TR14-27-35

6. The cobalt and nickel content of some sulphides from ore deposits in eastern Tasmania

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ABSTRACT

The distribution of Co and Ni between pyrite and arsenopyrite from tin-wolfram deposits shows a marked contrast to that for gold-quartz veins in eastern Tasmania and reinforces the concept of different sources for these types of mineralisation. The distribution of Co and Ni between pyrite and arsenopyrite from copper and Ag-Pb-Zn deposits in the Scamander area supports a genetic association with tin-wolfram deposits in the area, and the contrast between Co contents of pyrite and pyrrhotite from the copper deposits and the Ag-Pb-Zn deposits suggests a zonal character similar to that shown by other hydrothermal deposits in Tasmania. Sulphides from the copper and Ag-Pb-Zn deposits of Scamander and the adjacent gold-quartz veins from Hogans Track cannot be distinguished on the basis of trace element content.

INTRODUCTION

Trace element studies of sulphides from Tasmanian ore deposits by Loftus-Hills and Solomon, 1967; Groves and Loftus-Hills, 1968; Loftus-Hills, 1968; and Loftus-Hills *et al.,* 1969 have shown that trace element concentration trends can be used empirically as genetic discriminants provided local controls can be recognised. The previous work has been largely restricted to ore occurrences in western Tasmania.

This study is an extension of the work of Loftus-Hills, 1968, and is an attempt to define genetic associations of ore occurrences in NE Tasmania using the Co and Ni content of pyrite and arsenopyrite. The Co and Ni contents of these sulphides should reflect the availability of these elements during ore formation because in general they are the predominant sulphides (generally >90%). In this respect the NE Tasmanian occurrences are more suitable for trace element studies than the western Tasmanian deposits which have extremely variable sulphide compositions.

The main difficulty with this study has been the overall scarcity of sulphides in lodes in NE Tasmania, which has severely limited the sample data that can be obtained for any one locality.

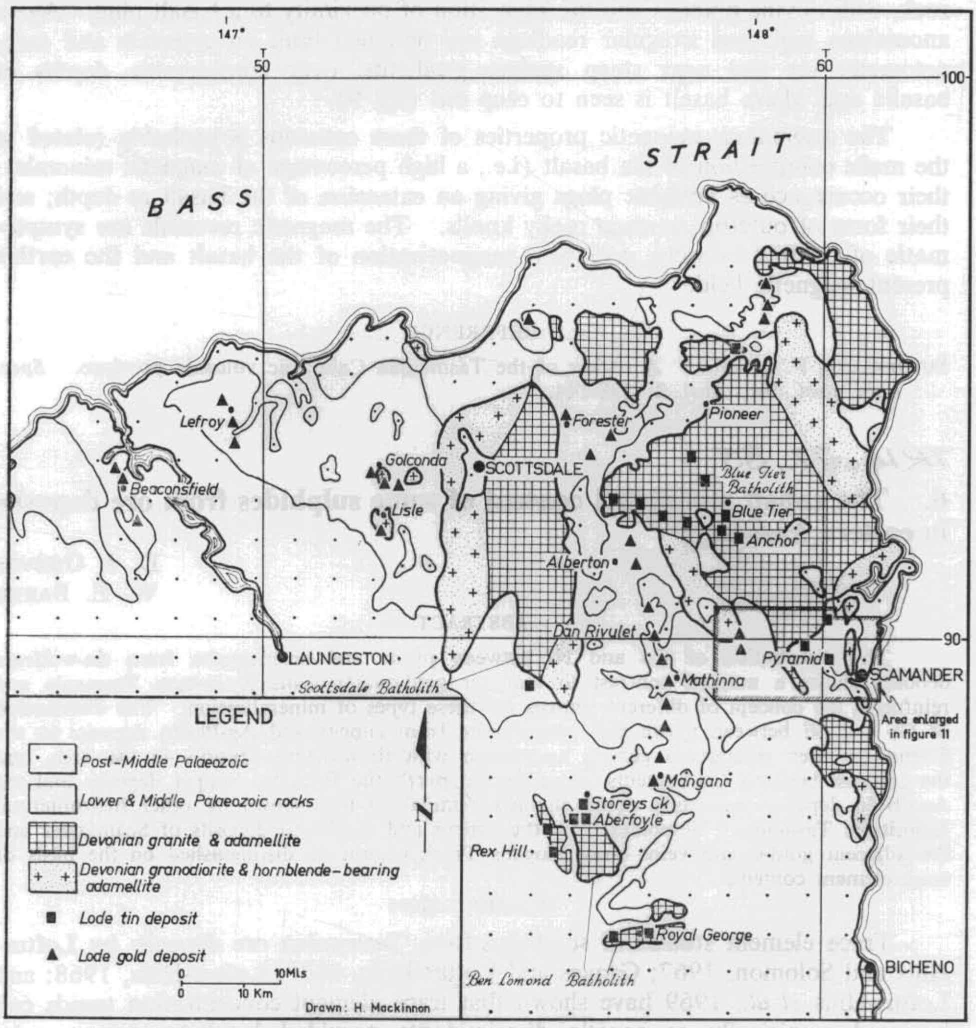

FIGURE 10: Geological sketch map of north-east Tasmania showing distribution of Middle Palaeozoic granitic rocks and tin and gold mineralisation. Map adapted from the Geological Map of Tasmania, 1:506,880, 1961.

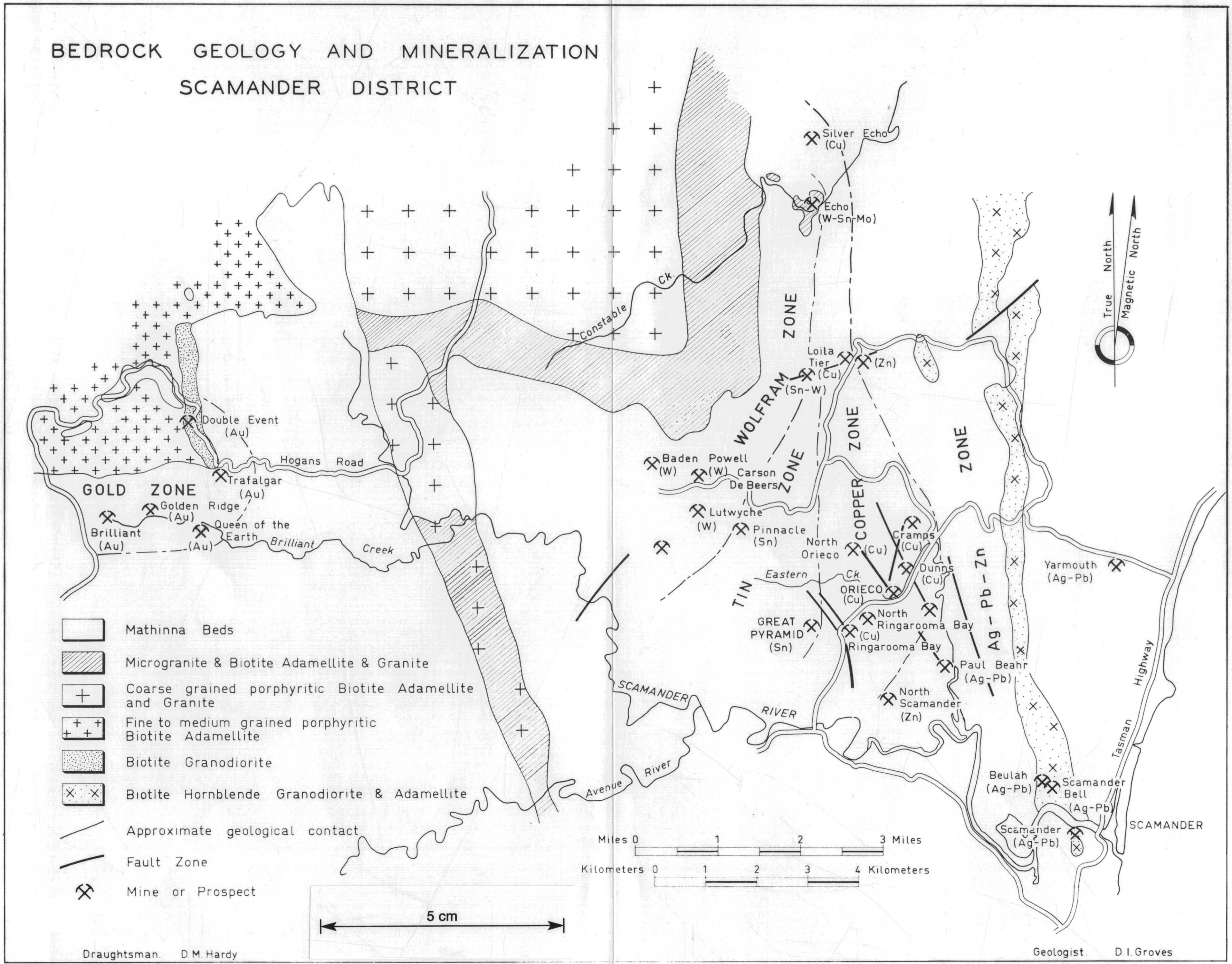

Figure 11: Bedrock geology and mineralisation if the Scamander District, north-east Tasmania showing zonal arrangements of deposits.

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GENERAL GEOLOGY OF ORE OCCURRENCES IN NE TASMANIA

The primary ore occurrences in NE Tasmania fall into three main categories: cassiterite and wolframite deposits (with molybdenite); gold and gold-silver deposits and copper and Ag-Pb-Zn deposits (fig. 10).

The cassiterite deposits occur predominantly either within Upper Devonian greisenised biotite adamellites and granites, with typical examples being Blue Tier (Jack, 1965), Rex Hill (Urquhart, 1967) and Royal George (Beattie, 1967), or in discordant quartz veins in the Mathinna Beds close to these granitic rocks, with typical examples occurring at Aberfoyle and Storeys Creek (Kingsbury, 1965). Irregular disseminations within fracture zones in the Mathinna Beds also occur at the Great Pyramid Mine, Scamander (Jack, 1964). The wolframite deposits occur almost exclusively close to biotite adamellite or granite contacts in discordant quartz veins in the Mathinna Beds in the Scamander district (Twelvetrees, 1911) and at Storeys Creek.

The close association of the tin and wolfram deposits with biotite adamellites and granites has been noted by many authors and a genetic relationship between them appears probable. A recent compilation of analyses of the tin-bearing granitic rocks and a comparison with those from other tin provinces of the world by Klomínský and Groves (1970) reinforces this suggestion.

Gold deposits occur almost exclusively in discordant quartz veins in the Mathinna Beds at considerable distances from exposed granitic rocks; for example at Beaconsfield (Noldart, 1964), Lefroy (Groves, 1965), and in a belt between Mangana and Forester including Mathinna, Alberton and Dan Rivulet (Threader, 1967). At Lisle and Golconda (Twelvetrees, 1909; Reid, 1926) and along Hogans Track, W of Scamander (Twelvetrees, 1900) gold-quartz veins occur in, or adjacent to, hornblende- and/or biotite-bearing granodiorites.

Although the evidence is not conclusive several authors (e.g., Twelvetrees, 1909; Reid, and Henderson, 1929; Carey, 1947; Hughes, 1947) have suggested a genetic relationship between the gold deposits and hornblende-bearing granodiorites. Comparisons of the chemistry of these granitic rocks with those from other gold provinces of the world further supports this relationship (Klomínský and Groves, 1970).

Copper and Ag-Pb-Zn deposits occur almost exclusively in Scamander district (fig. 11). They occur as discordant quartz-sulphide veins between a zone of tin and wolfram deposits adjacent to biotite adamellites and granites, and a dyke of hornblende-biotite adamellite that extends parallel to the eastern coastline. A zone of copper deposits occurs adjacent to the most western zones of wolfram and tin deposits, and an outer zone of Ag-Pb-Zn deposits occur farther east and extends in to the dyke of hornblende-biotite adamellite.

It is apparent that they have similar zonal sequences to that of many other zoned hydrothermal deposits (e.g., Both and Williams, 1968). The origin of these deposits is problematical: although Twelvetrees (1911) recognised the zonal nature of the deposits he considered that the outer Ag-Pb-Zn veins were genetically related to the dyke of hornblende-biotite adamellite. Similarly Carey (1947) suggested that the copper and Ag-Pb-Zn mineralisation was associated with gold mineralisation and the hornblende-bearing granitic rocks and were not related to the adjacent wolfram and tin mineralisation. The area has received little subsequent attention.

PREPARATION AND ANALYSIS OF SAMPLES

The samples were collected *in situ* or from drill cores where possible, although in several cases material from mine dumps was used because the adjacent workings were inaccessible.

The samples were crushed and sieved to liberate sulphide grains from the enclosing quartz, and purified on a micropanner or superpanner dependent on the concentration of the sulphide present. In most cases a sulphide concentrate rather than pure sulphide was produced. Contamination from grinding equipment was negligible.

The samples were roasted and digested as described by Loftus-Hills (1968) and the impurities (predominantly quartz) were determined as the acid insoluble fraction. The analyses were carried out on a Techtron A.A.4 Atomic Absorption Spectrophotometer. Dr Loftus-Hills provided several of his samples to test the accuracy of the measurements and the results were found to agree with his results within the limits of precision given by him (Loftus-Hills, 1968).

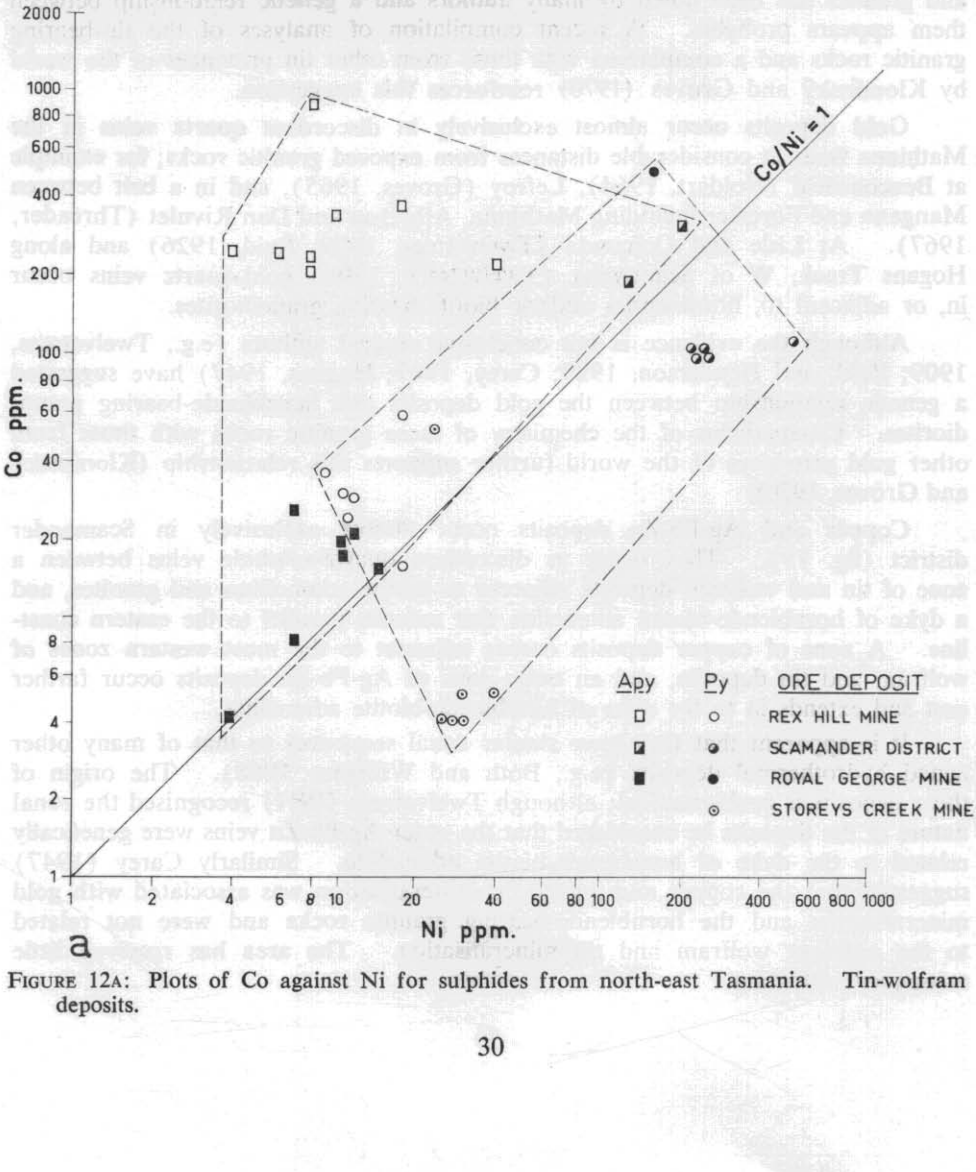

FIGURE 12A: Plots of Co against Ni for sulphides from north-east Tasmania. Tin-wolfram deposits.

RESULTS OF THIS STUDY

The cobalt and nickel content of arsenopyrite and pyrite from tin and wolfram deposits in NE Tasmania exhibits a wide spread of values. The Co/Ni ratios for arsenopyrite are all equal to or greater than 1. Those for pyrite are often less than 1 although some values are greater so that there is overlap of the Co/Ni ratio fields for the two minerals (table 1, fig. 12A). Arsenopyrite from the Rex Hill mine has a consistently higher Co/Ni ratio than pyrite from the same mine (fig. 12D), this being a similar distribution to that shown for arsenopyrite and pyrite from the tin deposits at Mt Bischoff and Renison Bell in western Tasmania (Groves, 1968; Loftus-Hills, 1968).

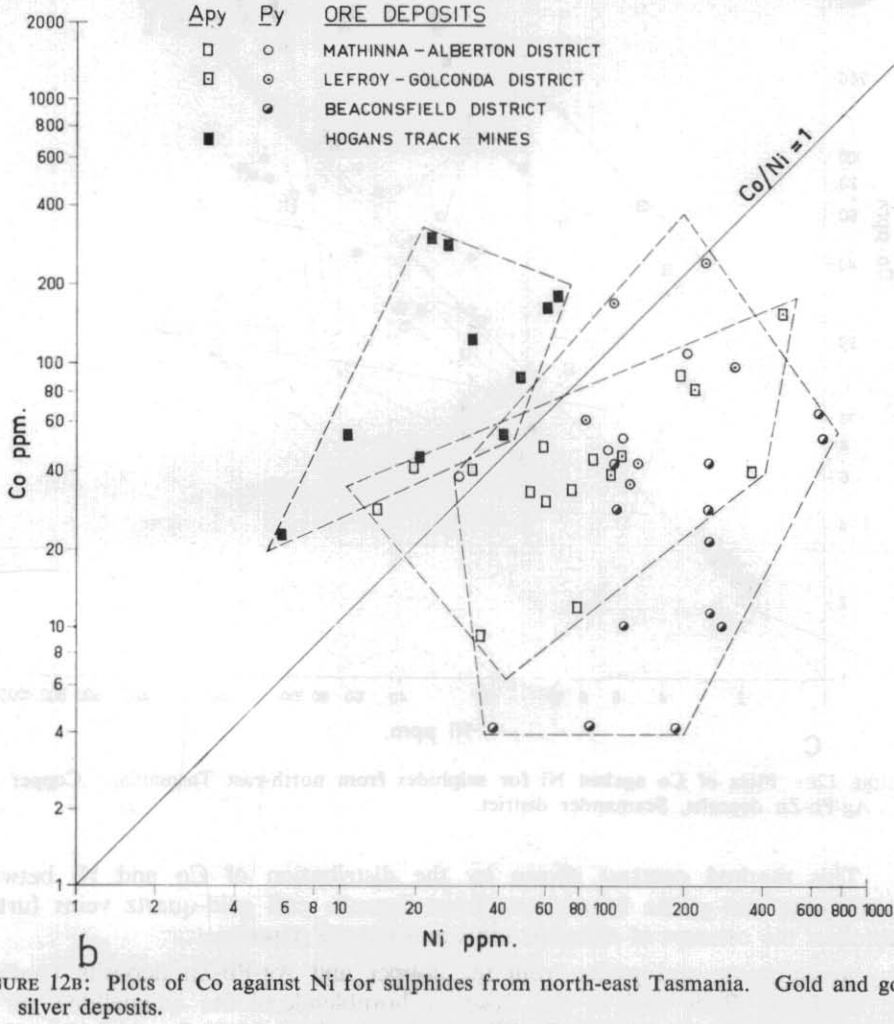

FIGURE 12B: Plots of Co against Ni for sulphides from north-east Tasmania. Gold and gold-silver deposits.

In sharp contrast the arsenopyrite and pyrite from gold-quartz veins (with the exception of those from Hogans Track) have Co/Ni ratios predominantly less than 1 (table 1, fig. 12B), and at Lefroy and Mathinna (the only deposits from which both arsenopyrite and pyrite were analysed) the arsenopyrite has an overall lower Co/Ni ratio than pyrite from the same deposit (table 1, fig. 12D).

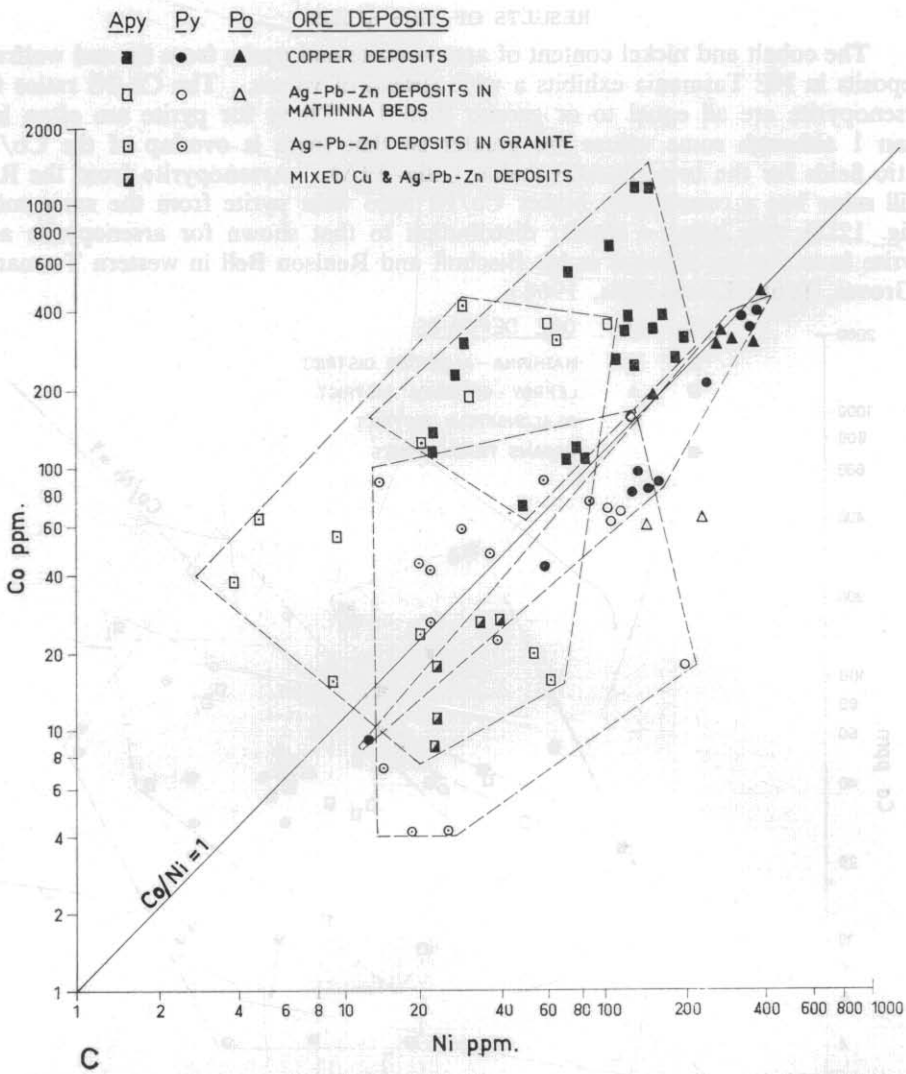

FIGURE 12C: Plots of Co against Ni for sulphides from north-east Tasmania. Copper and Ag-Pb-Zn deposits, Scamander district.

This marked contrast shown by the distribution of Co and Ni between arsenopyrite and pyrite from tin-wolfram deposits and gold-quartz veins further reinforces the concept of different sources for these deposits.

Arsenopyrite and pyrite from the copper and Ag-Pb-Zn deposits (both in the Mathinna Beds and in the dyke of hornblende-biotite adamellite) of the Scamander district show a similar distribution to those from the tin and wolfram deposits with most arsenopyrite having Co/Ni ratios greater than 1 (table 1, fig. 12C). Where arsenopyrite and pyrite have been analysed from the same deposit (Orieco, Beulah, Scamander) the Co/Ni ratio of the arsenopyrite is invariably higher than that of the pyrite (table 1, fig. 12D). This suggests a

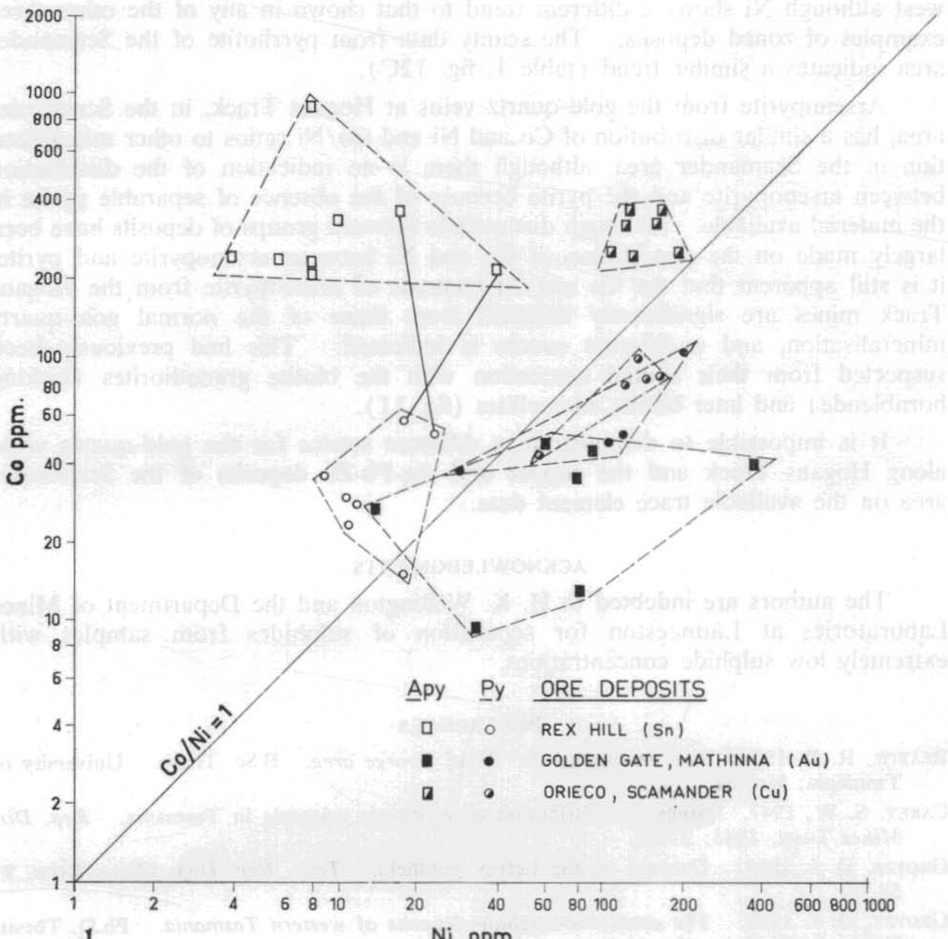

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FIGURE 12D: Plots of Co against Ni for sulphides from north-east Tasmania. Distribution between sulphides for individual deposits.

correlation with the tin-wolfram deposits rather than with the normal gold-quartz mineralisation associated with hornblende-bearing granodiorites.

Further evidence that the Cu and Ag-Pb-Zn mineralisation is possibly related to a source to the west (biotite adamellite and granite) rather than a source to the east (hornblende-biotite adamellite) is provided by the distribution of Co and Ni in pyrite and pyrrhotite in the copper and Ag-Pb-Zn zones. At Zeehan (Williams, 1968) and Mt Bischoff (Groves, 1968; Loftus-Hills, 1968) pyrite and pyrrhotite respectively show a decrease in Co and increase in Ni away from the apparent source, and at Storeys Creek (Loftus-Hills, 1968) pyrite shows a decrease in Co with relatively constant Ni contents away from the apparent source. Decreasing Co content of sulphides away from the apparent source is common to all these localities. At Scamander, pyrite from the copper deposits has a significantly higher Co and Ni content than that from the Ag-Pb-Zn deposits (table 1, fig. 12C), and here the trend for Co is consistent with a source to the west although Ni shows a different trend to that shown in any of the other three examples of zoned deposits. The scanty data from pyrrhotite of the Scamander area indicates a similar trend (table 1, fig. 12C).

Arsenopyrite from the gold-quartz veins at Hogans Track, in the Scamander area, has a similar distribution of Co and Ni and Co/Ni ratios to other mineralisation in the Scamander area, although there is no indication of the distribution between arsenopyrite and the pyrite because of the absence of separable pyrite in the material available. Although distinctions between groups of deposits have been largely made on the distribution of Co and Ni between arsenopyrite and pyrite, it is still apparent that the Co and Ni contents of arsenopyrite from the Hogans Track mines are significantly different from those of the normal gold-quartz mineralisation, and a different source is indicated. This had previously been suspected from their spatial assocation with the biotite granodiorites (lacking hornblende) and later biotite adamellites (fig. 11).

It is impossible to demonstrate a different source for the gold-quartz veins along Hogans Track and the copper and Ag-Pb-Zn deposits of the Scamander area on the available trace element data.

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TABLE 1. COBALT AND NICKEL CONTENTS OF SULPHIDES FROM ORE DEPOSITS IN NORTH-EAST TASMANIA

Type of deposits	Locality	Mineral* (No. of analyses)	Range of values Co ppm	Range of values Ni-ppm	Mean values Co ppm	Mean values Ni ppm	Mean Co/Ni
Tin deposits	Rex Hill	Apy (8)	206–900	4–42	344	13	26.5
		Py (7)	16–56	9–24	35	15	2.3
	Royal George	Apy (8)	4–38	4–31	19	12	1.6
		Py (1)	523	164	523	164	3.2
	Scamander						
	Pyramid	Py (1)	119	561	119	561	0.2
	Storys Creek	Py (5)	4–5	26–40	4	32	0.15
Wolfram deposits	Scamander						
	Wolfram Creek	Py (4)	96–103	240–257	99	251	0.4
	Carson de Beers	Apy (2)	193–298	128–208	246	168	1.5
Gold deposits	Lefroy	Apy (2)	40–44	116–125	42	121	0.3
		Py (7)	36–245	125–491	121	242	0.5
	Mathinna	Apy (7)	9–48	14–389	31	108	0.3
		Py (4)	38–109	31–207	61	117	0.5
	Beaconsfield	Py (13)	4–62	39–721	25	261	0.1
	Dan Rivulet	Apy (5)	28–46	20–58	37	37	1.0
	Alberton	Apy (2)	88–92	203–208	90	206	0.4
	Golconda	Py (1)	63	87	63	87	0.7
	Scamander						
	Trafalgar	Apy (5)	124–285	24–71	206	44	4.7
	Golden Ridge	Apy (2)	22–53	6–11	38	9	4.2
	Queen of the Earth	Apy (2)	50–85	43–51	68	47	1.4
Copper deposits	Scamander						
	Orieco	Apy (7)	227–342	113–194	286	146	2.0
		Py (5)	43–97	60–167	76	130	0.6
	Silver Echo	Py (4)	213–390	250–418	325	356	0.9
		Po (6)	213–442	250–445	319	337	0.9
	Dunns	Apy (4)	120–281	23–30	144	26	5.5
	Cramps	Apy (4)	561–1170	74–150	856	120	7.1
Mixed copper and Pb-Zn-Ag deposits	Scamander						
	Loila Tier (W)	Apy (5)	8–26	24–41	18	30	0.6
Pb-Zn-Ag deposits	Scamander						
	North Scamander	Py (2)	17–160	130–210	89	220	0.4
		Po (2)	60–63	158–241	62	200	0.3
	Scamander	Apy (7)	16–63	4–65	32	24	1.3
		Py (3)	4–85	17–58	38	33	1.2
	Beulah	Apy (3)	107–402	24–67	265	41	6.5
		Py (1)	23	40	23	40	0.6
	Loila Tier (E)	Apy (5)	9–125	14–89	87	61	1.4
	Yarmouth	Apy (4)	112–365	21–110	253	57	4.4
	Scamander Bell	Py (8)	4–84	15–89	45	32	1.4
	Paul Beahrs	Py (3)	66–67	114–118	67	116	0.6