ANNUAL REPORT

EL 10043

FRANCES MAUD PROJECT PINE CREEK

FOR THE PERIOD

5 SEPTEMBER 2016 - 4 SEPTEMBER 2017

Pine Creek: 1:1000 000

PINE CREEK: 1:250 000

(Target Commodities – Base metals, Gold, Graphite and Uranium)

Date: September 2017
Authors: Stephane Roudaut,
Costica Vieru (costica.vieru@thundelarra.com.au)

Distribution: NT Department of Mines and Energy
Thundelarra Ltd

Copyright Statement as per Regulation 126 of the Mineral Titles Act

SUMMARY

The Frances Maud Creek project (EL 10043) is situated in the central part of the Pine Creek Orogen. The tenement is located about 200 km SE of Darwin, and approximately 40 km NE of Pine Creek in the Northern Territory. The EL was granted on 5 September 2002 to a syndicate of Earthrowl (80%), Douglas (10%) and White (10%). With successive reductions the EL now has only one block of area. In 2007, Thundelarra Limited secured the exploration rights with an option to purchase for the tenement from the holders.

The project area is located within central part of the Pine Creek Orogen which is a folded sequence of Palaeoproterozoic pelitic and psammitic sediments with interlayered cherty tuff units. Mafic sills of the Zamu Dolerite (~1.87Ga) intruded the lower sequence of the package. These rocks have been intruded by the late-orogenic Palaeoproterozoic granites, causing wide spread contact/thermal aureole metamorphism, which contains most of the gold mineralisation, uranium and base metals mineralisation in the Orogen. EL 10043 is dominated by rocks of the Masson Formation (Namoona Group) which are generally surrounded by the Mundogie Sandstone (Mt Partridge Group).

During the year under review, 2 Drillholes were drilled in EL 10043, 1 diamond drillhole and 1 RC drillhole with diamond completion, for a total of 459.7 meters. A total of 77 samples were assayed for gold and base metals mineralisation, and 18 samples were selected for petropgrahy using reflected and transmitted light microscopy.

Contents

Figures

Tables

1. INTRODUCTION

EL 10043 constitutes Frances Maud project which is located about 200 km SE of Darwin in a close proximity of Frances Creek iron mine. It was granted combined reporting status in 2011. Thundelarra Ltd is exploring the project area for gold, graphite, uranium and base metals mineralisation. This communication documents the exploration activities undertaken during the reporting period ending on 4 September 2017.

2. TENEMENT LOCATION

The project area is located approximately 40 km NE of Pine Creek in the Northern Territory (Figure 1). The license area can be accessed via the Frances Creek Road, turning north off the Kakadu Highway approximately 3km east of Pine Creek. Frances Creek Road has been upgraded to service the Frances Creek iron ore mine and is accessible through the year. About 4 kilometres south of the Frances Creek mine, a track comes of the Frances Creek road and leads to the project area which could mainly be accessible during the dry season. Tenement can also be reached via Kakadu Highway – A track coming off from the Kakadu Highway about 27 km from Pine Creek and leads towards NE and passes through EL 10043. Access within the tenement is via station tracks. The climate is hot with periodic monsoonal rains between November and April for the remainder of the year, it is warm to hot and largely dry.

3. TENEMENT DETAILS

EL 10043 was applied for 29 December 1997 and was granted on 5 September 2002 to a syndicate of Earthrowl (80%), Douglas (10%) and White (10%) for a period of 6 years. Originally, it had 8 blocks (26.71 km^2) which have been reduced to just 1 block due to successive reductions. Expiry of the tenement was due on 4 September 2016 but a renewal application was lodged in September 2016 for two years extension of term of the Licence.

On 24 January 2007, Thundelarra Limited secured the exploration rights with an option to purchase the tenement from the holders, and from 2014 Thundelarra Limited has secured 100% equity in EL 10043.

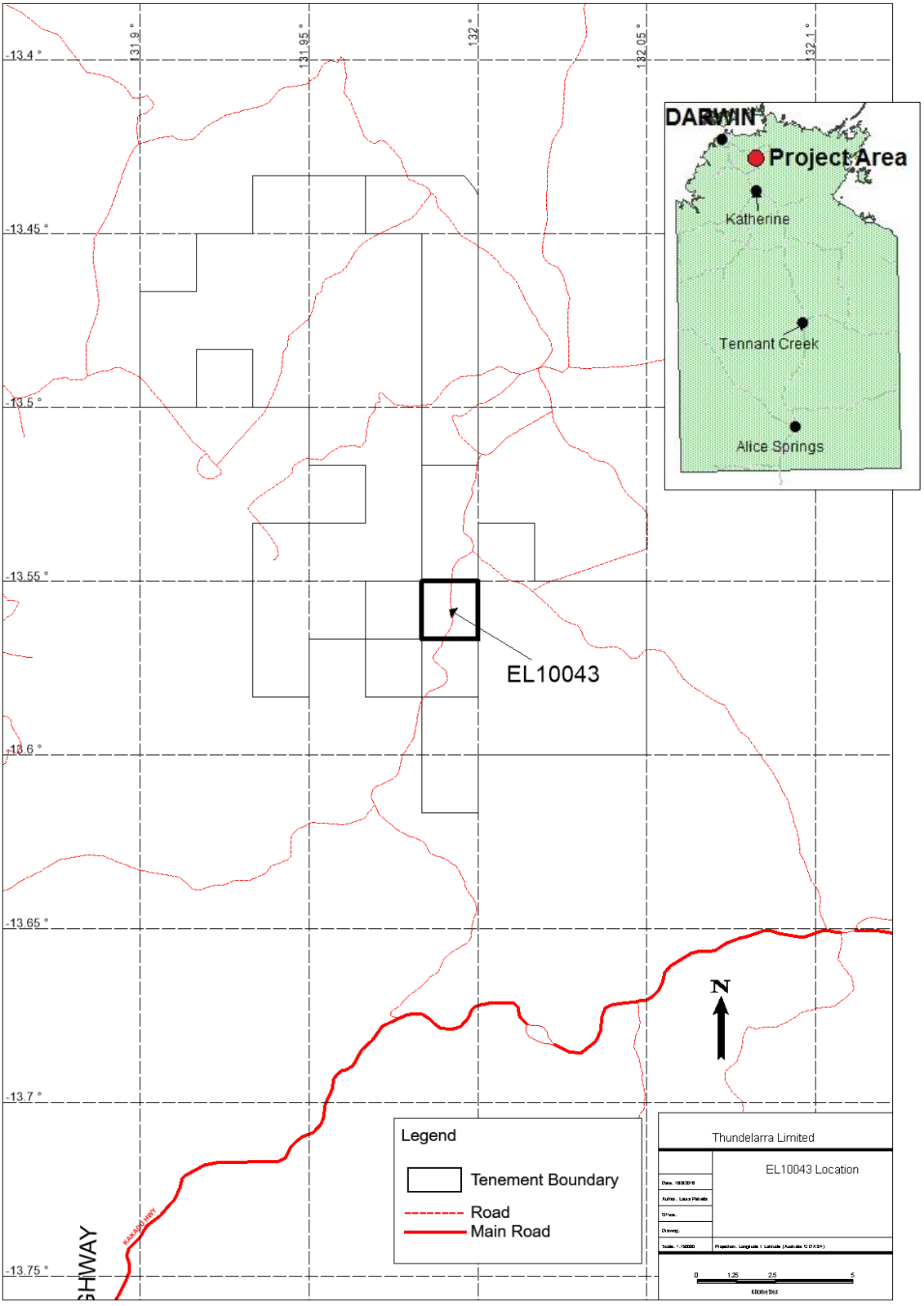


Figure 1: Location of the Project area.

4. GEOLOGICAL SETTING

The project area is located within central part of the Pine Creek Orogen (PCO). Regional geology of the PCO is outlined in many publications, notably Ahmad *et al*. (1994), and Needham and Stuart-Smith (1984), and Needham *et al.* (1988). The PCO is a folded sequence of Palaeoproterozoic pelitic and psammitic sediments with interlayered cherty tuff units. Mafic sills of the Zamu Dolerite (~1.87Ga) intruded the lower sequence of the package. These rocks have been intruded by the late-orogenic Palaeoproterozoic granites, causing wide spread

contact/thermal aureole metamorphism, which contains most of the gold mineralisation, uranium and base metals mineralisation in the Orogen (Bajwah, 1994). Less deformed Mesoproterozoic sedimentary and volcanic sequences unconformably overlie the Palaeoproterozoic rocks and is overlain by Cambrian-Ordovician lavas, sediments and Cretaceous strata. Cainozoic sediments, laterite and recent alluvium may obscure parts of the Orogen lithologies.

Local Geology

The project area is located in the central part of the Pine Creek Orogen which is a world-class mineral province, and contains significant gold, base metals, uranium and iron ore mineralisation. It still offers significant potential for the discovery of new mineral deposits of base metals, gold, uranium and iron ore.

The Geology of the project area is shown in Figure 2 (NTGS/GA Mapping). EL 10043 is dominated by rocks of the Masson Formation (Namoona Group) which are generally surrounded by the Mundogie Sandstone (Mt Partridge Group). Immediately east of EL 10043, Cleo group of uranium mineral deposits are located (Figure 2). Mundogie Sandstone forms thin narrow beds east and west of the Masson Formation. The Masson Formation is a thick sequence of carbonaceous phyllite, slate, siltstone and dolomite. The dolomitic sediments are exposed towards the base of the formation. Some massive ironstone and muscovite-tremolite marble horizons are also present. It has been intruded by the Minglo and Frances Creek Granites towards east and Allamber Granite towards south. The Masson Formation hosts significant uranium mineralisation towards east at Cleo, twins and Mercedes. In addition, it also contains some occurrences of base metals mineralisation. The Mundogie Sandstone contains a thick sequence of coarse clastic sediments deposited in shallow marine and fluvial environment. Pyritic lithologies are present at places and contain sedimentary structures such as graded bedding, cross-bedding and load clasts. In addition, thin hematitic interbeds of phyllite, carbonaceous phyllite and sandy siltstone probably comprise less than 50% of the formation. The Minglo and Allamber Springs Granites intrude the rocks towards north-east and south. Minor occurrences of vein-type base metals and Au mineralisation are hosted by the Mundogie Sandstone.

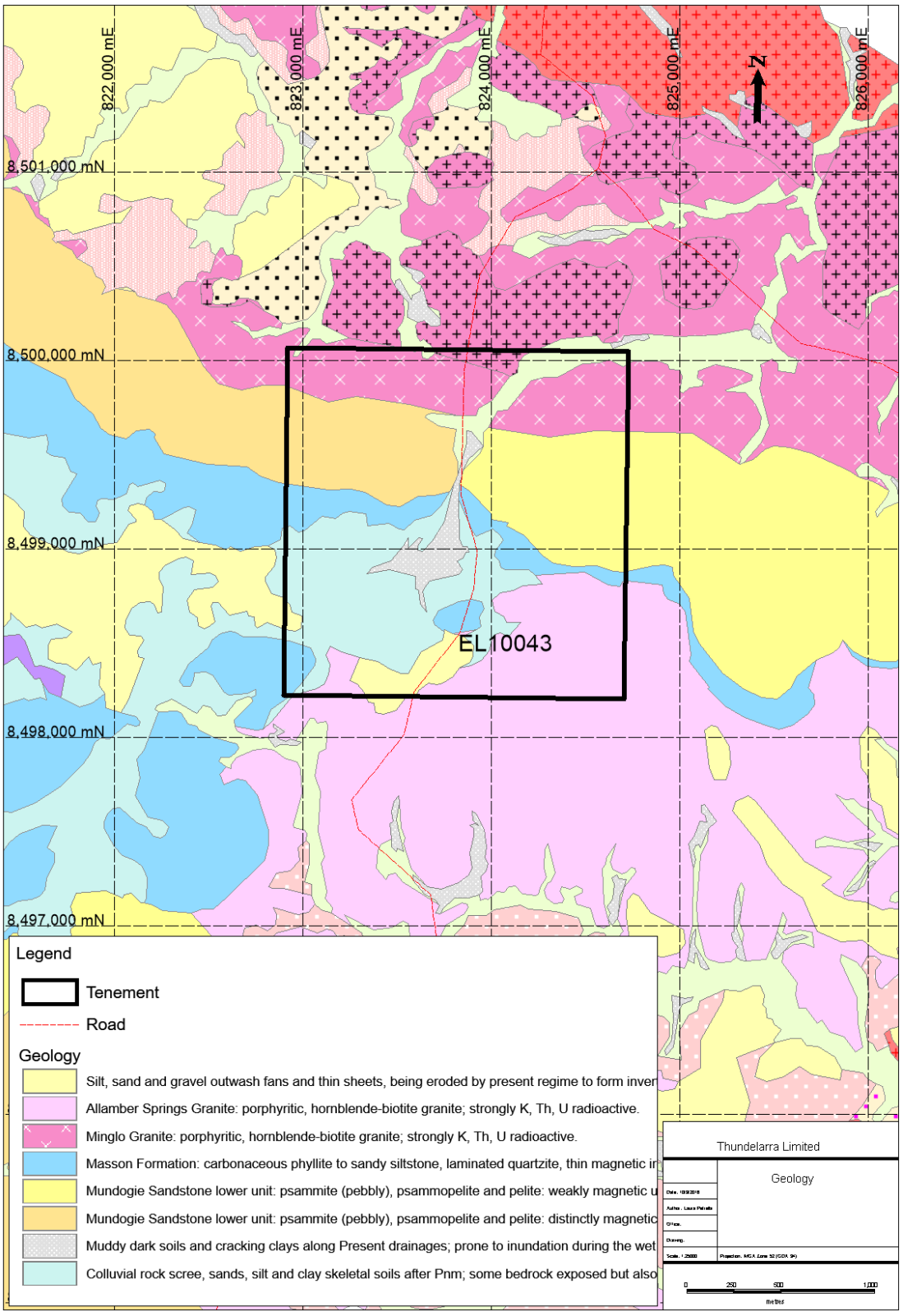


Figure 2: Geological setting of the Project area.

Uranium and Copper Mineralisation

As mentioned previous previously that Cleo group of uranium deposits (Cleo, Twins, Dam, Mercedes) are located in the south-east of the project area within Allamber Embayment (Figure 3). Uranium mineralisation occurs within a zone of about 3 km in strike length which was identified by Total Mining in the 1970's. More recent drilling by Atom Energy Ltd has identified a near surface resource of 1.4 Mt @ 304 ppm U_3O_8 at Dam and Twin prospects. Furthermore, zones of significant copper mineralisation have been intersected during drilling program. In

recent high resolution geophysical survey, a number of radiometric and magnetic anomalies have been identified.

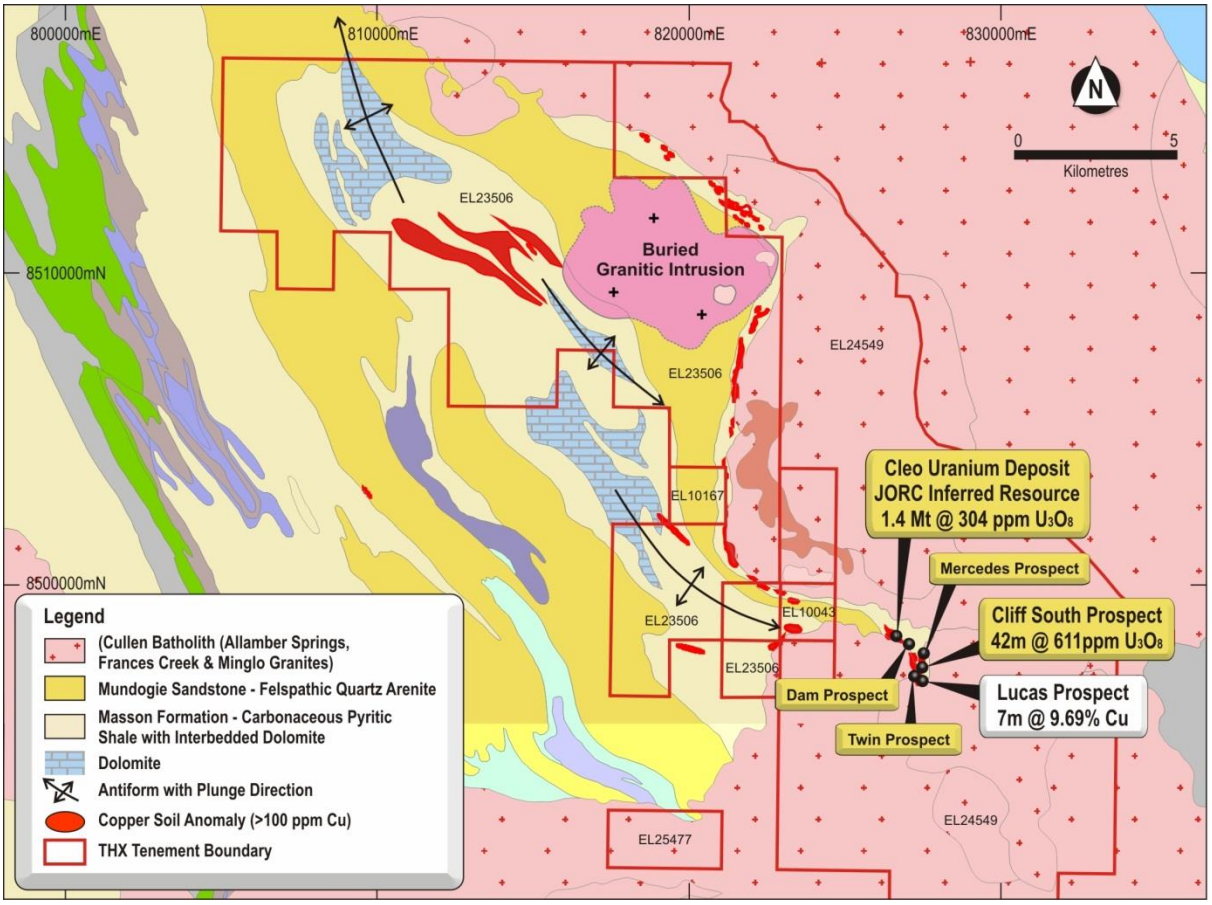


Figure 3: Projects location.

5. PREVIOUS EXPLORATION ACTIVITY

In the project area, previous exploration activity has been reported by Earthrowl (2007) and readers are advised to consult that report for more information.

During the 2009-10 period, Thundelarra Limited conducted exploration under optional agreement with the tenement holders. It involved ground-truthing, high resolution geophysical survey, ground radiometric survey, rock chip sampling and detail geological mapping. In additional, some planning for RC drilling was also done.

During the 2010-2012 period, detailed soil geochemical surveys were carried out over EL 10043, and a regional geological interpretation was completed by consultant Barry Cotton using publicly available satellite imagery and the results of the airborne geophysical surveys. During 2011 the company's exploration focus shifted from uranium to base metals mineralisation. The soil sampling program resulted in the identification of a number of strong base-metal anomalies. Four RC holes were drilled into the soil anomalies, resulting in the identification of significant copper mineralisation in the Tarpon Lode in the Ox-Eyed Herring area.

During the 2012-2013 period, work included soil geochemical surveys (75 Conventional and 25 Auger soil samples), a detailed ground magnetics survey (73.8 line km), 3 fixed loop ground EM surveys (259 stations), down-hole EM surveys on 3 drillholes, geological prospect mapping, and

the drilling of 10 RC holes for a total of 1036m and 199 samples. Copper zinc and gold mineralisation was identified at Ox-Eyed Herring Prospect.

During the 2013-2014 period, Thundelarra Limited conducted ground-truthing, data review, geological mapping and drilling of 1 RC hole for a total 60 meters. A total of 85 drill chip samples were retrieved and only 6 were assayed for gold and base metals mineralisation.

During the 2014-2015 reporting period, 4 RC holes were drilled in EL 10043 for a total 464 meters. A total of 70 drill chip samples were assayed for gold and base metals mineralisation. In addition, ground truthing was undertaken to inspect possible exploration targets for further field-testing.

During previous year 2015-2016, exploration only consisted in geological data processing and interpretation in order to prepare for further reverse circulation and diamond drilling at North Tarpon and North Brumby prospects.

6. EXPLORATION YEAR ENDING 4 SEPTEMBER 2017

During the year under review, exploration consisted in 2 Drillholes were drilled in EL 10043, 1 diamond drillhole TALDD001 and 1 RC drillhole with diamond completion TALRCDD002, for a total of 459.7 meters. A total of 77 samples were assayed for gold and base metals mineralisation. A petrography study has also been conducted on core samples by Pathfinder exploration service.

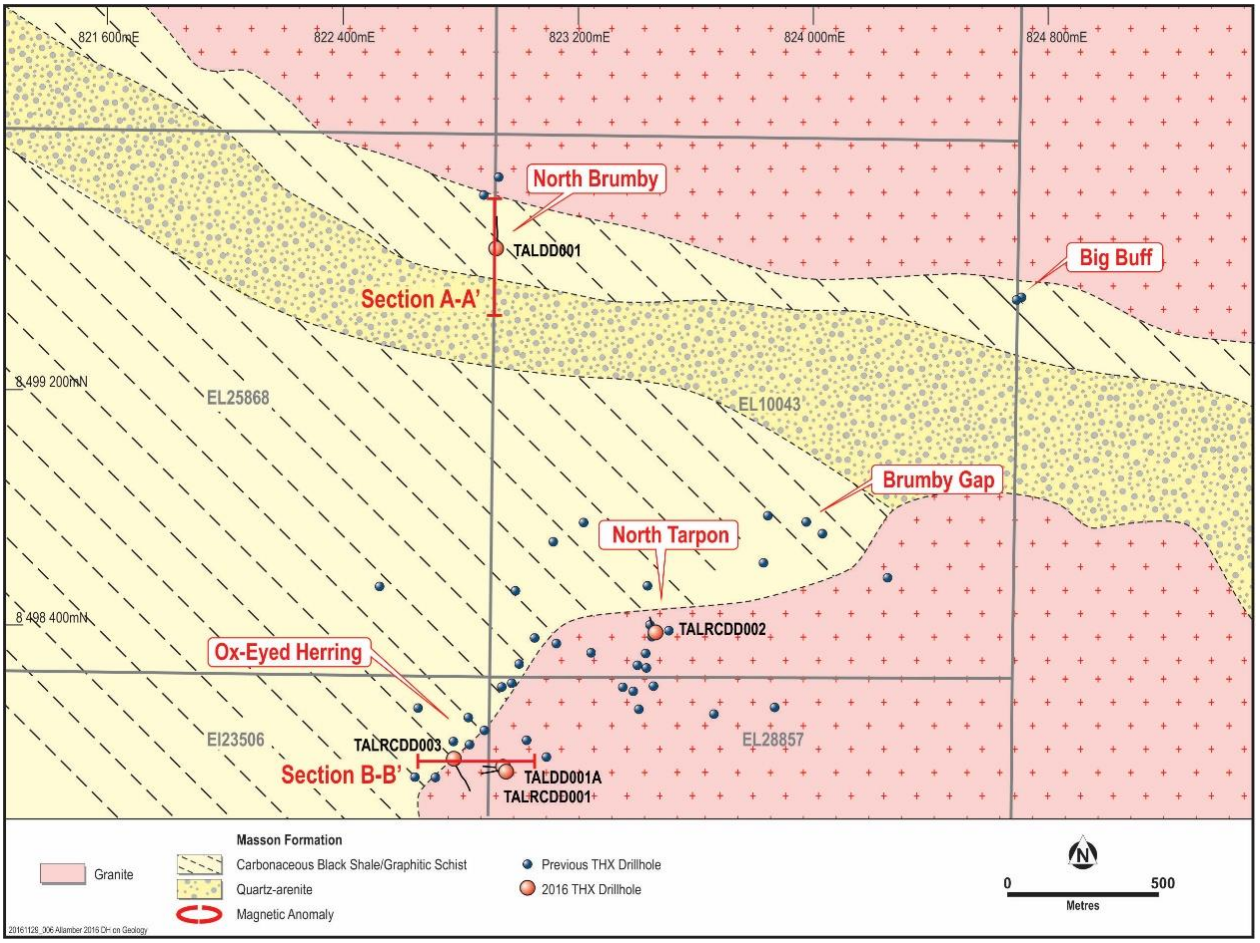


Figure 4: Drillhole location over Allamber geological settings.

Table 1: Drillholes location and details

Hole No	Prospect	Easting	Northing	Azimuth	Dip	Depth
TALDD001	North Brumby	822919	8499685	357	-65	249.1m
TALRCDD002	North Tarpon	823461	8498372	327	-75	209.7m

TALDD001 was drilled at North Brumby prospect to test from a different direction the strong magnetic anomaly located within the black shale package at the contact with the granitic batholith, to the north. The second reason for this hole was to test the graphite potential at the metamorphosed contact with the granitic intrusion. A thick sequence of psammitic/pellitic metadsediments was intersected. Several dykes of late-stage pink granites are present and only traces of pyrite and chalcopyrite have been noticed. Graphitic schists with various amounts of sulphides, mostly pyrrhotite and pyrite, were intersected and random samples were collected to test for total graphite content (TGC). 19 samples were delivered to Nagrom in Perth and the assay results are presented in Table 2.

Table 2: Assay results from TALDD001/North Brumby

From	To	Interval	Cuppm	Pbppm	Znppm	TGC%
61.5	61.6	0.1	110	110	75	12.4
96.75	97	0.25	140	30	25	10.5
110.15	110.35	0.2	190	20	315	13
118.3	118.6	0.3	170	20	10	11.3
127.8	127.95	0.15	200	30	75	10.6
136.2	136.4	0.2	220	10	455	12.9
145.5	145.7	0.2	190	60	85	13.1
150.45	150.6	0.15	200	10	25	14.6
153.15	153.25	0.1	200	40	440	12.8
162.75	162.95	0.2	80	30	25	8.9
168.8	168.95	0.15	250	50	1185	7.8
179.15	179.3	0.15	80	-10	150	5.6
189.2	189.4	0.2	130	20	20	6.2
195.7	195.9	0.2	80	100	65	13.8
216.6	216.8	0.2	130	40	135	17.4
225.25	225.5	0.25	220	50	-5	13
240.35	240.55	0.2	50	-10	45	11.9
246.45	246.65	0.2	80	-10	25	11.4

The thick carbonaceous shale package located between the Mason quartz-arenite, to the south, and the granitic batholith, to the north, has significant potential for graphite. 18 petrological samples sent to Pathfinder have showed that the average size of graphite flake is around 70 microns. The continuity of this stratigraphic horizon has the potential to host significant graphite content both to the north-west (Nipper prospect) and east towards the Cleo-twin uranium prospects.

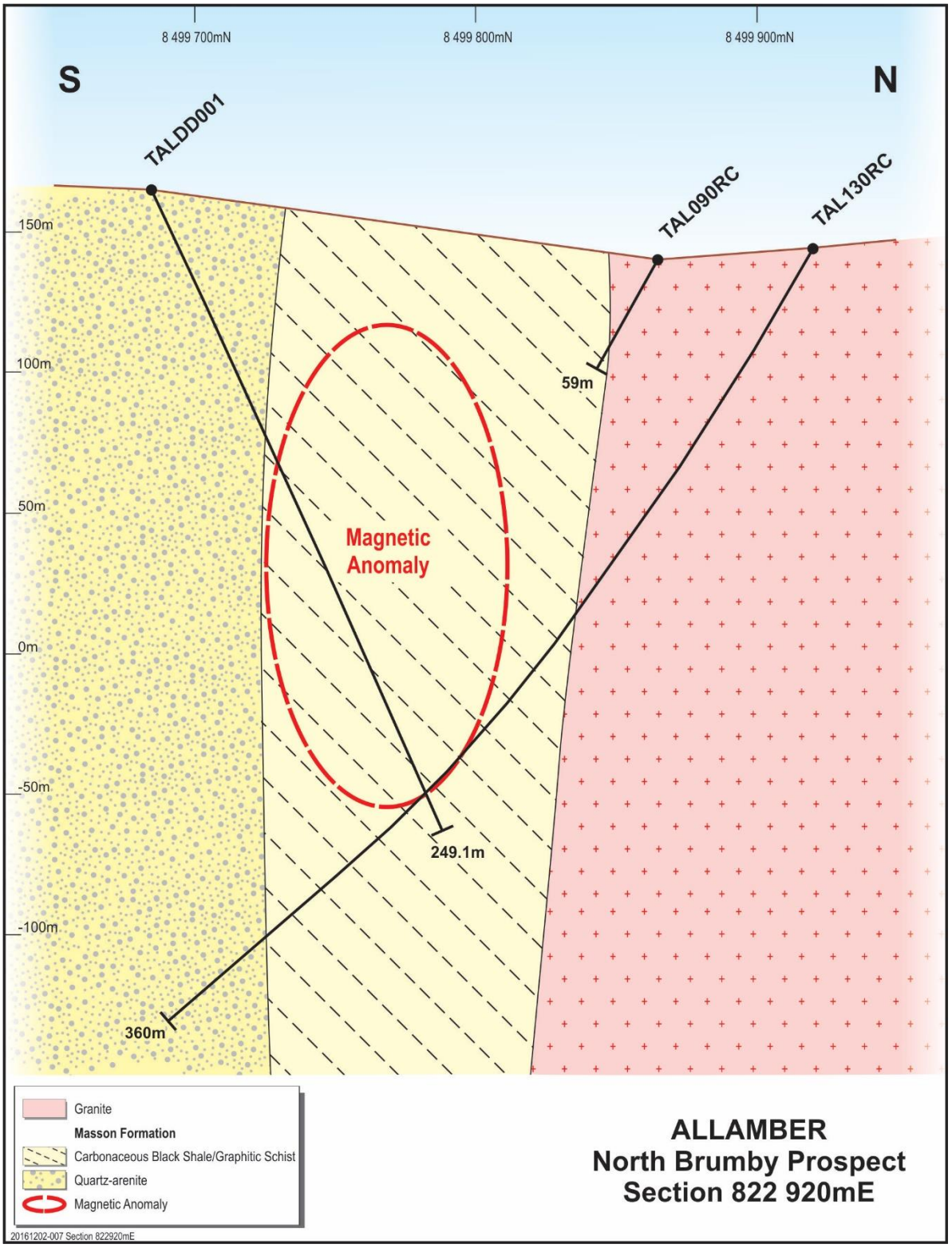


Figure 5: Cross section of North Brumby prospect showing drillholes

TALRCDD002 was drilled on the northern part of the Tarpon prospect where a prominent magnetic anomaly is present and significant conductive plates have been encountered in previous downhole surveys.

Table 3: Assay results from TALRCDD002/North Tarpon.

Hole ID	From	To	Length	Cu	As	Ag	Bi	Sn	W	Mo
TALRCDD002	85	86	1	1025	L	4	88.3	16.6	16	2.47
TALRCDD002	86	86.1	0.1	**36626**	L	**44**	89.3	350	14	3.22
TALRCDD002	86.1	87	0.9	507	L	L	39.2	16.8	9.4	3.92
TALRCDD002	87	87.5	0.5	2371	L	4	**468**	39.5	10	1.9
TALRCDD002	99.2	99.3	0.1	**18137**	L	**47**	**687**	172	**228**	2.11
TALRCDD002	104.15	104.5	0.35	3667	L	8	**1607**	33.5	8	2.45
TALRCDD002	105.5	105.75	0.25	9918	**135**	16	36.5	42.3	7.2	1.72
TALRCDD002	105.75	106	0.25	4984	48	8	7.41	62.6	7.9	2.11
TALRCDD002	111.2	111.65	0.45	2895	L	5	**1777**	103	15	1.89
TALRCDD002	111.65	112	0.35	**33797**	L	**48**	**5863**	**244**	57	2.31
TALRCDD002	112	112.3	0.3	**11890**	L	**18**	**837**	82.7	11	2.02
TALRCDD002	112.3	112.65	0.35	**21539**	L	**36**	**805**	**438**	12	2.06
TALRCDD002	112.65	113	0.35	5325	L	9	79.5	69.8	17	2.21
TALRCDD002	113	114	1	2092	**140**	4	58.4	25.9	14	2.08
TALRCDD002	114	115	1	6078	48	14	**497**	78	18	2.12
TALRCDD002	115	116	1	1960	**129**	2	**425**	31.6	22	2.69
TALRCDD002	116	117	1	2132	99	4	34.4	29.6	16	2.18
TALRCDD002	117	118	1	2868	72	4	7.75	31.8	14	1.96
TALRCDD002	118	118.9	0.9	4655	**117**	10	55.9	77	12	2.06
TALRCDD002	118.9	119.25	0.35	5293	**100**	6	**684**	30.9	10	2.42
TALRCDD002	131.8	132.2	0.4	3911	81	5	**319**	20.9	9.5	2.03
TALRCDD002	136	136.9	0.9	1713	L	2	23.6	14.2	7.1	8.67
TALRCDD002	136.9	137.1	0.2	9869	L	16	53.3	83.6	14	7.6
TALRCDD002	137.1	138.1	1	6419	L	8	**376**	53.8	12	11
TALRCDD002	138.1	139	0.9	1658	L	L	3.95	25	8.4	4.76
TALRCDD002	139	139.5	0.5	3345	L	2	**318**	20.6	12	3.65
TALRCDD002	177	177.8	0.8	2666	79	1	19.6	20.1	12	9.16
TALRCDD002	177.8	178.5	0.7	**18102**	**145**	8	**1451**	38.8	8.5	84.5
TALRCDD002	178.5	178.9	0.4	528	**459**	L	88.4	9.22	7.4	51.6
TALRCDD002	178.9	179.2	0.3	776	**294**	L	26.5	9.8	11	**97.6**
TALRCDD002	179.2	180	0.8	6790	L	4	9.42	20.7	12	49.3
TALRCDD002	192.5	193	0.5	**12599**	L	13	**435**	28.3	12	9.75
TALRCDD002	193	193.35	0.35	4513	404	8	**1834**	60.4	22	13.3
TALRCDD002	193.35	193.8	0.45	3714	17	5	**402**	84	33	10.5
TALRCDD002	193.8	194.2	0.4	**37090**	682	**26**	**1859**	78.4	13	4.03
TALRCDD002	194.2	195.1	0.9	8430	183	5	**385**	19.9	7.7	2.97

A reverse circulation pre-collar was drilled to the depth of 84m within red-brownish oxidised granite. Thin quartz veins with visible pyrrhotite and chalcopyrite were intersected below this level and the dominant strike is north-easterly with a shallow south-easterly dip. Although some local enrichments in copper values are present, overall the whole intersected package does not show potential for economic copper mineralisation (Table 3).

The petrography study on core sample consisted of 18 polished thin section from core from drillholeTALDD001. The study was conducted by Pathfinder exploration Pty Ltd using transmitted and reflected light microscopy.

Table 4: Petrography sample list:

Sample ID	Hole ID	from	To
TP002766	TALDD001	61.50	61.60
TP002767	TALDD001	96.75	97.00
TP002768	TALDD001	110.15	110.35
TP002769	TALDD001	118.30	118.60
TP002770	TALDD001	127.80	127.95
TP002771	TALDD001	136.20	136.40
TP002772	TALDD001	145.50	145.70
TP002773	TALDD001	150.45	150.60
TP002774	TALDD001	153.15	153.25
TP002775	TALDD001	162.75	162.95
TP002776	TALDD001	168.80	168.95
TP002777	TALDD001	178.15	179.30
TP002778	TALDD001	189.20	189.40
TP002779	TALDD001	195.70	195.90
TP002780	TALDD001	216.60	216.80
TP002781	TALDD001	225.25	225.50
TP002782	TALDD001	240.35	240.55
TP002783	TALDD001	246.45	246.65

PATHFINDER EXPLORATION PTY LTD
- GEOCHEMISTRY - PETROLOGY - GEOLOGY

11 Dennison Drive
Ocean Reef, WA 6027
Phone 618 9300 6689
Fax 618 9300 4429

Email: pfinder@bigpond.net.au
Web: www.pathfinderexploration.com.au

PETROGRAPHIC AND MINERAGRAPHIC DESCRIPTIONS

BRIEF PETROGRAPHIC DESCRIPTIONS

SAMPLE NO: TPOD 2766 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Mineralised (pyrite) graphite schist.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	56%	**Opaques (10%):**
Sericite/muscovite	32%	Graphite - dominant (10%)
Opaques	12%	Pyrite - minor (1%)
		Melnikovite pyrite - minor (1%)

Fine platy graphite aggregates occur as anastomosing schlieren (opaque) in a prograde metamorphic matrix comprising granoblastic quartz and platy muscovite closely associated with fine scaly to platy graphite (opaque) inclusions. Original andalusite porphyroblasts have been replaced by scaly sericite aggregates containing graphite inclusions.

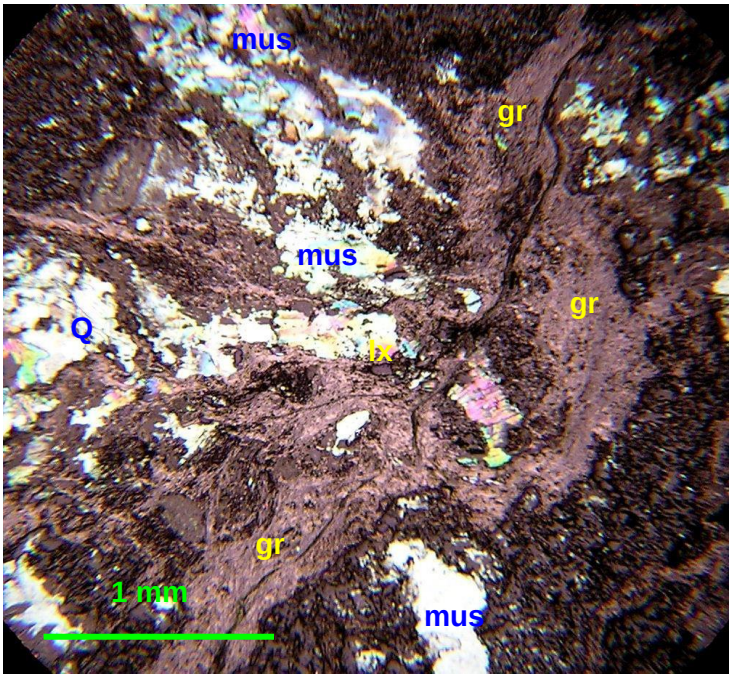
In reflected light, fine graphite flakes and flakey aggregates parallel an anastomosing schistosity. The individual graphite flakes range in size from 5 µm to 90 µm with an average size of approximately 40 µm. Graphite flakes also occur as massive aggregates or clusters up to 500 µm thick (typically 250 µm) within the anastomosing graphite schlieren.

Sulphides are dominated by blebby pyrite typically associated with porous secondary pyrite or melnikovite after original pyrrhotite. The presence of "birds-eye" textures in melnikovite pyrite confirms a pyrrhotite precursor.

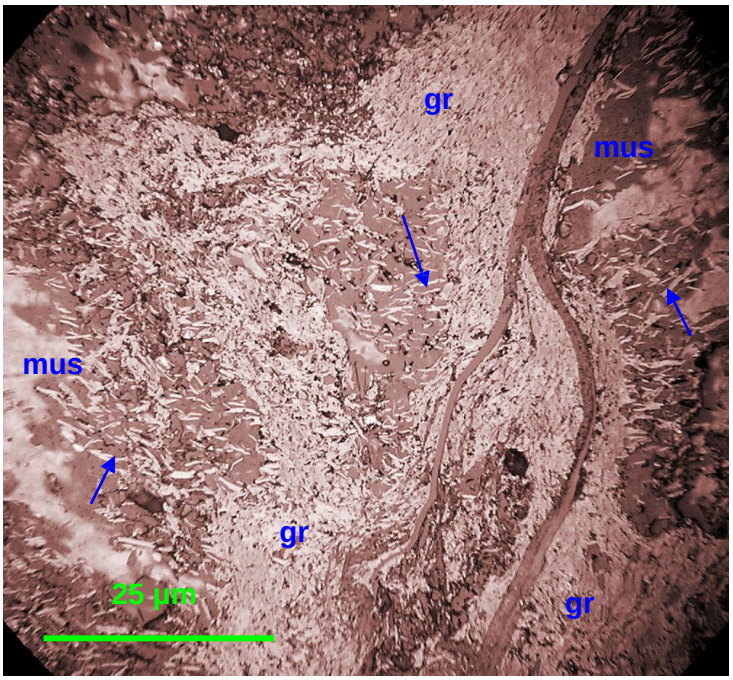
Comments: Flake graphite is ubiquitous in the sample although the flake size can be regarded as small (ie 5 to 90 µm, av – 40 µm). The massive flake clusters would probably separate relatively easily during the beneficiation process and comprise approximately 7 vol% of the sample, whereas most of the individual graphite flakes occur as inclusions in the quartz – muscovite – original andalusite(?) schistose host.

CLASSIFICATION: *Quartz - sericite/muscovite – graphite schist containing original andalusite porphyroblasts that have been pervasively sericitised.*

Brief Petrographic Descriptions



Sample TPOD 2766
Anastomosing aggregates of flake graphite (gr) cutting the quartz (Q) – muscovite (mus) schist host. Crossed polars under transmitted and reflected light. Field of view – 3 mm.



Sample TPOD 2766
A detailed view showing the presence of individual graphite (gr) flakes (arrowed) as well as massive graphite (gr) flake aggregates occurring in the muscovite (mus) host. Crossed polars under transmitted and reflected light. Field of view – 75 µm.

****

Brief Petrographic Descriptions

SAMPLE NO: TPOD 2767 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Mineralised (pyrite) graphite schist.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	57%	**Opaques (11%):**
Potash feldspar	4%	Graphite - dominant (8%)
Sericite/muscovite	25%	Pyrite - subordinate (2%)
Biotite	1%	Melnikovite pyrite - minor (1%)
Fe/Mg chlorite	2%	Chalcopyrite - tr
Rutile	tr	
Opaques	11%	

Flaky graphite aggregates occur as distinctive anastomosing schlieren (opaque) in a prograde metamorphic matrix comprising platy muscovite associated with granoblastic quartz and minor potash feldspar. Platy biotite occurs as a minor phase and has been locally replaced by Fe/Mg chlorite. Fine scaly to platy graphite (opaque) inclusions occur within the silicate gangue. Possible original andalusite porphyroblasts in the matrix have been replaced by scaly sericite aggregates as a retrograde phase.

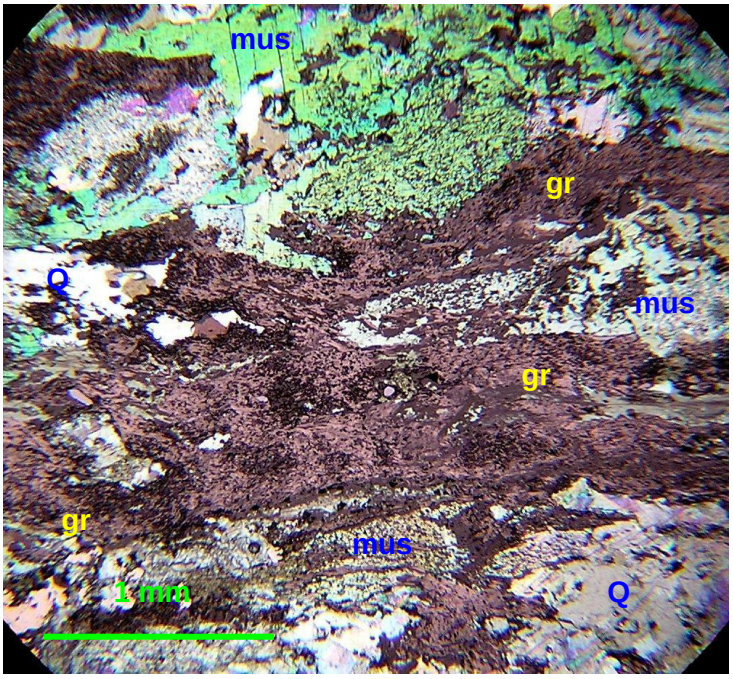
In reflected light, the graphite schlieren comprise fine graphite flakes (up to 110 μm) in the metamorphic host. The fine graphite flakes and flakey aggregates parallel an anastomosing schistosity. The individual graphite flakes range in size from 20 μm to 120 μm with an average size of approximately 70 μm. Graphite flakes also occur as aggregates or clusters up to 400 μm thick within the anastomosing graphite schlieren. Fine, anhedral rutile occurs as an accessory in the matrix and is obvious under reflected light.

Sulphides are dominated by blebby pyrite typically associated with porous secondary pyrite or melnikovite after original pyrrhotite. Trace chalcopyrite inclusions in pyrite.

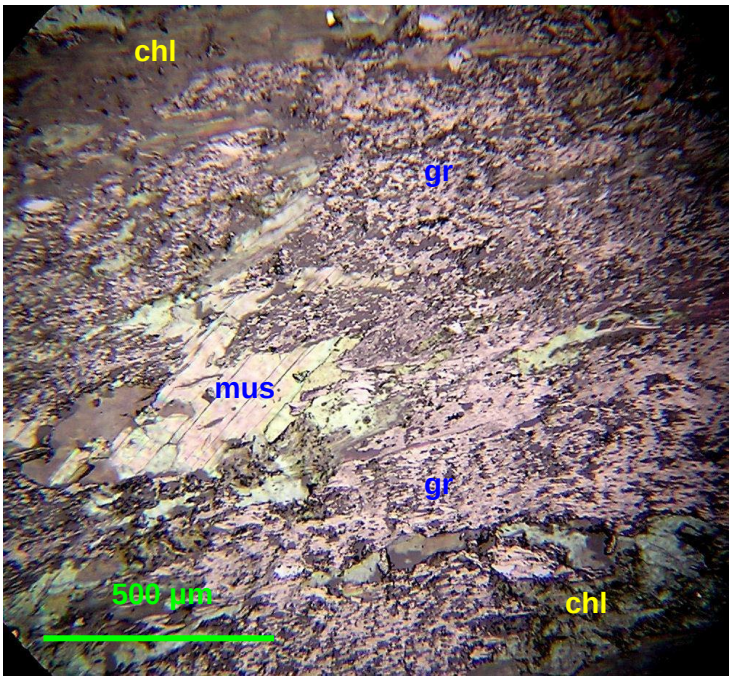
Comments: Flake graphite is typically concentrated in the flakey schlieren that parallels the anastomosing schistosity. The flake size can be regarded as small to medium (ie 20 to 120 μm, av – 70 μm). The prograde assemblage would be stable under lower amphibolite facies and has been retrogressed to sericite and Fe/Mg chlorite.

CLASSIFICATION: *Quartz - potash feldspar - muscovite/sericite – minor biotite - graphite schist, possibly containing original andalusite.*

Brief Petrographic Descriptions



Sample TPOD 2767
Flake graphite (gr) is concentrated in schlieren paralleling an anastomosing schistosity in a matrix comprising platy muscovite (mus) and quartz (Q). Crossed polars under transmitted and reflected light. Field of view – 3 mm.



Sample TPOD 2767
A detailed view showing concentration of graphite (gr) flakes in the matrix comprising platy muscovite (mus) and Fe/Mg chlorite after original biotite. Crossed polars under transmitted and reflected light. Field of view – 1.5 mm.

****

Brief Petrographic Descriptions

SAMPLE NO: TPOD 2768 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Mineralised (pyrite) graphite schist.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	42%	**Opaques (15%):**
Potash feldspar	4%	Graphite - dominant (10%)
Sericite/muscovite	35%	Pyrrhotite - subordinate (5%)
Biotite	4%	Chalcopyrite - tr
Rutile	tr	
Opaques	15%	

Broadly similar to Sample TPOD 2767 with flaky graphite aggregates occurring as distinctive anastomosing schlieren (opaque) in a prograde metamorphic matrix. The host comprises platy muscovite associated with granoblastic quartz, minor potash feldspar and platy biotite. A series of pyrrhotite stringers (opaque) cut the foliation. Fine scaly to platy graphite (opaque) inclusions occur within the silicate gangue. Possible original andalusite porphyroblasts in the matrix have been replaced by scaly sericite aggregates as a retrograde phase.

In reflected light, the graphite schlieren comprise fine graphite flakes (up to 110 μm) in the metamorphic host. The fine graphite flakes and flakey aggregates parallel an anastomosing schistosity. The individual graphite flakes range in size from 20 μm to 140 μm with an average size of approximately 70 μm. Graphite flakes also occur as aggregates or clusters up to 350 μm thick within the anastomosing graphite schlieren. Fine, anhedral rutile occurs as an accessory in the matrix and is obvious under reflected light.

Sulphides are dominated by blebby pyrite typically associated with porous secondary pyrite or melnikovite after original pyrrhotite. Trace chalcopyrite inclusions in pyrite.

Comments: Flake graphite is typically concentrated in the flakey schlieren that parallels the anastomosing schistosity. The flake size can be regarded as small to medium (ie 20 to 140 μm, av – 70 μm). The prograde assemblage would be stable under lower amphibolite facies and has been retrogressed to sericite and Fe/Mg chlorite.

CLASSIFICATION: *Quartz - potash feldspar - muscovite/sericite – minor biotite - graphite schist, possibly containing original andalusite porphyroblasts.*

****

Brief Petrographic Descriptions

SAMPLE NO: TPOD 2769 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Mineralised (pyrrhotite) graphite schist.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	53%	**Opaques (14%):**
Potash feldspar	4%	Graphite - (8%)
Sericite/muscovite	26%	Pyrrhotite - (6%)
Mg chlorite	3%	Chalcopyrite - tr
Rutile	tr	
Opaques	14%	

Flaky graphite (opaque) aggregates parallel an anastomosing schistosity in a prograde metamorphic matrix comprising coarse platy muscovite associated with granoblastic quartz and a subordinate feldspathic component. The feldspathic component includes minor potash feldspar and possibly plagioclase that has been pervasively altered to clay and scaly sericite as a retrograde phase. Platy Mg chlorite can be interlayered with muscovite and locally rims sulphides. Fine, scaly to platy graphite (opaque) inclusions occur within the silicate gangue. Possible original andalusite porphyroblasts in the matrix have been replaced by scaly sericite aggregates as a retrograde phase.

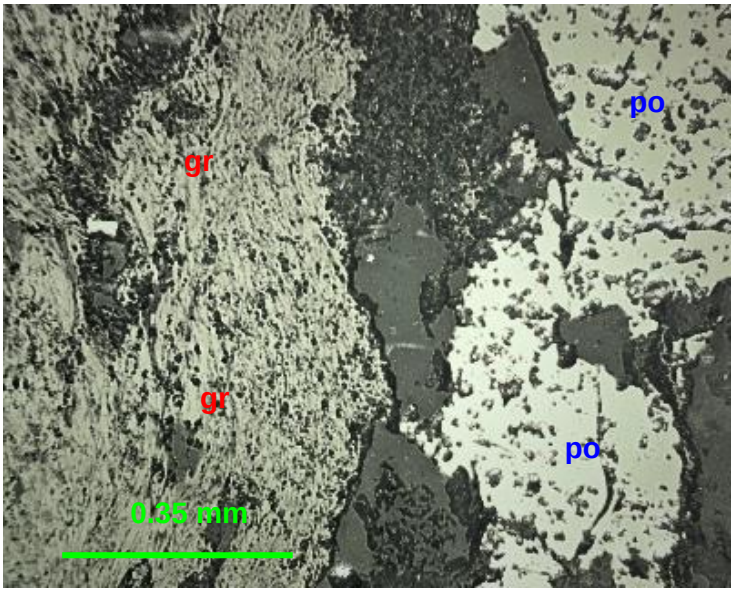
In reflected light, slightly increased graphite flake size is evident (up to 120 μm) in the metamorphic host. The fine graphite flakes and flakey aggregates parallel an anastomosing schistosity. The individual graphite flakes range in size from 25 μm to 120 μm with an average size of approximately 80 μm. Graphite flakes also occur as aggregates or clusters up to 420 μm thick within the anastomosing schistosity. Fine, anhedral rutile occurs as an accessory in the matrix and is obvious under reflected light.

Sulphides are dominated by pyrrhotite occurring as blebs and stringers cross-cutting the foliation. Pyrrhotite and flake graphite typically occur separately within the section and should not provide beneficiation challenges. Trace chalcopyrite is associated with pyrrhotite.

Comments: Flake graphite typically parallels the anastomosing schistosity. The flake size can be regarded as small to medium (ie 25 to 120 μm, av – 80 μm). The prograde assemblage would be stable under lower amphibolite facies and has been retrogressed to sericite, clay and Mg chlorite.

CLASSIFICATION: *Quartz - potash feldspar – original plagioclase - muscovite/sericite – graphite schist, possibly containing original andalusite. Blebby and stringer pyrrhotite mineralisation is present.*

Brief Petrographic Descriptions

	**Sample TPOD 2769** Flake graphite (gr) aggregate occurring separately to blebby pyrrhotite (po) in the high grade metamorphic host. Plane polarise reflected light. Field of view – 1 mm.

****

Brief Petrographic Descriptions

SAMPLE NO: TPOD 2770 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Mineralised (pyrrhotite) graphite schist.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	55%	**Opaques (13%):**
Potash feldspar	9%	Graphite - (7%)
Sericite/muscovite	20%	Pyrrhotite - (6%)
Biotite	tr	
Mg chlorite	3%	
Rutile	tr	
Opaques	13%	

Flaky graphite (opaque) parallels the strong preferred schistosity in the prograde metamorphic matrix comprising coarse platy muscovite associated with anhedral to granoblastic quartz and subordinate potash feldspar. Potash feldspar has been progressively altered to scaly sericite and dusted clays as a retrograde phase. Platy Mg chlorite can be associated with flake graphite lenses or schlieren paralleling the foliation. Fine scaly to platy graphite (opaque) inclusions occur within the silicate gangue as a minor component.

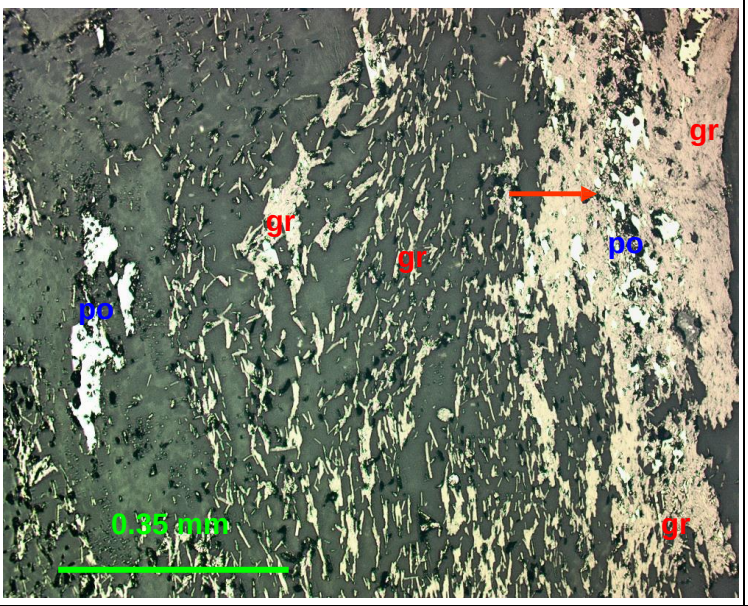
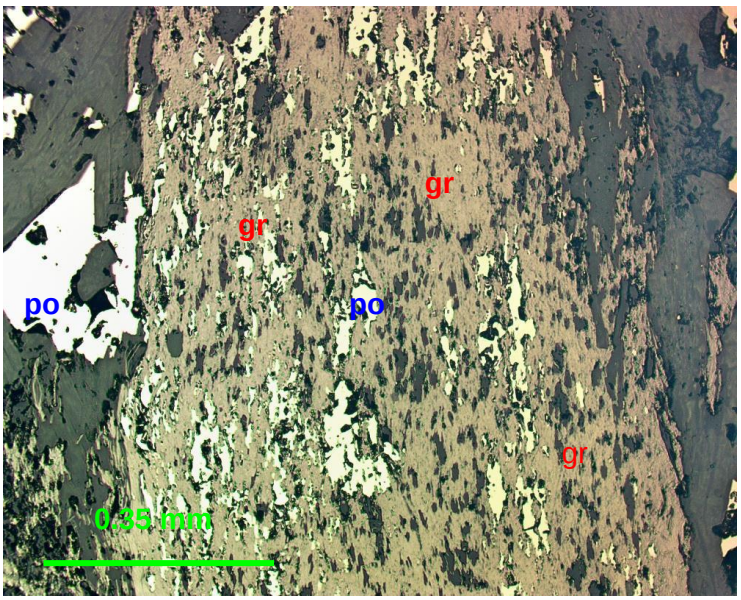
In reflected light, fine graphite flakes and clumps of flakes that parallel the foliation. The individual graphite flakes range in size from 20 μm to 110 μm with an average size of approximately 60 μm. Graphite flakes also occur as distinctive aggregates or clusters that parallel the foliation and can be up to 400 μm thick and are typically associated with the phyllosilicate component. Fine, anhedral rutile occurs as an accessory in the matrix and is obvious under reflected light.

Sulphides are dominated by pyrrhotite occurring as blebs in the matrix that can be moulded around flake graphite aggregates. Pyrrhotite and flake graphite can exhibit a closer relationship although it is not expected to afford beneficiation challenges.

Comments: Flake graphite typically parallels the strong preferred schistosity. The flake size can be regarded as small to medium (ie 20 to 110 μm, av – 60 μm) although the graphite clumps are significant. The prograde assemblage would be stable under lower amphibolite facies and has been retrogressed to sericite, clay and Mg chlorite.

CLASSIFICATION: *Quartz - potash feldspar – muscovite/sericite – graphite schist. Blebby pyrrhotite mineralisation is present.*

Brief Petrographic Descriptions

	**Sample TPOD 2770** Graphite (gr) flakes and aggregates parallel a preferred schistosity in the metamorphic host. Note the presence of pyrrhotite (po)occurring within the flake graphite aggregate or schlieren (arrowed). Plane polarised reflected light. Field of view – 1 mm.
	**Sample TPOD 2770** Another view showing pyrrhotite (po) inclusions in the flake graphite (gr) aggregate or schlieren. Blebby pyrrhotite (po) locally rims the graphite aggregate. Plane polarised reflected light. Field of view – 1 mm.

****

Brief Petrographic Descriptions

SAMPLE NO: TPOD 2771 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Mineralised (pyrrhotite as stringers and bands) graphite schist.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	51%	**Opaques (17%):**
Potash feldspar	5%	Graphite - (8%)
Sericite/muscovite	16%	Pyrrhotite - (9%)
Mg chlorite	1%	
Rutile	tr	
Opaques	17%	

Flaky graphite (opaque) aggregates parallel an anastomosing schistosity in a prograde metamorphic matrix comprising platy muscovite associated with granoblastic quartz and subordinate potash feldspar. Potash feldspar has been locally altered to clay and scaly sericite as a retrograde phase. Minor platy Mg chlorite parallels the foliation and can be associated with flake graphite. Fine scaly to platy graphite (opaque) inclusions occur within the silicate gangue (muscovite and to a lesser extent, quartz).

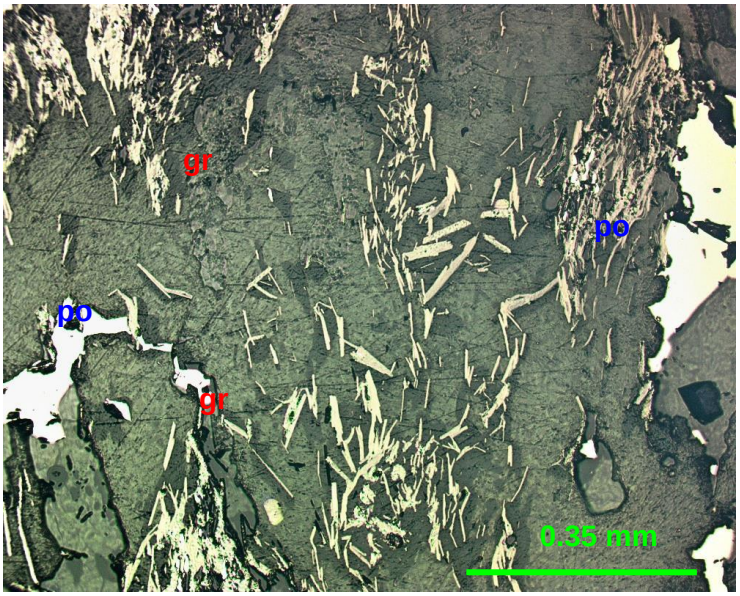
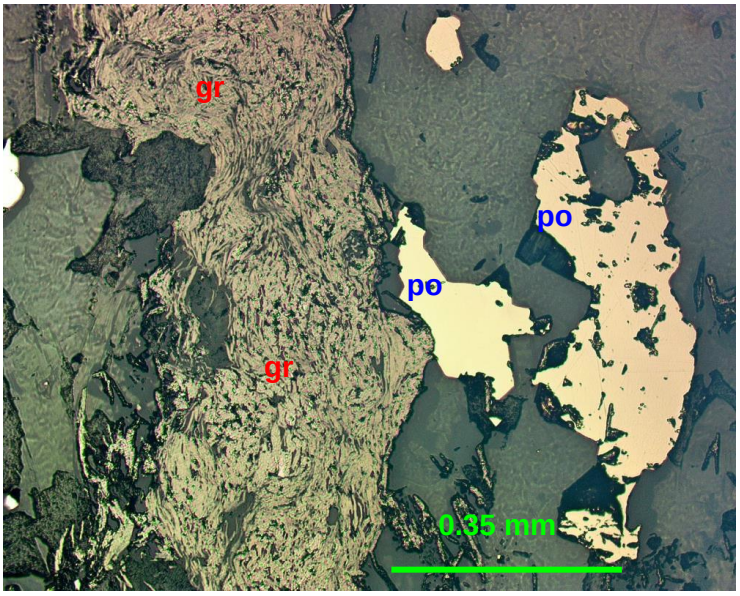
In reflected light, graphite as fine flakes and aggregates parallel the anastomosing schistosity. The individual graphite flakes range in size from 6 μm to 150 μm with an average size of approximately 80 μm. Graphite flakes also occur as aggregates or clusters up to 250 μm thick within the anastomosing schistosity. Fine, anhedral rutile occurs as an accessory in the matrix and is obvious under reflected light.

Sulphides are dominated by pyrrhotite occurring as blebs, stringers and bands locally paralleling the foliation. Pyrrhotite and flake graphite normally occur separately within the section although there is some evidence of graphite/sulphide layering. Overall, the association should not provide beneficiation challenges.

Comments: Flake graphite typically parallels the anastomosing schistosity. The flake size can be regarded as small to coarse (ie 6 to 150 μm, av – 80 μm). The prograde assemblage would be stable under lower amphibolite facies and has been retrogressed to sericite, clay and Mg chlorite.

CLASSIFICATION: *Quartz - potash feldspar - muscovite/sericite – graphite schist. Blebby, stringer and banded pyrrhotite mineralisation is present.*

Brief Petrographic Descriptions

	**Sample TPOD 2771** Graphite (gr) flakes and blebby pyrrhotite (po) occur in the high grade metamorphic host. Plane polarised reflected light. Field of view – 1 mm.
	**Sample TPOD 2771** Another view showing a flake graphite (gr) aggregate occurring separately to blebby pyrrhotite (po) in the high grade metamorph host. Plane polarised reflected light. Field of view – 1 mm.

****

Brief Petrographic Descriptions

SAMPLE NO: TPOD 2772 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Mineralised (pyrrhotite as stringers and bands) graphite schist.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	49%	**Opaques (26%):**
Potash feldspar	4%	Graphite - (7%)
Sericite/muscovite	18%	Pyrrhotite - (14%)
Biotite to Fe chlorite	2%	Pyrite - (5%)
Mg chlorite	1%	
Rutile	tr	
Opaques	26%	

An increased flake graphite content is apparent with flaky graphite (opaque) and flake graphite aggregates or schlieren paralleling an anastomosing schistosity in a prograde metamorphic matrix. The matrix comprises platy muscovite associated with granoblastic quartz and subordinate potash feldspar. There is evidence of minor biotite that has been replaced by Fe chlorite. Scaly sericite aggregates containing fine graphite (opaque) inclusions may have replaced an original porphyroblastic phase – possibly andalusite. Fine, scaly to platy graphite (opaque) inclusions also occur within the silicate gangue.

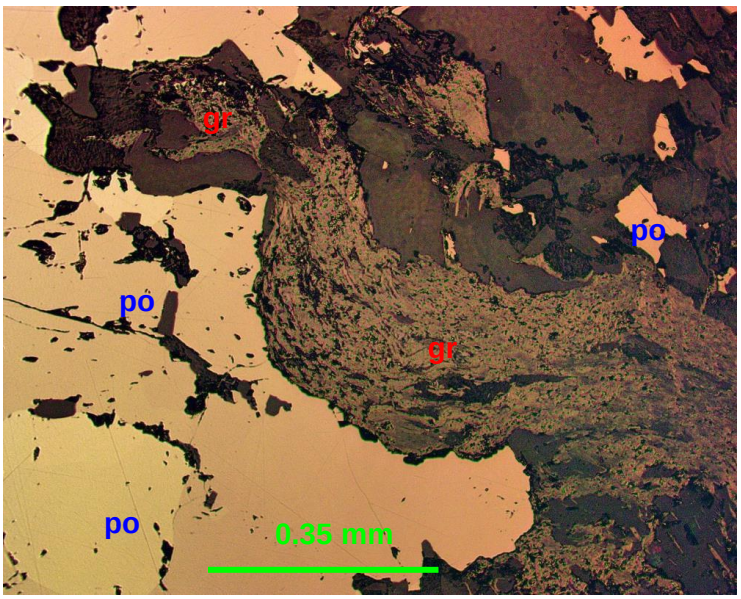
In reflected light, graphite as fine flakes and aggregates parallel the anastomosing and locally crenulated schistosity. The individual graphite flakes range in size from 10 μm to 120 μm with an average size of approximately 60 μm. Significantly, most of the graphite flakes occur as aggregates or clusters up to 200 to 400 μm thick within the anastomosing schistosity. Platy muscovite is typically interlayered with graphite in the clusters. Fine, anhedral rutile occurs as an accessory in the matrix and is obvious under reflected light.

Sulphides are dominated by pyrrhotite occurring as blebs and stringers or lenses that cross-cut the schistosity. Dominant pyrrhotite can exhibit simple intergrowths with pyrite. Pyrrhotite/pyrite and flake graphite normally occur separately and should not provide beneficiation challenges.

Comments: Flake graphite typically parallels the anastomosing and crenulated schistosity confirming superposed deformation phases. The flake size can be regarded as small to medium (ie 10 to 120 μm, av – 60 μm). The prograde assemblage would be stable under lower amphibolite facies.

CLASSIFICATION: *Quartz - potash feldspar - muscovite/sericite – original andalusite - graphite schist. Abundant blebby and stringer pyrrhotite and pyrite mineralisation is present.*

Brief Petrographic Descriptions



Sample TPOD 2772
Pyrrhotite (po) is moulded around flake graphite (gr) aggregate or schlieren in the mineralised prograde metamorphic host. Crossed polars under reflected light. Field of view – 1 mm.

****

Brief Petrographic Descriptions

SAMPLE NO: TPOD 2773 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Mineralised (pyrrhotite as stringers and bands) graphite schist.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	54%	**Opaques (18%):**
Potash feldspar	3%	Graphite - (11%)
Sericite/muscovite	23%	Pyrrhotite - (7%)
Mg chlorite	1%	Chalcopyrite - tr
Rutile	tr	
Staurolite	1%	
Opaques	18%	

Similar to Sample TPOD 2772, with an increased graphite (opaque) content as flakes and aggregates paralleling the strong schistosity. The prograde metamorphic matrix comprises coarse platy muscovite associated with granoblastic quartz and subordinate potash feldspar. Quartz – potash feldspar lenses or leucosomes parallel the schistosity and may reflect the original gneissosity. Occasional, medium grained, tabular to idioblastic staurolite porphyroblasts are apparent and represent part of the prograde assemblage.
Minor platy Mg chlorite aggregates occur as late stage veins oblique to the foliation and rimming sulphide (opaque) plus quartz lenses.
A significant proportion of the graphite occurs as fine scaly to platy (opaque) inclusions in muscovite and may indicate the presence of original andalusite (?).

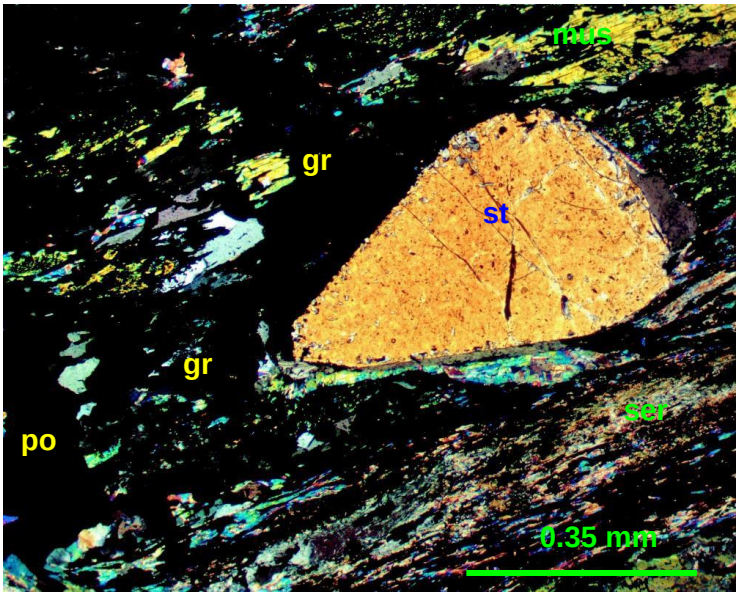
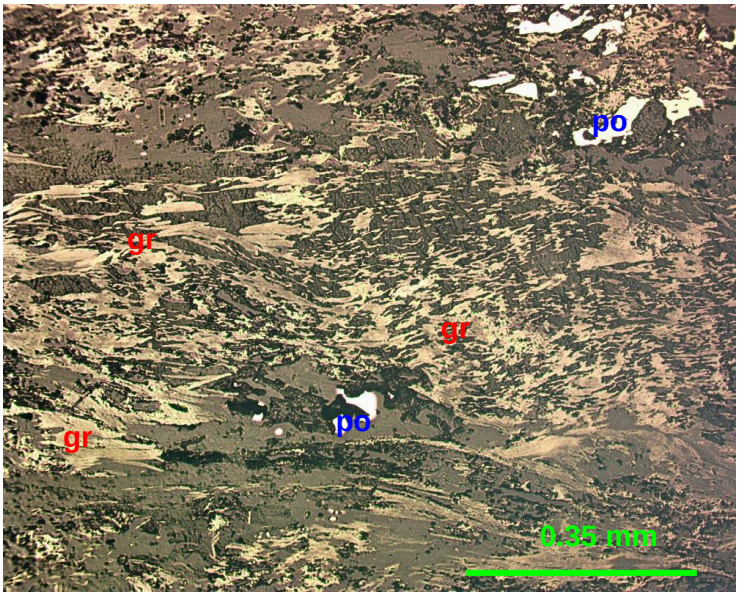
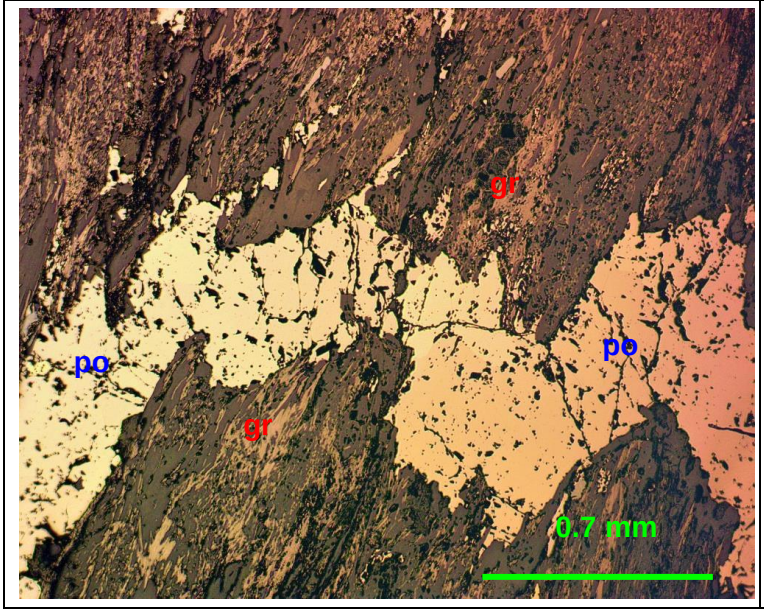
In reflected light, graphite as fine flakes and aggregates parallel the penetrative schistosity. The individual graphite flakes range in size from 12 μm to 130 μm with an average size of approximately 70 μm. Graphite flakes also occur as aggregates or clusters up to 300 μm thick and typically interlayered with muscovite in the schistose matrix. Fine, anhedral rutile occurs as an accessory in the matrix and is obvious under reflected light.

Sulphides are dominated by pyrrhotite occurring as blebs and stringers that locally cross-cut the foliation and have locally developed ptygmatic textures. Pyrrhotite can exhibit simple intergrowths with trace chalcopyrite. Pyrrhotite and flake graphite normally occur separately and should not provide beneficiation problems although the presence of interlayered muscovite may represent a challenge.

Comments: Flake graphite typically parallels the strong penetrative schistosity. The flake size can be regarded as small to medium (ie 12 to 130 μm, av – 70 μm) with the presence of aggregates of flake graphite. The prograde assemblage would be stable under lower amphibolite facies confirmed by the presence of staurolite porphyroblasts.

CLASSIFICATION: *Quartz - potash feldspar - muscovite/sericite – staurolite – original andalusite (?) graphite schist. Blebby and stringer pyrrhotite and trace chalcopyrite mineralisation is present.*

Brief Petrographic Descriptions

	**Sample TPOD 2773** A prismatic staurolite (st) porphyroblast occurs in the prograde metamorphic matrix comprising platy muscovite (mus) /scaly sericite closely associated with flake graphite (gr – opaque). A pyrrhotite (po) lens cross-cuts the foliation. Crossed polars unde transmitted light. Field of view – 2.2 mm.
	**Sample TPOD 2773** A detailed view under reflected light showing flake graphite (gr) paralleling the anastomosing foliation. Minor blebby pyrrhotite (po). Field of view – 1 mm.
	**Sample TPOD 2773** Flake graphite (gr) parallels the penetrative schistosity that has been cut by a ptygmatic pyrrhotite (po) vein. Plane polarised reflected light. Field of view – 2.2 mm.

Brief Petrographic Descriptions

SAMPLE NO: TPOD 2774 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Mineralised (pyrrhotite as stringers and bands) graphite schist.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	60%	**Opaques (16%):**
Potash feldspar	4%	Graphite - (8%)
Sericite/muscovite	18%	Pyrrhotite - (8%)
Mg chlorite	1%	Chalcopyrite - tr
Rutile	tr	
Staurolite	1%	
Opaques	16%	

Graphite (opaque) occurs as flakes and aggregates paralleling the anastomosing schistosity. The prograde metamorphic matrix comprises coarse platy muscovite associated with granoblastic quartz and subordinate potash feldspar. Occasional, fine, tabular to subidioblastic staurolite porphyroblasts are apparent and represent part of the prograde assemblage.
Minor platy Mg chlorite aggregates can be associated with sulphides (opaque).
A significant proportion of the graphite occurs as fine scaly to platy (opaque) inclusions in muscovite and scaly sericite aggregates, and may indicate the presence of original andalusite (?).

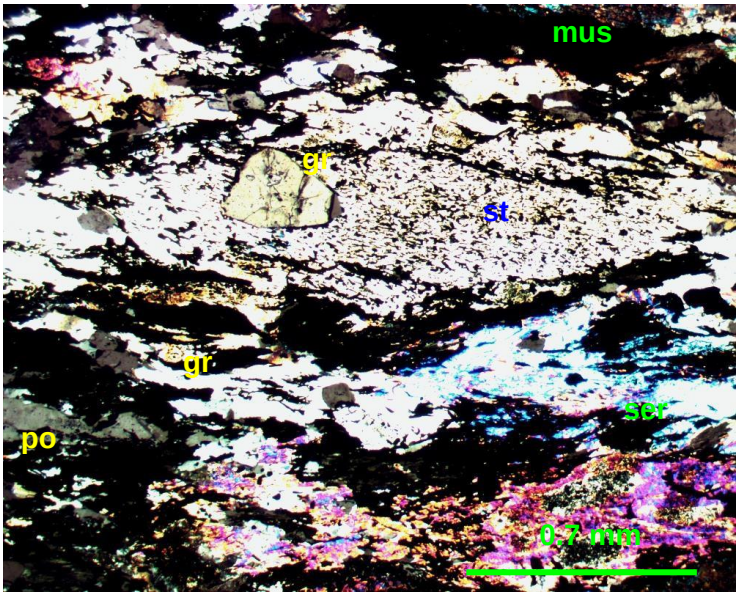
In reflected light, graphite occurs as fine flakes and aggregates paralleling the anastomosing schistosity. The individual graphite flakes range in size from 12 μm to 160 μm with an average size of approximately 90 μm. Graphite flakes also occur as aggregates or clusters up to 300 μm thick, with thickening occurring in crenulation "nodes". The flake graphite aggregates are typically interlayered with muscovite in the schistose matrix. Fine, anhedral rutile occurs as an accessory in the matrix and is obvious under reflected light.

Sulphides are dominated by pyrrhotite occurring as blebs and series of stringers or veins paralleling a alter deformation phase oblique to the schistosity. Pyrrhotite can exhibit simple intergrowths with trace chalcopyrite. Pyrrhotite and flake graphite normally occur separately and should not provide beneficiation problems although the presence of interlayered muscovite may represent a challenge.

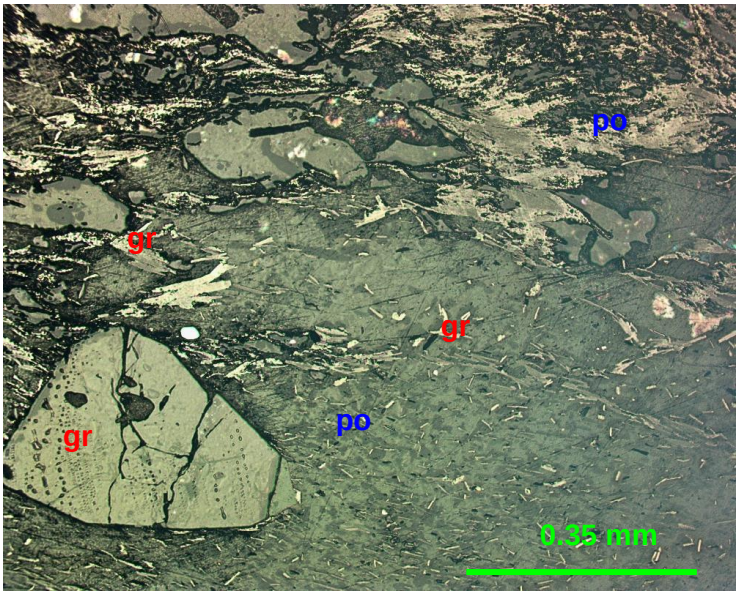
Comments: Flake graphite typically parallels the strong penetrative schistosity. The flake size can be regarded as small to coarse (ie 12 to 160 μm, av – 90 μm) with the presence of aggregates of flake graphite. The prograde assemblage would be stable under lower amphibolite facies confirmed by the presence of staurolite porphyroblasts.

CLASSIFICATION: *Quartz - potash feldspar - muscovite/sericite – staurolite – original andalusite (?) graphite schist. Blebby and stringer pyrrhotite and trace chalcopyrite mineralisation is present.*

Brief Petrographic Descriptions



Sample TPOD 2774
A fine staurolite (st) idioblas occurs within platy muscovite containing graphite (gr) flakes and rimmed by flake graphite aggregates. Crossed polars under transmitted light. Field of view – 2.2 mm.



Sample TPOD 2774
A detailed view under reflected light showing fine flake graphite (gr) occurring within the platy muscovite host. Field of view – 1 mm.

****

Brief Petrographic Descriptions

SAMPLE NO: TPOD 2775 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Fine sulphides (pyrrhotite) are disseminated through graphite schist.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	60%	**Opaques (14%):**
Potash feldspar	4%	Graphite - (9%)
Andalusite	3%	Pyrrhotite - (5%)
Sericite/muscovite	18%	Chalcopyrite - tr
Mg/Fe chlorite	1%	
Rutile	tr	
Opaques	14%	

Distinctive andalusite porphyroblasts are distributed through a foliated matrix comprising oriented flake graphite (opaque) associated with platy muscovite and interstitial granoblastic and minor potash feldspar quartz. Flake graphite follows a penetrative schistosity and locally wraps the andalusite porphyroblasts that have been progressvely replaced by scaly sericite aggregates. Fine, anhedral sulphides (opaque) are distributed through the matrix. Minor Mg/Fe chlorite aggregates have replaced a primary phase in the matrix.
Fine, flake to scaly graphite occurs as inclusions in the scaly sericite replacement of andalusite.

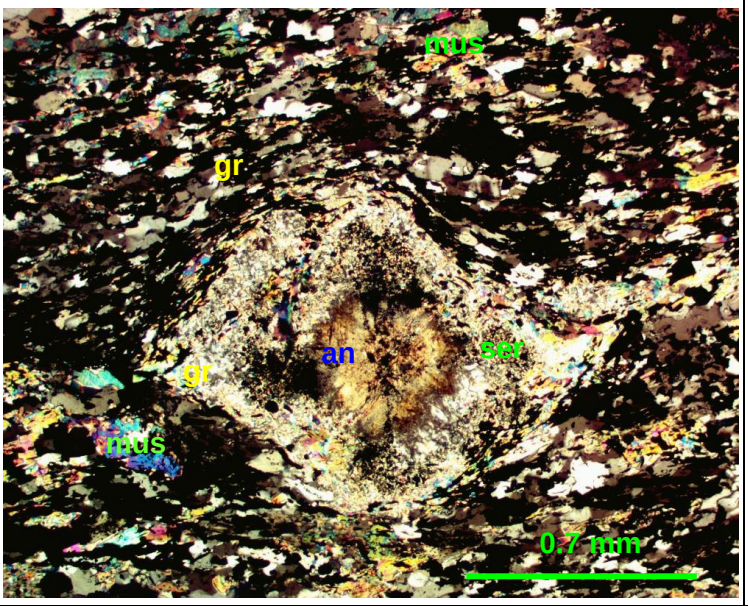
In reflected light, graphite occurs as fine flakes and flakey aggregates paralleling the schistosity. The individual graphite flakes range in size from 10 μm to 80 μm with an average size of approximately 50 μm. Flake graphite aggregates or clusters can be up to 140 μm thick, and are typically interlayered with quartz and muscovite. Very fine graphite flakes have been preserved in the andalusite porphyroblasts.

Sulphides are dominated by fine blebby pyrrhotite distributed through the metamorphic matrix. Pyrrhotite can exhibit simple intergrowths with trace chalcopyrite. Pyrrhotite and flake graphite normally occur separately and should not provide beneficiation problems although the flake graphite size is small.

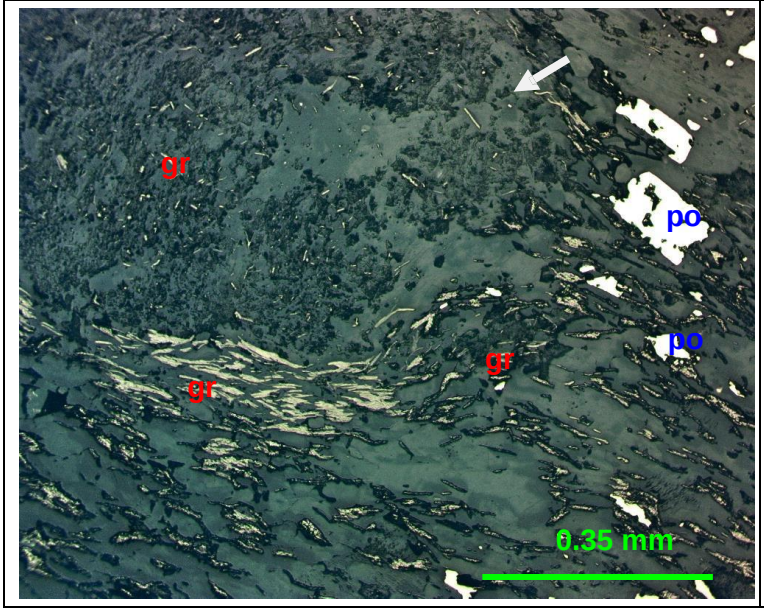
Comments: Flake graphite typically parallels the strong penetrative schistosity. The flake size can be regarded as small (ie 10 to 80 μm, av – 50 μm). The presence of andalusite porphyroblasts indicate that the prograde assemblage would be stable under upper greenschist to lower amphibolite facies, and has a carbonaceous pelitic origin.

CLASSIFICATION: *Quartz - potash feldspar - muscovite/sericite – andalusite - graphite schist. Fine blebby pyrrhotite and trace chalcopyrite is distributed through the matrix.*

Brief Petrographic Descriptions



Sample TPOD 2775
An andausite (an) porphyroblas occurs in the foliated metamorphi matrix comprising oriented flak graphite (gr – opaque) associate with platy muscovite (mu) an interstitial quartz (Q). Th andalusite porphyroblast has been progressively replaced by sericite (ser). Crossed polars under transmitted light. Field of view – 2.2 mm.



Sample TPOD 2775
A detailed view under reflecte light showing fine flake graphite (gr) rimming an andalusite porphyroblast (arrowed) tha contains finer flake graphite (gr) inclusions. Minor blebby pyrrhotite (po). Field of view – 1 mm.

****

Brief Petrographic Descriptions

SAMPLE NO: TPOD 2776 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Mineralised (pyrrhotite as stringers and bands) graphite schist containing quartz lenses.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz (matrix)	42%	**Opaques (12%):**
(veins)	12%	Graphite - (5%)
Sericite/muscovite	29%	Pyrrhotite - (6%)
Mg chlorite	5%	Pyrite - minor (1%)
Rutile	tr	
Opaques	12%	

A series of quartz lenses parallel the schistose matrix that comprises fibrous to scaly sericite associated with interstitial quartz and fine, flake graphite. Schlieren of fibrous to platy muscovite, exhibiting ongoing deformation textures, broadly parallel the foliation and typically rim the concordant quartz lenses. A series of pyrite lenses and stringers (opaque) that obliquely cut the foliation can be associated with platy Mg chlorite aggregates.

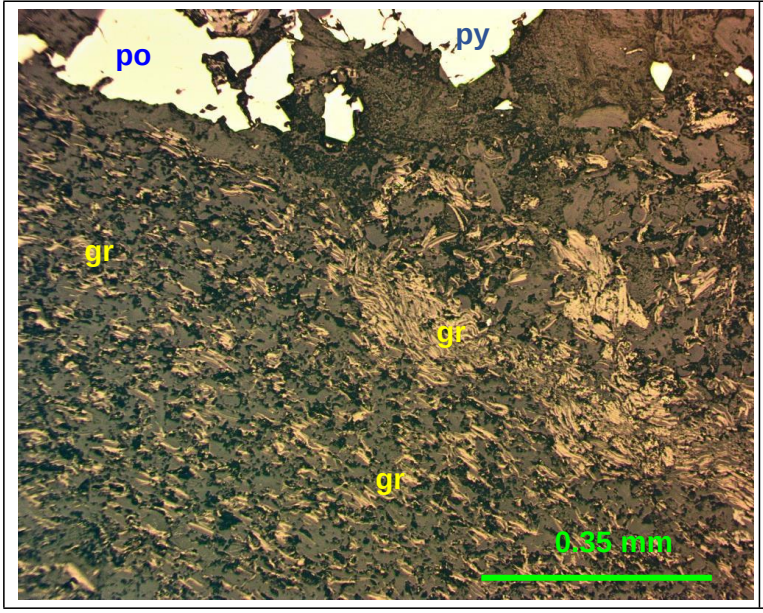
In reflected light, graphite occurs as very fine flakes and occasional flakey aggregates paralleling the schistosity. The individual graphite flakes range in size from 10 μm to 60 μm with an average size of approximately 30 μm. Occasional flakes aggregates or clusters are present and can be up to 80 μm thick, and are typically interlayered with with sericite/muscovite.

Sulphides - pyrrhotite occur as blebs and stringers both cross-cutting and occurring oblique to the foliation. Pyrite occurs as a minor subhedral phase within the quartz lenses.

Comments: Flake graphite typically parallels the strong penetrative schistosity that is interpreted as a shear zone associated with the introduction of the quartz lenses and the remobilisation of sulphides as veins and stringers. Shearing has not enhanced the flake size that can be regarded as small (ie 10 to 60 μm, av – 30 μm). The retrograde assemblage occurs within a shear zone and would be stable under greenschist facies.

CLASSIFICATION: *Quartz - muscovite/sericite – graphite schist. Pyrrhotite and minor pyrite mineralisation occurs as stringers cross-cutting the foliation.*

Brief Petrographic Descriptions



Sample TPOD 2776
Fine flake graphite (gr) and graphite aggregates occur in the schistose matrix. Blebby sulphides include pyrrhotite (po) and pyrite (py). Plane polarised reflected light. Field of view – 1 mm.

****

Brief Petrographic Descriptions

SAMPLE NO: TPOD 2777 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Muscovite porphyroblasts occur in a carbonaceous schist host.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	58%	**Opaques (14%):**
Sericite/muscovite	12%	Graphite - (7%)
Biotite	16%	Pyrrhotite - (5%)
Rutile	tr	Pyrite - minor (2%)
Opaques	14%	

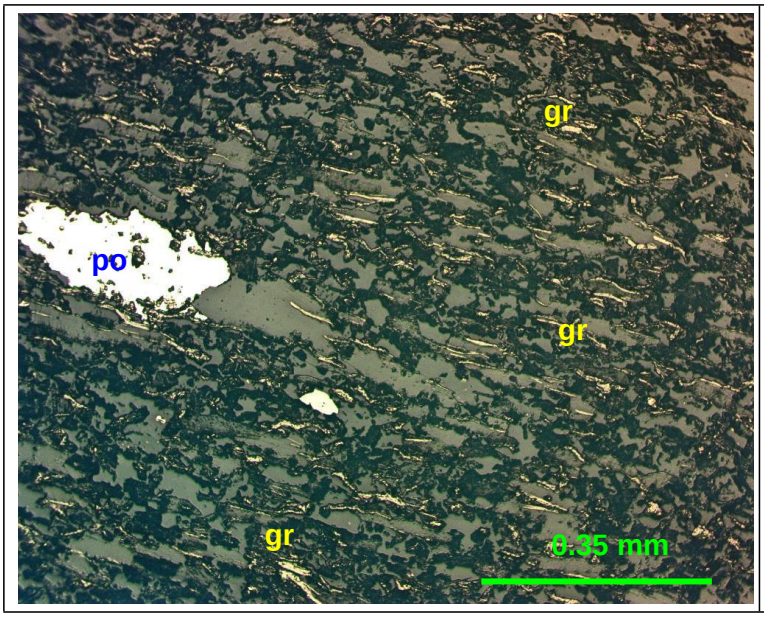
Distinctive coarse grained phyllosilicate porphyroblasts comprising platy muscovite associated with minor biotite occur in a foliated matrix. The carbonaceous matrix comprises fine platy biotite and muscovite associated with fine flake graphite and interstitial microcrystalline quartz. Fine, blebby sulphides (opaque) are distributed through the matrix.

In reflected light, fine, flake graphite is oriented parallel to the penetrative schistosity with individual graphite flakes ranging in size from 20 µm to 80 µm, with an average size of approximately 50 µm.

Fine blebby sulphides - pyrrhotite are distributed through the matrix. Pyrite represents a minor phase.

Comments: Fine flake graphite parallels the strong penetrative schistosity and the flake size can be regarded as small (ie 20 to 80 µm, av – 50 µm). The fine grained metamorphic assemblage with muscovite/biotite porphyroblast is consistent with mid to upper greenschist facies.

CLASSIFICATION: *Quartz - muscovite/sericite – biotite - graphite schist. Minor disseminated pyrrhotite and pyrite mineralisation.*



Sample TPOD 2777
Fine flake graphite (gr) occurs in the schistose matrix. Blebby sulphides include pyrrhotite (po) and pyrite. Plane polarised reflected light. Field of view – 1 mm.

****

Brief Petrographic Descriptions

SAMPLE NO: TPOD 2778 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Mineralised (pyrrhotite as stringers and bands) graphite schist. A quartz lens parallels the foliation.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz (matrix)	31%	**Opaques (14%):**
(veins)	25%	Graphite - (5%)
Potash feldspar	2%	Pyrrhotite - (8%)
Sericite/muscovite	22%	Pyrite - minor (1%)
Mg chlorite	6%	
Rutile	tr	
Opaques	14%	

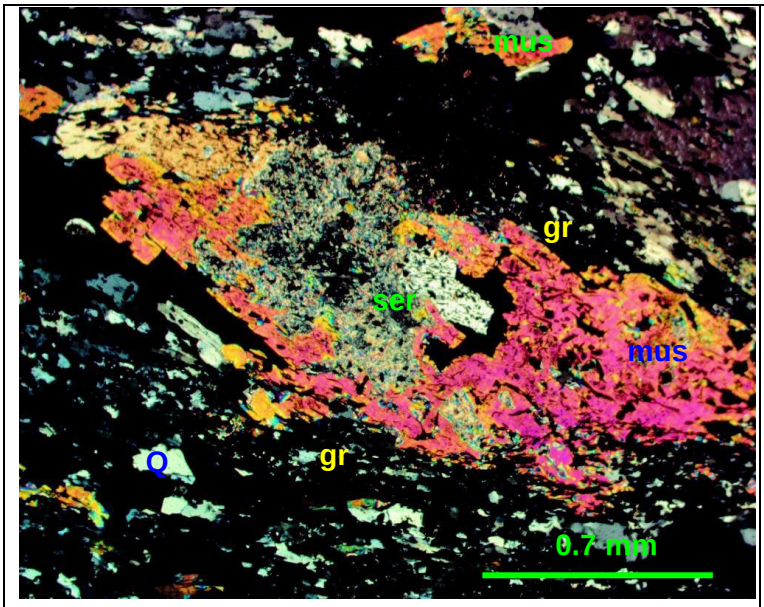
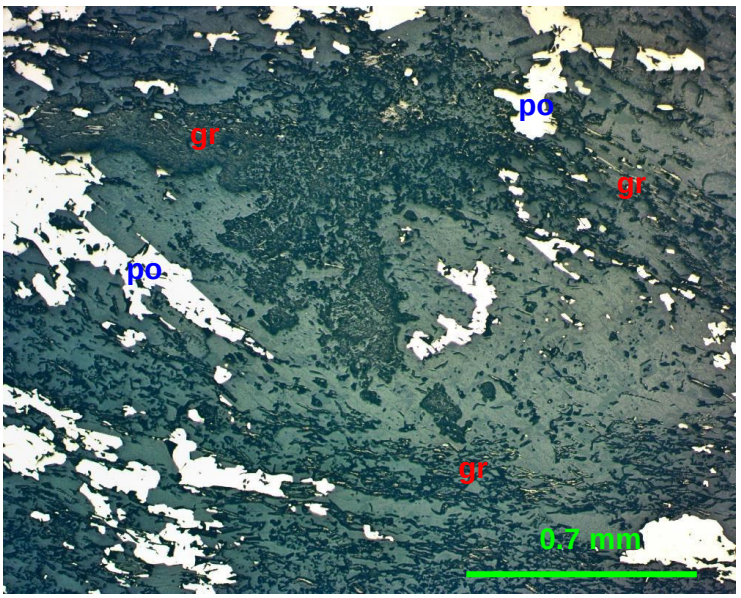
Quartz lenses parallel the schistosity in the metamorphic host comprising coarse platy muscovite and scaly sericite porphyroblasts in the fine grained matrix. The matrix comprises fine granoblastic quartz and subordinate potash feldspar associated with oriented flake graphite. Fibrous to platy Mg chlorite aggregates parallel the schistosity and locally rim anhedral sulphide (opaque) aggregates. The sericitic porphyroblasts can contain finely dispersed flake graphite and have probably replaced original andalusite porphyroblasts as a retrograde phase.

In reflected light, graphite occurs as fine flakes paralleling the schistosity. The individual graphite flakes range in size from 10 μm to 120 μm with an average size of approximately 60 μm. Fine, anhedral rutile occurs as an accessory in the matrix and is obvious under reflected light.

Sulphides are dominated by pyrrhotite occurring as blebs and lenses or veins paralleling the schistosity. Pyrrhotite can exhibit simple intergrowths with minor pyrite that also occurs as a porous secondary phase.

Comments: Flake graphite typically parallels the penetrative schistosity although the flake graphite component is low (ie 5 vol%) and the flake size can be regarded as small to medium (ie 10 to 120 μm, av – 60 μm). The prograde assemblage would have been stable under lower amphibolite facies and has been retrogressed to sericite and Mg chlorite as a syn-tectonic phase. Mg chlorite has accompanied remobilised sulphides (pyrrhotite) and quartz veining.

CLASSIFICATION: *Quartz - potash feldspar - muscovite/sericite – original andalusite - graphite schist that has been subject to syn-tectonic retrograde alteration (sericite, Mg chlorite). Remobilised sulphides include blebs and lenses of pyrrhotite that have probably accompanied retrograde alteration*

	**Sample TPOD 2778** A platy muscovite porphyroblast envelops scaly sericite (ser) as a probable replacement of original andalusite. The matrix comprises flake graphite (gr – opaque) and interstitial granoblastic quartz (Q). Crossed polars under transmitted light. Field of view – 2.2 mm.
	**Sample TPOD 2778** The same view under reflected light showing flake graphite (gr) rimming the platy muscovite porphyroblast. Pyrrhotite (po) has penetrated both the matrix and the porphyroblast. Field of view – 2.2 mm.

****

SAMPLE NO: TPOD 2779 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Mineralised (pyrrhotite) graphite schist. A leucogranite dyke cuts the assemblage.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Metamorphic matrix		**Granophyre**		**Opaques (3 to 16%)**
Quartz	47%	Quartz	27%	Graphite - (11%)
Potash feldspar	2%	Potash feldspar	65%	Pyrrhotite - (5%)
Sericite/muscovite	32%	Sericite/muscovite	5%	
Mg chlorite	3%	Opaques	3%	
Rutile	tr			
Opaques	16%			

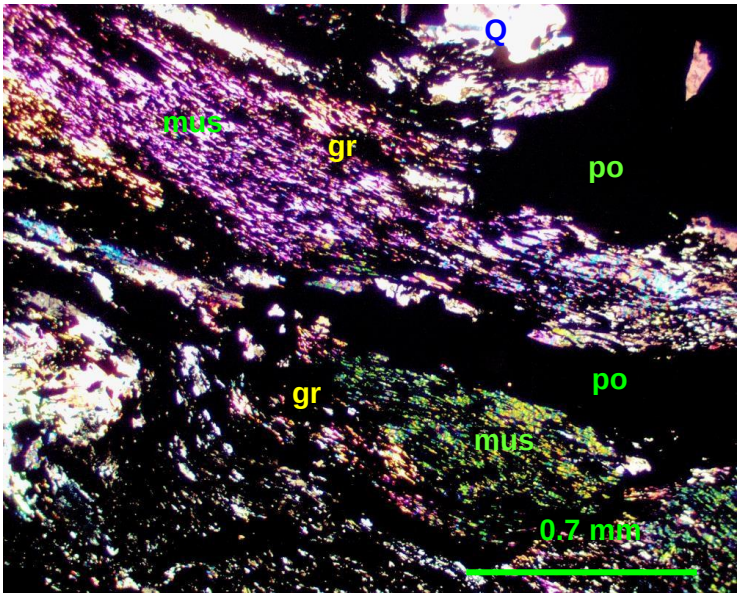
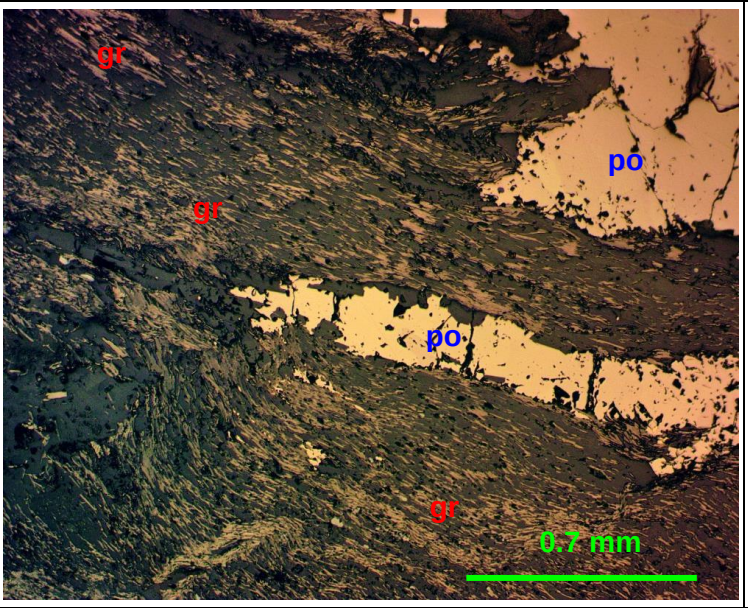
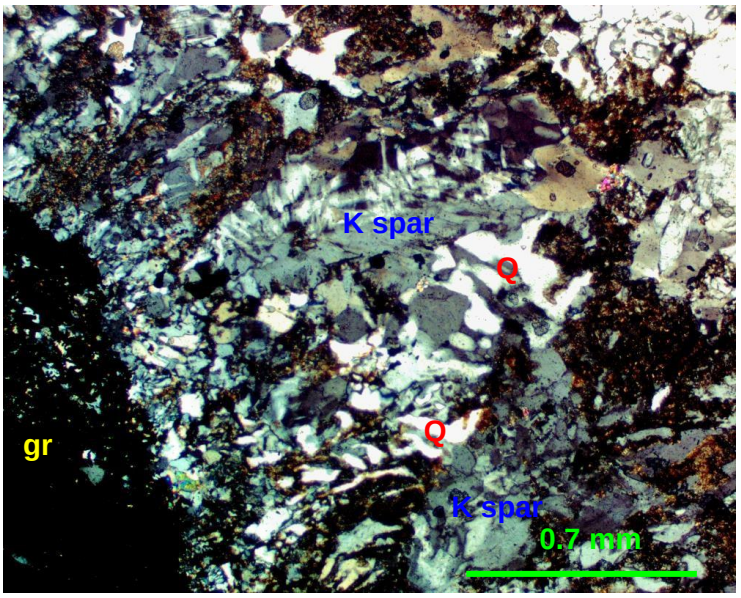
Flake graphite dominates in the foliated metamorphic host and is associated with platy muscovite, scaly sericite porphyroblasts, after original andalusite, and interstitial microcrystalline to fine granoblastic quartz. Potash feldspar and oriented platy Mg occur as minor phases in the matrix that has been penetrated by sulphide (opaque) veins and stringers associated with anhedral secondary quartz and platy muscovite.
The schistose assemblage has been cut by a leucocratic intrusive comprising distinctive intergrowths of quartz and potash feldspar to produce a granophyric assemblage. Fibrous to scaly sericite has penetrated along grain boundaries as a retrograde phase.

In reflected light, concentrations of flake graphite parallel the anastomosing schistosity, with individual graphite flakes ranging in size from 10 μm to 120 μm, with an average size of approximately 60 μm. Flake graphite aggregates or clusters can be up to 400 μm thick, and are typically interlayered with quartz and muscovite. Very fine graphite flakes have been preserved in the sericite porphyroblasts.
Fine, anhedral rutile occurs as an accessory in the matrix and is obvious under reflected light.

Sulphides are dominated by pyrrhotite occurring as blebs and stringers that cross-cut and clearly disrupt the foliation, and can be associated with a quartz - muscovite gangue. Minor blebby pyrrhotite also occurs as inclusions within the intrusive granophyre.

Comments: The schistose host comprises concentrations of fine flake graphite with small to medium flake sizes (ie 10 to 120 μm, av – 60 μm). The prograde assemblage would have been stable under lower amphibolite facies and has been clearly intruded by a later leucocratic granophyre. Sulphides (pyrrhotite) have been remobilised and are associated with anhedral secondary quartz.

CLASSIFICATION: *Quartz - potash feldspar - muscovite/sericite – original andalusite - graphite schist that has been intruded by a quartz – potash feldspar granophyre. Remobilised sulphides include blebs and stringers of pyrrhotite.*

	**Sample TPOD 2779** Platy muscovite contains flake graphite (gr) paralleling a penetrative schistosity. Pyrrhotite (po – opaque) lenses have cut the foliation as a product of late remobilisation. Crossed polars under transmitted light. Field o view – 2.2 mm.
	**Sample TPOD 2779** The same view under reflected light clearly showing remobilised pyrrhotite (po) veins penetrating oriented flake graphite (gr) in the metamorphic matrix.. Field of view – 2.2 mm.
	**Sample TPOD 2779** Intergrowths of quartz (Q) and potash feldspar (K spar) are apparent in the granophyre that has intruded the graphite (gr) schist host. Field of view – 2.2 mm.

SAMPLE NO: TPOD 2780 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Pyrrhotite stringers cut a strongly carbonaceous/graphite schist host containing distinctive phyllosilicate porphyroblasts.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz (matrix)	5%	**Opaques (62%):**
(veins)	5%	Carbonaceous material - (38%)
Potash feldspar	tr	Graphite - (15%)
Sericite/muscovite	27%	Pyrrhotite - (9%)
Mg chlorite	1%	
Rutile	tr	
Opaques/carbonaceous material	62%	

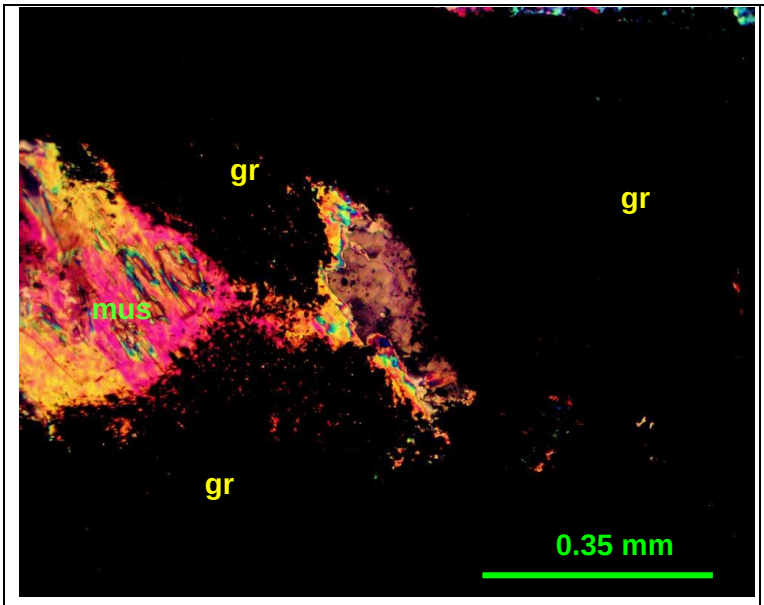
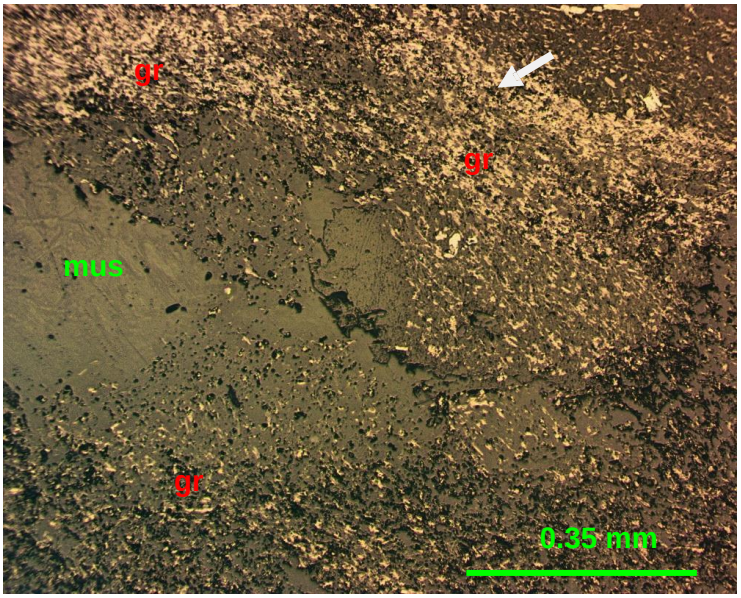
Distinctive prismatic and tabular porphyroblasts occur in a dark carbonaceous schist host. The porphyroblasts have been replaced by scaly sericite to platy muscovite and probably represent original andalusite porphyroblasts. A series of cross-cutting sulphide (opaque) stringers can be associated with anhedral secondary quartz and platy to stellate Mg chlorite aggregates.

In reflected light, very fine flake graphite occurs in the carbonaceous schist host. The individual graphite flakes range in size from 5 μm to 20 μm with an average size of approximately 10 μm, and can be regarded as amorphous. There are local concentrations of fine flake graphite occurring in 300 μm thick schlieren paralleling the anastomosing schistosity.

Pyrrhotite lenses and stringers cut the foliated carbonaceous schist host. Accessory subhedral rutile is apparent under reflected light.

Comments: The flake graphite size is very small and can be regarded as amorphous (ie 5 to 20 μm, av – 10 μm) and may be due to a lower metamorphic grade of the carbonaceous pelite – ie greenschist facies. Original andalusite porphyroblasts have been retrogressed to sericite/muscovite.

CLASSIFICATION: *Carbonaceous/graphite schist originally containing andalusite porphyroblasts that have been altered to sericite/muscovite. Pyrrhotite lenses and stringers cut the matrix.*

	**Sample TPOD 2780** An andausite (an) porphyroblast has been replaced by platy muscovite/sericite (mus) in a dark carbonaceous/graphite (gr) schist host. Crossed polars under transmitted light. Field of view – 1 mm.
	**Sample TPOD 2780** The same view under reflected light showing very fine flake graphite aggregates (arrowed) (gr) rimming the relict porphyroblast in the carbonaceous/fine flake graphite schist host. Field of view – 1 mm

****

SAMPLE NO: TPOD 2781 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Pyrrhotite stringers cut a strongly carbonaceous/graphite schist host containing distinctive phyllosilicate porphyroblasts.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	5%	**Opaques (80%):**
Potash feldspar	tr	Carbonaceous material - (55%)
Sericite/muscovite	13%	Graphite - (10%)
Mg chlorite	2%	Pyrrhotite - (15%)
Opaques/carbonaceous material	80%	

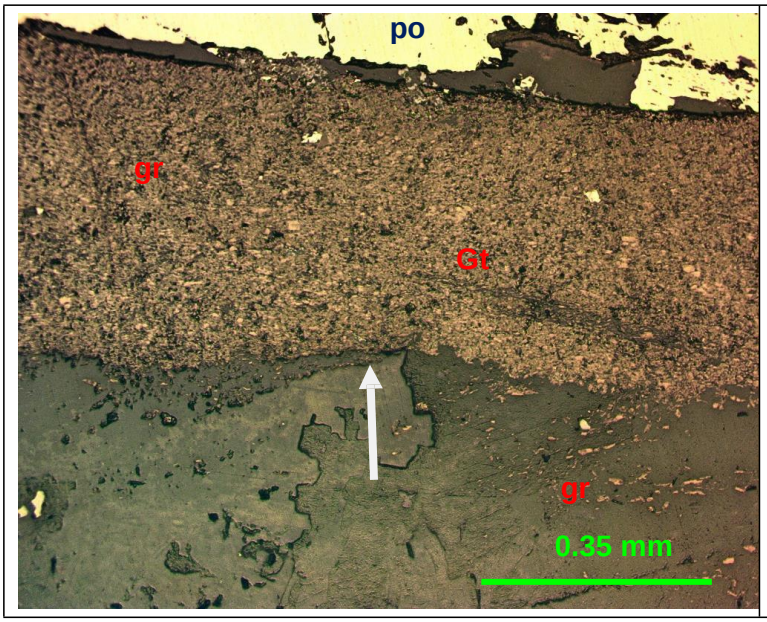
Similar to Sample TPOD 2780, with distinctive prismatic and tabular porphyroblasts occurring in a dark carbonaceous schist host. The porphyroblasts have been replaced by scaly sericite to platy muscovite and probably represent original andalusite porphyroblasts. A series of cross-cutting sulphide (opaque) stringers and finely disseminated sulphides occur in the matrix and can be associated with anhedral secondary quartz and platy Mg chlorite aggregates.

In reflected light, very fine flake graphite occur in the carbonaceous schist host. The individual graphite flakes range in size from 3 μm to 20 μm with an average size of approximately 10 μm, and can be regarded as amorphous. There are local concentrations of fine flake graphite occurring in 140 μm thick schlieren and veins paralleling the anastomosing schistosity.

Pyrrhotite lenses and stringers cut the foliated carbonaceous schist host. Finely dispersed pyrrhotite has flooded the matrix.

Comments: The flake graphite size is very small and can be regarded as amorphous (ie 3 to 20 μm, av – 10 μm) and may be due to a lower metamorphic grade of the carbonaceous pelite – ie greenschist facies. Original andalusite porphyroblasts have been retrogressed to sericite/muscovite.

CLASSIFICATION: *Carbonaceous/graphite schist originally containing andalusite porphyroblasts that have been altered to sericite/muscovite. Pyrrhotite lenses and stringers cut the matrix.*



Sample TPOD 2781
A vein of concentrated very fine flake graphite (arrowed) (gr) bordering a remobilised pyrrhotite vein in the carbonaceous/graphite schist host. Field of view – 1 mm.

****

SAMPLE NO: TPOD 2782 **LOCATION:**

TYPE: Core

FIELD IDENTIFICATION: Thin pyrrhotite stringers and disseminations occur in a strongly carbonaceous/graphite schist host containing distinctive porphyroblasts.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	5%	**Opaques (75%):**
Sericite/muscovite	18%	Carbonaceous material – (65%)
Mg chlorite	2%	Graphite - (6%)
Opaques/carbonaceous material	75%	Pyrrhotite - (4%)
		Chalcopyrite - tr

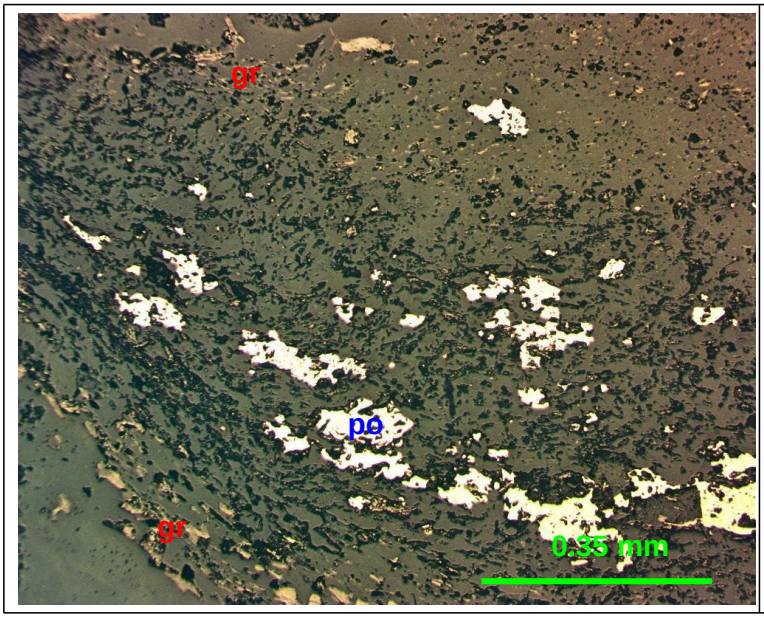
Similar to Samples TPOD 2780 & 2781, with distinctive prismatic, tabular and bladed porphyroblasts occurring in a dark carbonaceous schist host. The porphyroblasts have been replaced by scaly sericite to platy muscovite and probably represent original andalusite porphyroblasts. Minor quartz can be associated with the porphyroblasts and occurs in the carbonaceous matrix. A series of cross-cutting sulphide (opaque) stringers are apparent. Minor platy Mg chlorite aggregates can be associated with sulphides.

In reflected light, very fine flake graphite parallels the schistosity in the carbonaceous schist host and has been typically concentrated around relict porphyroblasts. The individual graphite flakes range in size from 3 μm to 40 μm with an average size of approximately 20 μm, and can be regarded as fine grained to amorphous.

Thin pyrrhotite stringers cut the foliated carbonaceous schist host that also contains finely dispersed anhedral pyrrhotite plus trace chalcopyrite.

Comments: The flake graphite size is very small and can be regarded as very fine grained to amorphous (ie 3 to 40 μm, av – 20 μm) and may be due to a lower metamorphic grade of the carbonaceous pelite – ie greenschist facies. Original andalusite porphyroblasts have been retrogressed to sericite/muscovite.

CLASSIFICATION: *Carbonaceous/graphite schist originally containing andalusite porphyroblasts that have been altered to sericite/muscovite. Pyrrhotite and trace chalcopyrite occur as thin stringers and disseminations.*



Sample TPOD 2782
Anhedral pyrrhotite rims fine flake graphite (gr) peripherally to a relict porphyroblast in the carbonaceous/graphite schist host. Field of view – 1 mm.

****

SAMPLE NO: TPOD 2783

LOCATION: TYPE: Core

FIELD IDENTIFICATION: Pyrrhotite disseminations occur in a strongly carbonaceous/graphite schist host containing distinctive porphyroblasts.

SECTION TYPE: Polished Thin Section

DESCRIPTION:

Quartz	3%	**Opaques (76%):**
Sericite/muscovite	20%	Carbonaceous material – (64%)
Mg chlorite	1%	Graphite - (7%)
Rutile	tr	Pyrrhotite - (5%)
Opaques/carbonaceous material	76%	

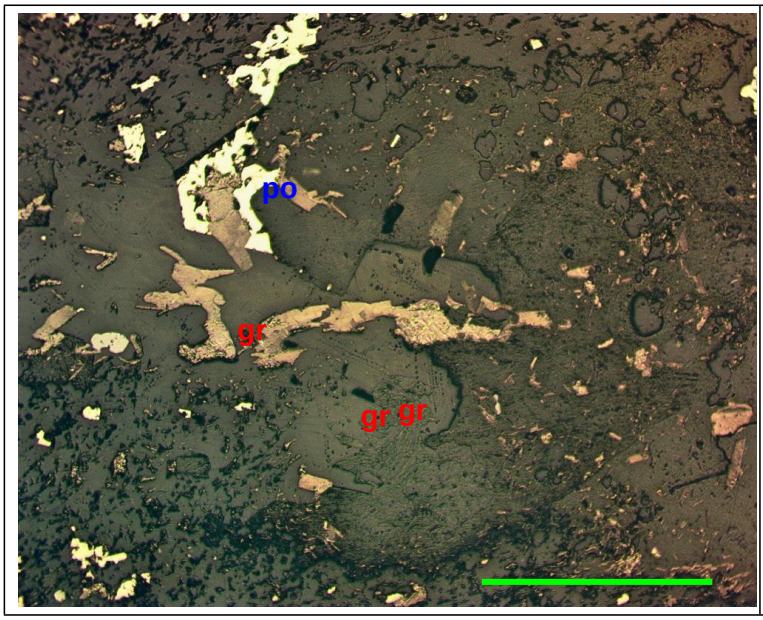
Similar to Samples TPOD 2780, 2781 & 2782, with distinctive prismatic, tabular and bladed porphyroblasts occurring in a dark carbonaceous schist host. The porphyroblasts have been replaced by scaly sericite to platy muscovite and probably represent original andalusite porphyroblasts. Minor platy Mg chlorite and quartz occur in the matrix. Finely disseminated sulphides.

In reflected light, very fine flake graphite parallels the schistosity in the carbonaceous schist host and has been typically concentrated around relict porphyroblasts. Coarser graphite flakes occur in recrystallized platy muscovite. The individual graphite flakes range in size from 2 μm to 80 μm with an average size of approximately 30 μm. Most of the flakes can be regarded as fine grained.

Anhedral pyrrhotite is finely dispersed through the matrix. Accessory rutile is apparent in reflected light.

Comments: The flake graphite size is very small and can be regarded as fine grained (ie 2 to 80 μm, av – 30 μm) and may be due to a lower metamorphic grade of the carbonaceous pelite – ie greenschist facies. Original andalusite porphyroblasts have been retrogressed to sericite/muscovite.

CLASSIFICATION: *Carbonaceous/graphite schist originally contained andalusite porphyroblasts that have been altered to sericite/muscovite. Pyrrhotite occurs as disseminations.*



Sample TPOD 2783
Anhedral pyrrhotite rims coarser flake graphite (gr) occurring within platy muscovite in the carbonaceous/graphite schist host. Field of view – 1 mm.

7. CONCLUSIONS AND RECOMMENDATION

The Frances Maud project underlies mainly prospective Palaeoproterozoic rocks of the Masson which contain significant base metal, graphite and uranium mineralisation.

While drilling at Tarpon prospect did not indicate potential for economic copper mineralisation, the thick carbonaceous shale at North Brumby shows great potential to host significant graphite content.

Drilling geophysical targets at Allamber was partially successful with the intersection of carbonaceous shale displaying great potential for graphite. The next objective is to identify potential graphite and/or base metals sulphides at the contact with the Allamber Spring granite. For this reason, proposed exploration activities for the next 12 reporting period are: 1. Ground electromagnetic surveys to define more clearly broad conductor targets previously interpreted from airborn surveys; 2. two RC holes, with possible diamond tails, to test the conductive targets defined from the ground EM surveys.

8. REFERENCES

Ahmad, M., Wygralak, A.S., Ferenczi, P.A., and Bajwah, Z.U. 1993. Explanatory Notes andMineral Deposit Data Sheets. *1:250,000 Metallogenic Map Series, Department of Mines and Energy, Northern Territory Geological Survey.*

Bajwah, Z.U. 1994. A contribution of geology, petrology and geochemistry to the Cullen Batholith and related hydrothermal activity responsible for mineralisation, Pine Creek Geosyncline, *Northern Territory. Northern Territory Geological Survey Report 8.*

Cotton, B., 2011, Photogeological Mapping at 1:40 000 Scale of the Pine Creek Regional Area 2, Northern Territory. Consultant Report for Element 92 Pty Ltd.

De kever, N., 2010, ELS 10043 and 10167 (Frances Maud tenements) Pine Creek NT, Annual Report for the Period 5 September 1009 to 4 September 2010. Annual Report to NT Dept of Resources.

Earthrowl, J.A. (2003) First Annual Report for Frances Maude Project (ELs 9899, 10043, 10167). Annual Report to NT Dept of Primary Industry, Fisheries and Resources.

Mees, H., 2013, Annual report on GR 266 (EL 10043 and EL 10167) Frances Maud Project, Pine Creek, Northern Territory to 4 September 2013. *Thundelarra Annual Report to Department of Mines and Energy, Darwin.*

Needham, R.S and Stuart-Smith, P.G., 1984. Geology of the Pine Creek Geosyncline, Northern Territory – 1:500,000 scale map. *Bureau of Mineral Resources, Australia*.

Needham, R.S., Stuart-Smith, P.G., and Page, R.W., 1988. Tectonic evolution of the Pine Creek Inlier, Northern Territory. *Precambrian Research 40/41, pp 543-564*.