's Tunnel from CP12.

Plate 51

Plate 51: This core illustrates the contrast between intrusive quartz-felspar porphyry, and felspathic "tuff" or siltstone units. The core on the left and lower centre contains intrusive quartz felspar porphyry, with some brecciated black argillite. Note the porphyry partly contaminated by black argillite in the lower centre, and the growth of felspar (felspathic alteration) within the fragment. The core in the upper centre and on the right contains felspathic tuff or siltstone, possibly with a high connate water content, indicated by its partly intrusive behaviour.

Locality: Core is CP7/99.2 m.

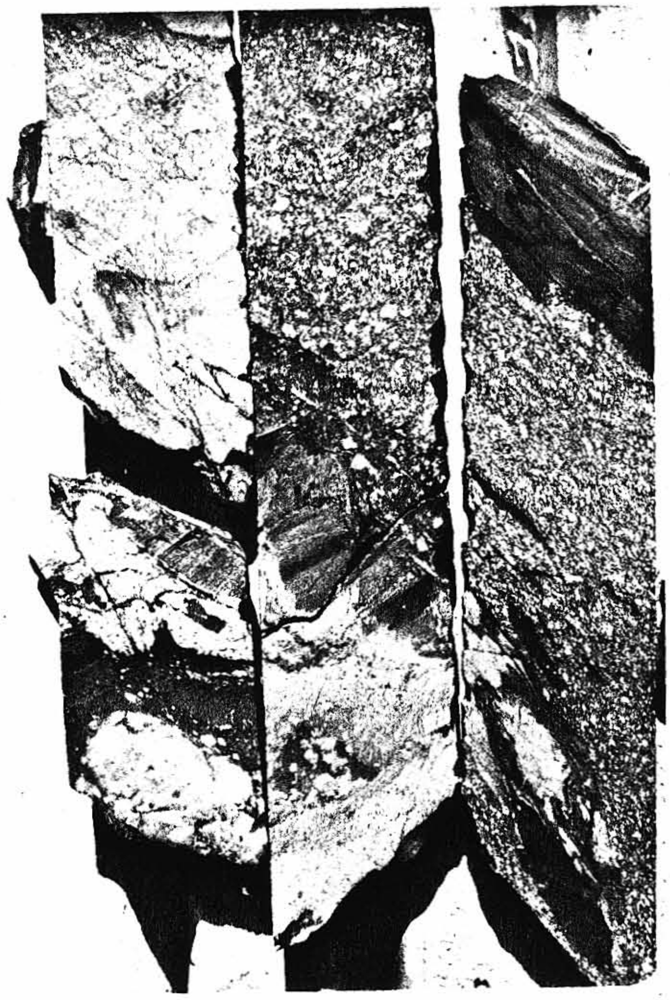


Plate 52

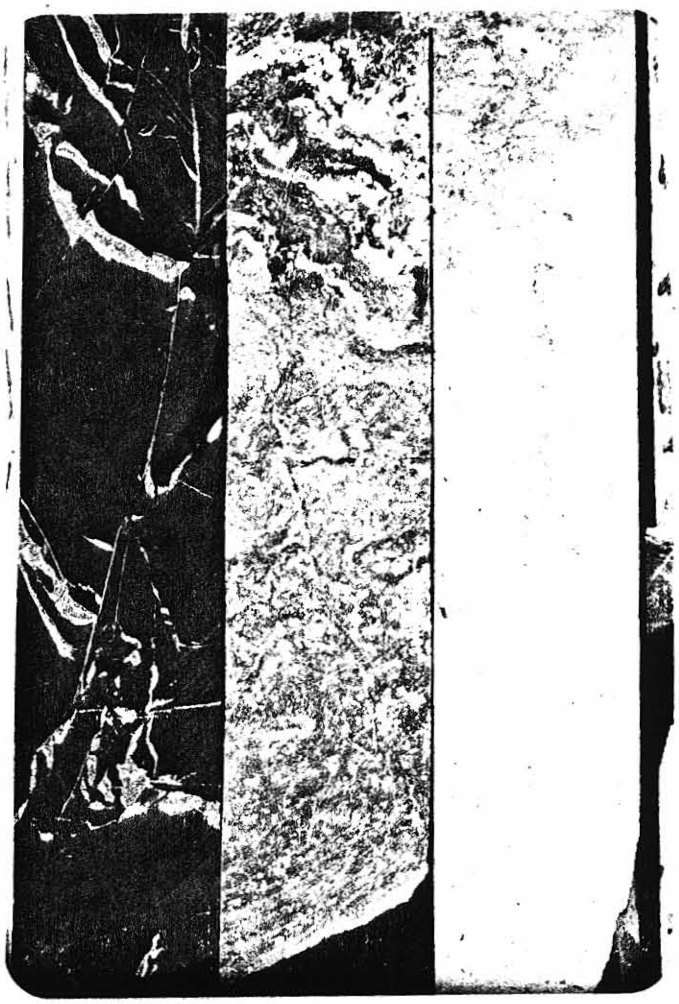


Plate 52: This illustrates three phases at the contacts of the porphyry. The core on the left shows laminated black argillite, with net-vein fractures and stringer veins containing zoned mineralisation. The veinlets are zoned from brown sphalerite to quartz. The core on the right consists of quartz porphyry, with a dense siliceous (silicified ?) matrix. The central core is partly contaminated by argillite (cf. the halo around the argillite inclusion in Plate 51). Note the irregular patches of silicification and the felspar phenocrysts.

Locality: Drill core CP7/196.4, 196.1, 199.5 m.

Plate 53

<u>Plate 53:</u> This core shows black argillite from the contact zone, and bleaching of the argillite within the immediate vicinity of the contact zone. The core on the left is unaltered black argillite, containing zoned veins of brown sphalerite-quartz in net-vein fractures. The core on the right shows early diffuse bleaching in its lower half. Note the segregated patches of chlorite (?) and/or graphite. The two central pieces of core show notable bleaching; note segregated chloritic patches within the bleached areas. The irregular bedding-like laminae in the lower contact material, may be bedding, but may also be a diffuse chemical alteration effect, acting in a fashion similar to "leisegang rings."

Locality: Core from CP7/170.1, 171.7, sphalerite from 187.3 m.

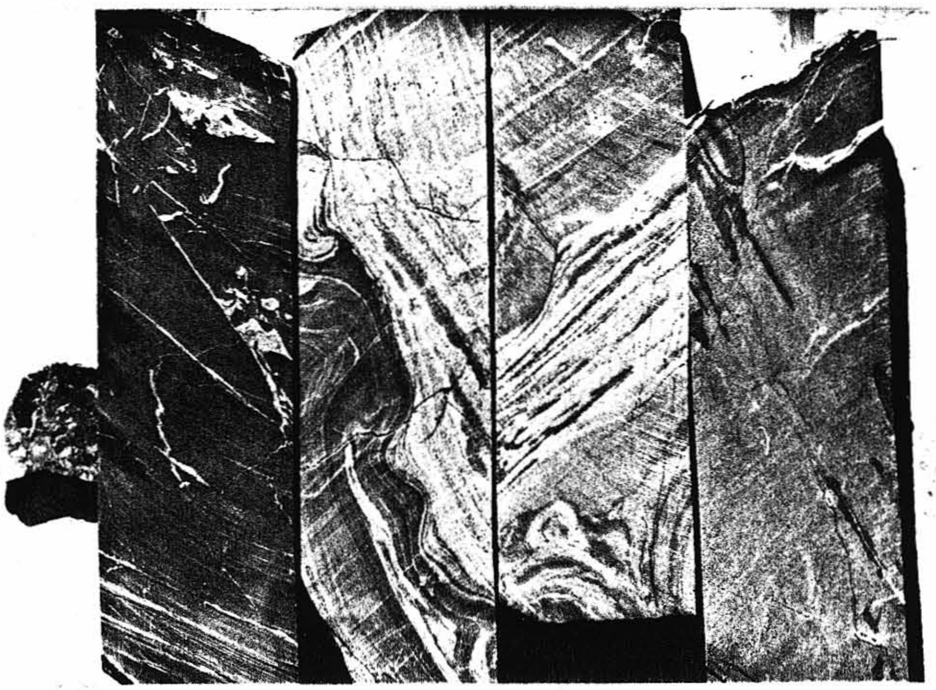


Plate 54

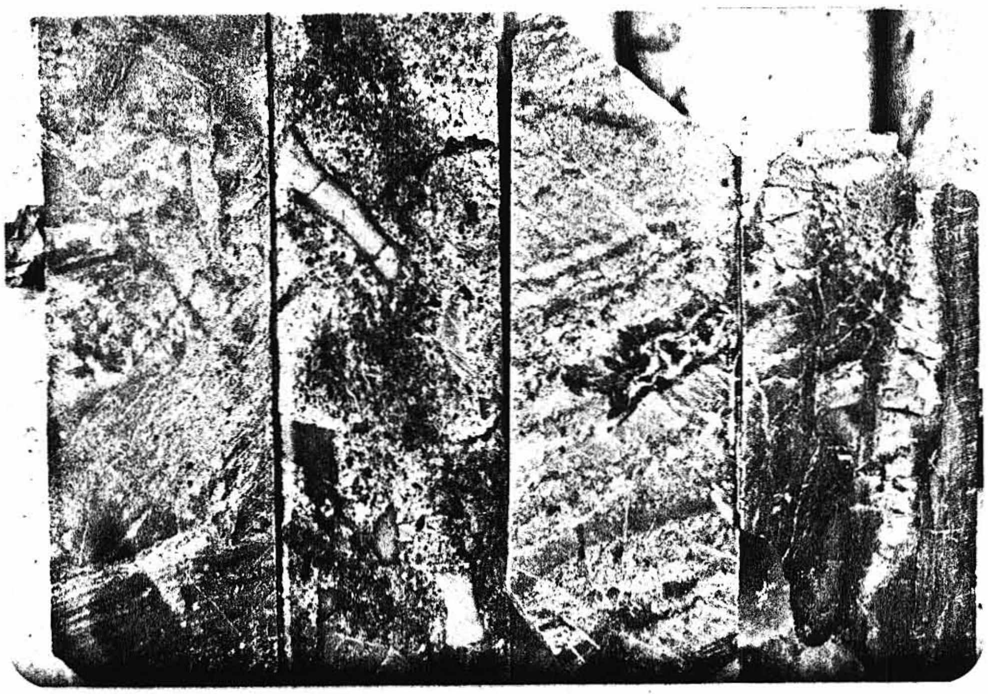


Plate 54: This plate illustrates silicification on the contact of the Tsc phase of the composite porphyry body, with sediment. The core on the right (CP9/61 m) illustrates "chert" or silicification interfoliated with argillite, near the contact zone. Note the zoned nature of the "chert" lens, and the diffuse contacts. It is considered that selective silicification (in part) is caused by the precipitation of silica from groundwaters due to change in Eh caused by contact with pyrite (see Plate 34). The core second from the right illustrates silicification on the Tsc contact. The core second from the left shows silicification of an original felspathic breccia (with an original matrix similar to that of the core on the right Plate 51). Note the zoned rims of silicification on former fragments. The core on the far left is silicified sediment from within Tsc, containing minor sphalerite.

Locality: Core from CP9/67.4, 63.9, 62.4 and 61 m.

Plate 55

Plate 55: This plate illustrates contrasts between intrusive quartz felspar porphyry and felspathic alteration. The core on the right shows the contact of quartz felspar porphyry with sediment, and an extensive zone of silicification on the contact. The central core shows the contact of quartz felspar porphyry with black shale. Note the extensive net-vein fracturing of the porphyry. The fracture filling is sphalerite-quartz. The core on the left shows irregular patches of felspathic alteration or altered porphyry (cf. material of Plates 13, 16 and 17 of the Sock Creek prospect).

Locality: CP7/130.8, 135.4, 130.4 m.

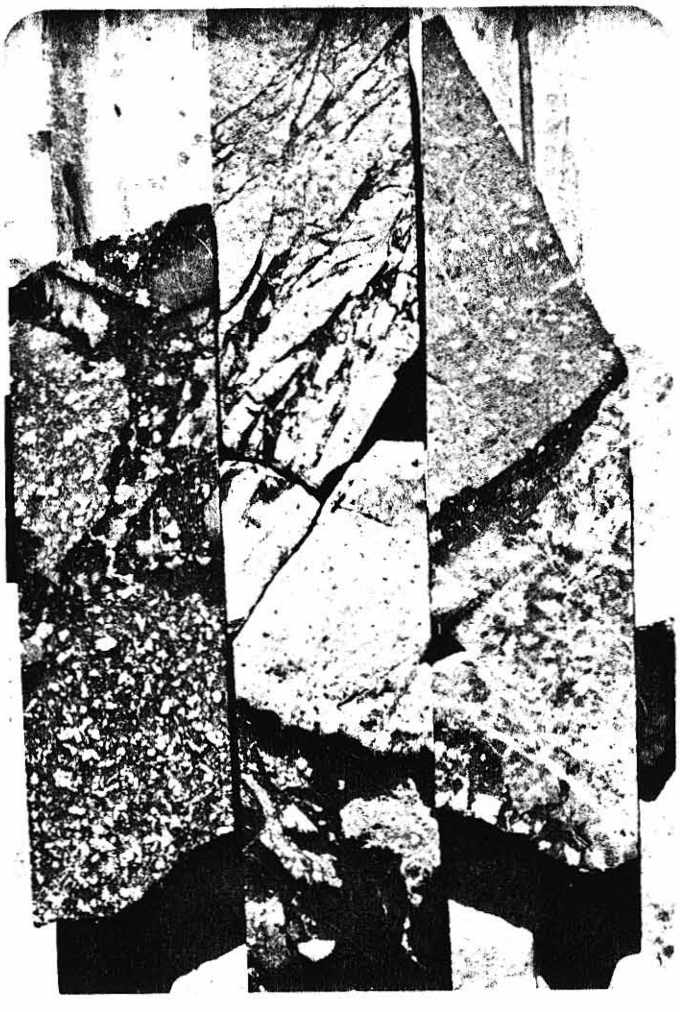


Plate 56

Plate 56: This plate shows inclusions of black argillite within quartz porphyry. The argillite inclusions have developed felspar porphyroblasts, which can be seen in the central upper core.

Locality: CP7/58,7 m.

Plate 57

Plate 57: This plate shows the contrast between felspathic alteration and the felspathic "tuff" or siltstone units. The core on the left consists of felspathic tuff with an irregular patch of felspathic alteration. Similar patches of felspathic alteration or contaminated porphyry are shown in the core on the right. The material on the right is the core-expression of material similar to that of Plate 46 on the surface.

Locality: Drill hole CP7/107.1, 125.3, 127.1 m.

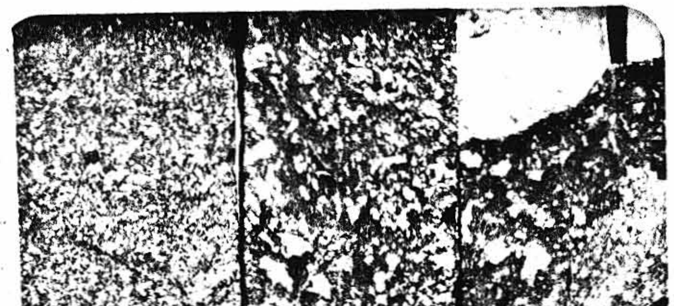


Plate 58

Plate 58: This plate shows changes at a contact of the Tsc phase of the composite intrusive porphyry. The core on the left (CP9/103.4 m) is sericite schist (altered argillite ?) with zones and stringers of silicification. The central core (CP9/115.3 m) is sericite schist, with patchy overprinted felspathic alteration, the core on the right is Tsc, consisting of a sericite schist matrix, containing chert nodules. The sericitic matrix has been overprinted by felspathic alteration. Stringers of galena occur parallel to the foliation.

Plate 59

Plate 59: This plate illustrates banded galena-sphalerite (-barytes) mineralisation from the zone of mineralisation (C), on the sketch map Figure 5, and Figure 7H. This layering is folded about parasitic folds, F_1, which appear to indicate a syncline-east sense (right in the photo). It is assumed in this outcrop that the S_0-layering (bedding equivalent) dips east (right in the photo), and the cleavage is almost vertical (parallel to knife). This geometry indicates a north plunge, consistent with other northerly F_1 plunges in the area, approximately 20° to 50° north. A mineral streaking lineation (A-elongation direction of the ellipsoid of bulk regional strain, Hopwood, 1975) occurs plunging 70°S, as indicated on the maps.

Locality: Line 16.0S, 16.662W (200 m approximately, west of Thomas's Tunnel).

Plate 60

Plate 60: This plate illustrates the development of a mineral streaking lineation, within the mineralisation of Plate 59. Such mineral streakings or roddings are usually defined by elongate grain aggregates of sphalerite, galena, and barytes (associated with grainsize contrasts). The streaking is parallel to the A-elongation direction of the strain-ellipsoid of bulk regional strain (see Hopwood, 1975). This lineation plunges 70^{o}S, whereas the bedding cleavage intersection (F_1) is thought to plunge between 20 and 50^{o} north.

Locality: Line 16S, 16.662W, approximately 200 m west of Thomas's Tunnel.

Plate 61

Plate 61: This plate illustrates banded sphalerite-galena mineralisation from the southern trenches, zone D of Figure 5 and 7H. The style of mineralisation is very similar to that of zone C ~~south~~ WEST of Thomas's Tunnel and the mineralisation within Thomas's Tunnel. This lens of massive sulphide mineralisation is located withon the hinge of a tight syncline, defined by opposed senses of intersection of bedding with cleavage (S_0/S_1) as indicated on Figure 7H.

Locality: Centre of Tr 2, Figure 6.

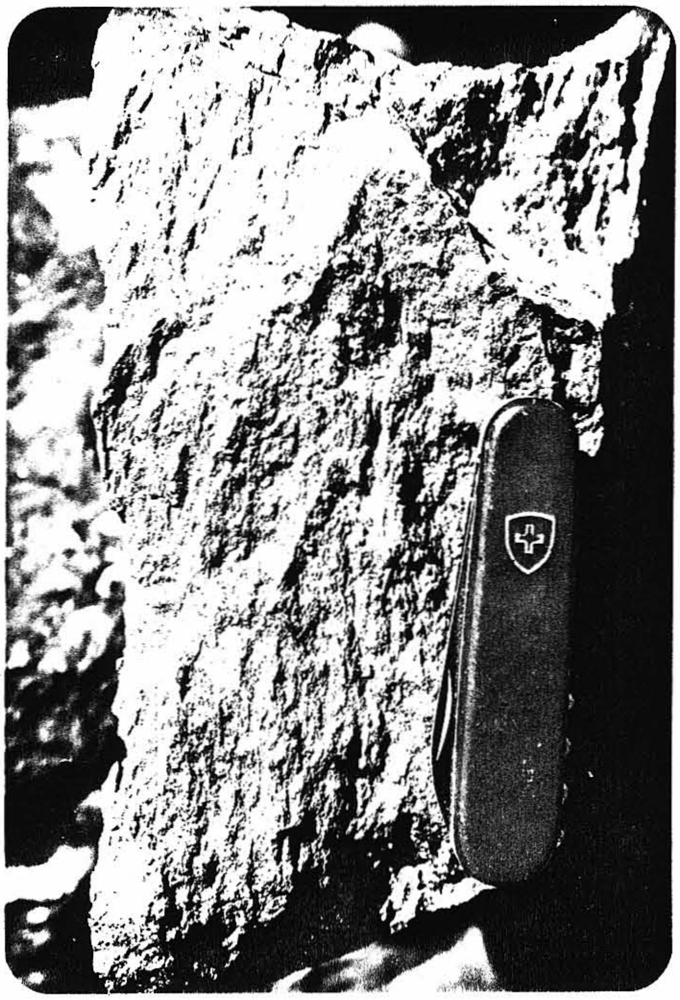


Plate 62

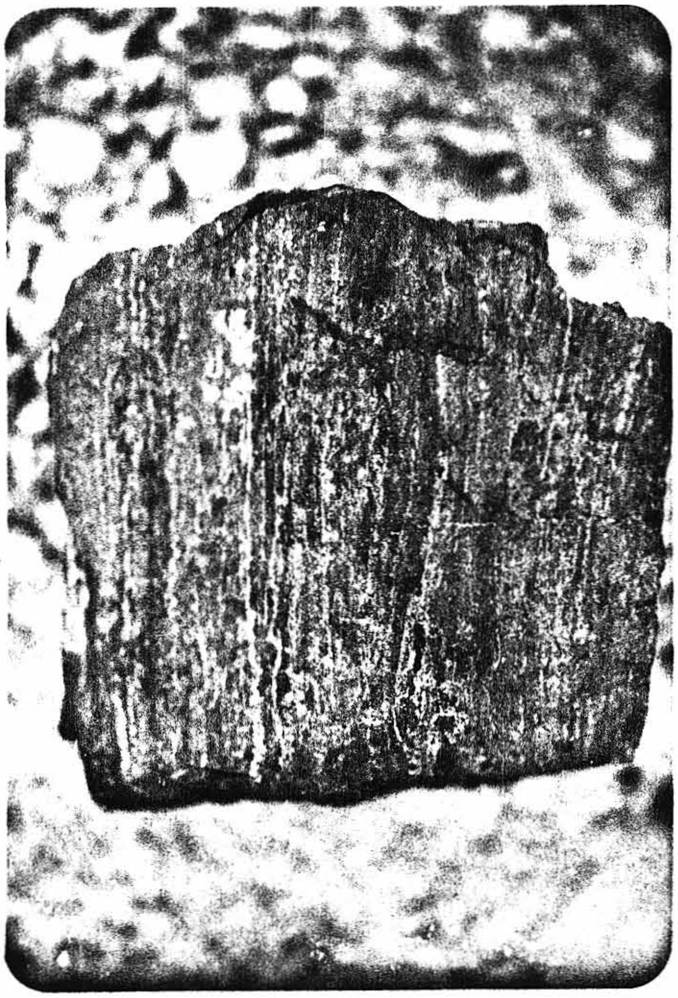


Plate 62: This plate illustrates banded fine grained sphalerite galena ore from the Que River deposit (Figure 1). This mineralisation is very similar in style to that of the Pinnacles deposit, Zones B, C and D of Figure 5. Cf. the banded sphalerite galena of Plates 59, 61 above.

Plate 63

Plate 63: This plate shows small blebs of sphalerite-galena which occur within the black argillite stratigraphy, associated with the quartz-eye rock (Tqe), similar to that described in Appendix B, (Sample P5). There are patches of chert or silicification associated with the mineralisation.

Locality: Approximately 50 m west of CP12 on Line 18S.

Plate 64

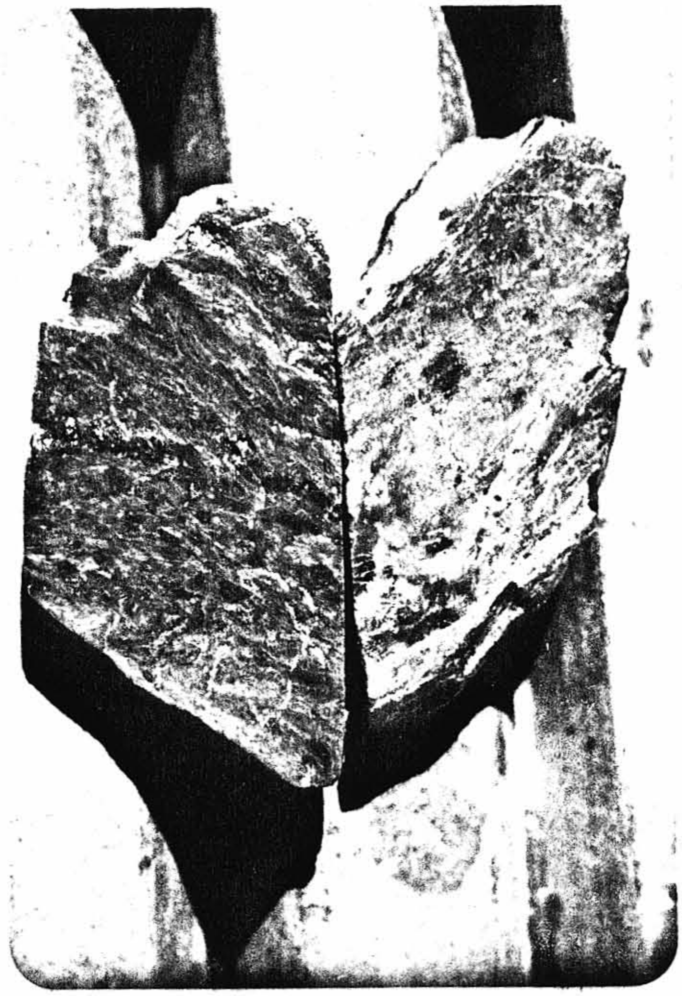


Plate 64: This plate shows flecks and disseminations of sphalerite and galena in the Tsc phase of the composite porphyry (sericite schist with chert nodules). Presumably zones of disseminated mineralisation of this type cause the soil geochemical anomalies at approximately 14S, 12W and 17S, 13W of Figure 5.

Locality: From DH CP7/7.25 m.

Plate 65

Plate 65: This shows rhyolites from the Chester area, a few km south of the Pinnacles prospect. The upper half of the plate shows massive rhyolite, with a fine flow banding. The lower part, near the boot shows the development of rhyolite fragmental texture (due to autobrecciation ?). The infill of the breccia fragment is finely pyritic.

Locality: 8.5 on the Chester Road.

Plate 66

Plate 66: This rock type is composed of chlorite patches similar to that of Plate 39 of the pseudo-agglomerate from the Pinnacles area. Inclusions or fragments of more rhyolitic material are zoned. The matrix is acid and finely porphyritic in felspar. The diversity of clasts suggest that the rock is a true agglomerate, (or volcanoclastic ?) but may also be a fragmental rock type, intruded by a composite porphyry similar to that of the Pinnacles. Sufficient time was not spent at Chester to resolve this ambiguity.

Locality: Access track to CP3, north of Chester.

Plate 67

Plate 67: This plate illustrates a thin argillitic unit within the massive pyrite of the Chester deposit. The argillitic unit defines bedding, S_0; cleavage S_1, within the unit is parallel to the hammer handle of the plate. This bedding cleavage sense indicates an anticlinal hinge to the left (west); structurally this outcrop is located at position (3) on the section of the Chester Mine illustrated in Figure 7F.

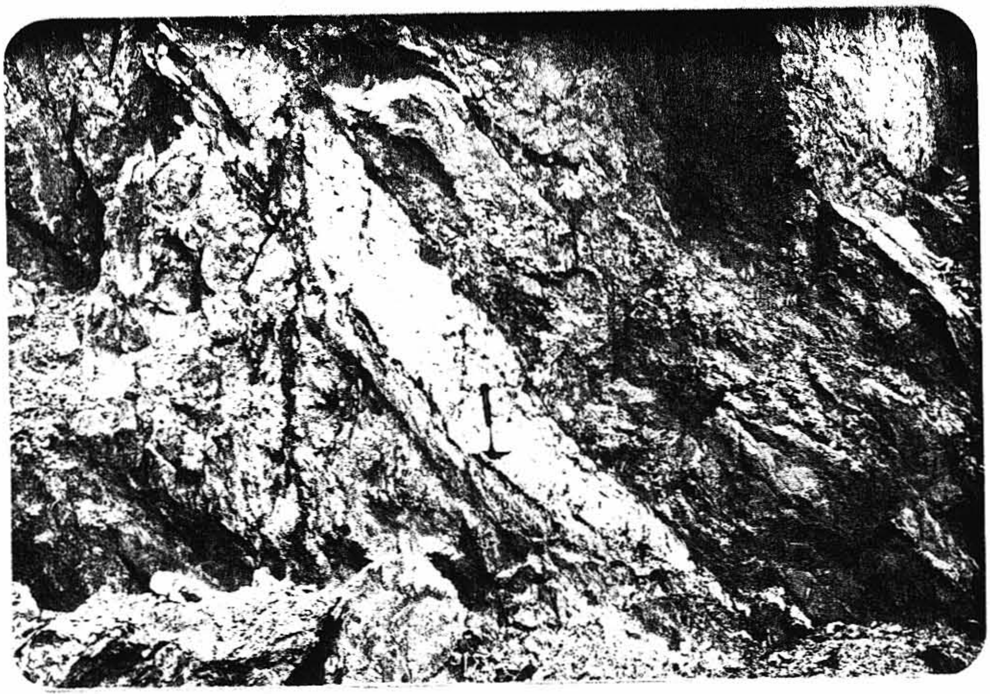


Plate 68

Plate 68: This plate shows bedding/cleavage relationships in massive pyrite of the Chester Deposit. The blue siliceous or cherty layer dipping to the left (west) indicates bedding, S_o. Cleavage S_1, is parallel to the penknife (vertically in the photo). The S_o/S_1 vergence sense indicates an anticline to the right (east); structurally this outcrop lies at locality 1 of the Chester Mine Section, Figure 7F.