"The Geology and Mineralization of

Geevor Tin Mine, Cornwall."

Volume III

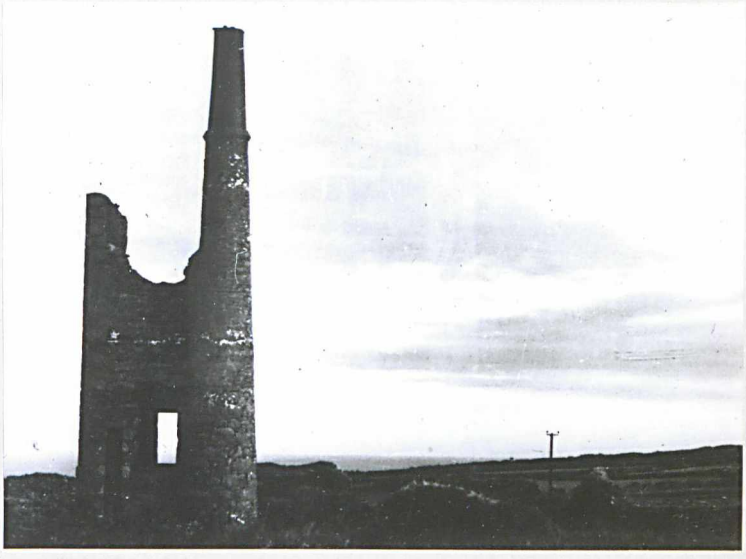


Photo. (1)

All that remains from the 19th Century. Long-term planning, closer geological supervision, and experience gained from past errors could result, with the correct financial encouragement, in a more prosperous and rewarding future for all concerned in the Cornish mining industry.



Photo. (2)

An aerial photograph of Geevor Mine (centre) to a scale of 1:10,460, showing the adjacent Boscaswell Downs, Levant, and North Levant Mines.

Photo. (3)

Levant Mine - 1860

The Skip Shaft Engine House is situated in the centre foreground. To the left the hand spalling sheds were sited upon an extensive area of false ground.

Photo. (4)

Levant Mine - 1960

A few derelict buildings are all that remain as evidence of the workings which extended to a depth of 350 fathoms for a distance of over one mile beneath the sea.

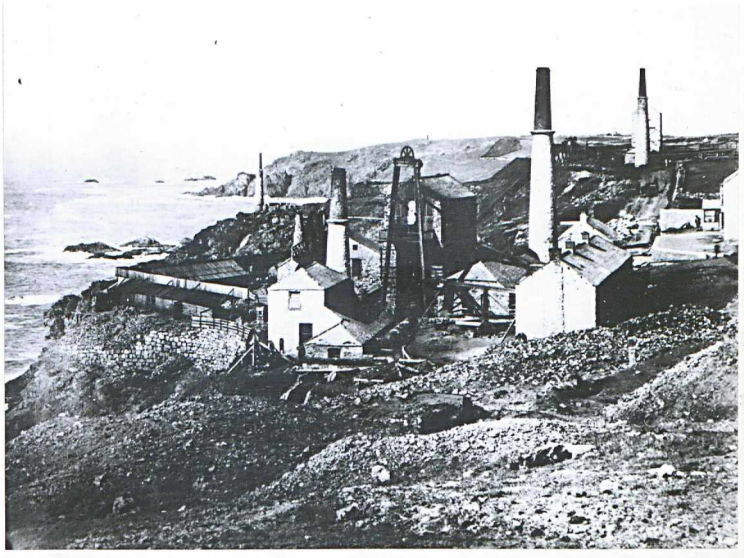




Photo. (5)

Levant Mine viewed from a point over the '40 Backs'. The Skip Shaft and Engine House are situated at the back of the Skip Shaft Zawn which is in the centre. To the right is Levant Zawn and to the left is Phillips Shaft Zawn.

Photo. (6)

The Crowns Engine House, Botallack, viewed from De Narrow Zawn.





Photo. (7)

The headframe of Victory Shaft, Geevor Mine, upon which work was commenced in 1920. A depth of 1550 feet below the collar, equivalent to Level 16, has now been reached.

Photo. (8)

Wethered Shaft was collared in 1909 and continued to a depth of 805 feet. Hoisting in the Shaft was terminated in 1944.



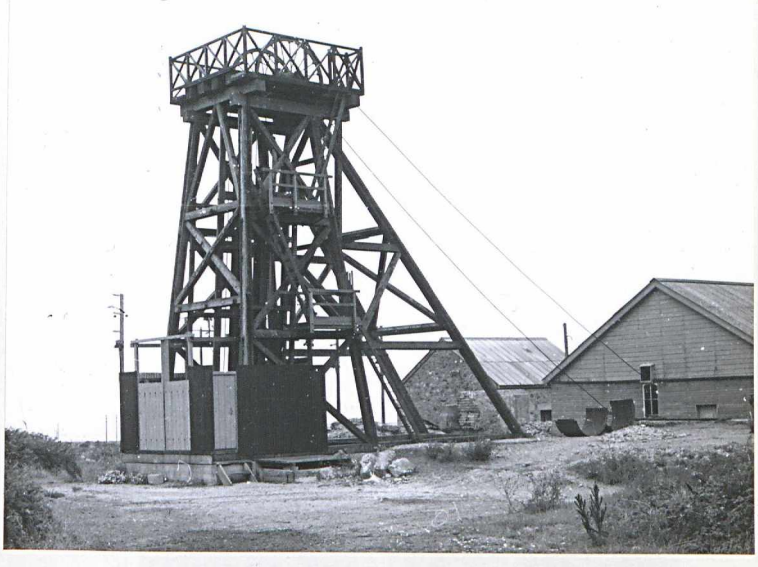


Photo. (9)

Drilling in an underhand stope in Geevor Mine.

(Photo. by I.C.I.)

Photo. (10)

Blasting in an underhand stope.

(Photo. by I.C.I.)

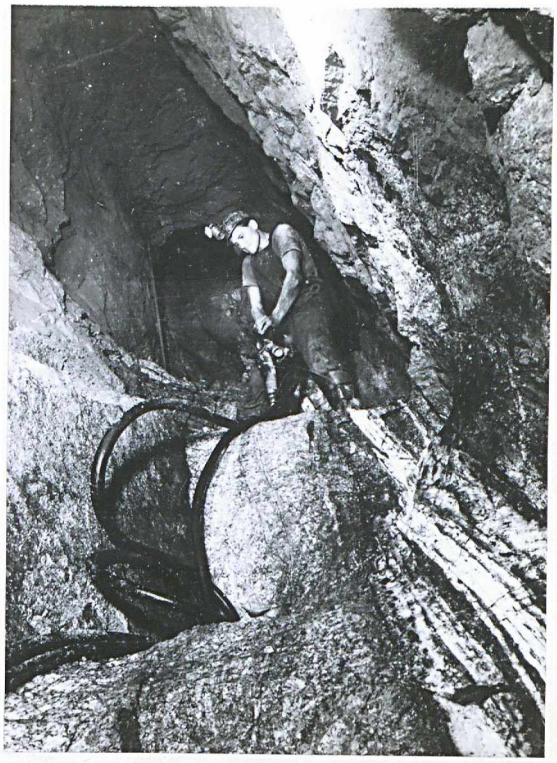




Photo. (11)

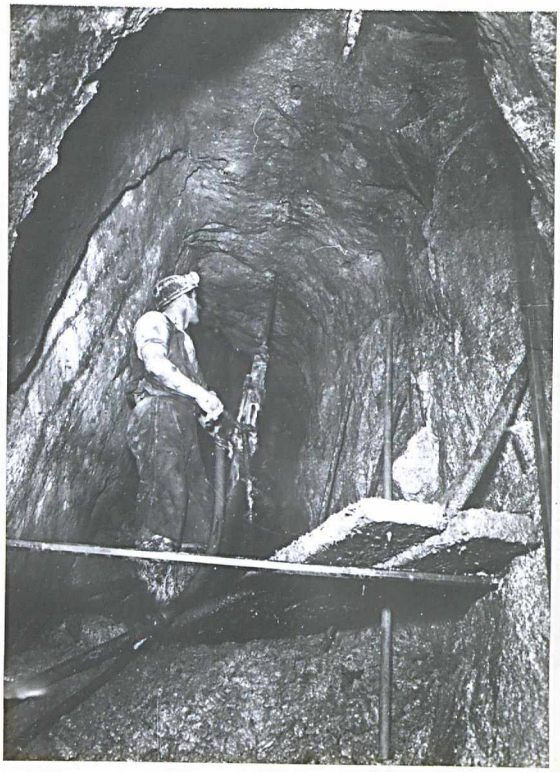
Drilling in an overhand stope.

(Photo. by I.C.I.)

Photo. (12)

The Underground Manager examining a specimen from the Coronation Lode.

(Photo. by I.C.I.)



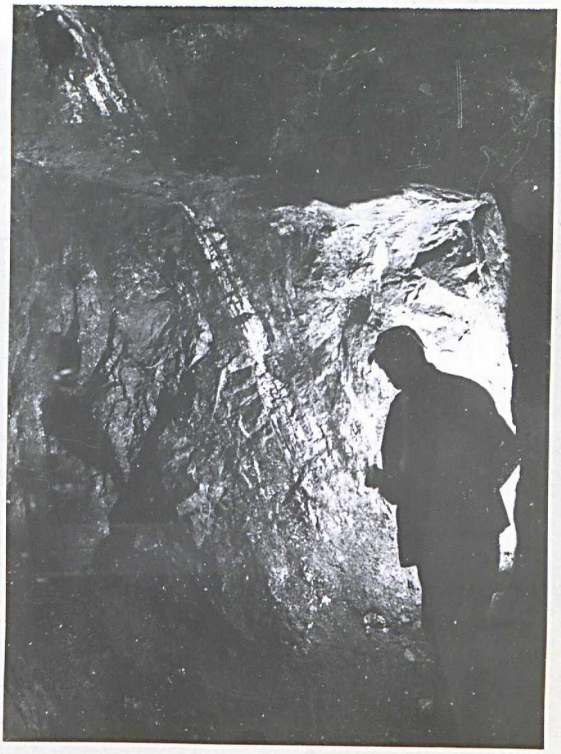


Photo. (13)

The Western side of Porthmeor Cove on the North-Western flank of the Land's End Granite. A small dome in the granite roof with the localized formation of flat-lying, longitudinal, and cross joints.

Photo. (14)

Rinsey Cove, Godolphin Granite.

A small raft of killas, most probably a remnant of the original roof, and below which there is a pegmatitic development.





Photo. (15)

Intersecting, 2 foot wide granite dykes are shown traversing interbedded killas and greenstone at Porthmeor Cove on the North-West flank of the Land's End Granite

Photo. (16)

Localized stoping of the killas (dark grey) by the Land's End Granite (light grey) at Porthmeor Cove.

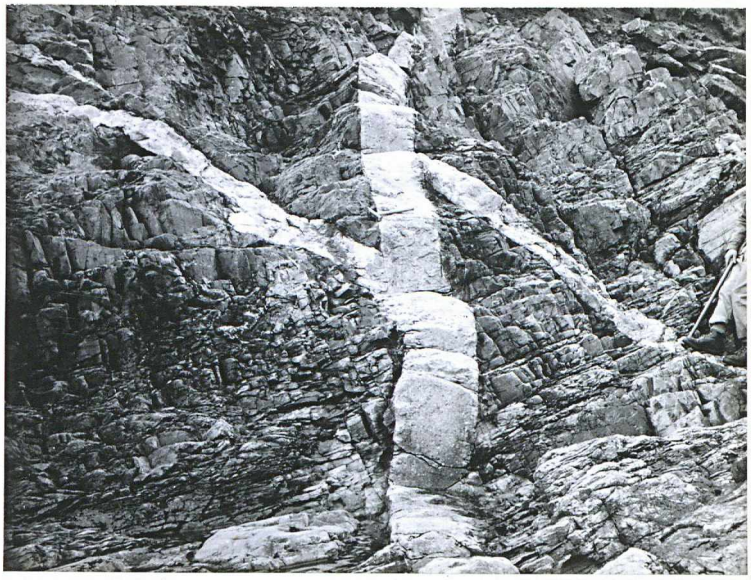




Photo. (17)

The headframes of Victory and Wethered Shafts viewed from the collapsed collar of Carne Shaft, Geevor Mine.

Photo. (18)

A view to the North-East along the coastline from the summit of Carn Eanes showing the typical land profile rising to over 700 feet. Flat-lying granite joints are visible in the foreground.





Photo. (19)

Trewellard Zawn viewed from the sea. The head-frame of Victory Shaft and the Mill of Geevor Mine are in the background with the remnants of Levant Mill on the top of the cliffs to the right. Interbedded greenstone and killas dips to the North in the centre foreground. Steep, South-West dipping fractures outcrop to the left in cliffs composed of sheared pillow lavas.

Photo. (20)

The Skip Shaft Engine House of Levant Mine and the Skip Shaft Zawn viewed from the sea. Levant Zawn to the right is omitted from the photo. Colour differences indicate the inclination of the conformable killas and greenstone series which dip to the North-West at between 20 and 30 degrees. Above the light grey band is the greenstone series. It overlies killas which extends down to the water mark, whilst a little interbedded killas out-crops at the top of the cliffs.



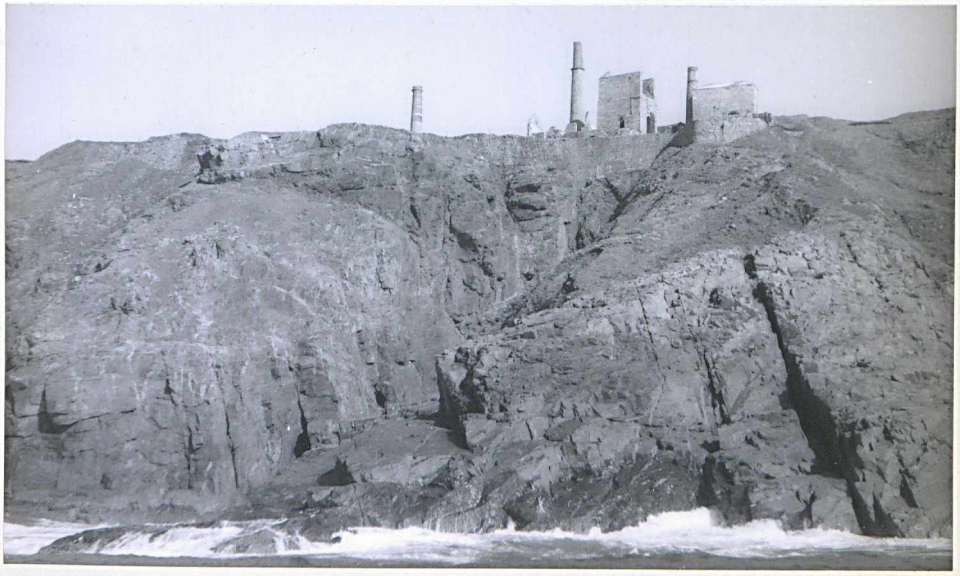


Photo. (21)

The cliffs in the vicinity of Carn Du. Sheared pillow lavas are overlain by North-dipping greenstone and killas, the contacts being marked by low angle thrust planes and the development of adinole. Later vertical fractures trend NW-SE and are equally developed in all the rock types except the pillow lavas.

Photo. (22)

Cordierite hornfelses veined by quartz are exposed in the cliffs between De Narrow Zawn and Zawn a Bal. Large cordierites are visible on the weathered rock surfaces, and the scale is indicated by the two 6" arms of the rule.





Photo. (23)

Sheared pillow lavas in the cliffs around Boscregan Zawn near Levant Mine. Individual pillows are outlined by actinolite veining, and the series dips to the North in conformity with the remainder of the greenstone series and killas. The scale is indicated by 18" rule.

Photo. (24)

Part of the greenstone series outcropping to the South of Levant Zawn. Two phases of actinolite veining are visible. The scale is indicated by the 18" rule.





Photo. (25)

Ptygmatic quartz veining in killas on the Avarack. The vertical extent of the veining is 18".

Photo. (26)

Folding in killas in the vicinity of the Avarack. The scale is indicated by the compass.

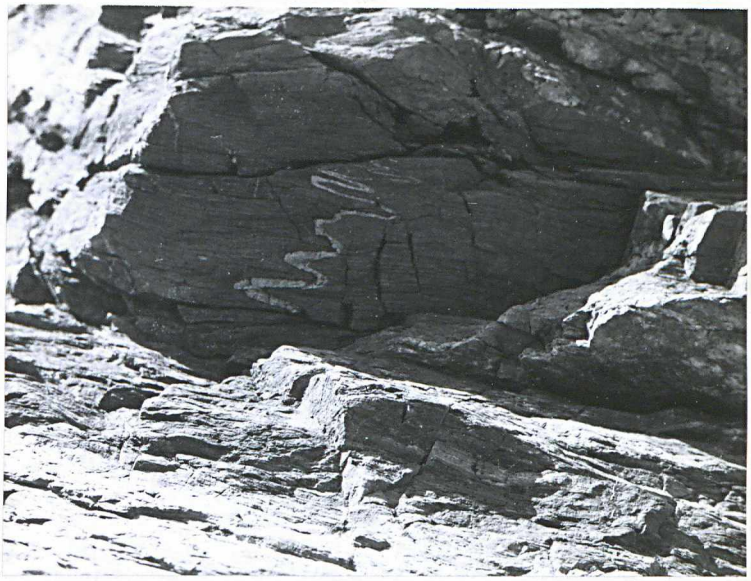




Photo. (27)

Shear folding in interbedded killas and greenstone near the Crowns Engine House, Botallack. The scale is indicated by the 6" rule.

Photo. (28)

Similar folding in killas, indicated by the banding, near Pendeen Watch.

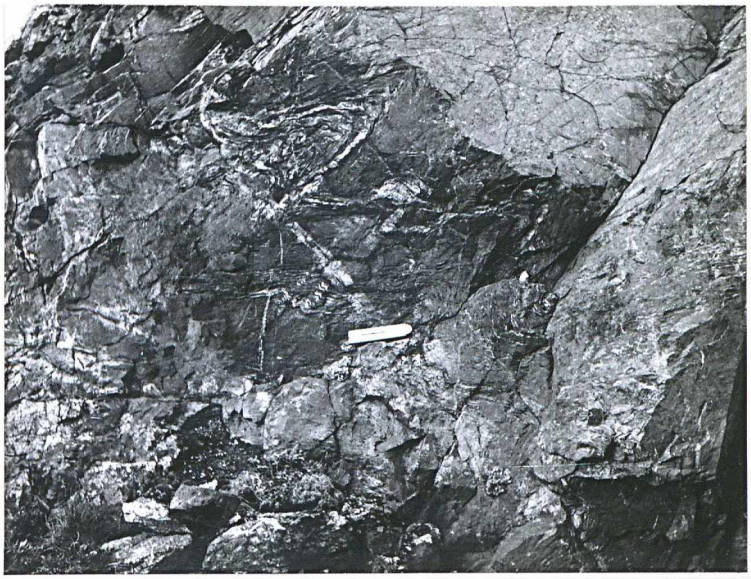




Photo. (29)

Concentric Folding in killas near Pendeen Watch.

Photo. (30)

Folding in killas near Pendeen Watch. Note the well-developed jointing and its relation to the axial planes of the folds.



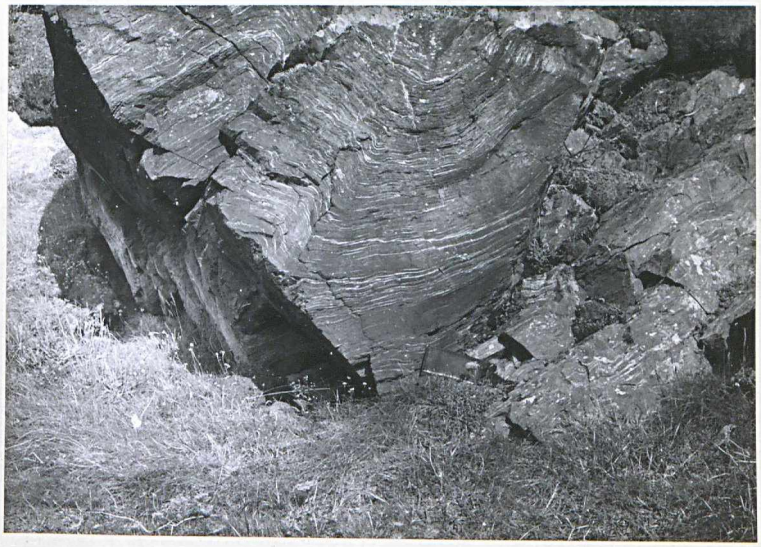


Photo. (31)

The granite quarry on the summit of Carn Eanes near Geevor Mine. Longitudinal and secondary joints, the faces of which are encrusted with tourmaline and quartz, form the visible wall of the quarry.
Cross-joints dip to the South-East, and the local development of flat-lying joints may be observed in the wall.

Photo. (32)

The coast near Mousehole in the South-East of the Land's End Peninsula. Strongly-developed flat-lying joints in the granite control the form of the coastline.





Photo. (33)

Newmill granite quarry. The furthest wall is formed along a NW-SE striking longitudinal joint. Equally well-developed regional and local cross-joints form the North-West and South-East limits to the quarry. In the foreground the quarry floor is defined by the flat-lying joints.

Photo. (34)

A further view of Newmill granite quarry showing the relationship between the longitudinal joints and cross-joints. The average depth of overburden may be observed to the right.





Photo. (35)

Castle-an-Dinas quarry. A strongly developed longitudinal joint in the fine-grained granite, G_2, of the Land's End Peninsula. At the North-Western end of the quarry tourmaline veins are common and are associated with an intense reddening of the adjacent granite. A limited amount of kaolinization has also occurred.

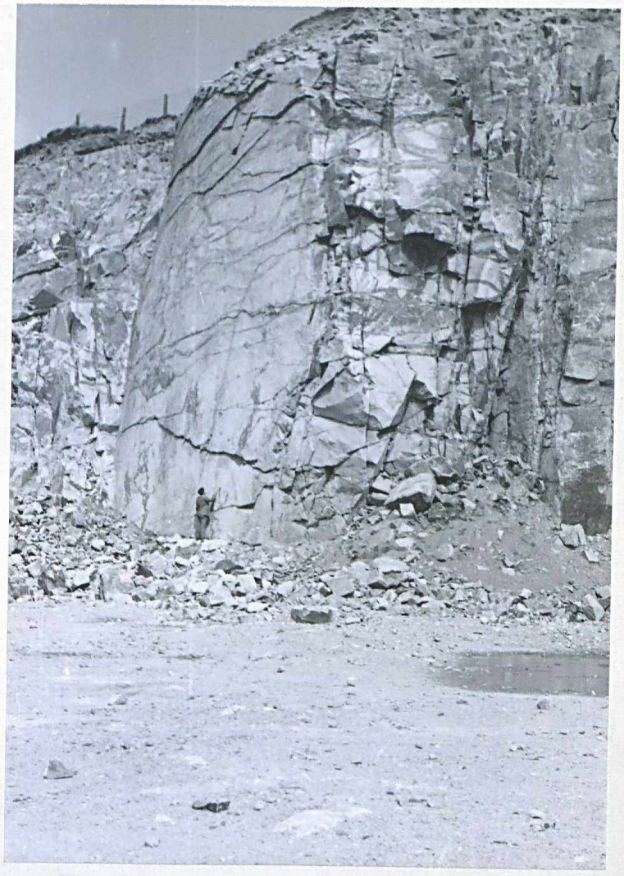


Photo. (36)

Closely spaced longitudinal joints in the Castle-an-Dinas quarry. The quarry face is the same height as that shown in Photo. (35)

Photo. (37)

Well developed cross-joints dipping to the North-West in the Castle-an-Dinas quarry.





Photo. (38)

Castle-an-Dinas quarry. Locally developed marginal fissures dipping at low angles to the South-East.

Photo. (39)

Castle-an-Dinas granite quarry. The marginal fissures are shown in relation to the longitudinal joints.





Photo. (40)

The outcrop of the South Lode in the Skip Shaft Zawn. An adit entrance may be seen in the bottom of the cliff face from where it leads to the Skip Shaft. The lode, of which a longitudinal section is shown in Fig. (24), consists mainly of banded quartz. It dips to the North-East at this point and intersects several South-West dipping major fractures which are continuous throughout the killas and the greenstone series.

Greenstone is exposed in the cliffs to the right, whereas the cliff face to the left is composed of folded and silicified killas. The result of changes in the dip of the lode upon its width may be observed. Above the adit level the lode is steep and attains a width of over 2 feet. Continuing upwards, the lode dip decreases and is accompanied by a very evident decrease in the lode width. Further variations in the dip produce the same results upon the width. Such changes may be explained by a downward relative movement of the hanging-wall of the lode.

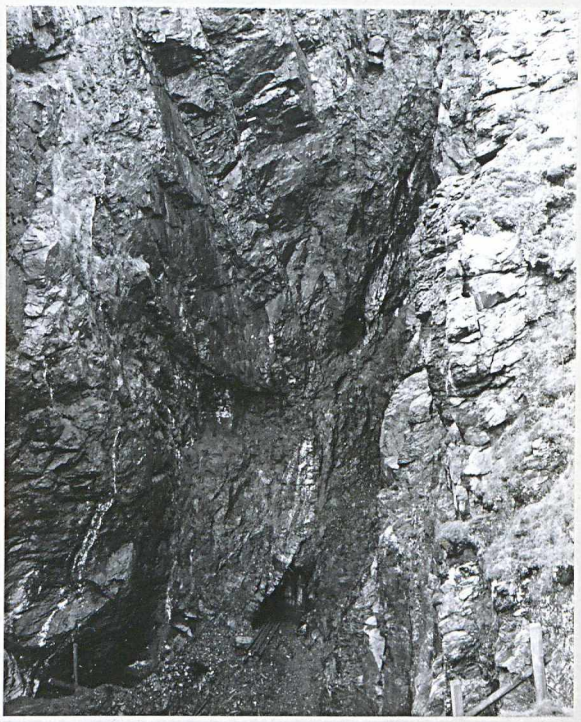


Photo. (41)

North Pig Lode, Level 11 (West).
Kodacolour, P.F.5. bulbs, 1/30 th,
f5.6-8, @ 9'.

Intense tourmalinization and reddening of the granite wall-rock preceeded the main cassiterite mineralization phase in the North Pig Lode. The centre of the Lode is indicated by the small quartz stringer. The tourmalinization was controlled by cross-joints and fractures parallel to the lode, and the width of alteration visible at this locality is unusually high for the mine.

Photo. (42)

North Pig Lode, Level 11 (West).
Kolacolour, P.F.5. bulbs. 1/30 th,
f8-11, @ 7'.

The same locality as Photo. (41), the scale being indicated by the small 2" wide quartz vein which marks the centre of the lode fissure. Especially within the tourmalinized wall-rock, blebs of pyrite and chalcopyrite occur as replacement products of original feldspar and as infillings of voids produced during the tourmalinization. The alteration is very similar to that illustrated in Photo's. (48) and (88/A).

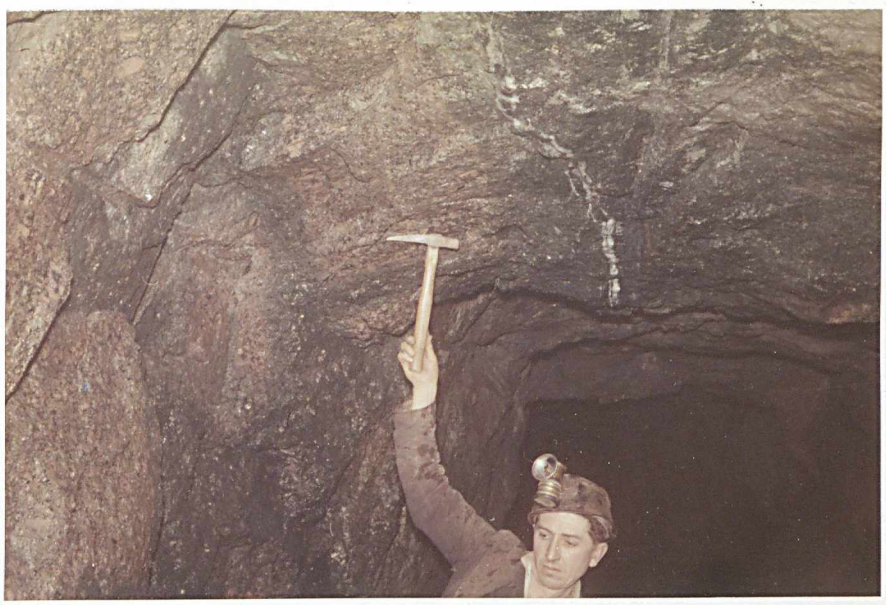




Photo. (43)

No.3 Branch Lode, Level 11 (West).
Kodacolour, P.F.1 bulb.

Three parallel fractures are present:-

(a) To the left: Tourmalinization, chloritization, and reddening of the granite have occured, and a little cassiterite is present by replacement of the original feldspars. Later vertical movement is indicated by slickenslides on the fracture wall (not visible in the photo.).

(b) In the centre: Similar wall-rock alteration as above was followed by intense cassiterite replacement of the wall-rock and a later infilling by quartz. The latter contains small fragments of the pre-existing wall-rock. Faulting has not taken place at the top of the photo. The apparent displacement is due to the irregular surface of the back of the drive.

(c) To the right: An early fracture was subjected to greisenization, one of the first forms of wall-rock alteration. Later infilling by a little tourmaline occured.

Kaolinization post-dated the above forms of granite alteration, and is associated with only those fractures along which movement took place. The scale is indicated by the central quartz vein which is 2" wide.

Photo. (44)

No. 3 Branch Lode, Level 11 (West).
Kodacolour, P.F.1 bulb.

Tourmalinized, chloritized, and reddened granite borders a single lode fissure, alongside of which intense replacement and veining (not visible in the photo. due to very slight colour differences) by cassiterite was followed by quartz infilling. Kaolinization occured on only the footwall of the lode. Large porphyrytic feldspars are visible in the reddened granite.





Photo. (45)

No.3 Branch Lode, Level 11 (West).
Kodacolour, P.F.1. bulb.

Two parallel lode fissures exist:-

(a) To the left: There is a small fissure approximately parallel to the main lode fissure, and on both sides of which the granite has been tourmalinized, reddened, and hematized. The 6" aplite dyke normal to the fissure has not been deflected, and no movement has taken place along the plane of the fissure. In the vicinity of the dyke the fissure has been displaced slightly by small post-mineralization conjugate faults.

(b) To the right: The main lode fissure has been subjected, after the original tourmalinization and reddening of the granite wall-rock, to approximately vertical movement. This resulted in the introduction of cassiterite and hematite, which were eventually followed by the quartz infilling. The small dyke was displaced for a horizontal distance of several feet by the main lode fissure.

Several clots of coarser-grained, tourmaline-rich material are contained within the dyke which has been subjected to tourmaline veining in the vicinity of the lode. The left-hand fissure represents an arrested stage in the history of mineralization of the right-hand fissure.

Photo. (46)

No.3 Branch Lode. Level 11 (West).
Kodacolour, P.F.1. bulb.

An enlarged view of the main lode fissure shown in Photo. (45). The reddened granite zone merges into tourmalinized granite which extends over several inches. Cassiterite is situated within the heavily hematized granite between the tourmalinized zone and the later quartz veining. It has originated through both replacement of the wall-rock and veining. A zone of kaolinization is visible only on the footwall of the lode at a distance of between 1 and 2 feet.

The apple green coloration arises from colour distortion by percolating water, and is not a different mineral infilling.





Photo. (47)

No.3 Branch Lode, Level 11 (West).
Kodacolour, P.F.1 bulb.

The predominant form of wall-rock alteration is tourmalinization, which is superseded, with increasing distance from the centre of the lode, by tourmalinization and reddening of the granite. Beyond the reddened zone the granite was subjected to kaolinization over a width of 3 to 4 inches. It exists on both the hanging-wall and the footwall but is predominant on the latter. Cassiterite occurs as veins, attaining a maximum width of one inch, in the chloritized granite. A large proportion of the final quartz infilling took the form of amethyst.

Photo. (48)

No.3 Branch Lode, Level 12 (West), @ 165 ft.
Kodacolour, P.F.1 bulb.

The central portion of the lode consists of tourmalinized and chloritized granite in which a few feldspar remnants are the only indication of its original nature. On both the hanging-wall and foot-wall there is a wide zone of reddened and kaolinized granite. The cassiterite is associated entirely with the tourmalinized and chloritized granite. Early sulphides (chalcopyrite and pyrite) are scattered throughout the altered granite, with the exception of the kaolinized zone. The central portion of the lode has been subjected to veining by quartz and pyrite, with which pitchblende is associated.

Chloritized granite containing the pitchblende mineralization is illustrated in greater detail in Photo. (106). The final phase of mineralization took the form of minor fracturing and the introduction of calcite, some of which infilled the re-opened pyrite veins.

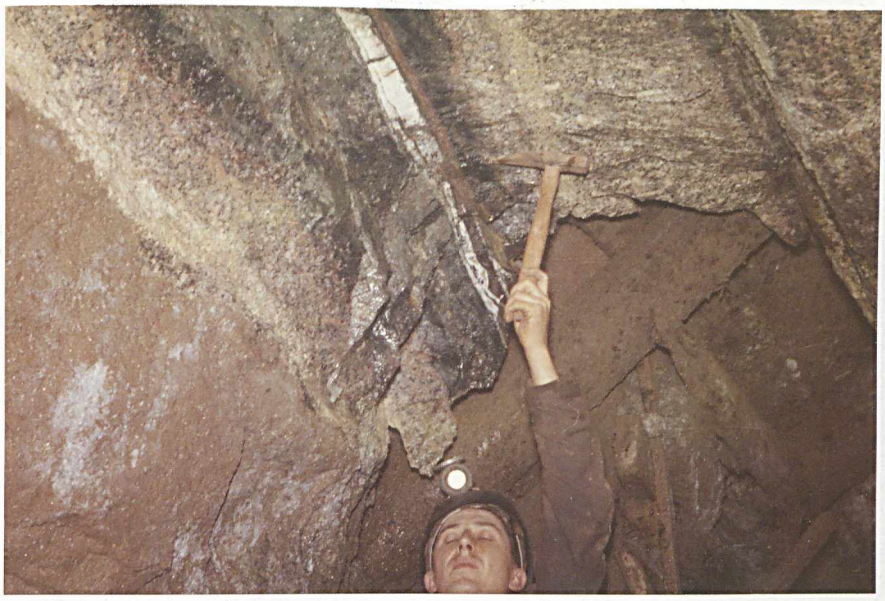




Photo. (49)

No.3 Branch Lode, Level 13 (East).
Kodacolour, P.F.5 bulb, 1/30th, f8, @ 9'.

The width of the fissure is indicated by the banded quartz and tourmaline infilling and later calcite. Wall-rock alteration of the granite comprises kaolinization on the footwall and slight red-brown discoloration on the hanging-wall. A small rounded xenolith is visible in the top centre of the photo.

Photo. (50)

No.3 Branch Lode, Level 13 (East).
Kodacolour, P.F.5. bulb, 1/30th, f8, @ 9'.

The infilling of the lode fissure consists entirely of opaque quartz and a little salmon-pink, hypothermal feldspar. The green copper coloration has arisen from water percolation from the stope above and not from mineralization in the lode as exposed at this locality in the drive. Kaolinization, partly controlled by small fractures adjacent to the lode, was the main form of wall-rock alteration.





Photo. (51)

No.3 Branch Lode, Level 13 (East).
Kodacolour, P.F.5 bulb, 1/30th, f8, @ 9'.

The lode fissure has been infilled as a result of two main mineralization phases. The first introduced feldspar which was followed almost immediately by a little quartz and cassiterite. Sulphide mineralization, associated with later lode movements, produced a local concentration (opposite the hammer) of chalcopyrite, pyrite, chalcocite, and bornite. Kaolinization was the only form of wall-rock alteration.

Photo. (52)

No.3 Branch Lode, Level 13 (East)
Kodacolour, P.F.5. bulb, 1/30th, f8, @ 9'

An early infilling of tourmaline, with which tourmalinization of the wall-rock was associated, was brecciated and the fragments cemented by calcite which possesses a brown coloration in the photo. Wall-rock alteration consisted chiefly of a red-brown discoloration of the granite parallel to the lode fissure and along pre-existing joints. Kaolinization took place only on the footwall. The copper staining has originated from the stope above and not from the lode as exposed in the drive. Water percolation has taken place also through the kaolinized granite.





Photo. (53)

Prospect @ 1,250 feet on the Main Level 9 X-cut, @ 50 feet West of the X-cut.
Kodacolour, P.F.5. bulb, 1/30th, f8-11, @ 7'.

The photo. shows the lode exposed in the back of the drive, and the scale is indicated by tourmalinized granite which covers a width of the order of 6". Intense tourmalinization and reddening affected the granite adjacent to the original fissure which is now marked by later movement and a slight infilling of chlorite and quartz. Kaolinization, on both the footwall and the hanging-wall, appears to have post-dated the tourmalinization and reddening of the granite.

The above photo. is not typical of the Prospect which is extremely variable in appearance and cassiterite content throughout the 50 feet over which it is exposed. It consists typically of banded tourmaline and quartz with a total width varying between 6 and 12 inches. Wall-rock alteration comprises hematization and kaolinization of the granite.

Recent development on the Borehole Lode has indicated that this North-East dipping Prospect is most probably a continuation of the Borehole Lode (West).

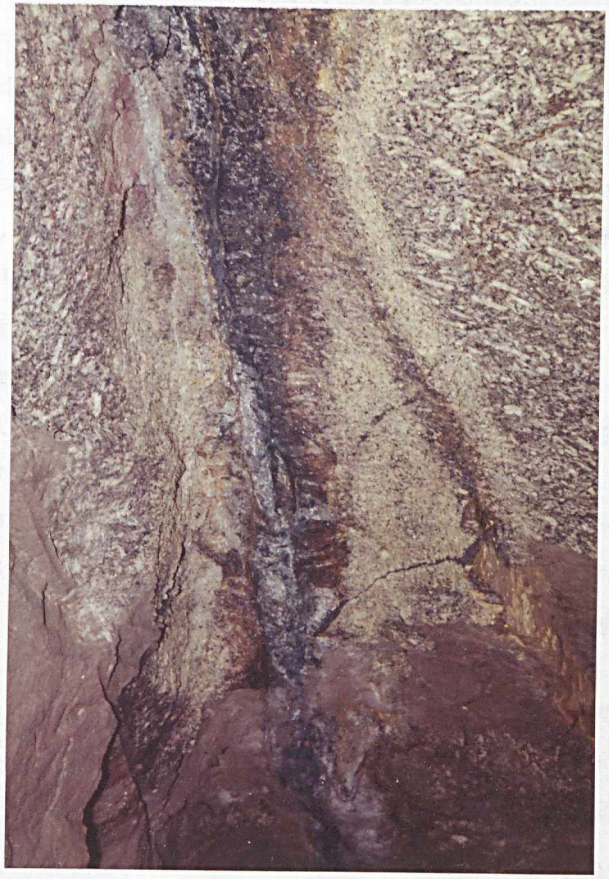


Photo. (54)

Footwall Branch Lode, Level 13 (West).
Kodacolour, P.F.5. bulb, 1/30th, f5.6, @ 9'.

Early alteration of the granite was followed by the infilling of the lode fissure to a width of 18" with massive feldspar which contains blebs of chalcopyrite and tourmaline. Later movements along the lode fissure resulted in the introduction of cassiterite, quartz, and chlorite on the footwall over a width of 12" (on the left).

A feature of the lower horizons of many of the lodes of Geevor Mine is the abundance of early hydrothermal feldspar such as illustrated in Photos. (97/A, 98, 102/D & 105). At this locality, it is not associated, as is usually the case, with tourmaline, quartz and arsenopyrite. Instead, a little tourmaline and chalcopyrite are present with the unusually large quantity of feldspar.

A similar occurrence was recorded on the North Lode at 485' West of the North Pig Lode on Level 11 where a 12" wide mass possessed a horizontal extent of only a few feet. In this case purple fluorspar was present within the feldspar.



Photo. (55)

Hanging-wall vein, Level 13, @ 30 feet West of the Footwall Branch Lode.
Kodacolour, P.F.5. bulb, 1/30th, f.5.6. @ 9'.

The 12" wide lode is viewed in the back of the drive where a large amount of the ground has broken away. An early tourmaline infilling and tourmalinization of the wall-rock adjacent to the original fissure, was followed by a cassiterite-quartz phase of mineralization. Wall-rock alteration consists of intense hematization and superimposed kaolinization.

Although the Hanging-Wall Vein, like the other Geevor Lodes, is extremely variable in content and appearance throughout its course, its value is due almost entirely to the cassiterite-quartz phase of mineralization. The Vein was first detected on Level 13 where it appeared to develop as a branch in the hanging-wall of the Footwall Branch Lode. It is likely however, that the Vein is continuous, but uneconomic, on the footwall side of the Footwall Branch Lode. At its junction with the latter the Vein consists of tourmalinized granite which is veined by feldspar and quartz. Chalcopyrite and other sulphides, which are normally absent in the Footwall Branch Lode, were abundant at the junction.



Photo. (56)

Hanging-Wall Vein, Level 13, @ 100 feet West of the Footwall Branch Lode.
Kodacolour, P.F.5. bulb, 1/30th, f.5.6. @ 9'.

Greisenization was the first form of wall-rock alteration adjacent to the lode and is shown in an arrested stage by the two parallel stringers on the left. Further tourmaline infilling and alteration characterized the succeeding stage of mineralization, accompanied by vertical movement in the plane of only the lode fissure on the right. Later movement along this fissure, indicated by well developed vertical slickenslides on the faces of the tourmalinized walls, resulted in the selective mineralization of the lode fissure by a cassiterite-quartz phase which brecciated and re-cemented fragments of the wall-rock and previous tourmaline infilling. A specimen obtained from the locality of Photo. (56) is shown in Photo. (101/C).

Later vertical movements resulted in the introduction of a little tourmaline, chlorite and cassiterite, upon which were superimposed later horizontal slickenslides originating during the post-mineralization conjugate tear faulting period.

The absence of any observed dykes prevents an evaluation of the relative directions of movement of the hanging-wall and footwall of the Vein. The small vug shown in the centre of the lode fissure slightly below the hand may be an indication of the direction of movement. The vug has been twisted during its formation into a sigmoidal shape.



Photo. (57)

Borehole Lode, Level 12 (West), @ 70 ft.
Kodacolour, P.F.5. bulb, 1/30th, f5.6-8 @ 9'.

The Photo. shows the typical tourmaline content of the Borehole Lode. A large proportion of the tourmaline has arisen through alteration of the granite wall-rock. Early sulphide impregnation, consisting mainly of chalcopyrite and pyrite and similar to that shown in Photo. (42), was common at this stage. Later vertical movements resulted in the introduction of a tourmaline-cassiterite, a cassiterite-quartz-fluorspar (green), and a cassiterite-Chalcopyrite-fluorspar (Green) phase. Photo. (57) illustrates the tourmaline replacement and infilling and the succeeding cassiterite-quartz-fluorspar phase. The latter infilled small fractures parallel to, and traversing, the lode, one of which is visible in the top centre of the photo. A similar vein, which is transitional towards the cassiterite-chalcopyrite-fluorspar phase, is illustrated in Photo (92).

Photo. (58)

North Lode, Level 10.
Kodacolour, P.F.5.bulb, 1/30th, f8-11, @ 6'.

The lode is exposed between the North Pig Lode and the Hanging-Wall Branch Lode. The first, and cassiterite-bearing, phase is visible as banded quartz and tourmaline on the right-hand side. Cassiterite is associated with the tourmaline which tended to precede the quartz and be concentrated on the original footwall and hanging-wall of the lode. The later quartz fragmented the tourmaline and was injected into the centre of the original tourmaline lode. Each phase was associated with a relative downward movement of the hanging-wall. During the period of infilling of the North Levant Lode, relaxation of the stres environment resulted in the introduction of the massive quartz on the hanging-wall of the North Lode. The central void was eventually filled with jasperiodal hematite of the character shown in Photo. (110). Vertical movements, unassociated with mineralization, are indicated by the central sheeted zone between the massive quartz and the banded quartz and tourmaline.

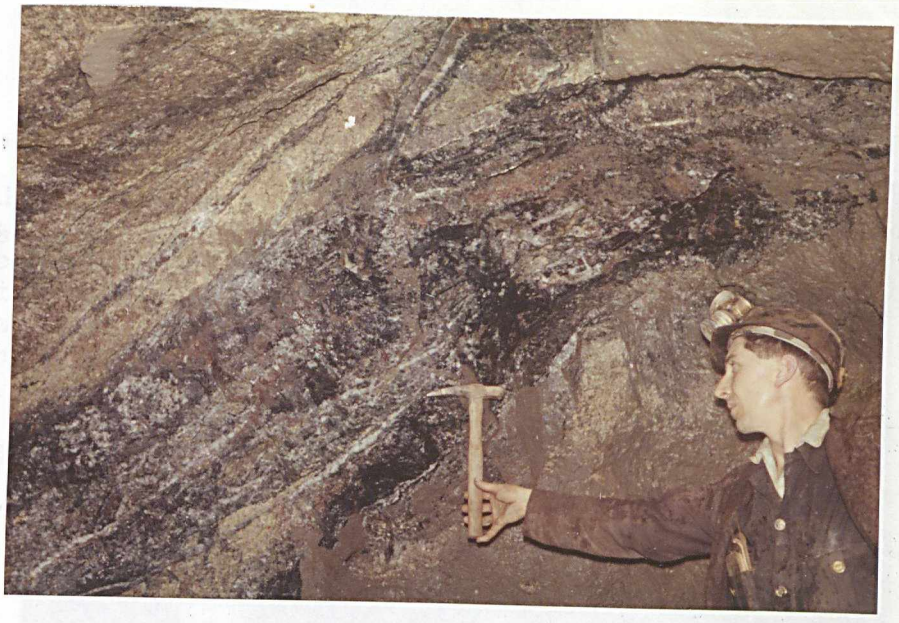




Photo. (59)

Coronation Lode, Level 9.
Kodacolour, P.F.5. bulb, 1/30th, f8, @ 9'.

The photo. shows a typical exposure of the Coronation Lode from the main Level 9 x-cut. Slight reddening and discoloration of the wall-rock adjacent to the original fissure was followed by banded infilling of quartz and tourmaline with which the cassiterite is associated. Further relative downward movements of the hanging-wall and slight stress relaxation produced successive phases of quartz mineralization together with sulphides, fluorspar, and calcite. The lode possesses a width of approximately 2 feet.

Photo. (60)

Coronation Lode, Level 8.
Kodacolour, P.F.5. bulb, 1/30th, f5.6-8 @ 9'.

The lode is exposed in the back of the x-cut from the North of the Hanging-Wall Branch Lode. With a width of about 2 feet, it consists of banded tourmaline and quartz. Wall-rock alteration comprises discoloration and kaolinization of the granite.





Photo. (61)

Wethered Lode, Level 9.
Kodacolour, P.F.5. bulb, 1/30th, f16, @ 4'.

A 2" wide vein of quartz and sphalerite parallel to the main fissure of the Wethered Lode, and at a distance of 3 feet from the latter.

Photo. (62)

Coronation Lode, Level 12 (West).
Kodacolour, P.F.1 bulb.

Massive quartz occupying the main fissure of the Coronation Lode. It is possible that this infilling was associated with an oblique relative movement of the footwall and hanging-wall of the Lode. There is a very obvious increase in the width of the fissure, as indicated by a variation in the amount of the quartz, with changes in the strike of the Lode.

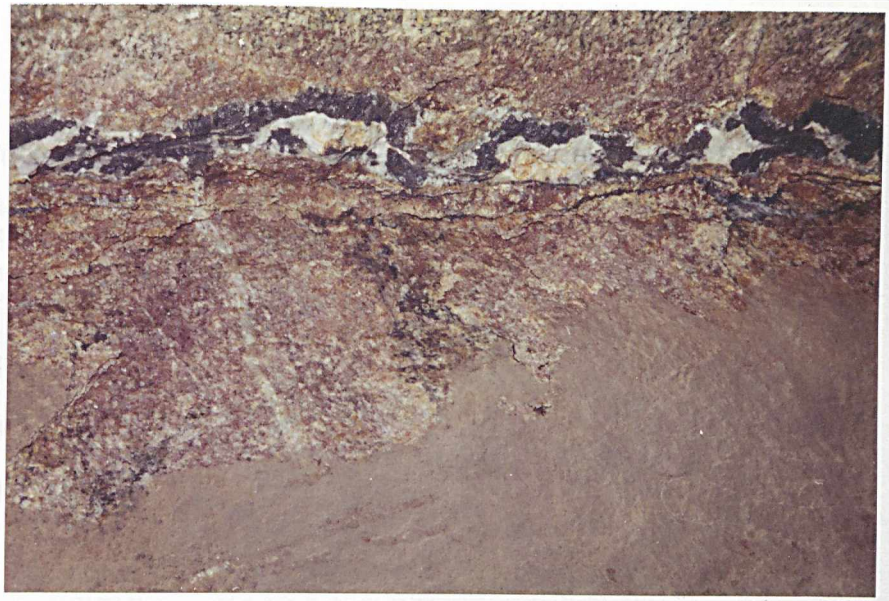




Photo. (63)

The 'C' Lode, Level 13.
Kodacolour, P.F.5. bulb, 1/30th, f8, @ 9'.

A typical exposure of the 'C' Lode on Level 13 where the lode was stoped for a short distance. Early tourmalinization of the granite adjacent to the fissure is evident over about one or two inches. Downward relative movement of the hanging-wall was accompanied by the introduction of massive quartz which brecciated the wall-rock and 'froze' the fragments into place in the centre of the resulting lode. Cassiterite was introduced with the first quartz as a cassiterite-quartz phase. Successive stress relaxation and infilling produced only barren quartz and jasperiodal hematite.

Photo. (64)

North Lode, Level 11 (West), @ 600 ft.
Kodacolour, P.F.1. bulb.

The photo. illustrates the North Lode where it is exposed 50 feet West of the North Levant Lode. A downward relative movement of the hanging-wall was accompanied by infilling of massive quartz which cemented the fragments of tourmalinized granite wall-rock resulting from an earlier alteration around the fissure. The granite throughout a wide area is discoloured and the lode possesses a very low cassiterite content at this location, which is indicated in Fig. (64).





Photo. (65)

No.3 Branch Lode, Level 13 (East).
Kodacolour, P.F.5. bulb, 1/30th, f.8, @ 9'.

The lode exists as two branches which are separated by about 2 feet of granite. Each branch is poorly mineralized, containing only a little tourmaline and quartz. A small xenolith is situated between the two branches above the hammer.

Photo. (66)

North Levant Lode, Level 11.
Kodacolour, P.F.1. bulb.

At the junction with the North Lode, which it displaces, the North Levant Lode consists of banded quartz and jasperiodal hematite. As shown in Photo. (68), the infilling of the North Levant Lode took place in two stages, one of which is represented in Photo. (66). Only a trace of cassiterite is present in the Lode.

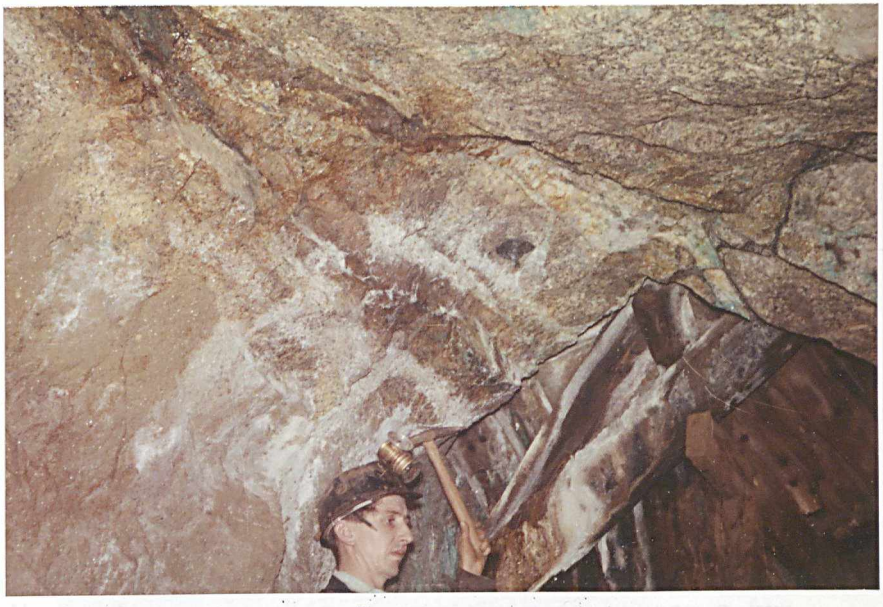




Photo. (67)

Footwall Branch Lode, Level 11. At the x-cut from the No.2 Branch Lode.
Kodacolour, P.F.5. bulbs, 1/30th, f5.6-8, @ 9'.

The Footwall Branch Lode, on all the levels on which it has been developed, junctions with the North Levant Lode to the West of the former's intersection with the North Lode as shown in Fig. (30). From the junction the North Levant Lode extends to the West occupying the same fissure as the Footwall Branch Lode for a distance of approximately 500 feet. It is represented by later infillings of the Footwall Branch fissure with quartz and jasperiodal hematite.

In the exposure illustrated in this photo. the Footwall Branch Lode is represented by a little quartz and a narrow zone of heavily altered granite on the footwall to the left. The North Levant Lode enters the drive and joins the Footwall Branch Lode a short distance along the drive and may be seen in the development end which appears faintly in the photo. in the bottom right. The North Levant Lode branches and contains large horses of granite. In the vicinity of this location the Footwall Branch Lode, considered in conjunction with the North Levant Lode, has a low cassiterite content and has not been stoped. It contains a large amount of fluorspar in three colours; green, purple and grey.



Photo. (68)

North Levant Lode, Level 11.
Kodacolour, P.F.1. bulb.

The two phases of infilling of the North Levant Lode are visible. To the left the lode consists of banded quartz and jasperiodal hematite and is characterized by the excessive amount of ochre. To the right the Lode comprises massive quartz in which occasional vugs are infilled with jasperiodal hematite similar to that shown in Photos. (58) and (110).

The usual form of wall-rock alteration adjacent to the North Levant Lode is a strong brown discolouration and sporadic kaolinization of the granite.

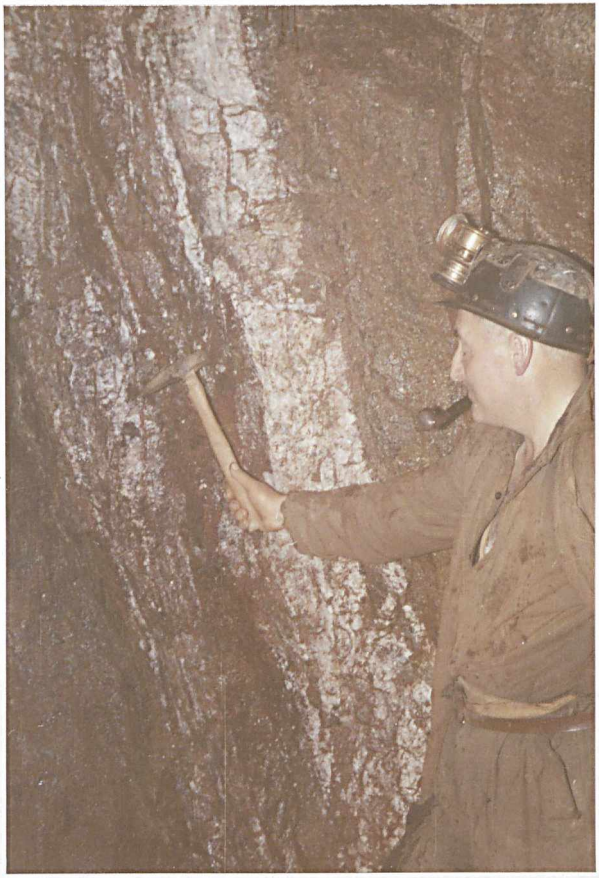


Photo. (69)

Footwall Branch Lode, Level 12 (West), @ 200 ft.
Kodacolour, P.F.5 bulb, 1/30th., f8, @ 9'.

The Photo. illustrates the association of the North Levant and the Footwall Branch Lodes. The latter is represented by a little quartz, cassiterite, and heavily discoloured granite on the footwall to the left. The North Levant Lode is represented by the two phases of infilling shown in Photo. (68).

Photo. (70)

No.3 Branch Lode, Level 13, @ 60 ft. East of the X-cut.
Kodacolour, P.F.5 bulb, 1/30th., f8, @ 9'.

A thin fracture infilled with tourmaline and bordered by a few inches of kaolinized granite, is displaced by the main lode fissure. The latter consists of tourmaline and feldspar which fill a narrow fracture surrounded by reddened and kaolinized granite. Narrow tourmaline veins are a characteristic feature of the No.3 Branch Lode and represent an arrested stage in the formation of the Lode.



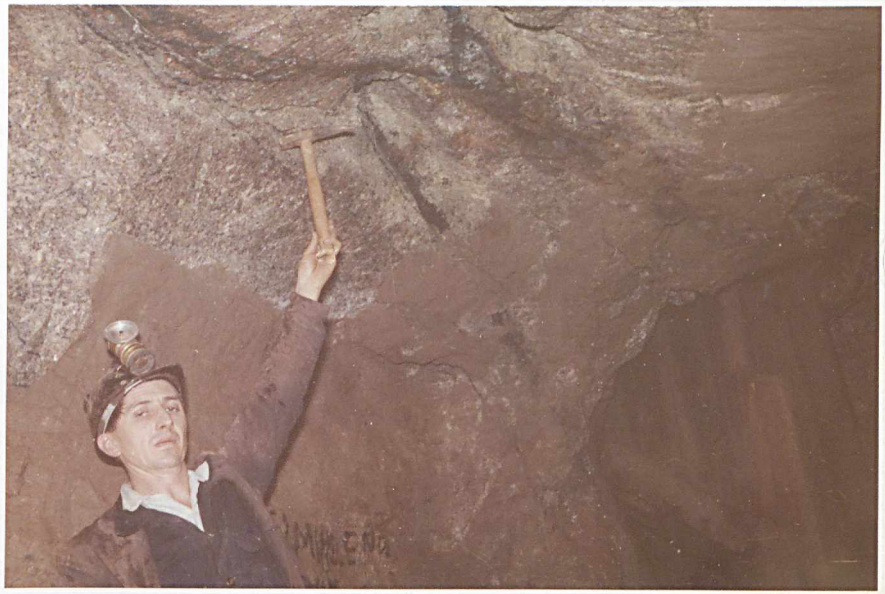


Photo. (71)

The Prospect No.1, Level 12.
Kodacolour, P.F.5. bulb, 1/30th., f8, @ 9'.

The Prospect No.1, which has been driven on for a considerable distance, consists, at this locality, of a narrow tourmaline vein bordered by kaolinized granite. It is displaced by another vein of tourmaline alongside of which the wall-rock alteration takes the form of reddened, as opposed to kaolinised, granite.



Photo. (72)

Hanging Wall Branch Lode, Level 9.
Kodacolour, P.F.5. bulb, 1/30th., f8, @ 8'.

The photo. shows one of the intersections between the Hanging-Wall Branch Lode and the 'A' Lode. The latter, which has been developed to both the East and West of the Hanging-Wall Branch, is continued to the left of the photo. and the Hanging-Wall Branch Lode is continued in the background as shown in Fig. (57). Late movement and simultaneous mineralization of the 'A' Lode resulted in the displacement of the Hanging-Wall Branch Lode fissure, which had already been selectively mineralized between the 'A' Lode and the 'D' Lode. This Hanging-Wall Branch Lode mineralization accompanied the first phase on the 'A' Lode and the main phase of cassiterite mineralization in the 'D' Lode. The scale is indicated by the timber stull and pipe in the bottom left of the photo.

Photo. (73)

Coronation Lode, (Footwall Branch), Leval 11 (West).
Kodacolour, P.F.5 bulb, 1/30th., f8-11, @ 7'.

As a branch of the Coronation Lode, the Footwall Branch is very similar in mineralogy to the latter. It consists of banded tourmaline and quartz, with the values lying both in the tourmaline and in soft hematite on either the footwall or the hanging-wall. The 18" wide Lode is displaced sinistrally for a few feet by a post-mineralization tear fault which is approximately parallel to the Main Western Fault but appears to have exerted no structural control upon the mineralization. Conjugate post-mineralization tear faults are common in the vicinity.





Photo. (74)

Footwall Branch Lode, Level 13 (West).
Kodacolour, P.F.5. bulb, 1/30th., f5.6, @ 9'

The Footwall Branch Lode in the vicinity of the main Western Fault, F_2, consists of a 6" wide central quartz leader which is bordered on both sides by tourmaline and a little reddened granite. At the intersection with the Main Fault on Level 13 the Lode does not change appreciably in appearance. Both the quartz and the tourmaline seem to be continuous for up to 10 feet on each side. For a short distance to the West of the Fault the Lode possessed a tin content greater than that present to the East. However, eventual development indicated an overall decrease in the tin content of the Lode to the West of the Fault.

The Main Western Fault is sharply defined, and, as shown in the lower photo. and Fig. (61), step faulting occurred during the post-mineralization tear movement. The entire granite for a distance of the order of 10 feet on both sides of the Fault is discoloured in red and brown. The fault planes contain hematite and vertical and horizontal slickenslides are present in both the Lode and the Fault.





Photo. (75)

No.3 Branch Lode, Level 13 (East) @ 10 ft.
Kodacolour, P.F.5 bulb, 1/30th., f8, @ 9'.

A common feature of many of the Geevor Lodes is sporadic intense tourmalinization of the granite wall-rock. As shown in the photo., it usually occurs at the junction of a branch fracture and the main lode fissure. Slight kaolinization is the only other form of alteration and it surrounds the belt of coarse-grained tourmalinized granite. The main lode fissure is marked by the reddened granite and the introduction of chlorite and cassiterite. In this vicinity the lode contains feldspar and arsenopyrite which were followed by cassiterite, chlorite, chalcopyrite and pyrite.

Photo. (76)

No.3 Branch Lode, Level 13 (East), @ 25 ft.
Kodacolour, P.F.5 bulb, 1/30th., f8, @ 9'.

A branching mass of tourmalinized granite, similar to that shown in Photo. (75), is present on only one side of the lode - probably as a result of vertical displacement. The lode fissure is infilled with feldspar and arsenopyrite containing fragments of earlier tourmaline. The wall-rock alteration consists of reddening and slight kaolinization of the granite. A primary granite cross-joint contains a large amount of hematite developed locally near the lode. It should be noted that in each case illustrated in Photos. (75) and (76) the tourmalinization occurs on the hanging-wall of the lode.





Photo. (77)

North Lode, Level 12 (West), @ 220 ft. West of the X-Cut.
Kodacolour, P.F.1 bulb.

The North Lode is shown in the development end to the West of the major fault zone, FZ_1, which occurs in the immediate vicinity of the North Levant Lode, as illustrated in Fig. (64). To the East of the Fault zone the North Lode has been extensively stoped, and consists of banded quartz and tourmaline bordered by reddened granite. To the West very little movement has taken place in the plane of the lode fissure with a consequent absence of infilling. Hematite is developed to the same extent as to the East of the fault zone and kaolinization is the only form of wall-rock alteration.

Within the major fault zone, which appears to possess a width of over 300 feet, very little movement and mineralization took place along the North Lode fissure. The extension of the fissure, beyond the fault zone appears to have been detected recently by x-cutting on Level 13, where although infilled with quartz and tourmaline, the lode dips at a low angle of between 50 and 55 degrees to the South-West.

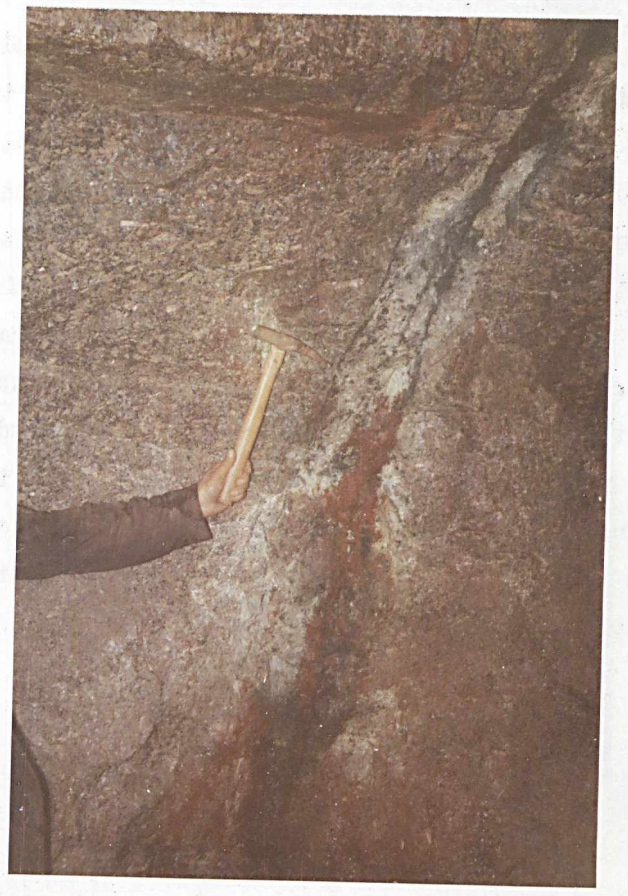


Photo. (78)

Kodacolour, P.F.5 bulb, 1/30th., f11-16, @ 4.5'.

One of the largest xenoliths exposed in Geevor Mine is visible on the main Level 9 x-cut in the vicinity of the Coronation Lode. A transitional zone, containing blebs of tourmaline, and between 1 and 3 inches in width is visible around the margin. The small detached fragment to the bottom left was removed from the top of the xenolith where porphyrytic feldspars are developed parallel to the margin. They are normally developed throughout the xenoliths, and unless sporadically distributed, they either comply with the orientation of the feldspars in the surrounding granite or arrange themselves parallel to the margin of the xenolith. The scale is indicated by the shaft of the hammer.



Photo. (79)

Wethered Lode, Level 9, @ the X-cut to the Borehole Lode.
Kodacolour, P.F.5 bulb, 1/30th., f5.6, @ 11'

The mineralization of this section of the Wethered Lode has comprised the following stages:-

(a) Wall-rock alteration of the granite adjacent to the original lode fissure; discolouration, slight kaolinization, and especially tourmalinization.
(b) Downward movement of the hanging-wall was accompanied by the introduction of tourmaline, cassiterite and quartz. Fragments of the fissure walls were frozen into the centre of the lode (now concentrated nearer the footwall).
(c) Further downward movement of the hanging-wall resulted in the introduction of quartz carrying pyrite and chalcopyrite (shown by green copper staining) against the hanging-wall.
(d) Later quartz veining penetrated both the pre-existing lode and the granite footwall.

A sketch of the lode cross-section in the vicinity of the site of this photo. is provided in Fig. (138).

Photo. (80)

Coronation Lode, Level 15 (West).
Kodacolour, P.F.5. bulb, 1/30th, f4, @ 13'

The separate stages of mineralization of the Coronation Lode are easily discerned in this photo. -

(a) Early wall-rock alteration resulted in a widespread brown discoloration of the granite.
(b) The first, and only phase of cassiterite mineralization accompanied the complete alteration of the fissure walls forming a chloritized and hematized granite (now visible on the hanging-wall to the left).
(c) The introduction of two phases of quartz mineralization which probably took place around the same time as the infilling of the North Levant Lode, shown in Photo. (68).

The other mineralization phases on the Coronation Lode consisting of tourmaline-cassiterite, quartz-sulphides, and quartz-fluorspar, are not present at this locality which is approximately 200 feet East of the Main Western Fault, F_2.





Photo. (81)

Grenfell Lode, Level 10 (East), @ approx. 200 ft.
Kodacolour, P.F.5 bulb, 1/30th, f5.6, @ 12'

The photo. shows the two dominant stages in the structural and mineralogical history of the Grenfell Lode:-

(a) The infilling of a vertical fissure with tourmaline, quartz, and a little cassiterite over a total width of approximately 3 feet. This was accompanied by tourmalinization and slight discoloration of the adjacent granite, now marking the footwall and hanging-wall of the Lode.

(b) Further relative movements in the approximate plane of the pre-existing lode are indicated by the 6" wide later period of infilling. Two phases are represented; quartz-cassiterite, and hematite-cassiterite.

The two mineralization phases present at this locality are represented to varying extents in other lodes of the mine. It is only in exceptional cases that they are so well defined. The first phase is typical of the 'C' Lode where the cassiterite is usually associated with the quartz. The 'C' Lode is remarkable for the low amount of payable ground that it contains in relation to the amount of driving. This first phase by itself, therefore, is apparently not sufficient to yield payable ground. Only when the second phase, which possesses a higher tin content, is superimposed upon the first does the whole form a lode which warrants stoping.

The lode is viewed at the point of commencement of a boxhole raise in the back of the drive.



Photo. (82)

Prospect between the 'D' Lode and the Coronation Lode, Level 10, at the junction with the Central dyke.
Kodacolour, P.F.5 bulb, 1/30th, f8, @ 8'.

The change from the coarse-grained porphyrytic granite to the fine-grained aplo-granite dyke rock is visible on the wall to the left of centre. The lode illustrates only a late quartz phase, although values are present to the West of the dyke as a result of the introduction of a tourmaline-cassiterite phase. To the East a feldspar phase, which was selectively replaced by cassiterite and followed by fluorspar, produced good values. The dyke possesses a width of the order of 10 feet and appears to have exerted no influence upon the formation of the lode. There is a slight change in the strike at the junction and two small parallel fissures have developed in the hanging-wall, but there has been no apparent control exerted upon the mineralization.

Wall-rock alteration, which is predominantly reddening, takes the same form in both the granite and the dyke, which occupies a local cross-joint in the granite.

Photo. (83)

Grenfell Lode, Level 12 (East).
Kodacolour, P.F.5 bulb, 1/30th, f4-5.6, @ 13'.

East of the X-cut into the Grenfell Lode a major dyke enters the drive. It is composed of a fine-grained tourmaline-rich granite which grades into a tourmalinized granite and quartz-tourmaline rock. With a strike approximately the same as the Grenfell Lode it occupies a well-defined longitudinal joint in the granite.

At the locality shown in the photo. the lode changes in strike and cuts through the dyke. As in Photo. (81), two major phases of structural formation and mineralization are visible in the lode. To the right the early quartz-tourmaline phase contains fragments of dyke rock. To the left a narrow zone of later movement localizes the majority of the cassiterite. A post-mineralization conjugate tear fault with associated earthy hematite crosses the lode without any appreciable horizontal displacement at an angle of approximately 45 degrees.





Photo. (84)

Grenfell Lode, Level 10 (West).
Kodacolour, P.F.5 bulb, 1/30th, f4, @ 13'.

The photo. shows several features which are of interest:-

(a) To the left two sills are exposed in the development end. They consist of a tourmaline-rich, fine-grained granite and dip at about 20 degrees to the North-West, occupying flat-lying, primary granite joints.

(b) The two sills, together with a nearby steeply inclined aplite dyke indicate that the major block of granite on the North-East of the Grenfell Lode has moved downwards relative to the South-West side through a distance of the order of 10 feet.

(c) The first phase of mineralization affected not only the final lode fissure but also several less steeply inclined major primary joints, which are now bordered by a little graisen and reddened granite. The formation of the main fissure (now regarded as the lode) post-dated the development of the primary granite joints which dip towards the South-West.

(d) Whereas the steeply inclined dykes apparently exerted no structural control upon the extent of mineralization within the Geevor lodes the two sills shown in this photo. impounded the mineralization of the main Grenfell Lode fissure. In the bottom half of the photo. the Lode is approximately 6 inches wide and contains quartz, feldspar, tourmaline, and pyrite. In the upper half these minerals are not represented in the fissure.

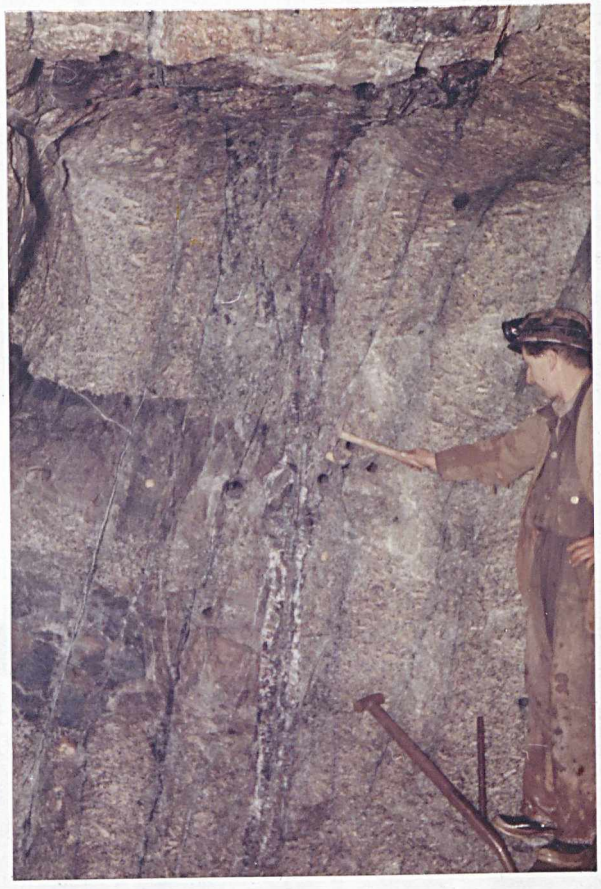


Photo. (85)

Kodacolour.

A: Carn Eanes type granite. From the quarry on the summit of the Carn.

B: Boscaswell type granite. From the Northern end of the main Level 9 x-cut, Geevor Mine.

C: Western type granite. From the No.3 Branch Lode, Level 13 (West).

D: Normal Geevor type granite, containing a zoned porphyritic feldspar.

The results of chemical analyses of the specimens are presented in Table (4), and the distribution of the various granite types is indicated in Fig. (17).

Photo. (86)

Kodacolour.

A: A fine-grained quartz-feldspar-tourmaline dyke in normal Geevor type granite, (no. 0405).

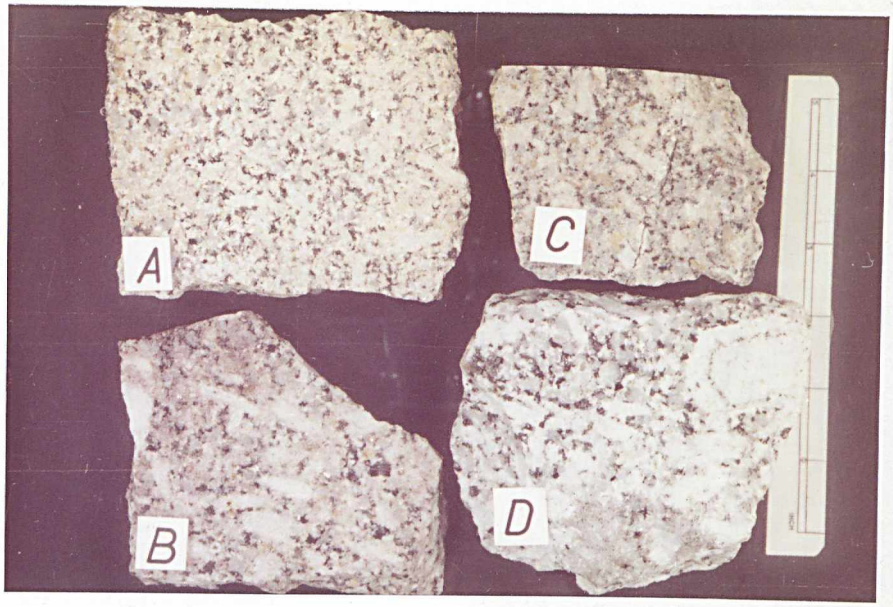
B: Medium-grained granite dyke rock from the Prospect No.2 (West) to the North of the No.3 Branch Lode, Level 11, (No. 0493, T/S 16431).

C: Fine-grained granite from the Main Central Dyke at its intersection with the Coronation Lode, Level 12, (No. 0419).

D: Fine-grained tourmaline granite dyke rock, (No. 0410).

E: Aplite dyke rock from the No.3 Branch Lode, Level 11, (No. 0355, T/S 14553).

F: Heavily tourmalinized fine-grained granite dyke rock from the Prospect South, Level 9. See Fig. (53).


A
C
B
D

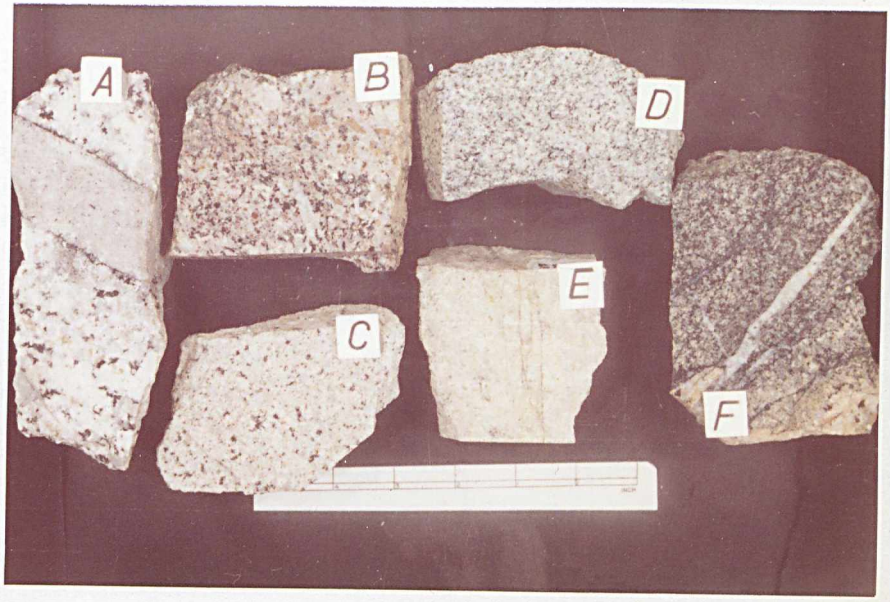

A
B
D
E
C
F

Photo. (87)

Kodacolour.

A: The sharp granite-killas contact on the No.3 Branch Lode, Level 12, (No. 0270, T/S 13741).

B: Coarse-grained porphyritic Land's End Granite, G_1, from Lamorna Cove, (No. 0258).

C: Fine-grained Land's End Granite, G_2, from the Castle-an-Dinas Quarry, (No. 0036, T/S 12627).

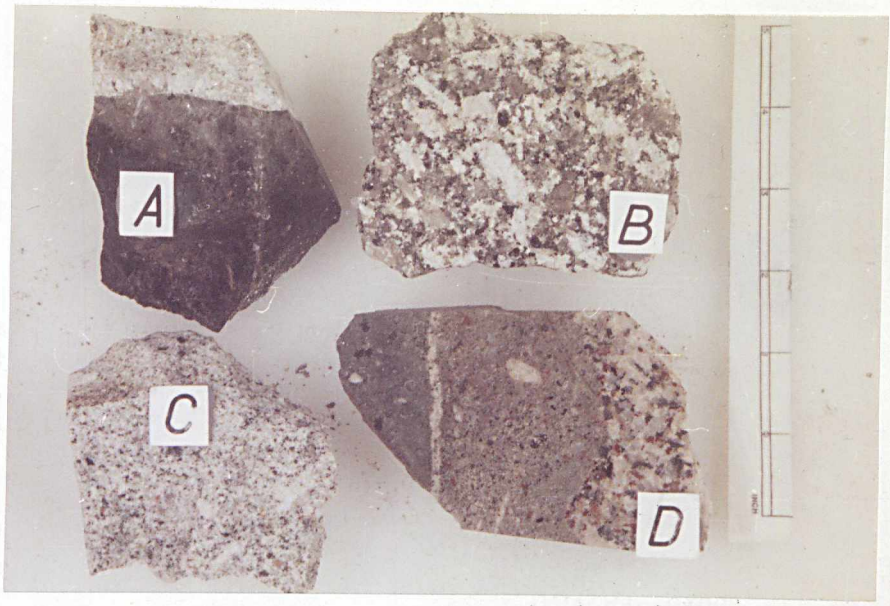
D: A section through a typical xenolith showing the gradational zone between the centre of the xenolith to the left and the slighly altered normal Geevor type granite to the right.

Photo. (88)

Kodacolour.

A: The complete zone of altered granite adjacent to the No.3 Branch Lode, Level 11 (West). The results of chamical analyses are presented in Table (5) and Figs. (126 & 127). The results of modal analyses are presented in Figs. (124 & 125).

B: A complete section of the lode bounded by discoloured granite and illustrated in Photo. (52) from the No.3 Branch Lode, Level 13, @ 125 feet East of the x-cut. Early tourmaline, quartz, and cassiterite infilling the fissure have been brecciated during a late phase of calcite mineralization.


A
B
C
D


A
B

Photo. (89)

Kodachrome.

A complete section of the lode and the altered granite footwall from the No.3 Branch Lode, Level 11 (West), (No. 0371).

The specimen is 9 inches high and the top marks the position of the 2 inches wide zone of kaolinization. The granite is slightly reddened and all the cassiterite present was formed by replacement of the wall-rock. It is visible as a dark brown coloration of the granite over a width of between one and two inches.

Later intermittent quartz and feldspar mineralization produced the 'leader' which contains fragments of the cassiterite-bearing wall-rock. A similar specimen is shown in Photo. (93/D).

Photo. (90)

Kodachrome.

The complete zone of altered granite adjacent to the No.3 Branch Lode on Level 12 at the locality illustrated in Photo. (48), (No. 0360 & 0361).

The same zones of alteration are present as in the specimen shown in Photo. (88/A).




10 CENTIMETRES
1 DECIMETRE

Photo. (91)

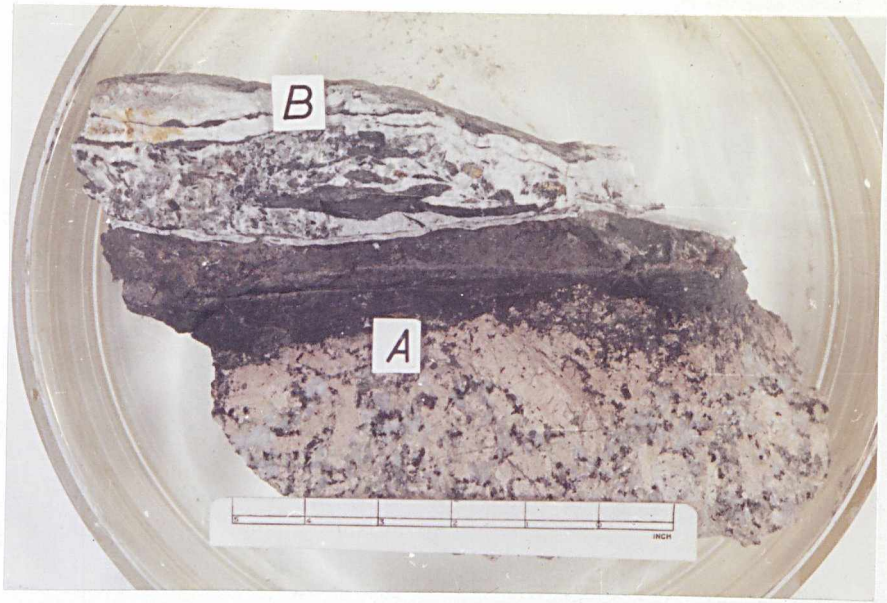
Kodacolour.

A complete section of the lode (B) and the altered granite footwall (A) from the No.3 Branch Lode, Level 11 (West). The specimen is very similar to that illustrated in Photo. (89), but whereas the latter contained cassiterite by replacement, the specimen shown in Photo. (91) contains quartz-chlorite-cassiterite veins traversing the highly altered granite wall-rock (above A). Later quartz infilling contained blebs of chalcopyrite and some chalcocite and was followed by the introduction of a little amethyst (to the left of B).

Photo. (92)

Kodacolour.

A specimen from the Borehole Lode, Level 12, @ 70 feet West of the x-cut from the Wethered Lode. The locality is shown in Photo. (57) and Fig. (51). Where changes in the direction of dip of the Borehole Lode take place, narrow fractures were developed parallel to the main lode fissure, as shown in Fig. (104). These were subsequently infilled with cassiterite during the mineralization phase. The specimen shows the tourmalinized granite wall-rock being traversed by a 1" wide vein (1) of cassiterite with accessory sulphides (chalcopyrite and pyrite), quartz, and green fluorspar.


B
A


1

Photo. (93)

Kodacolour.

A: Heavily chloritized granite wall-rock from the North Lode (West) in the vicinity of the Major Fault Zone, FZ_1, near the North Levant Lode, (No. 0434). The original texture is still visible.

B: Altered granite wall-rock from the No.3 Branch Lode (West), Level 11, (No. 0031). In the alteration of the granite the feldspars have been selectively replaced by tourmaline, and in places the original texture of the rock is completely destroyed.

C: Silicified granite wall-rock from the Footwall Branch Lode, (No. 0383), with the original texture and porphyrytic feldspars preserved.

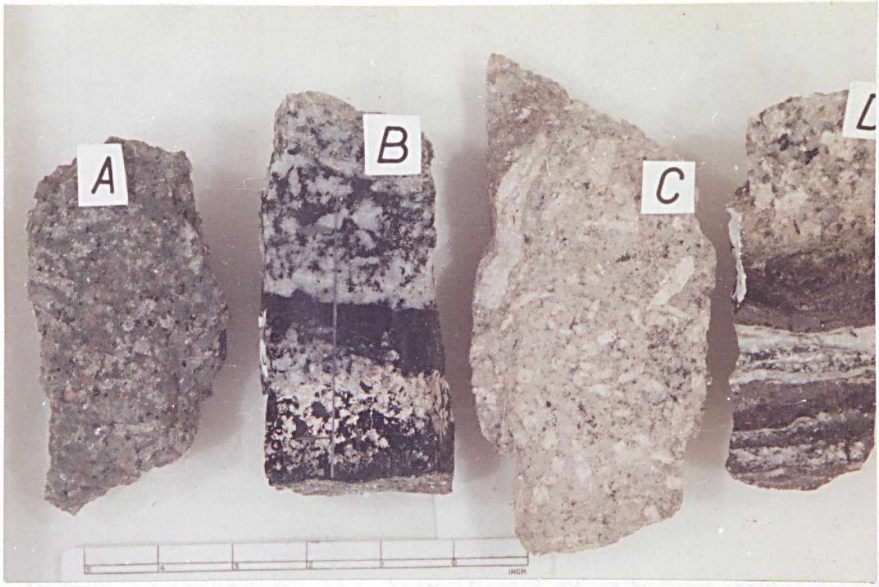
D: Altered granite and the central quartz leader from the No.3 Branch Lode, Level 11 (West), (No. 0029), and identical in detail to the specimen shown in Photo. (89). The specimen is shown in thin section in Photo. (114).

Photo. (94)

Kodacolour.

A: No.3 Branch Lode, Level 11, (West). The specimen consists of fine-grained cassiterite and 'earthy' red hematite and is typical of the cassiterite-hematite association in which cassiterite often occurs in the lodes of Geevor mine. More usually this combination takes the form of veins one to two inches wide on either the footwall or hanging-wall of the lode. In this case the hematite and cassiterite occupied a 6" wide fissure flanked by reddened and kaolinized granite. The hematite appears to form through the breakdown of arsenopyrite.

B: No.3 Branch Lode, Level 11 (West). The specimen shows another characteristic form of occurrence of cassiterite in Geevor Mine; as a cassiterite-chlorite-quartz association. Later pyrite-chalcopyrite-quartz mineralization exists as veinlets. The specimen consists partially of altered granite which has completely lost its original form, and is distinguishable with difficulty from the fissure infilling.


A
B
C
D

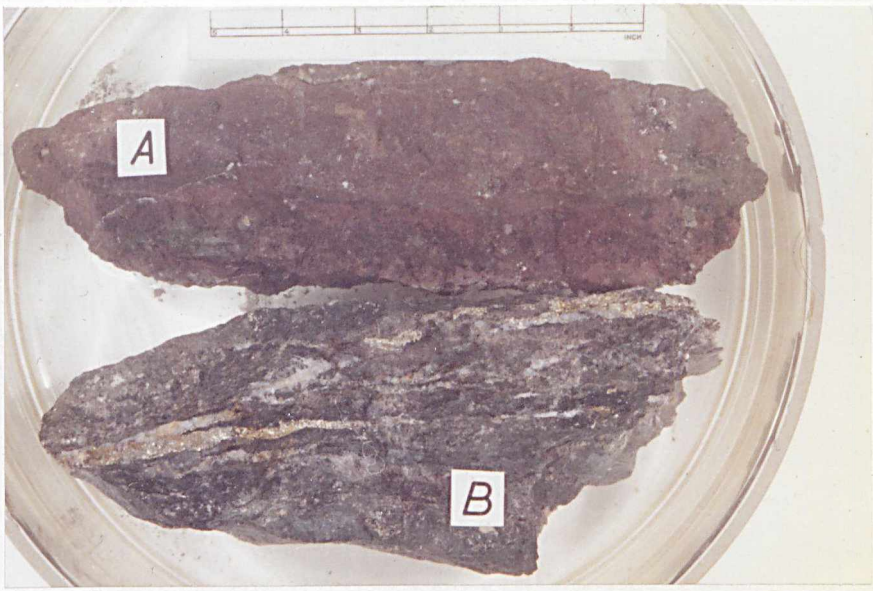

A
B

Photo. (95)

Kodacolour.
Borehole Lode, Level 13 (East), @ 100 ft.

The photo. illustrates a complete section across the Borehole Lode with the exception of the altered wall-rock. The latter is heavily tourmalinized and impregnated with both sulphides (pyrite and chalcopyrite) and cassiterite. Well developed vertical slickenslides indicate that relative vertical movement of the hanging-wall and footwall preceeded and accompanied the later infilling phase of mineralization which is illustrated in this photo. The cassiterite is associated with quartz, chalcopyrite and pale green fluorspar (centre). A little tourmaline appears to have been introduced with the cassiterite and broken from the wall-rock. Later quartz (top and bottom) increased the lode width and veined the cassiterite phase.

Photo. (96)

Kodacolour.
North Pig Lode, Level 11.

The specimen shows the early feldspar and tourmaline phases followed by quartz veining and finally brecciated. The resulting fragments of lode material are coated with a thin covering of fine siderite crystals. These are dark brown in colour and usually occur in open fractures and vughs. Similar siderite, such as that illustrated in Photo. (108/D), is a late mineralization feature of many of the lodes of Geevor Mine, especially the Wethered, North, Coronation, and Footwall Branch Lodes.



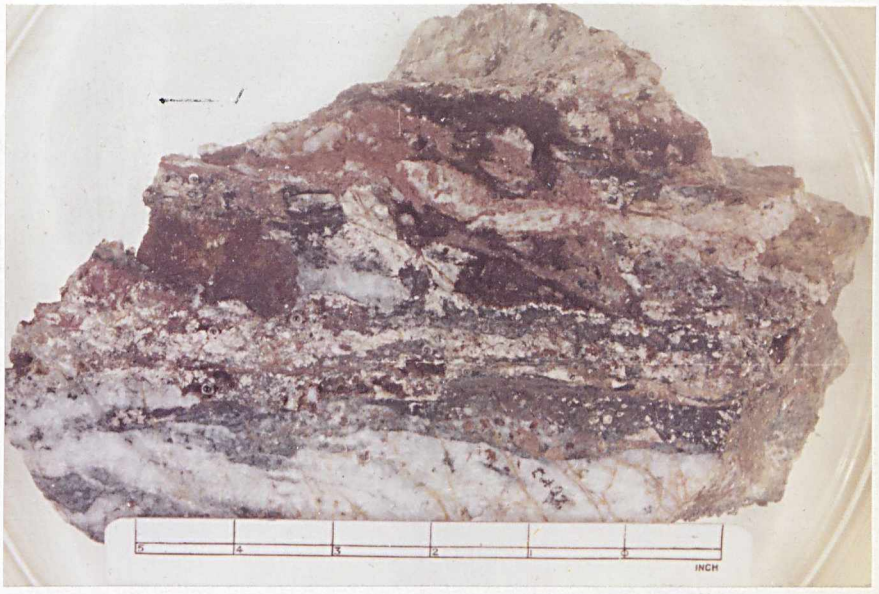

INCH

Photo. (97)

Kodacolour.

A: No.3 Branch Lode, Level 13 (East), @ 125 ft. (No. 0534).

An early quartz-feldspar vein has been followed by tourmaline and cassiterite. The latter has replaced the feldspar (around A), and a later cassiterite phase is associated with the tourmaline and earthy hematite.

B: No.3 Branch Lode, Level 12 (West).

An early tourmaline-quartz-cassiterite phase has been followed by sulphides among which both primary and secondary chalcocite (which appears blue) is predominant. Also present are chalcopyrite, pyrite, etc. Later calcite veins penetrate the entire specimen.

Photo. (98)

Kodacolour.
No.1 Lode, Level 13.

A and B: Both specimens are arranged to illustrate the footwall and hanging-wall of the lode and to indicate the lode width. The first phase of mineralization consisted of intense tourmalinization of the granite wall-rock and some infilling by tourmaline. Relative movement of the lode walls accompanied the introduction of feldspar (pink) which coated the tourmaline fragments and was followed immediately by arsenopyrite and quartz (especially in the centre of A).

Later movements along both the footwall and hanging-wall enabled the introduction of a tourmaline-chlorite-cassiterite phase, among which fragments and lenses of the earlier lode material are now situated. Specimen B includes, on the left, a fragment of less altered granite wall-rock.


A
B

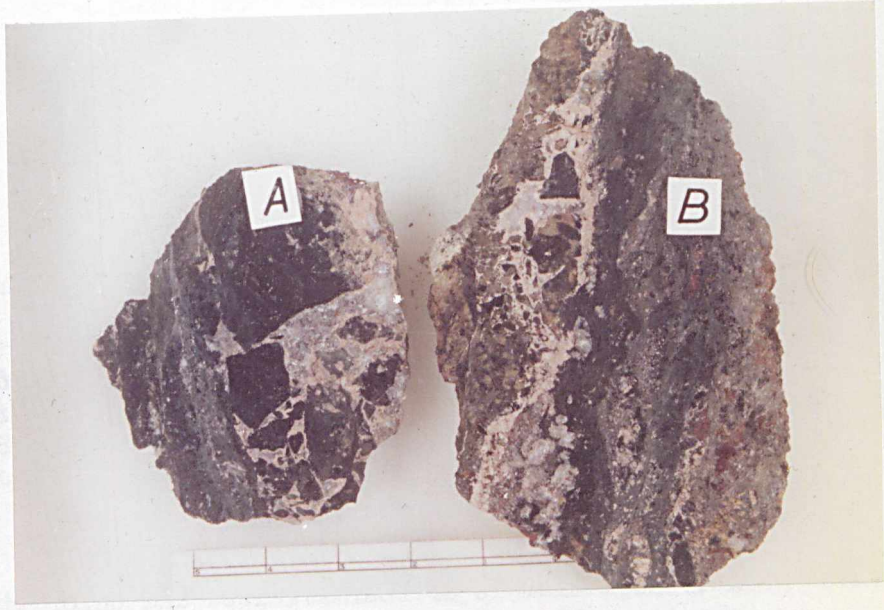

A
B

Photo. (99)

Kodacolour.

The specimen, which is approximately 12 inches long, illustrates many phases of lode movement and mineralization. The first stage consisted of tourmalinization and kaolinization of the wall-rock. Movement brecciated the walls and the resulting fragments were frozen into place during the introduction of tourmaline which is now apparent as a 1" wide vein.

The whole lode was then subjected to further relative movement of the walls which culminated in the introduction of quartz and feldspar, the latter now being visible as occasional pink blebs. A succeeding chlorite-cassiterite phase is visible in contact with the upper surface of the chalcopyrite by which it was followed in the mineralization sequence.

Photo. (100)

Kodacolour.

A: Borehole Lode, Level 13 (East), @ 100 ft.

An example of unusually massive chalcopyrite and pyrite. This followed a chlorite-cassiterite phase (bottom left) and a green fluorspar phase (bottom right), which was itself followed by earthy red hematite and cassiterite. Some later cassiterite-free chlorite is visible to the left centre. Stringers of chalcopyrite (not visible in the photo.) traverse the earlier mineral phases.

B: No.3 Branch Lode, Level 12 (No. 0103).

A typical example of tourmalinized and chloritized granite wall-rock which has been impregnated by a large variety of sulphides.



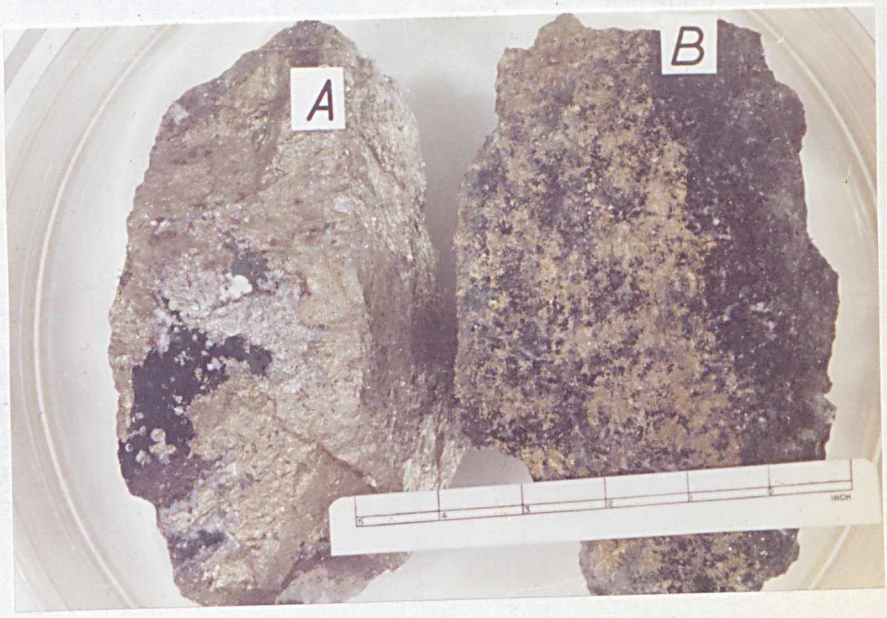

A
B
INCH

Photo. (101)

Kodacolour.

A: Wethered Lode, Level 11 (East), @ 475 ft.

A diagrammatic cross-section of the lode at the locality from which this specimen was obtained is provided in Fig. (137). Banded quartz and fine-grained tourmaline accompanied the first major relative movement of the lode walls. The tourmaline was frequently associated with cassiterite as a tourmaline-cassiterite phase, or was subjected, as shown in Photo. (101/A), to veining by cassiterite. Further mineralization phases at this locality comprised quartz-chlorite-cassiterite, quartz-chalcopyrite, and fluorspar.

B: Wethered Lode, Level 7.

Sphalerite (grey-brown) is associated with chalcopyrite and late chlorite (dark green), and followed by quartz. Parts of Levels 7 and 8 of the Wethered Lode are the only localities from which such quantities of sphalerite have been obtained, despite its fairly general distribution in minor quantities throughout the whole mine. The sphalerite is often associated (although not shown in this photo.) with pale green fluorspar. An alternative form in which the sphalerite frequently occurs is illustrated in Photo. (103/B).

C: Hanging-Wall Vein @ 100 ft. West of the junction with the Footwall Branch Lode.

The specimen, which represents a complete section across the lode shown in Photo. (56), illustrates a cassiterite-quartz mineralization phase with accessory tourmaline. A minor amount of later chlorite with no associated cassiterite is present to the left and in the centre of the specimen.

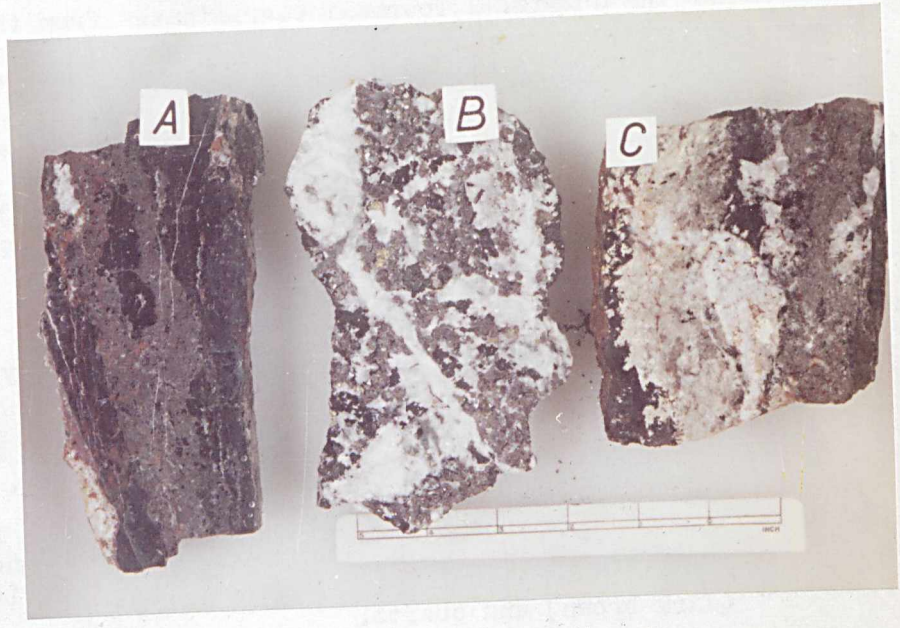

A
B
C

Photo. (102)

Kodacolour.

A: The 'A' Lode, Level 9 (West of the Hanging-Wall Branch Lode).

The specimen illustrates a quartz-cassiterite phase of mineralization in which the cassiterite (grey-brown) is visible in the centre of the quartz. Tourmaline originates from the altered lode walls and early feldspar is present towards the top of the specimen. When cassiterite occurs in association with quartz it takes the form shown in either Photo. (102/A) or (101/C). Cassiterite has been observed from Level 13 (West) of the 'C' Lode coating one side of quartz crystals developed in a vugh within the centre of the lode. This form, however, is rare.

B: Borehole Lode, above Level 12 (No. 0555).

Botryoidal chalcopyrite which is closely associated with bornite and covellite.

C: No.3 Branch Lode, Level 12, @ 146 ft. West of the Main Western Fault, F_2, (No. 0479, T/S 16817).

The specimen illustrates the first main phase of cassiterite mineralization on the No.3 Branch Lode. Early vein feldspar (red) is replaced by cassiterite (dark brown) and quartz.

D: North Pig Lode, Level 13, near the junction with the North Lode, (No. 0415).

The specimen is typical of the whole lode at this horizon. It consists of an infilling of feldspar, tourmaline, and arsenopyrite, followed by a little cassiterite which replaced the feldspar and arsenopyrite. Such a mineral assemblage is normally indicative of the proximity of the lower limit of the zone of economic tin mineralization, and may also be observed on Level 13 of the No.2 and No.3 Branch Lodes.

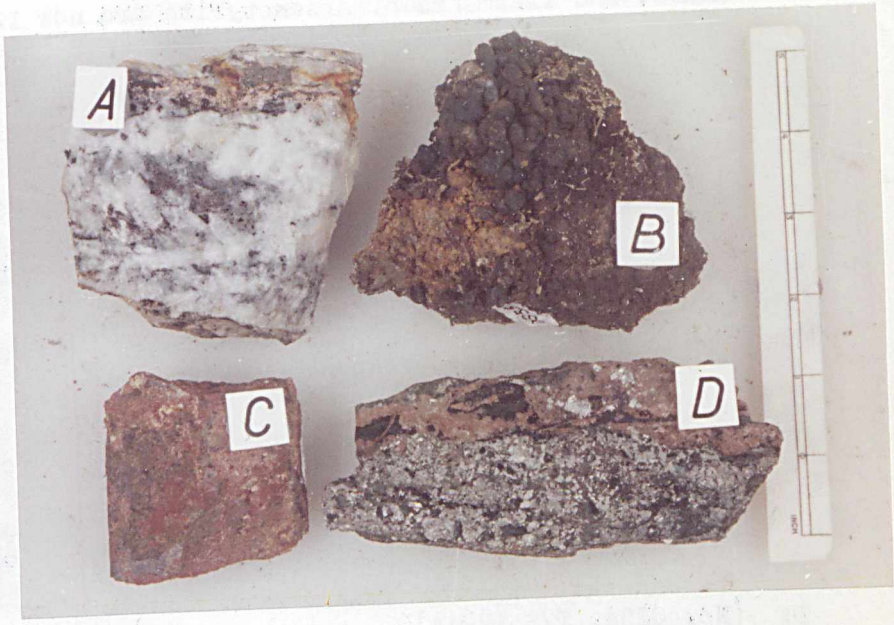

A
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C
D

Photo. (103)

Kodacolour.

A: No.2 Branch Lode, Level 13, (No. 0332).

Cassiterite and arsenopyrite, the latter having been partly altered to hematite along the lode walls, were followed by a cassiterite-chlorite phase, and fragments of arsenopyrite are now preserved in the centre of the lode. A later quartz-pyrite-chalcopyrite phase veined the centre of the specimen and was succeeded by calcite (white).

B: Wethered Lode, Level 10, (No. 0225).

The altered granite footwall of the Wethered Lode is penetrated by numerous veinlets of sphalerite and partially altered chalcopyrite. A similar occurrence on the same lode is shown in Photo. (61).

C: No.3 Branch Lode, Level 12, West of the Main Western Fault, F_2, (No. 0381).

The specimen illustrates the first phase of cassiterite mineralization which selectively replaced the earlier feldspar infilling in the same manner as shown in Photo. (102/C). Later veining by quartz, which included pyrite and chalcopyrite, resulted in the formation of the 'leader'.

D: (No. 0254, T/S 12944).

A typical cassiterite-hematite association, the cassiterite being grey-brown in colour. The final product originates largely from the complete alteration of the granite wall-rock.

E: North Lode, Level 11, @ 585 ft. West, (No. 0512, T/S 16834).

The locality of this specimen is shown in Fig. (64). A localized high concentration of cassiterite associated with hematite occurred at the junction of the North Lode and a North-South fracture. The specimen is shown in thin section in Photo. (125).

F: Coronation Lode, Level 12, (No. 0207).

The specimen illustrates the typical quartz phase of the Coronation Lode which contains cassiterite and sulphides.

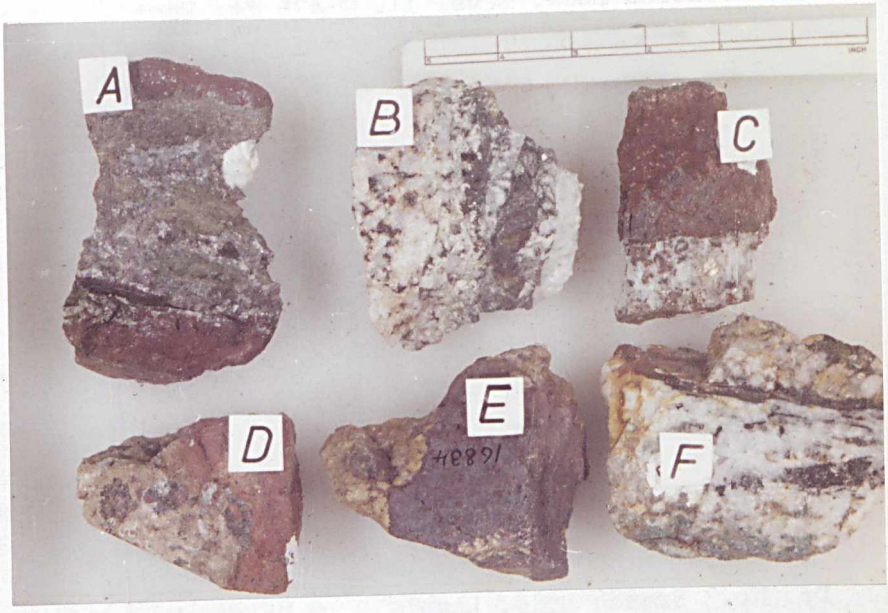

A
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E
F
16831

Photo. (104)

Kodacolour.

A: New Lode, Level 9, @ 550 ft., (No. 0336, T/S 14546).

The altered granite wall-rock shows veining by feldspar (centre) and replacement by cassiterite.

B: Wethered Lode, Level 11, @ 475 ft. East.

This specimen was obtained from the same locality as that shown in Photo. (101/A) and Fig. (137). It represents a cassiterite-chlorite phase of mineralization with accessory quartz and tourmaline. Later fluorspar (green), chalcopyrite and quartz are also visible.

C: Coronation Lode, Level 15, (No. 0097).

Early massive tourmaline is veined on the right by fluospar and sulphide-bearing quartz. Such tourmaline, which contains only trace amounts of cassiterite, appears to be typical of the lower limit of the zone of economic tin mineralization on the Coronation Lode. The same Lode was recently intersected by D.D.H. No. 29 on Level 14 where it consisted entirely of massive medium-grained tourmaline with a width of the order of 12 inches.

D: No.3 Branch Lode, Level 12, @ 85 ft. West of the Main Western Fault, F_2, (No. 0480, T/S 16840).

The early feldspar infilling of the No.3 Branch Lode is almost completely replaced by the first main cassiterite phase. Wall-rock alteration was very slight.

E: (No. 0189, T/S 12991).

The entire specimen has resulted from the intense alteration and impregnation of the granite wall-rock by tourmaline, cassiterite, chlorite and chalcopyrite. Remnants of reddened feldspar are visible on the left.

F: Wethered Lode, Level 7, (No. 0065, T/S 12996).

A chlorite-cassiterite phase which has resulted in medium-grained material with a 50% cassiterite content.

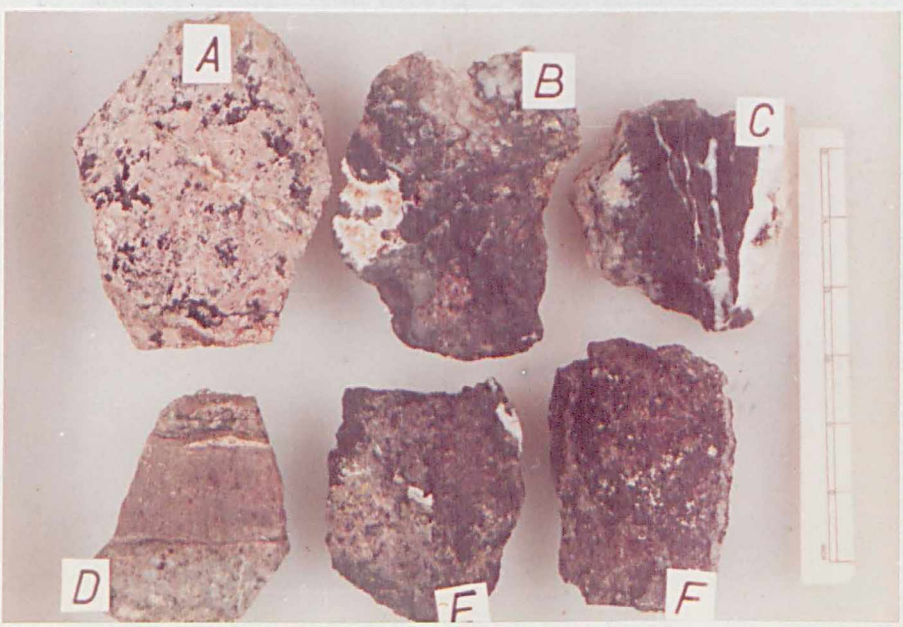

A
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E
F

Photo. (105)

Kodachrome.
No.3 Branch Lode, Level 13, @ 30 ft. East of the x-cut, (No. 0520).

The photo. illustrates a complete section across the Lode which is shown in Photo. (76). The first infilling of tourmaline has been brecciated and re-cemented by pink feldspar and minor amounts of associated arsenopyrite.

Later quartz and cassiterite, the majority of which ascended to a higher horizon in the lode fissure, selectively replaced the feldspar, especially along the zone of movement. Further phases of mineralization which were concentrated in successively higher horizons are indicated by the presence of minor amounts of tourmaline, cassiterite and chlorite.

Photo. (106)

Kodachrome.
No.3 Branch Lode, Level 12, @ 165 ft. West of the x-cut.

The locality from which this 9 inch long specimen was obtained is shown in Photo. (48). Heavily chloritized and tourmalinized granite is traversed by two post-cassiterite veins approximately one inch wide. Each contains pyrite, calcite and meta-colloidal radio-active material. According to Darnley (personal communication 1961), the latter appears to be a pitchblende-coffinite association which is later in age than the uraninite found in other parts of the mine and normally recovered in the Mill.

The distribution of this radio-active material throughout the left-hand vein is indicated by the photo-graphic plate. Although the pyrite veins shown in this photo. are continuous for over 50 feet along the drive the distribution of radio-active material throughout them is very limited and sporadic.





Photo. (107)

Kodacolour.

A: Coronation Lode, Level 15, (No. 0092).
The specimen represents a typical post-sulphide and post-cassiterite quartz-fluorspar mineralization phase. Under these conditions the fluorspar is characteristically dark purple in colour, but on occasions is also both dark green and grey.

B: Prospect No.1, Level 11, (No. 0421).
Altered granite is traversed in the upper part by a vein representing a sulphide-fluorspar mineralization phase. Chalcopyrite and pyrite are closely associated with characteristically pale green fluorspar.

C: Footwall Branch Lode, Level 12, @ 900 ft. West, (No.0426)
A combination of several fluorspar phases results in the co-existence of all shades of purple, green, grey and white fluorspar.

D: No.1 Lode, Level 13, (No. 0364)
Pale green and grey fluorspar associated with massive chalcopyrite and pyrite is veined by the same minerals.

Photo. (108)

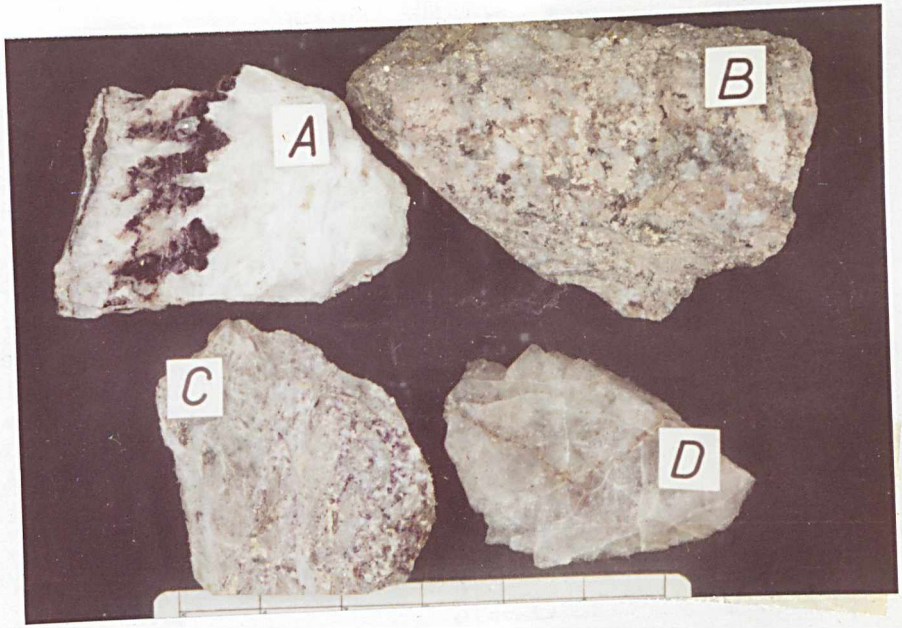
Kodacolour

A: Coronation Lode, Level 14.
Calcite crystals coating altered granite wall-rock from a vugh in the footwall of the Lode.

B: No.3 Branch Lode, Level 11.
Well developed quartz crystals are coated with pale pink calcite. The specimen originates from a vugh in a North-South fracture in killas which crosses the No.3 Branch Lode in the vicinity of the x-cut North from the No.3 Branch Lode (West).

C: Footwall Branch Lode, Level 12, @ 900 ft. West,(No.0427).
Later calcite and siderite crystals from a vugh in the centre of the Lode. Together with the slightly earlier fluorspar shown in Photo. (107/C), this mineral assemblage represents the final phases of mineralization of the Footwall Branch Lode.

D: Wethered Lode, Level 11.
Large quartz crystals developed in an earlier vugh have been brecciated and the fragments set in a matrix of linonite. Some of the crystals are coated with hematite and small, dark brown siderite crystals are visible on part of the specimen.


A
B
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D

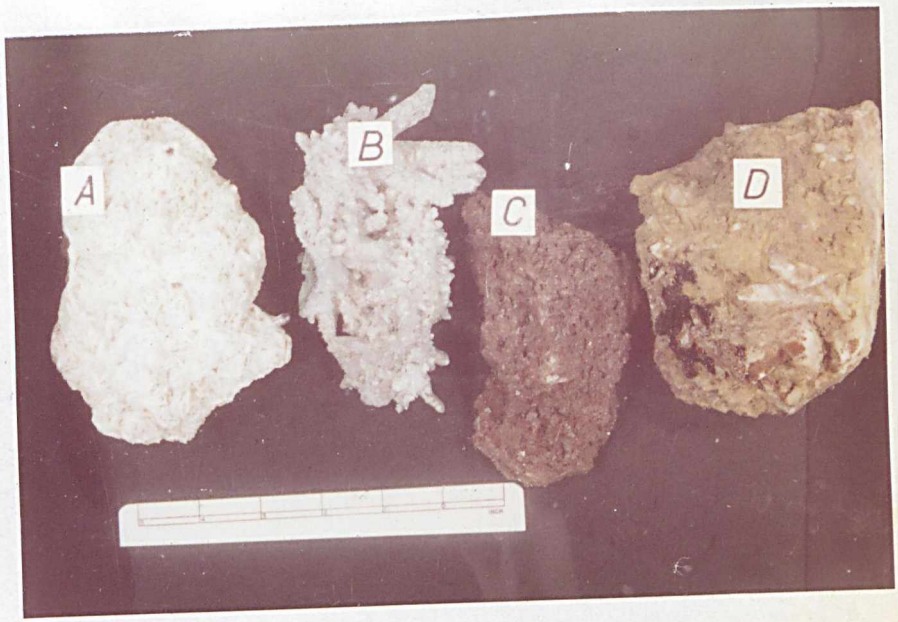

A
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Photo. (109)

Kodacolour
Wethered Lode, Level 10 (East)

The photo. illustrates the sequence of some of the post-cassiterite and post-sulphide mineralization phases in the Wethered Lode. Cassiterite-bearing lode material was brecciated during post-cassiterite mineralization movements and the fragments, one of which is visible towards the upper left, were cemented in massive white quartz.

The latter was followed by amethyst and successive deposits of quartz with a hematite coating (indicating the growth of the crystals). The sequence is completed by pale brown chalcedony which completely infilled the vugh in which the previously existing minerals were deposited.

Photo. (110)

Kodacolour.

A: Coronation Lode, Level 9, North of the junction with the Wethered Lode, (No. 0546).

B: North Levant Lode, Level 11, exposed at 271 feet in the x-cut from the No.2 Branch Lode to the Footwall Branch Lode, (No. 0522).

Both specimens represent the final phase of mineralization present in Geevor Mine; massive quartz with frequent vughs which are infilled with later jasperoidal hematite. The North Levant Lode is composed entirely of the products of this mineralization phase which is also represented in the remaining lodes throughout the entire mine at widely varying horizons.

Examples are provided by the North Lode (East) on Level 5, the North Lode on Level 10 as shown in Photo. (58), the footwall Branch Lode on Level 14, and the NE-dipping lode towards the end of the main Level 9 x-cut shown in Fig. (66).



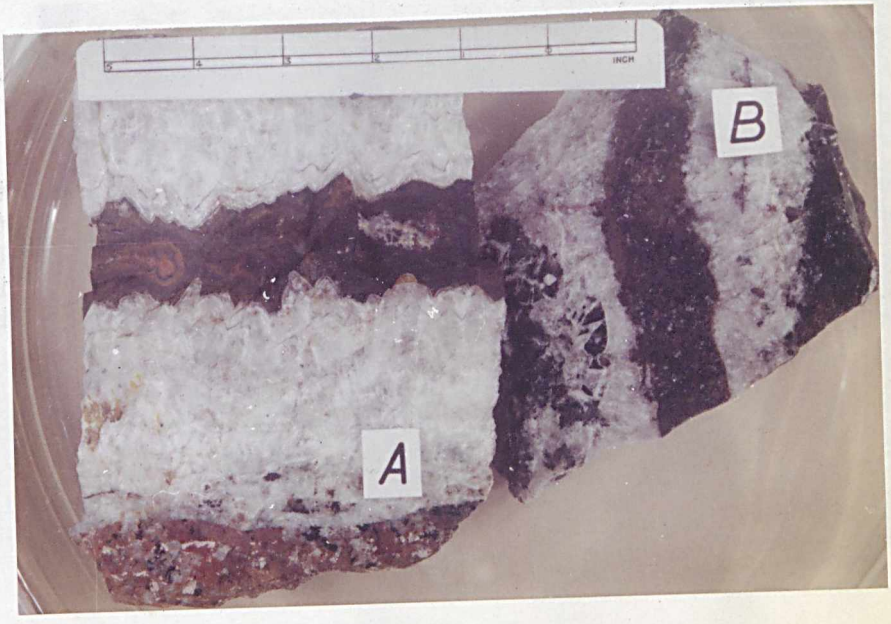

INCH
B
A

Photo. (111)

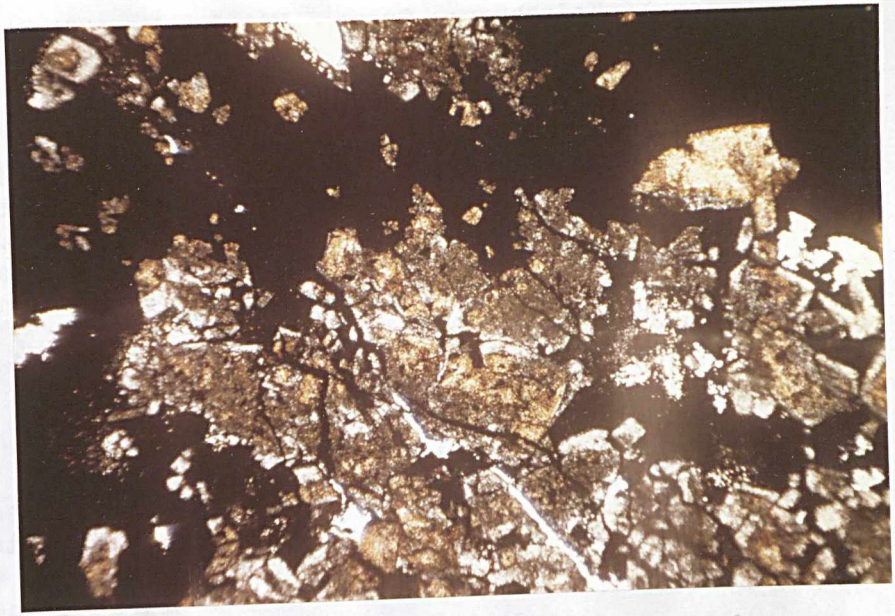
Kodachrome, P.P. Light, Magnification x 40.
Coronation Lode, Level 11, (No. 0548,
T/S 16825).

Relatively coarse-grained cassiterite, surrounded and veined by later primary chalcocite, provides an example of the cassiterite-chalcocite association that is frequently encountered in the lower levels of the lodes, i.e. on Level 15 of the Coronation Lode. The cassiterite is generally zoned from red-brown in the centre, through yellow, grey, and finally to off-white, and is an example of more highly coloured cassiterite than is the average for the mine. Final quartz veining is visible in the lower part of the photo.

Photo. (112)

Kodachrome, P.P. Light, Magnification x 40.
No.3 Branch Lode, Level 11 (West),
(No. 0497, T/S 16819).

A typical subhedral 'grain' of cassiterite, irregularly zoned in yellow, brown, and grey, is set in a matrix of fine-grained tourmaline and chlorite. The green coloration of the latter has been distorted in this photograph although the colour of the cassiterite is correctly reproduced.



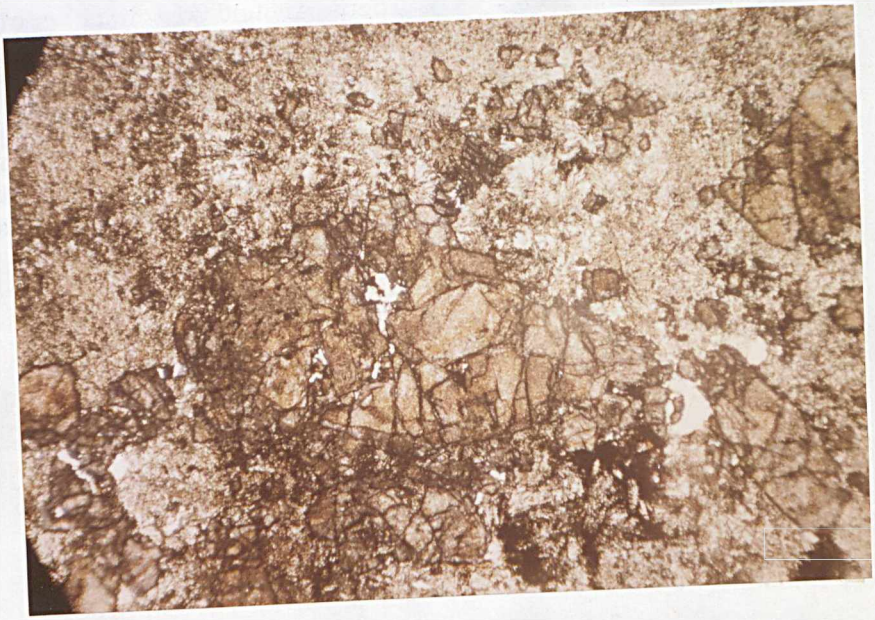


Photo. (113)

Kodachrome, Crossed Nicols, Magnification x 40
No.3 Branch Lode, Level 12 (West),
(No. 0352/F, T/S 14564).

The thin section illustrated in Photo. (113) represents part of the wall-rock alteration zone in granite on the No.3 Branch Lode. Referring to Photo. (88/A), which shows the complete zone, and to Fig. (125), the location of the section would be at a distance of approximately 5 inches from the lode, i.e. adjacent to the letter 'A'.

Original perthitic orthoclase feldspars were altered to fine-grained, fibrous chlorite (top left), medium-grained mica (centre left), and quartz, the alteration commencing along the albite veining. The red colouration (in the hand specimen) was increased with proximity to the lode. The occasional albite feldspars were, in the outermost zone, altered to sericite and kaolin which were replaced by quartz nearer the fissure. Biotite was chloritized, the pleochroic haloes being retained (bottom right), and at a lesser distance from the lode this transformation was also characterized by the formation of brown tourmaline, topaz and iron oxide blades. The latter served as a locus around which characteristic spherulitic chlorite (top centre) developed at the expense of quartz which was often re-crystallized.

Primary orange tourmaline (not visible) was slowly eroded by quartz, leaving only the rims which were eventually overgrown by fibrous blue tourmaline and spherulitic chlorite. Some arsenopyrite (not visible) developed at the expense of feldspar remnants.

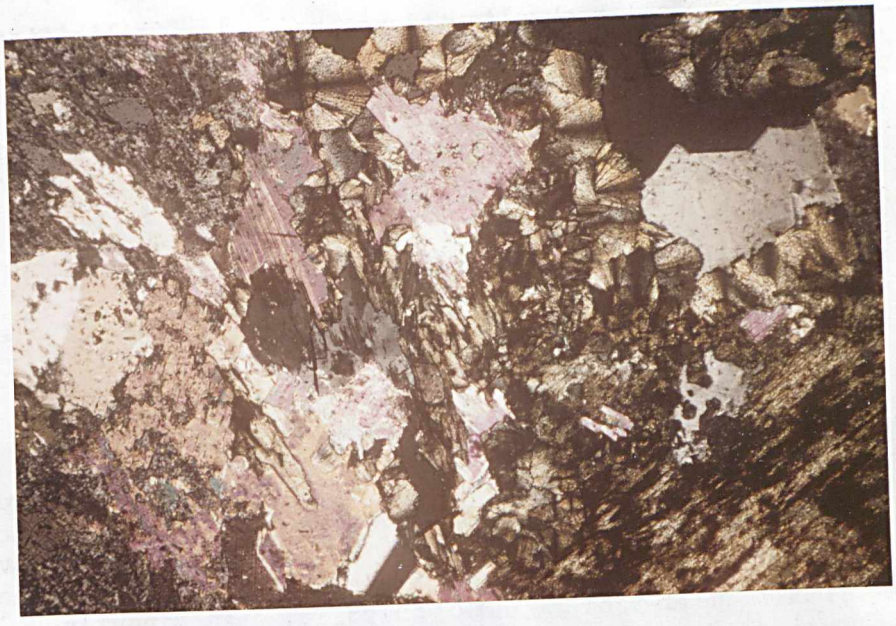


Photo. (114)

Perutz Colour, P.P. Light, Magnification x 40.
No.3 Branch Lode, Level 11 (West),
(No. 0029, T/S 12642).

The thin section was taken from the lower part of the specimen shown in Photo. (93/D), the order of development of this specimen having been as follows:-

(a) Formation of the lode fissure, and further movements continuing through to Stage (f) below.

(b) Wall-rock alteration; reddening, silicification, sericitization, and chloritization of the granite continuing through to Stage (e).

(c) Replacement by cassiterite of primary feldspars adjacent to the fissure, and impregnation by sulphides of the wall-rock.

(d) Infilling by a tourmaline-cassiterite phase of mineralization.

(e) Infilling by a chlorite-cassiterite phase of mineralization.

(f) Brecciation and infilling by quartz and associated chalcopyrite.

The photo. illustrates the results of Stages (b) and (c) above. Fine-grained, fibrous, pleochroic chlorite (green), anhedral cassiterite, and quartz have almost completely replaced the primary feldspar of the granite wall-rock. Later sulphide, predominantly pyrite, is moulded around the cassiterite and has resulted in the development of some hematite. Very fine-grained cassiterite which contains a number of inclusions is zoned from brown in the centre to white at the outer margins. A similar specimen is visible in Photo. (89).

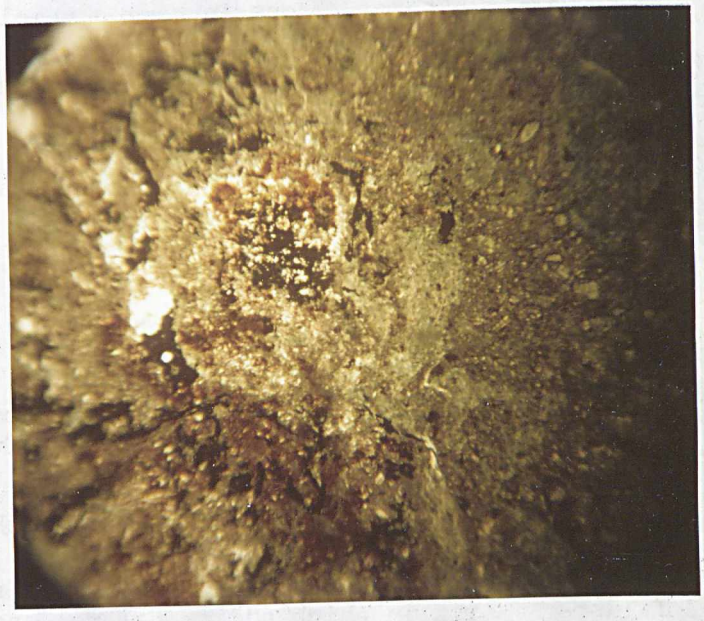


Photo. (115)

Perutz Colour, P.P. Light, Magnification x 40
Prospect South, Level 10, (No. 0287, T/S 13759).

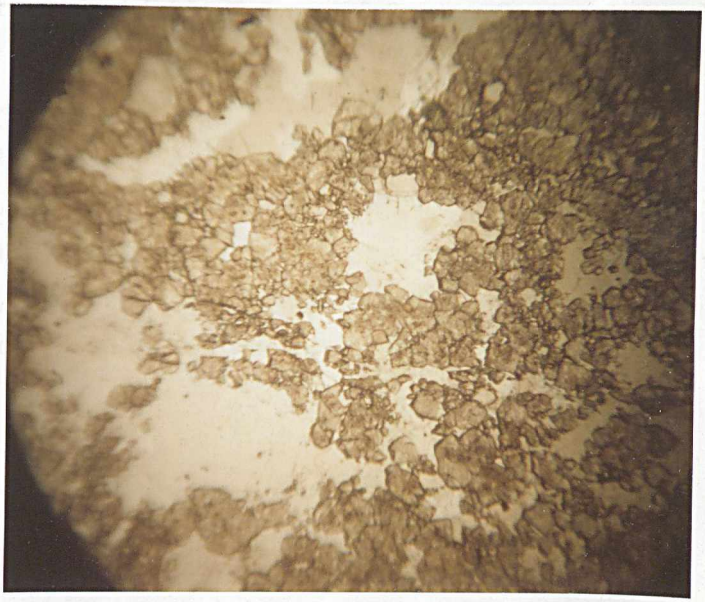
A good example of the quartz-cassiterite mineralization phase in thin section. The cassiterite, which possesses a mottled brown colour, is set in a mosaic of coarse-grained quartz in which acicular tourmaline, spherulitic chlorite and pyrite occur as occasional accessories.

The location from which the specimen was obtained is shown in Fig. (65). A one inch wide veinlet of cassiterite and quartz is surrounded by tourmaline and kaolinized granite and post-dates the main wall-rock alteration phase in the region of the 'Complex Dyke'.

Photo. (116)

Perutz Colour, P.P. Light, Magnification x 40.
No.3 Branch Lode, Level 13, @ 494 ft. West of the x-cut, (No. 0508, T/S 16823).

The photo. provides an example of the replacement of hydrothermal feldspar by cassiterite. The latter is mottled brown in colour and is selectively replacing the feldspar matrix in which additional feldspar laths of a different composition are less easily affected. Later replacement of the unaffected laths by quartz renders their detailed identification difficult.



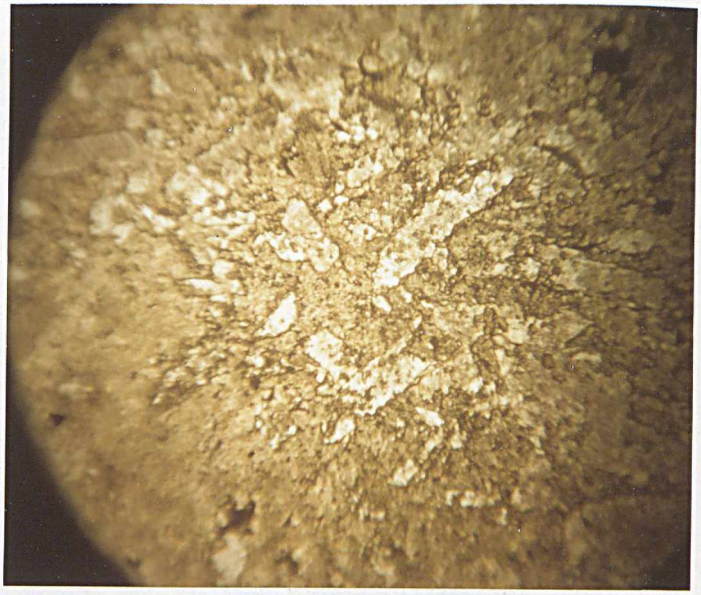


Photo. (117)

Perutz Colour, P.P. Light, Magnification x 40. North Pig Lode, Level 13 (West), (No. 0302, T/S 13744).

A relic of primary orange tourmaline (top left) from the altered wall-rock is veined and over-grown by a secondary blue-green fibrous variety. The whole, together with accessory spherulitic chlorite and pyrite, is set in a matrix of quartz which has frequently replaced pyrite (not visible). Later acicular green tourmaline (centre) is associated with pale brown, subhedral cassiterite (top centre), in which the former is often present as inclusions, and represents a cassiterite-tourmaline phase of mineralization.

Photo. (118)

Perutz Colour, P.P. Light, Magnification x 40. Prospect No.3 Level 11, @ the x-cut from the No.3 Branch Lode, (No. 0494/1, T/S 16828).

Coarse-grained tourmaline (right), zoned in orange, blue, brown and green, constituted the first phase of infilling of the Prospect No.3 on Level 11. At this stage the lode would have resembled some of the branches of tourmaline on the No.3 Branch Lode (although it would have originated more by infilling than by replacement of the wall-rock) such as those illustrated in Photos. (75) and (76). The deposition of tourmaline, however, was immediately followed by a mineralization phase resulting in fine-grained, blue-green, acicular tourmaline and brown to yellow cassiterite. Later quartz was accompanied by accessory spherulitic chlorite (not visible) and pyrite which partially replaced the original laths of tourmaline (right). A cross-section through the lode is shown in Fig. (131).



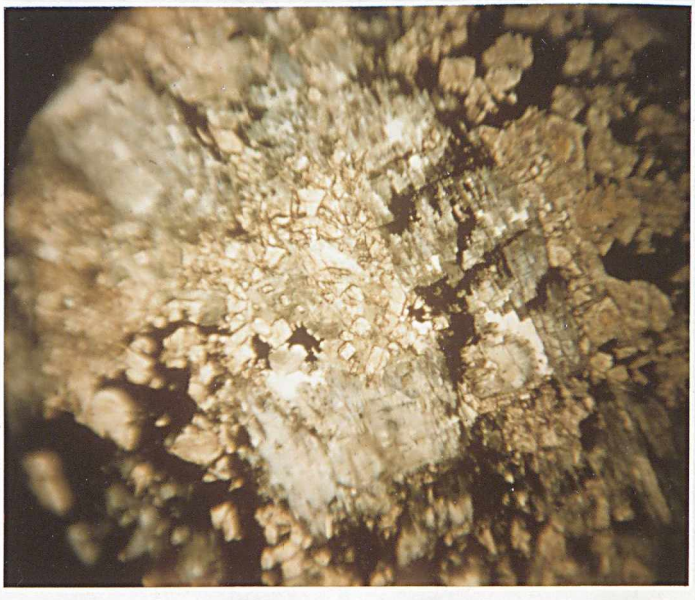


Photo. (119)

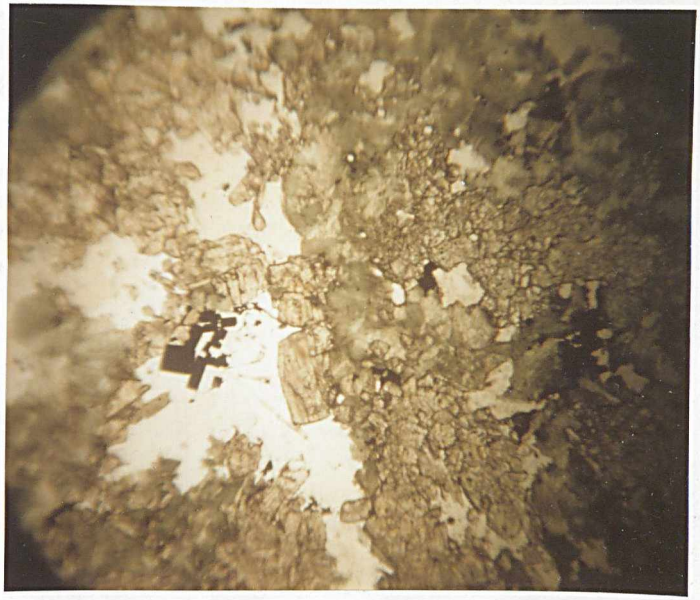
Perutz Colour, P.P. Light, Magnification x 40. Wethered Lode, Level 7, (No. 0065, T/S 12996).

Specimen No. 0065 is illustrated in Photo. (104/F) and is representative of a chlorite phase of mineralization. The spherulitic chlorite is the typical hydrothermal variety which is pleochroic from green to colourless and possesses bi-refringence colours as shown in Photo. (113). Twinned crystals of cassiterite (not visible) are common in this section.

Photo. (120)

Perutz Colour, P.P. Light, Magnification x 40 (No. 0325, T/S 13764).

An uncommon iron-rich variety of chlorite, similar in form to the spherulitic variety shown in Photo. (119), is associated with a cassiterite mineralization phase.



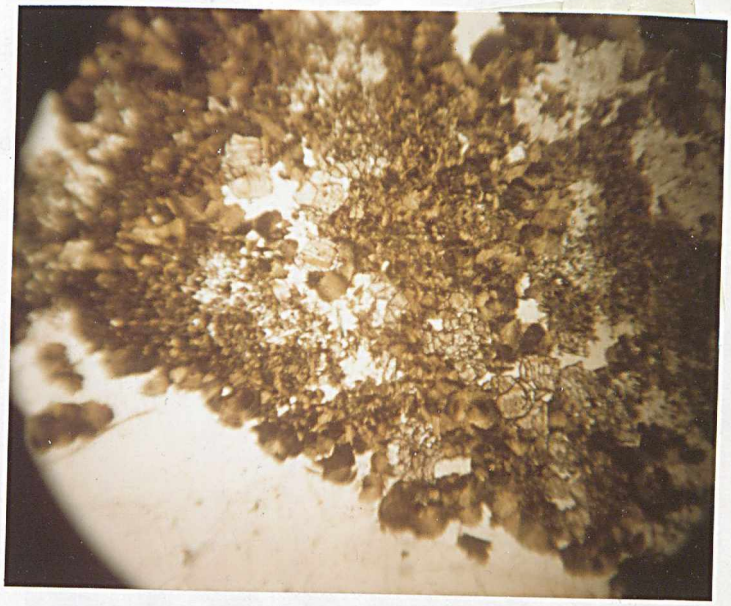


Photo. (121)

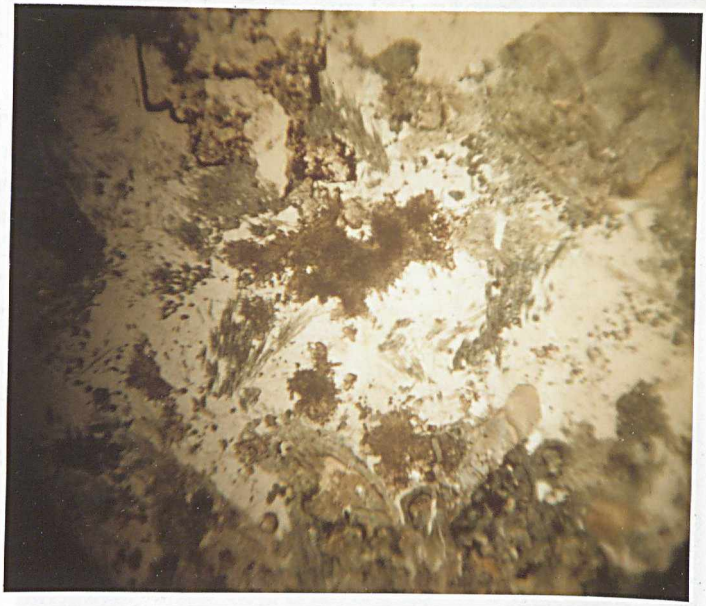
Perutz Colour, P.P. Light, Magnification x 40. No.3 Branch Lode, Level 12, West of the Main Western Fault, F_2, (No. 0217, T/S 13000).

Early, coarse-grained tourmaline (lower centre) zoned in blue, orange, and green, and similar to that shown in Photo. (118), was followed by acicular tourmaline and fine-grained, dark brown cassiterite (centre). Pyrite was eroded by quartz until only the rims remained (top left).

Photo. (122)

Perutz Colour, P.P. Light, Magnification x 40. No.3 Branch Lode, Level 11 (West), (No. 0497, T/S 16819).

Coarse-grained cassiterite, zoned in brown, yellow, and white is set in a matrix consisting of an intergrowth of fine-grained, acicular, green tourmaline and fibrous, green chlorite. A cassiterite 'grain' from the same thin section is illustrated in Photo. (112).



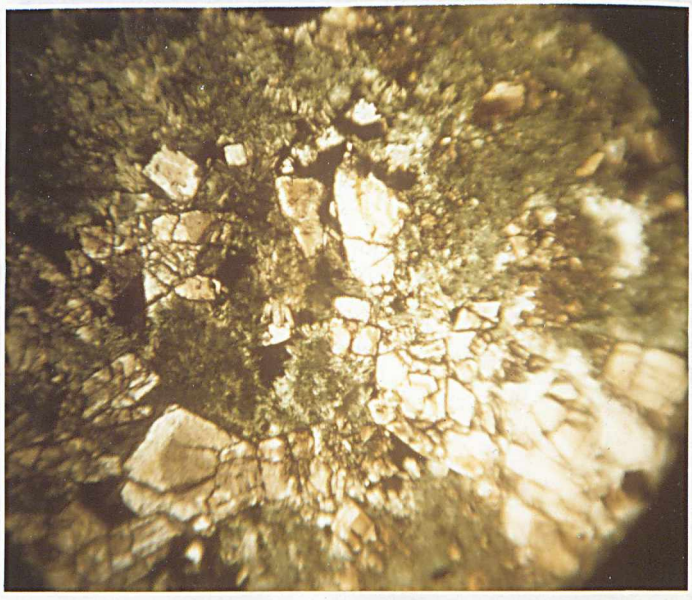


Photo. (123)

Perutz Colour, P.P. Light, Magnification x 40. No.3 Branch Lode, Level 12 @ 245 fet. West, (No. 0487, T/S 16830).

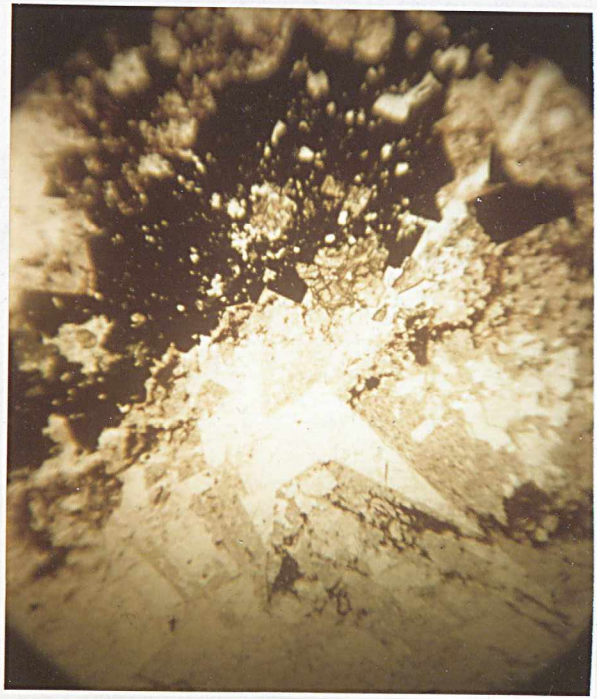
Relatively large arsenopyrite crystals were associated with hydrothermal feldspar in the first infilling mineralization phase of the lode fissure. Later movements of the fissure walls and the consequent detachment of some of the arsenopyrite accompanied the introduction of cassiterite. The latter selectively replaced the feldspar (not visible) and eroded the arsenopyrite.

An example is provided in this photo. of the replacement of an arsenopyrite crystal by fine-grained, mottled, dark brown to yellow cassiterite. Further medium-grained subhedral cassiterite accompanied the introduction of additional quartz.

Photo. (124)

Perutz Colour, P.P. Light, Magnification x 40. Wethered Lode, Level 8, @ 50 ft. East, (No. 0148, T/S 12984).

Although specimen No. 0148 is representative of a fine-grained tourmaline-cassiterite phase of mineralization, Photo. (124) is presented in order to illustrate the post-cassiterite pyrite and chalcopyrite which is moulded around the cassiterite 'grains'. Relics of primary feldspar laths, which are elsewhere selectively replaced by cassiterite and quartz, are also visible. The section is heavily stained by hematite originating from the pyrite.



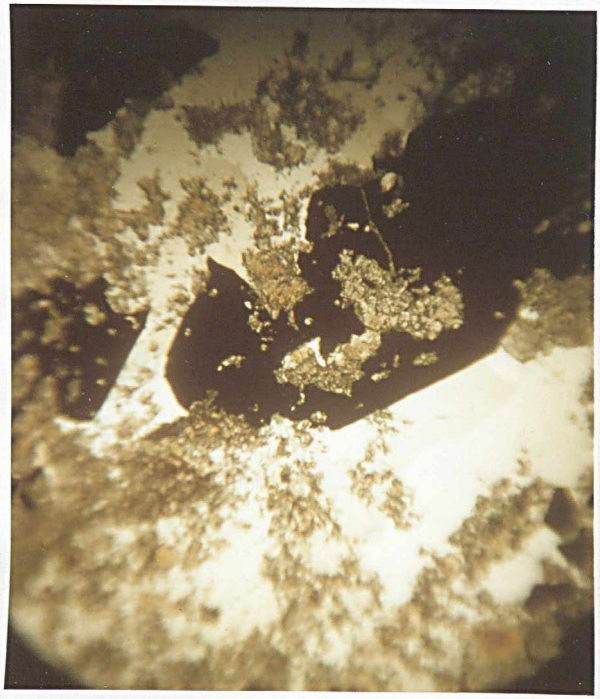


Photo. (125)

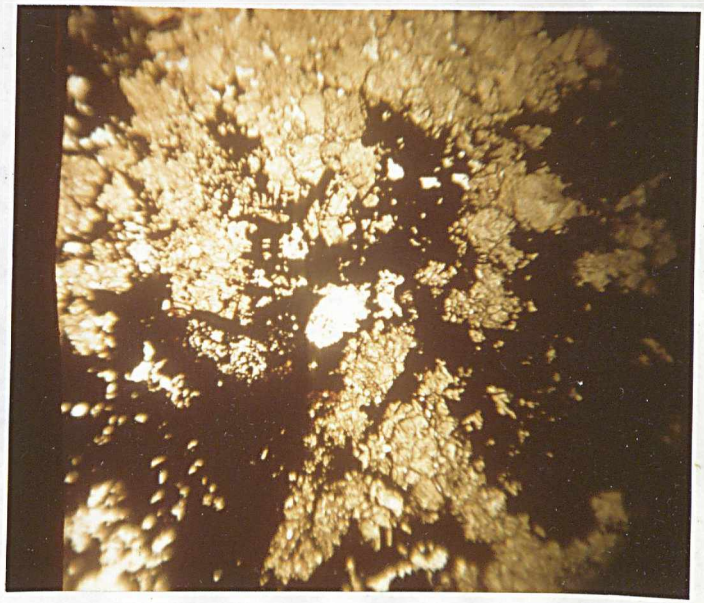
Perutz Colour, P.P. Light, Magnification x 40.
North Lode, Level 11, @ 585 ft. West,
(No. 0512, T/S 16834).

The thin section illustrated in Photo. (125) was taken from the specimen shown in Photo. (103/E). Hematite, in close association with cassiterite, frequently results from the disintegration of arsenopyrite or later sulphides, remnants of which may be observed between the cassiterite 'grains'. The ore illustrated as specimen No. 0512 arose from structural impounding on the main lode fissure by a pre-existing crossing fracture. Only slight traces of original pyrite are present among the hematite which is later than the enclosed cassiterite 'grains'.

Photo. (126)

Perutz Colour, P.P. Light, Magnification x 40.
Borehole Lode, Level 11, (No. 0337, T/S 13742).

Cassiterite, pyrite and chalcopyrite are set in a matrix of quartz. The majority is approximately contemporaneous and may be considered as being representative of a sulphide-cassiterite phase of mineralization. Later relative movements of the lode walls resulted in the brecciation of the pre-existing material and the formation of hematite which may now be observed veining the quartz and cassiterite (the latter two minerals are indistinguishable in the photo.). Later fine-grained, fibrous chlorite veined the entire specimen.



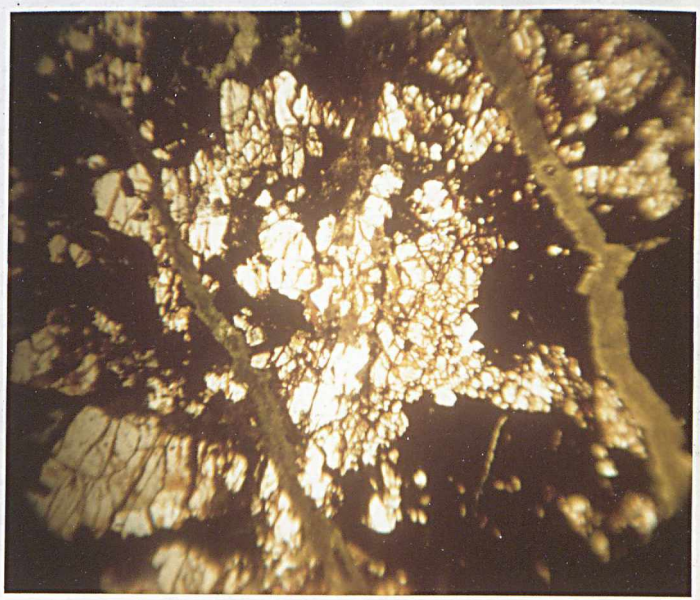


Photo. (127)

Perutz Colour, P.P. Light, Magnification x 40. No.2 Branch Lode, Level 13, (No. 0250, T/S 12990).

Post-cassiterite, elongated quartz crystals (centre), similar in form to those illustrated in Photo. (108/B) and occurring in a vugh, were coated with iron-material. Later relative movement of the lode walls was accompanied by the introduction of further quartz which dislocated and shattered the earlier crystals.

Photo. (128)

Perutz Colour, P.P. Light, Magnification x 40. North Lode, Level 12, (No. 0374/75).

The specimen originates from the Western end of the North Lode in the vicinity of the junction with the North Levant Lode. Late mineralization of the type characterized by the North Levant Lode, also affected the North Lode as shown in Photo. (58). Pre-existing siderite crystals which were lining the walls of vughs in the central quartz infilling were altered and finally replaced by additional quartz. As replacement proceeded they yielded an outline very similar to the quartz crystals shown in Photo. (127) above.

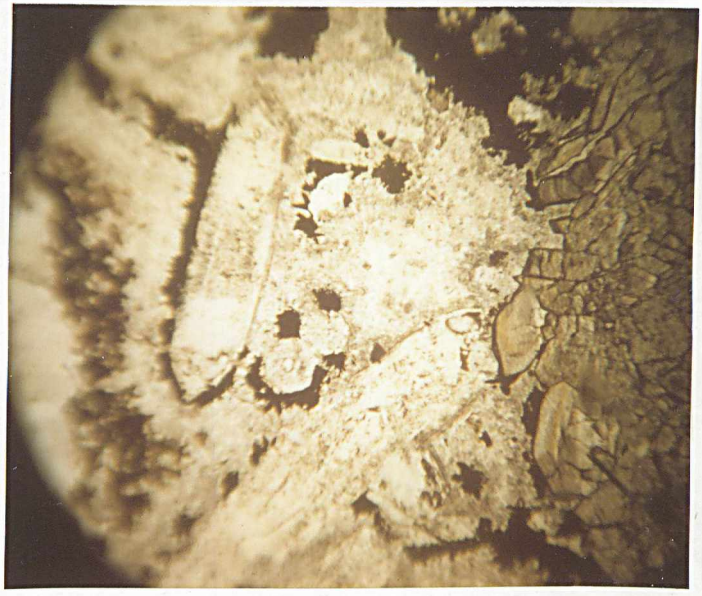




Fig. (F)



Plan of

Geevor and North Levant Tin Mines

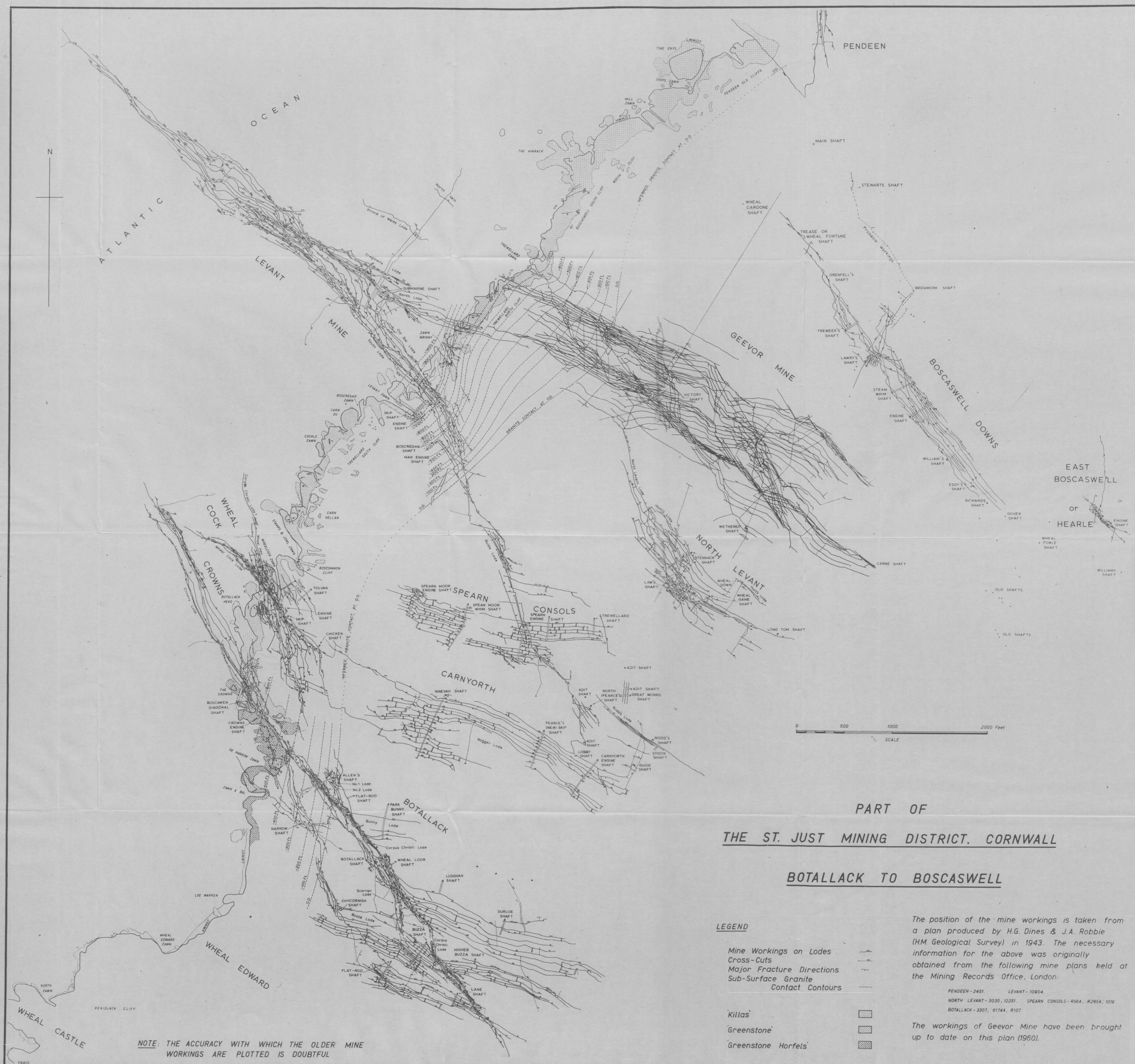
Scale of feet

180 0 100 200 300 400 500 600 700 800 900 1000

Fig. (G)



Fig. (H)



NOTE: THE ACCURACY WITH WHICH THE OLDER MINE WORKINGS ARE PLOTTED IS DOUBTFUL

PART OF
THE ST. JUST MINING DISTRICT, CORNWALL
BOTALLACK TO BOSCASWELL

LEGEND

- Mine Workings on Lodes
- Cross-Cuts
- Major Fracture Directions
- Sub-Surface Granite Contact Contours
- Killas
- Greenstone
- Greenstone Horfels

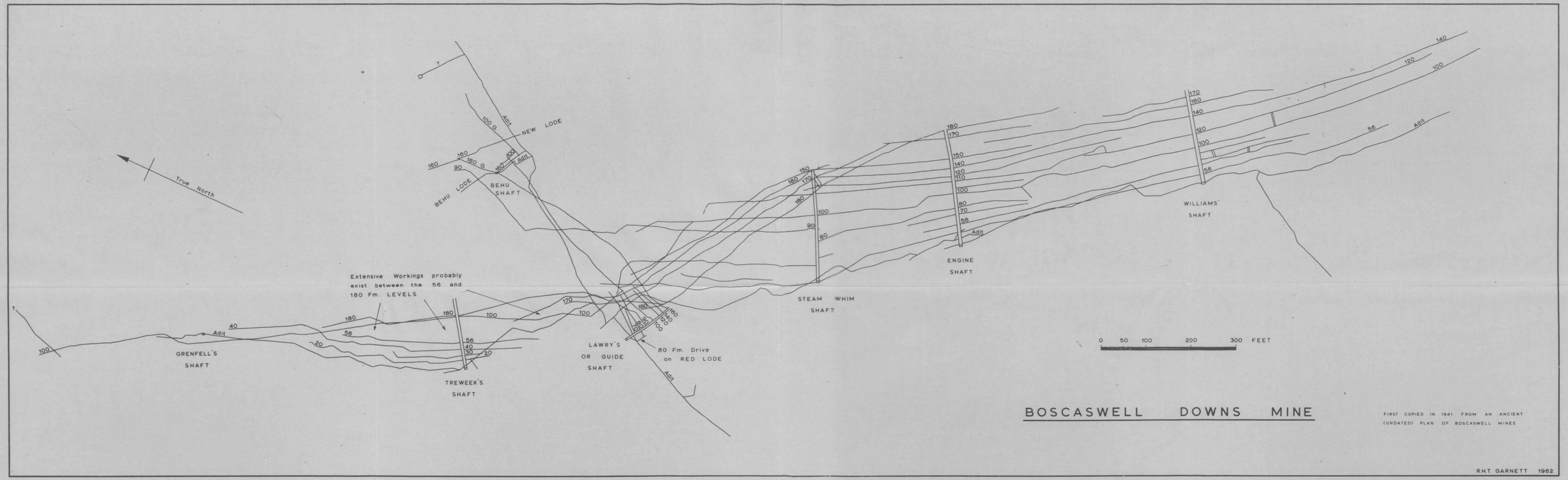
The position of the mine workings is taken from a plan produced by H.G. Dines & J.A. Robbie (H.M. Geological Survey) in 1943. The necessary information for the above was originally obtained from the following mine plans held at the Mining Records Office, London:

PENDEEN - 2451. LEVANT - 10904.
NORTH LEVANT - 3030, 12251. SPEARN CONSOLS - R56A, R285A; 1019
BOTALLACK - 3307, 6174A, R107.

The workings of Geevor Mine have been brought up to date on this plan (1960).

R.H.T. GARNETT

Fig. (I)



BOSCASWELL DOWNS MINE

FIRST COPIED IN 1941 FROM AN ANCIENT (UNDATED) PLAN OF BOSCASWELL MINES

R.H.T. GARNETT 1962

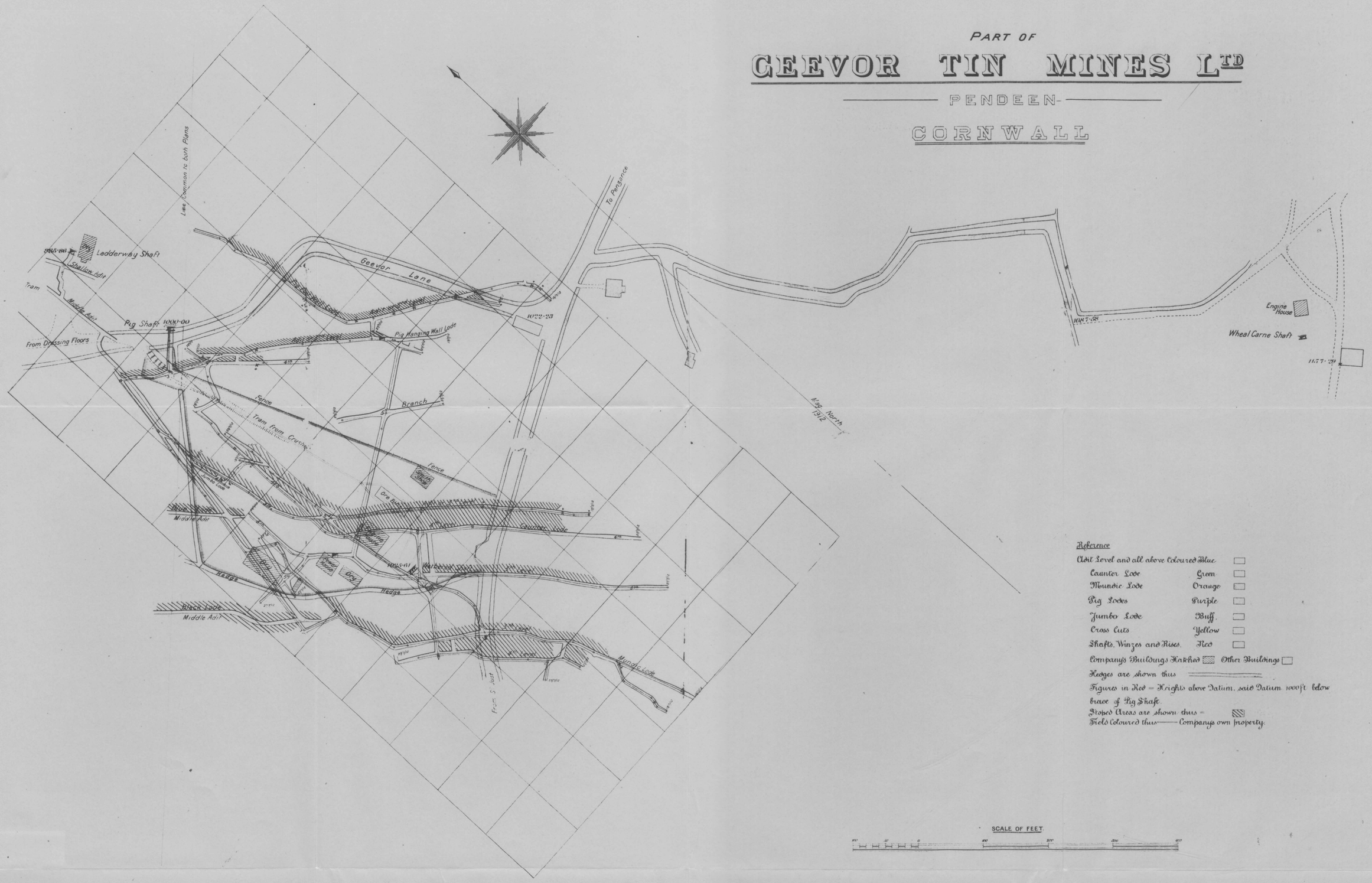
Fig. (J)

PART OF

GEEVOR TIN MINES Ltd

PENDEEN

CORNWALL



Reference

Adit Level and all above Coloured Blue

Caunter Lode	Green	
Mundic Lode	Orange	
Pig Lodes	Purple	
Jumbo Lode	Buff	
Cross Cuts	Yellow	
Shafts, Winzes and Rises.	Red	

Company's Buildings Hatched ▨ Other Buildings ☐

Hedges are shown thus ═══

Figures in Red = Heights above Datum, said Datum 1000ft below brace of Pig Shaft.

Proved Areas are shown thus = ▨

Fields Coloured thus——— Company's own property.

SCALE OF FEET

BJ HALL & Co Ltd 11 TH GREAT PETER ST WESTMINSTER