Memorandum

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From	Exploration Department, Petrology Section Melbourne Research Laboratories
To	MR. P. WHINCUP, RESOURCES, HEAD OFFICE
Subject	E8/16-28/1-Q. PRELIMINARY REPORT ON THE MINERALOGICAL OCCURRENCE OF GOLD PALLADIUM, PLATINUM, URANIUM AND RARE EARTHS IN HEAVY LIQUID FRACTIONS, WITH A NOTE ON THE OCCURRENCE OF A RARE PLATINUM SELENIDE MINERAL FROM DDH5, CORONATION HILL, N.T.

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1. INTRODUCTION

This preliminary report focuses on the mineralogy of six + 38 micron heavy liquid sink/float fractions which were separated using Clerici Solution (SG = 4.05). These separations were carried out by Mineral Deposits Limited and the fractions were then forwarded to Mr. P. Whincup for mineralogical analysis to determine the mineralogy, grain size and liberation characteristics of the gold and platinum group minerals.

The mineralogy and textural features of these samples (MRL 21946-21951) are outlined in Table 1, while the grain sizes and liberation characteristics of the gold/platinum group mineral phases are illustrated with the use of back scattered scanning electron photomicrographs in Plates 1-7.

In addition, the recent discovery of a discrete previously unrecorded platinum selenide mineral in a diamond drill core sample from DDH5, 107.08-107.13 metres (MRL 21957E) has necessitated some preliminary comments which are outlined in Appendix I. (See also Plates 8 and 9.)

2. PROCEDURES

Representative portions of the + 38 micron float and sink fractions from each of six heavy liquid separation samples were mounted in polished sections and examined microscopically in reflected light with the use of an oil immersion lens.

Selected phases were then marked with the use of a diamond scribe, for follow up examination using the scanning electron microscope (SEM). All gold, platinum group mineral, uranium and rare earth phases were qualitatively analysed, where back scattered electron images were used to show atomic number contrasts of the various phases.

During SEM examinations of mineralised diamond drill core material from DDH5, 107.08-107.13 metres a rare previously unrecorded discrete fine grained platinum selenide mineral was discovered. Follow up examination using the Jeol High Resolution Microprobe/Scanner was used to further characterise this phase and to determine its mineralogical associations/liberation characteristics.

SEM examination of the mineralisation in DDH5, 107.08-107.13 metres has also revealed the occurrence of two palladium antimonide minerals which were quantitatively analysed and identified (see Appendix I).

3. DISCUSSION OF RESULTS

(see Table 1, Plates 1-9, Appendix 1).

3.1 Ore Mineralogy

The following ore minerals and opaques have been identified:-

(a) Precious metal phases

Mineral	SG
gold (pure and silver bearing varieties)	19.3 (depending on purity)
stibiopalladinite (Pd_5Sb_2)	9.5
native palladium	11.5
bismuth palladium antimony phase (bismuthian stibiopalladinite or antimony bearing froodite?)	-
platinum/palladium/?iron phase (associated with silver bearing gold)	14-19 (approx)
gold palladium phase (rare; porpezite?)	15.6
bismuth silver selenide*	-
bismuth palladium selenide*	-
palladium mercury selenide*	-
sudburyite (Pd Sb)#	-
platinum (palladium) selenide*# (closely associated with florencite and clausthalite)	-

Footnotes:

* Possible unrecorded or new mineral species.

\# Recorded in diamond drill core sample, DDH5, 107.08-107.13 metres. Sudburyite may be the first recorded occurrence in Australia (see Appendix I).

(b) Iron sulphides/Base metal sulphides and selenides

Mineral	SG
pyrite (some nickel bearing)	5.1
marcasite	4.9
pyrrhotite (rare inclusions in pyrite)	4.6
clausthalite (Pb Se)	8.2
sphalerite	4.0
chalcopyrite	4.2
galena	7.5
nickel cobalt selenide phase (associated with clausthalite)	-
nickel cobalt sulphide phase	-
bornite (rare)	5.2
chalcocite (rare)	5.6

(c) Uranium and yttrium phases

Mineral	SG
uraninite (some lead bearing)	9.0 (approx)
uranium yttrium silicate phase (?yttrian coffinite)	5.1 (approx)

(d) Rare earth element phases

Mineral	SG
florencite [(Ce, La, Ca) Al_3 $(PO_4)_2(OH)_6$] (associated with gold/PGM phases, including the platinum selenide phase; also with clausthalite)	3.58
monazite (rare) [(Ce, La) PO_4]	5.1

(e) Miscellaneous oxides

Mineral	SG
hematite (colloform and tabular varieties)	5.2
rutile/leucoxene	4.2
ilmenite	4.7
magnetite	5.2

3.2 Gangue Mineralogy

The main gangue minerals would include chlorite, sericitic mica, quartz, earthy colloform hematite (after chlorite) tabular hematite and rarer carbonate (probably mainly dolomite). Much of the earthy colloform hematite appears to replace earlier radiating iron-rich chlorite, which is substantiated by the presence of minor to trace Mg, Al, Si, V and Cr besides major Fe, according to SEM examination.

3.3 Textural Features of Gold and Platinum Group Minerals (see Table 1 and Plates 1-9).

The liberated gold and silver bearing gold in the heavy liquid fractions ranges in grain size from 3.5 to 332.5 microns.

Some of the gold/silver bearing gold is still locked inside hematite and silicate composites where it ranges in grain size from <0.9 to 105 microns. These composite grains would range in grain size from 21 to 700 microns, indicating that finer grinding would be necessary to liberate all the gold.

In one case <0.9 to 17.5 micron gold grains are enclosed in earthy hematite, while in another case a 10.5 micron gold grain occurs within 21 micron fractured pyrite crystals.

Intergrowths of gold/clausthalite/stibiopalladinite are relatively common, ranging in grain size from 15 to 332.5 microns, generally enclosed in the silicate matrix. Generally speaking the intergrowths of stibiopalladinite, clausthalite and very fine gold/stibiopalladinite occur on or near the margins of the gold grains at the interface between gold and the silicate/hematite matrix.

The grain sizes and mineralogical associations of the platinum group mineral phases discovered to date are listed as follows:-

(i) Stibiopalladinite ($Pd_5 Sb_2$)

This phase occurs as 2 to 50 micron grains, generally intergrown with clausthalite surrounding silver-bearing gold. It also occurs as intergrowths up to 15 microns across with very fine < 1 micron gold. Occasionally stibiopalladinite forms < 1 to 5 micron inclusions within silver bearing gold.

(ii) Native palladium

This phase ranges in grain size from 2.5 to 12.5 microns where it forms intergrowths with gold and occurs at the grain boundary interface between gold and the silicate matrix.

(iii) Platinum/palladium/iron phase

This phase shows a porous texture where it is associated with silver bearing gold (3.5 - 17.5 µm). The composite gold, platinum/palladium/iron intergrowth is only 20 microns across enclosed in a matrix of earthy hematite.

(iv) Bismuth/palladium/antimony phase

This rare phase forms a 3-20µm intergrowth with silver-bearing gold.

(v) Bismuth palladium selenide

This rare phase forms <1-2.5 µm inclusions within a bismuth silver selenide phase, where these phases form composite 7.5µm inclusions within a large 332.5µm silver bearing gold grain.

(vi) Palladium mercury selenide

This rare phase forms minute <1-2.5µm inclusions within silver bearing gold, associated with clausthalite and stibiopalladinite.

(vii) Platinum (palladium) selenide phase

(recorded in DDH5, 107.07-107.13 m)

This phase forms porous patches ranging from 5 to 10 microns in size, generally closely associated with florencite and clausthalite, where all these phases are enclosed in the silicate (chloritic) matrix. Individual platinum selenide grains within these porous patches are often < 1 micron in size.

In one case, a 0.5 micron thick zone of platinum selenide surrounds a 9 micron florencite grain in turn surrounded by clausthalite where all these phases are embedded in the chloritic matrix.

(viii) Sudburyite (Pd Sb)

(recorded in DDH5, 107.07-107.13 m)

This phase forms an intergrowth with stibiopalladinite. The whole grain is 9 µm across, embedded in the silicate matrix where the sudburyite itself measures 5 microns across.

3.4 General Comments on Mineral Processing (provisional route open to discussion)

Preliminary indications are that the ore should be subjected to finer grinding since composite gold/platinum group mineral/silicate grains up to 700 microns in size have been noted in the heavy liquid fractions. This would mean grinding in the range 100 to 200 microns so that most of the coarse grained gold could be liberated and then concentrated by gravity methods.

After removal of the coarse grained (>100 micron) gold, the gravity tail could then be subjected to cyanidation. Due to the expected insolubility of the recently discovered platinum selenide phase in cyanide solution, the residue would then need to be pulverised in the range 20 to 50 microns (or less) and subjected to flotation in order to concentrate the finer grained platinum group mineral phases.

The fine grain size of the discrete platinum (palladium) selenide phase in the range <1 to 10 microns, enclosed in the chloritic matrix material may pose problems during flotation. However the presence of associated coarser grained clausthalite may help in floating off composite platinum selenide/clausthalite/chlorite grains.

In this context it is interesting to note that the generally low recovery of platinum during cyanidation tests carried out by Mineral Deposits Ltd. can probably be explained by this expected low solubility of the platinum selenide phase and its fine grain size, where it would tend to be locked up within the silicate matrix.

4. CONCLUSIONS

(1) To date, precious metal mineralisation in these Coronation Hill heavy liquid fractions occurs as gold/silver bearing gold, stibiopalladinite (Pd_5Sb_2), native palladium, platinum/palladium/iron phase, bismuth/palladium/antimony phase, rare bismuth palladium selenide, rare bismuth silver selenide and rare palladium mercury selenide. In addition, a discrete platinum (palladium) selenide phase and the rare mineral sudburyite (PdSb) have been recorded in DDH5, 107.05-107.13 metres.

(2) The stibiopalladinite is generally associated with clausthalite, towards the margins of silver-bearing gold grains in contact with the silicate or hematite matrix. Minute stibiopalladinite inclusions sometimes occur in gold and stibiopalladinite is sometimes intergrown with sudburyite.

(3) The gold and platinum group mineral phases show a distinct selenide association where clausthalite (PbSe) is generally present. However gold is less commonly associated with pyrite indicating a sulphide association.

(4) Platinum mineralisation to date comprises a porous platinum/palladium/iron phase associated with silver bearing gold, where this intergrowth is 20 microns across enclosed in earthy

hematite. A discrete porous platinum (palladium) selenide phase has also been recorded, ranging in grain size from <1 to 10 microns enclosed in a chloritic matrix. This platinum selenide phase may represent a new mineral species, where it is closely associated with florencite, clausthalite and stibiopalladinite.

(5) Uranium mineralisation has been recorded in the heavy liquid fractions, generally closely associated with base metal sulphides such as galena, chalcopyrite and sphalerite. The main uranium minerals are uraninite and yttrian coffinite (uranium yttrium silicate phase), where fine grained coffinite can sometimes form intergrowths along the grain boundaries of pyrite/marcasite.

(6) A nickel cobalt selenide phase is sometimes intergrown with clausthalite.

(7) The rare earth phosphate mineral florencite has again been recorded, where it is closely associated with the platinum (palladium) selenide phase, clausthalite and stibiopalladinite.

(8) Preliminary indications are that the Coronation Hill ore would need to be subjected to finer grinding in the range 100 to 200 microns in order to liberate the coarser gold which could then be concentrated by gravity methods. The gravity tail could then be subjected to cyanidation to dissolve the remaining gold and most of the platinum group metal phases. In order to extract the insoluble platinum selenide phase, the residue would then need to be pulverised in the range 20 to 50 microns (or less), prior to flotation and concentration of the remaining fine grained platinum group mineral phases.

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TABLE 1: MINERALOGICAL OCCURRENCE OF GOLD AND PLATINUM GROUP MINERALS IN HEAVY LIQUID SINK AND FLOAT FRACTIONS, CORONATION HILL, N.T.

Sample No. MRL No. Sample Type Head Assay (g/t)	Mineralogy and Texture of heavy liquid fraction (approx. decreasing order)	Grain size of gold (microns) Free Grains	Grain size of gold (microns) Locked Composites	Grain size of PGM phases (microns)	General comments Occurence of gold and PGM phases
No. 1 21946A (PS) Float fraction (SG < 4.05) Au Pt Pd 4.45 0.23 0.67 Ni Cr Hg (mg/t) 55 45 110	Silicates (including pale radiating chlorite). Goethite (rust). Hematite (colloform and tabular varieties). Tramp iron. Pyrite (composites with silicates). Carbonate. Marcasite. Rutile. Zircon. Ilmenite. Magnetite. Chalcopyrite (rare). Gold (rare). Pyrrhotite (rare inclusions in pyrite).	7 - 35	1.8-70.0 in composites ranging from 87 - 157.5	None detected.	Gold ranging from 1.8-70.0 µm occurs in iron stained silicate composite grains ranging in size from 87.5 - 157.5 µm. Occasional intergrowths of pyrite/marcasite are also evident.

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No. 1 21946B (PS) Sink fraction (SG > 4.05)	Pyrite. Ilmenite (some coarse exsolution blades in magnetite) Goethite (rust). Hematite. Tramp metals (including iron, bronze and brass). Zircon. Magnetite. Gold (rare). Clausthalite (rare; confirmed by SEM).	3.5-120	10.5 (enclosed in microfractured pyrite). 21.0 (at grain boundary between pyrite and silicate).	None detected.	Gold ranging from 10.5 to 21.0µm occurs in pyrite and along the pyrite/silicate grain boundary.

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No. 2 21947A (PS) Float fraction (SG < 4.05) See Plate 1a-c Au 5.33 Pt 0.24 Pd 0.74 Ni 66 Cr 92 Hg (mg/t) 100	Hematite (colloform > tabular variety). Silicates (including radiating colourless chlorite). Pyrite (forms composites with silicates). Goethite (rust). Tramp iron. Carbonate. Rutile. Uraninite (SEM). Marcasite (associated with carbonate). Galena (SEM). Gold (trace Ag according to SEM). Stibiopalladinite (SEM). Monazite? (rare Ce, La, Nd phosphate - SEM).	3.5-35.0	0.9-70.0	Stibiopalladinite forms 2-3μm grains enclosed in clausthalite, forming a zone (2.5μm thick), at the interface between silver bearing gold and the silicate matrix.	Some of the colloform hematite is partly replaced by pyrite. Uraninite forms rims around pyrite, rutile and sometimes galena. Gold forms grains ranging from 0.9 to 70.0 μm, generally enclosed in silicates, where the silicate/gold/PGM composites range from 52.5 to 315 μm. Stibiopalladinite forms 2-3μm grains enclosed in clausthalite (see Plate 1c).

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No. 2 21947B (PS) Sink fraction (SG > 4.05) See Plates 2f and 3a-b	Pyrite. Tramp iron. Goethite (rust). Hematite. Ilmenite. Rutile/leucoxene (relict Ti magnetites). Zircon. Galena (SEM). Sphalerite (SEM). Chalcopyrite. Uranium yttrium silicate phase (yttrian coffinite; SEM detected major U, Si, Y) Marcasite (sometimes intergrown with pyrite). Uraninite (SEM detected major U, minor Pb, trace Fe) Gold (trace Ag; SEM). Stibiopalladinite (SEM). Bismuth palladium antimony phase* (bismuthian stibiopalladinite? - SEM). * According to SEM, this phase contains more bismuth in the outer rim. Thallium contamination from the heavy liquid Clerici solution has been recorded in this phase.	14 x 35 - 140x24.5	3.5 - 54.0	The Bi Pd Sb phase intergrown with gold, ranges from 3-20µm.	A rare gold/sulphide association is evident where a 3.5 µm gold grain occurs at the grain boundary interface between pyrite and later encrusting galena. Gold is also associated with pyrite where 17.5 to 38.5 µm grains occur along the grain boundaries between pyrite crystals. An intergrowth of silver bearing gold (up to 50 µm) and a palladium antimony phase (3-20µm) occurs within a sericitic grain which is 70µm across. Uraninite is closely associated with sphalerite and the yttrian coffinite is also closely associated with pyrite, sphalerite and galena.

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Sample No. MRL No. Sample Type Head Assay (g/t)	Mineralogy and Texture of heavy liquid fraction (approx. decreasing order)	Grain size of gold (microns) Free Grains	Grain size of gold (microns) Locked Composites	Grain size of PGM phases (microns)	General comments. Occurence of gold and PGM phases
No. 3 21948A (PS) Float fraction (SG < 4.05) Au Pt Pd 4.26 0.27 0.77 Ni Cr Hg (mg/t) 134 49 200	Rutile/leucoxene (abundant leucoxenized Ti magnetite of high temperature origin). Silicates. Hematite (colloform and tabular varieties). Goethite (rust). Tramp iron. Pyrite. Ilmenite (rare). Gold (rare).	Nil.	3.5-35.0 In silicate and iron stained silicate associated with tabular hematite and rutile.	Not detected.	Gold occurs as 3.5-35.0 μm grains locked within the silicate matrix. The grain size of these composite grains ranges from 280-525 μm.

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No. 3 21948B (PS) Sink fraction (SG > 4.05) See Plates 3c-f, 4a-b	Rutile/leucoxene (some relict octahedral texture after high temperature Ti magnetite). Hematite (SEM has detected major Fe together with minor to trace Si, Al, K suggesting replacement of micas by earthy hematite). Tramp iron. Goethite (rust). Magnetite. Ilmenite. Pyrite (minor). Zircon. Gold (SEM has also detected trace to minor silver). Native palladium (at silicate/gold interface or intergrown with gold). Stibiopalladinite (SEM; minute inclusions within silver bearing gold).	3.5-122.5 x 17.5	7 - 70	Native palladium ranges from 2.5 to 12.5, generally forming a fine intergrowth with gold. Stibiopalladinite also forms minute (<1-5 µm) inclusions within silver-bearing gold. Rare ?porpezite also forms <1 µm inclusions associated with native palladium.	Gold (7-70µm) forms composite grains with silicates and hematite, where these composites range from 70-175µm in size. Silver bearing gold (up to 77µm) also forms an intergrowth with native palladium where the latter ranges in size from 2.5-12.5µm. Some zoned gold contains variable silver together with minute (<1-5µm) inclusions of stibiopalladinite. SEM scans of the native palladium failed to detect platinum.

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Sample No. MRL No. Sample Type Head Assay (g/t)	Mineralogy and Texture of heavy liquid fraction (approx. decreasing order)	Grain size of gold (microns) Free Grains	 Locked Composites	Grain size of PGM phases (microns)	General comments. Occurence of gold and PGM phases
No. 4 21949A (PS) Float fraction (SG of liquid = +2.85-4.05) See Plate 1d Au Pt Pd 5.44 0.23 0.67 Ni Cr Hg (mg/t) 300 42 70	Rutile/leucoxene (relict octahedral texture after Ti magnetite). Silicates. Hematite* (colloform > tabular varieties). Tramp iron. Goethite (rust). Pyrite. Clausthalite (rare; major Pb Se detected by SEM). Gold (rare; SEM confirmed pure gold with no silver). * An SEM area scan of colloform hematite has detected major Fe together with minor Si and traces of Mg, Al, Ti and V. This colloform hematite appears to re-lace radiating chlorite.	Nil.	<0.9-17.5	Not detected. The minute white isotropic grains enclosed in colloform hematite proved to be clausthalite, not a platinum group mineral phase.	Gold occurs as minute (<0.9 – 17.5 µm) grains enclosed in colloform hematite, iron stained silicates, rutile and quartz. These composites range in size from 140 to 630 µm. The colloform hematite also sometimes contains minute (3.5 µm) grains of clausthalite.

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Sample No. MRL No. Sample Type Head Assay (g/t)	Mineralogy and Texture of heavy liquid fraction (approx. decreasing order)	Grain size of gold (microns) Free Grains	Locked Composites	Grain size of PGM phases (microns)	General comments. Occurence of gold and PGM phases
No. 4 21949B (PS) Sink fraction (SG of liquid = +2.85-4.05) See Plate 4c	Tramp iron/rust. Hematite (colloform and tabular varieties). Rutile/leucoxene (some leucoxenized Ti magnetites of high temperature origin). Magnetite. Pyrite. Zircon. Gold (pure; SEM). Stibiopalladinite* (SEM). Native palladium* (SEM). * Thallium recorded indicating contamination from the Clerici solution.	17.5-140	Nil.	Stibiopalladinite forms discrete 3-5µm grains and fine intergrowths with <1µm gold.	One large 140µm pure gold grain is partly surrounded by radiating colloform hematite (hematite after chlorite). A fine grained intergrowth of gold/stibiopalladinite (about 5µm wide) occurs at the interface between the gold and hematite. The large gold grain also contains minute (3-5µm) inclusions of stibiopalladinite.

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Sample No. MRL No. Sample Type Head Assay (g/t)	Mineralogy and Texture of heavy liquid fraction (approx. decreasing order)	Grain size of gold (microns)		Grain size of PGM phases (microns)	General comments. Occurence of gold and PGM phases
		Free Grains	Locked Composites		
No. 5 21950A (PS) Float fraction (SG of liquid = +2.85-4.05) Au Pt Pd 10.35 0.72 1.87 Ni Cr Hg (mg/t) 470 1540 160	Iron stained silicates. Hematite (colloform and tabular varieties where some colloform hematite is post-dated by pyrite veinlets). Rutile/leucoxene. Tramp iron/rust. Pyrite. Carbonate. Marcasite. Chalcopyrite (rare; some pyrite/marcasite subhedra surrounded by later chalcopyrite). Gold (rare).	Nil.	1.8-10.5 enclosed in iron stained silicates and earthy hematite.	Not detected.	Gold occurs as minute (1.8-10.5 μm) grains enclosed in iron stained silicate/quartz/rutile/earthy hematite grains ranging in size from 192.5-700 μm.

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Sample No. MRL No. Sample Type Head Assay (g/t)	Mineralogy and Texture of heavy liquid fraction (approx. decreasing order)	Grain size of gold (microns) Free Grains	Locked Composites	Grain size of PGM phases (microns)	General comments. Occurence of gold and PGM phases
No. 5 21950B (PS) Sink fraction (SG > 4.05) See Plates 4d-f; 5a-f	Hematite (earthy colloform radiating variety after chlorite and tabular variety). Tramp iron/rust. Rutile/leucoxene. Pyrite (SEM has detected traces of Ni in some pyrite. It also partly replaces colloform hematite and forms veinlets after colloform hematite. Occasional tabular hematites are also surrounded by later pyrite). Marcasite (intergrown with pyrite and coffinite; SEM). Ilmenite. Magnetite. Zircon. Uraninite (SEM; associated with tabular hematite, pyrite, galena, chalcopyrite and sphalerite). Chalcopyrite (sometimes enclosed in uraninite). Galena (associated with uraninite). Bornite (rare). Chalcocite (encrusting bornite).	3.5-332.5	1.8-42.0	(i) Stibiopalladinite. 20µm grains associated with silver bearing gold, clausthalite and palladium mercury selenide. (ii) Platinum/palladium phase. Porous texture, associated with silver-bearing gold, all enclosed in iron oxide. The gold ranges from 3.5-17.5µm and the complete gold-platinum/palladium intergrowth is approximately 20µm across, in turn enclosed in a larger iron oxide grain. (iii) Bismuth palladium selenide phase. Minute <1-2.5µm inclusions within the bismuth silver selenide phase. These two phases form composite inclusions about 7.5µm long enclosed in a large silver-bearing gold grain (332.5µm).	Gold forms 1.8 to 42.0µm grains (sometimes intergrown with clausthalite and the platinum group mineral phases) enclosed in porous hematite and quartz. Some sulphidation of colloform hematite is evident. Subhedral pyrite is also post-dated by chalcopyrite/galena in the paragenesis. Uraninite is associated with Ni-pyrite and the base metal sulphides, where there is no obvious direct association with gold and the PGM phases. These PGM phases are invariably associated with silver-bearing gold and clausthalite, where the following have been recorded: (i) stibiopalladinite. (ii) platinum/palladium/iron phase. (iii) bismuth palladium selenide phase (rare). (iv) palladium mercury selenide phase (very rare). It is interesting to note that the platinum/palladium phase and these other rare platinum group

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21950B (Cont.)	Gold (SEM has detected trace to minor silver). Clausthalite (SEM). Nickel cobalt selenide phase (SEM; associated with clausthalite). Stibiopalladinite (SEM). Uranium silicate phase (coffinite?) associated with pyrite/marcasite; identified by SEM). Platinum/palladium/iron phase* (SEM; associated with silver bearing gold). Bismuth silver selenide phase (SEM; rare minute inclusions in silver-bearing gold). Bismuth palladium selenide phase (SEM; intergrown with the bismuth silver selenide phase enclosed in silver-bearing gold). Palladium mercury selenide (SEM; rare minute inclusions in silver-bearing gold, associated with stibiopall-adinite and clausthalite).			(iv) Palladium mercury selenide. Minute (<1-2.5 µm) inclusions within silver bearing gold.	mineral phases are associated with clausthalite (Pb Se) which is sometimes intergrown with a nickel cobalt selenide. Geochemically the association of platinum and palladium with nickel cobalt and chromium is expected. Though chromium bearing phases were not detected, anomalous chromium (up to 1540 ppm) has been recorded in the head analysis of bulk sample no. 5.

TABLE 1: MINERALOGICAL OCCURRENCE OF GOLD AND PLATINUM GROUP MINERALS IN HEAVY LIQUID SINK AND FLOAT FRACTIONS, CORONATION HILL, N.T.

Sample No. MRL No. Sample Type Head Assay (g/t)	Mineralogy and Texture of heavy liquid fraction (approx. decreasing order)	Grain size of gold (microns) Free Grains	 Locked Composites	Grain size of PGM phases (microns)	General comments. Occurence of gold and PGM phases
21950B (Cont'd)	* Possible Pt/Pd/Fe alloy. SEM has also recorded iron in this phase, which may in part be due to the surrounding hematite. Some thallium also occurs in this phase, representing contamination from the heavy liquid Clerici solution.				

TABLE 1: MINERALOGICAL OCCURRENCE OF GOLD AND PLATINUM GROUP MINERALS IN HEAVY LIQUID SINK AND FLOAT FRACTIONS, CORONATION HILL, N.T.

Sample No. MRL No. Sample Type Head Assay (g/t)	Mineralogy and Texture of heavy liquid fraction (approx. decreasing order)	Grain size of gold (microns) Free Grains	Grain size of gold (microns) Locked Composites	Grain size of PGM phases (microns)	General comments. Occurence of gold and PGM phases
No. 6 21951 A (PS) Float fraction. SG of liquid = +2.85 -4.05. See Plates 1e-f; 2a-e. Au Pt Pd 9.12 0.54 1.47 Ni Cr Hg (mg/t) 500 1410 190	Silicates Rutile/Leucoxene Hematite* (colloform and tabular varieties.) Carbonate. Pyrite Tramp iron Goethite (rust.) Gold (rare; both pure and also with traces of silver according to SEM.) Clausthalite** (SEM) Stibiopalladinite (SEM) * SEM has detected major Fe minor Si, Ti and traces of Al, Mg & Cr in some of the colloform hematite, indicating replacement of earlier radiating Fe-rich chlorite. ** Clausthalite (PbSe) forms minute crystals (0.9-3.5 µm) enclosed in colloform hematite, according to SEM.	Nil	<0.9-70.0 in composites comprising quartz, hematite, hematite/carbonate ranging from 157-700.	Stibiopalladinite 2.5-5.0 µm, is generally intergrown with clausthalite and gold.	Gold (0.9-70.0 µm) is often enclosed in composite grains. This gold is sometimes completely enclosed in quartz, where some would be difficult to liberate, even after grinding to 30µm. Fine grained stibiopalladinite and clausthalite (3-6 µm) sometimes occur along the grain boundary between gold and quartz (see Plate 2e).

TABLE 1: MINERALOGICAL OCCURRENCE OF GOLD AND PLATINUM GROUP MINERALS IN HEAVY LIQUID SINK AND FLOAT FRACTIONS, CORONATION HILL, N.T.

Sample No. MRL No. Sample Type Head Assay (g/t)	Mineralogy and Texture of heavy liquid fraction (approx. decreasing order)	Grain size of gold (microns) Free Grains	Grain size of gold (microns) Locked Composites	Grain size of PGM phases (microns)	General comments. Occurence of gold and PGM phases
No. 6 21951 B (PS) Sink fraction. (SG > 4.05) See Plates 6 and 7	Hematite (colloform and tabular varieties). Pyrite. Marcasite (often intergrown with pyrite). Rutile/leucoxene. Ilmenite (occasional coarse intergrowths of Ti hematite/ ilmenite of high temperature igneous origin). Magnetite. Tramp iron. Goethite (rust). Zircon. Clausthalite (SEM; some minute inclusions in gold). Gold (both pure and silver bearing varieties according to SEM.) Florencite (SEM; Ce, La, Al phosphate phase enclosed in clausthalite.) Stibiopalladinite (SEM.) Palladium antimonide phase* (SEM; this phase forms a darker rim on stibio-palladinite.) Galena (SEM; rare discrete grains.) Nickel cobalt sulphide phase (SEM; rare inclusions in clausthalite.)	7-350	<0.9-105 in composites ranging from 105-280. These composites comprise iron stained sericitic mica, earthy hematite and quartz.	Stibiopalladinite 4-50µm generally occurs intergrown with clausthalite surrounding silver bearing gold. The clausthalite and stibiopalladinite often occur towards the grain boundary interface between gold and the matrix silicate/hematite phase. Intergrowths of fine gold (<1µm) and stibiopalladinite are also evident, some of which are 15µm across (see plate 6b.)	Silver-bearing gold is closely associated with clausthalite, stibiopalladinite and a very fine intergrowth of gold/stibiopalladinite. Area scans for platinum within some of these phases proved negative. Most of these clausthalite/ stibiopalladinite intergrowths occur towards the margins of the gold grains in contact with the matrix hematite, quartz and sericitic mica. There is some textural evidence to suggest that the clausthalite and stibiopalladinite are slightly later in the paragenetic sequence since gold appears to be partly replaced by these phases in some instances. Florencite is closely associated with the gold, stibiopalladinite and clausthalite mineralisation where it is sometimes enclosed in the latter. (See Plate 7a-b).

* Two palladium antimonide phases appear to be present.

APPENDIX I

MINERALOGY OF DIAMOND DRILL CORE SAMPLE FROM DDH5, 107.08-107.13 METRES (MRL 21957E)

This sample comprises an altered (sericitized, hematised and chloritised) quartz porphyry. There is some textural evidence to suggest that it represents an original vitric felsic volcanic rock.

The following minerals have been identified by reflected light microscopy and follow up SEM examination:-

- hematite (colloform variety)
- pyrite
- rutile/leucoxene
- gold (SEM; pure and some with a trace of silver)
- clausthalite (SEM)
- stibiopalladinite* (SEM)
- sudburyite* (SEM)
- platinum selenide phase# (SEM)
- florencite (SEM)
- galena (rare)
- chalcopyrite (rare)

The gold, clausthalite and platinum group minerals are finely disseminated within a brecciated quartz/chlorite zone which abuts against the hematite/pyrite.

Reference to Fig. 1, confirms the presence of a discrete platinum (palladium) selenide mineral, where these elements are shown on the energy dispersive spectra.

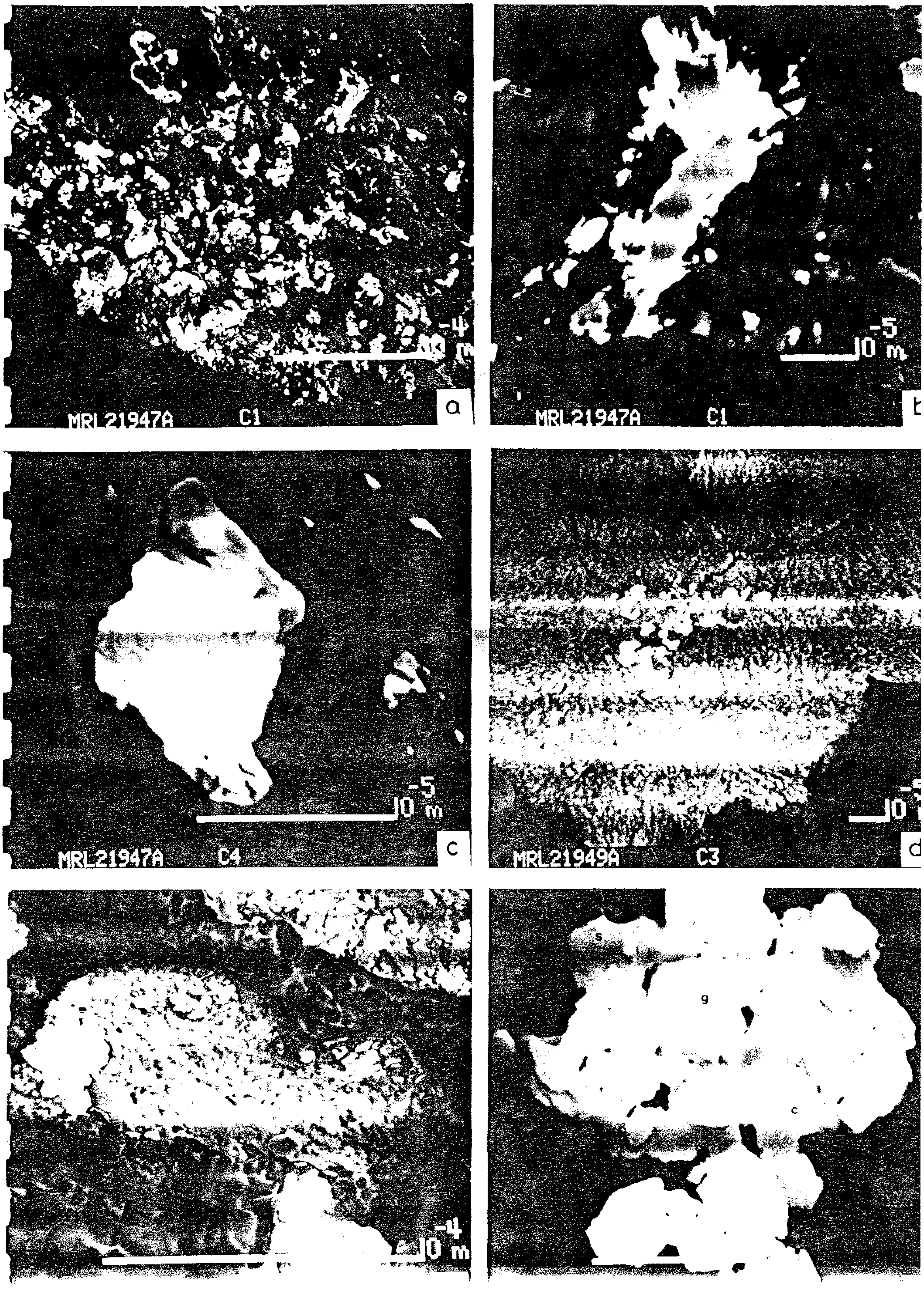
Footnotes:

* An intergrowth of stibiopalladinite (Pd_5Sb_2) and sudburyite (PdSb) confirmed by SEM. Energy dispersive analyses for these phases are listed as follows:-

(i) sudburyite - 50.0% Pd, 49.74% Sb
(ii) stibiopalladinite 68.92% Pd, 30.42% Sb

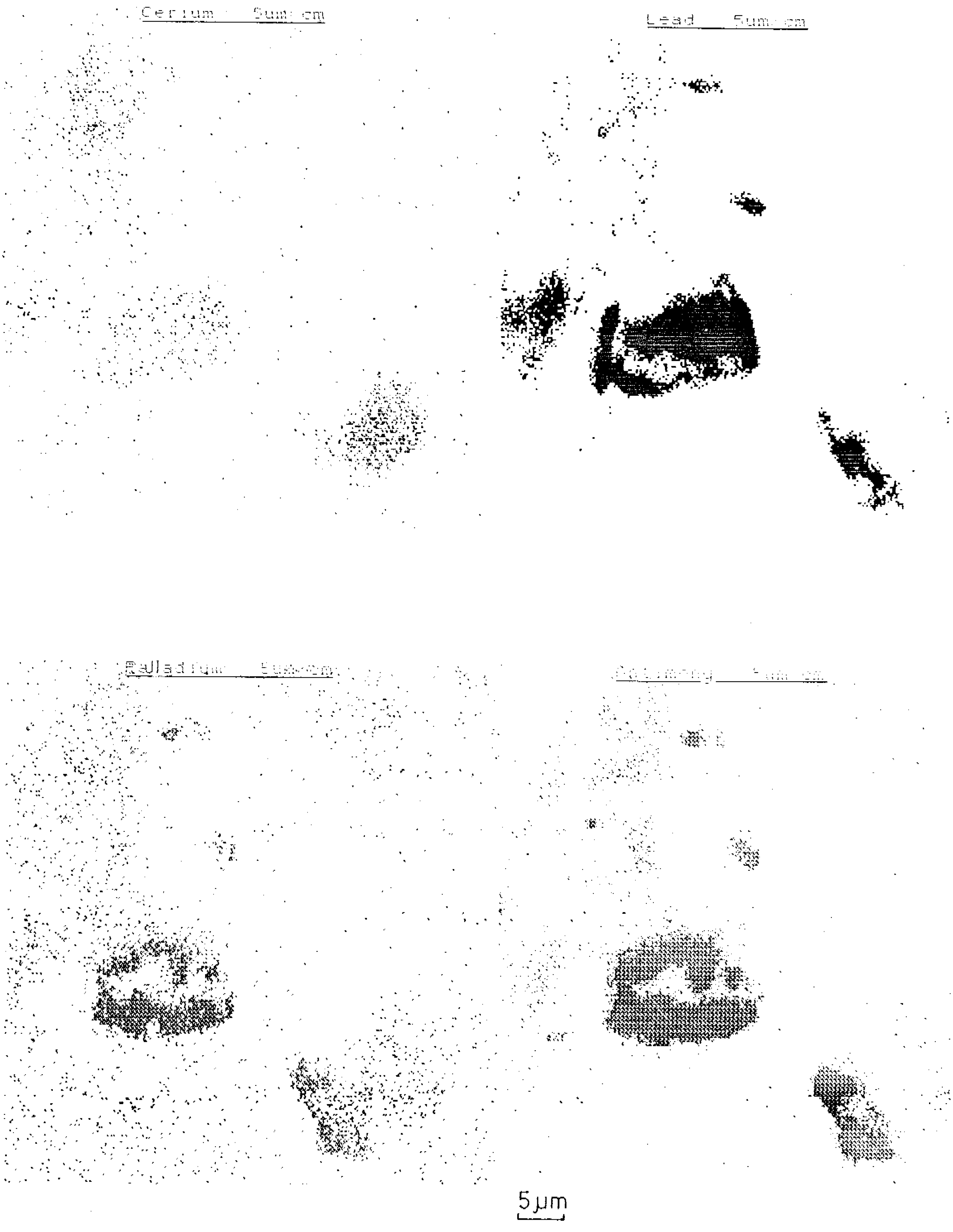
\# SEM has detected major platinum, selenium together with a trace of palladium.

1



-4
10 m
MRL21947A
C1
a
-5
10 m
MRL21947A
C1
b
-5
10 m
MRL21947A
C4
c
MRL21949A
C3
d
-4
10 m
s
g
c

X-ray maps showing distribution of the elements



This platinum (palladium) selenide phase is very fine grained, forming porous patches up to 10 µm across, where some individual grains would be less or equal to 1 µm. In one case a 0.5 µm thick zone of platinum selenide has formed around florencite, in turn surrounded by clausthalite/stibiopalladinite, where all these phases are embedded in the chloritic matrix (see Plates 8 and 9).

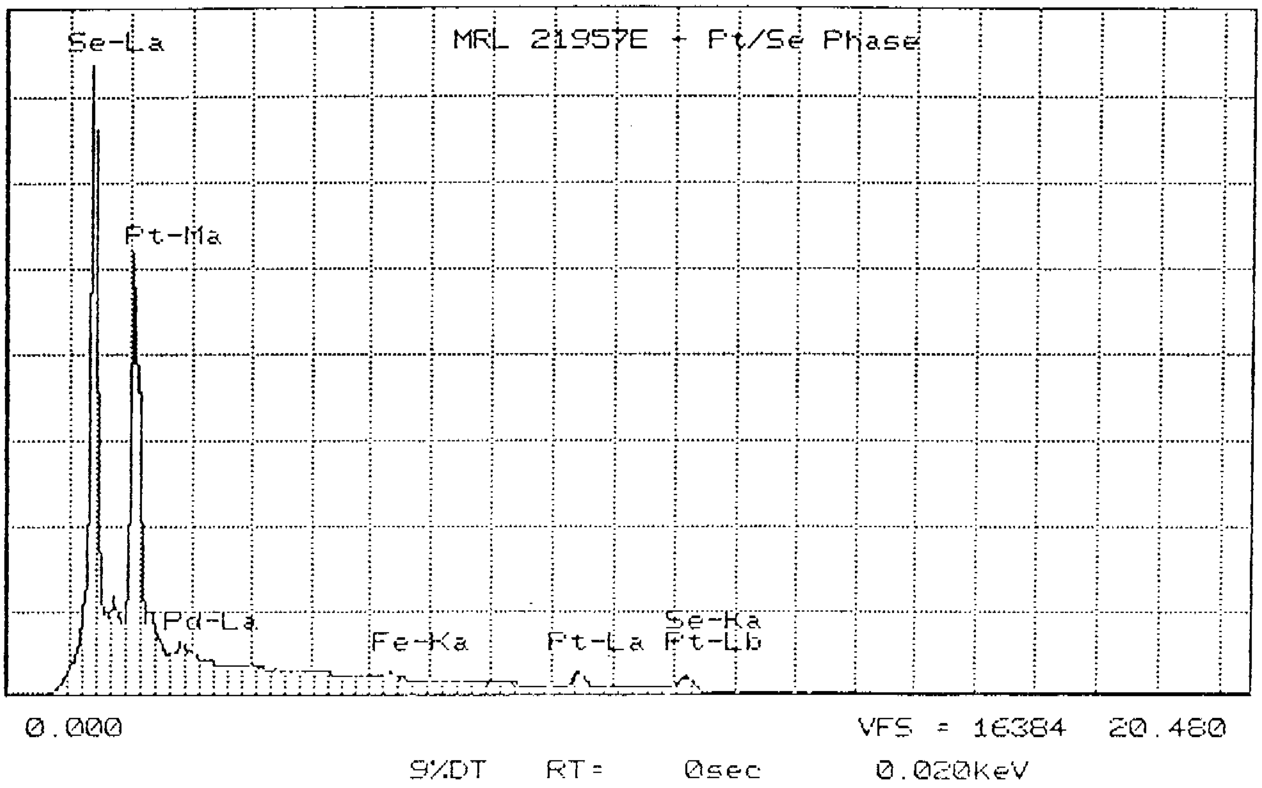


Fig. 1: Energy Dispersive Spectra Confirming the Presence of Platinum, Selenium and a Trace of Palladium

PLATE 2

SEM BSE Photomicrographs of Float Fractions (a-e) and one Sink Fraction (f) from Heavy Liquid Separation. (SG = +2.85 - 4.05 for floats and + 4.05 for sinks).

(a) Minute white specks of clausthalite (see arrows) enclosed in colloform hematite. SEM has detected major Fe, minor Si, Ti, Cr and traces of Al, Mg in the colloform hematite indicating probable replacement of chlorite by hematite. Sample no. 6 (MRL 21951A, C4).

(b) Intergrowth of pure gold, clausthalite and stibiopalladinite (white) enclosed in quartz. Some circular patches of colloform hematite (grey) are also present. Sample no. 6 (MRL 21951A, C5).

(c) Detail as above showing pure gold (white), clausthalite (light grey) and stibiopalladinite (darker grey) enclosed in quartz (black).

(d) Pure gold (white) with marginal clausthalite and stibiopalladinite enclosed in quartz (black). Note the minute gold grains (white) scattered in quartz. Sample no. 6 (MRL 21951A, C6).

(e) Detail as above showing pure gold (white) together with marginal clausthalite (light grey) and stibiopalladinite (darker grey) at the gold/quartz interface.

(f) Galena (bright white) together with an uranium yttrium silicate phase (yttrian coffinite?; light grey), sphalerite (medium grey) and pyrite (dark grey at left). Sample no. 2 (MRL 21947B, C2, + 4.05 SG sink fraction).

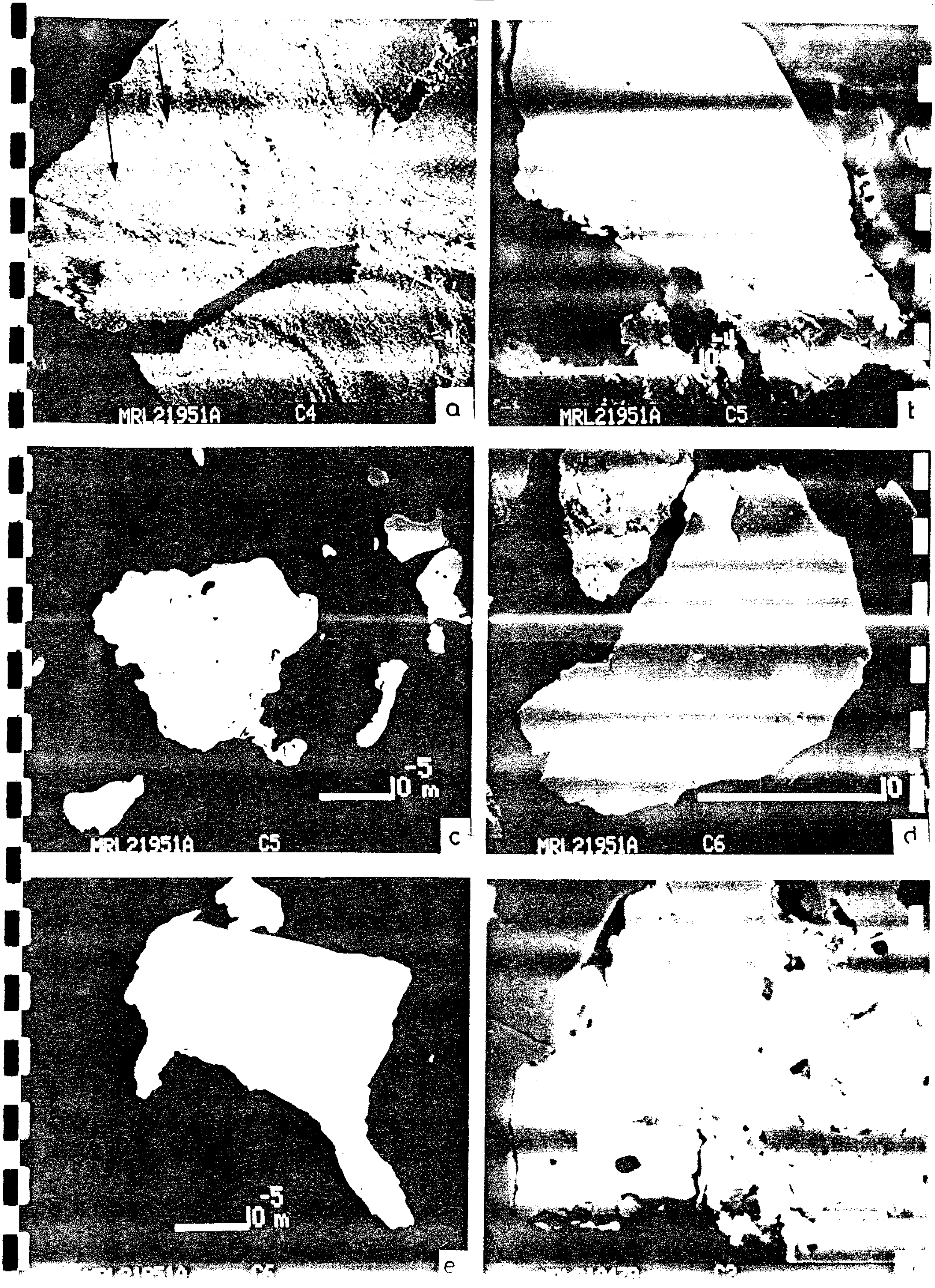

MRL21951A C4 a
MRL21951A C5 b
-5
0 m
MRL21951A C5 c
0
MRL21951A C6 d
-5
0 m
e

PLATE 3

SEM BSE Photomicrographs of Sink Fractions from Heavy Liquid Separation. (SG of liquid = 4.05.)

(a) An uranium-lead phase (uraninite?; white) associated with sphalerite (grey, upper right). Sample no. 2 (MRL 21947B, C3).

(b) Gold with a trace of silver (white) intergrown with a palladium antimony bismuth phase (darker grey at arrow). According to SEM, there is a higher content of bismuth in the rim of this phase. The matrix is sericitic mica, where SEM detected major K, Al and Si. Sample no. 2 (MRL 21947B, C4).

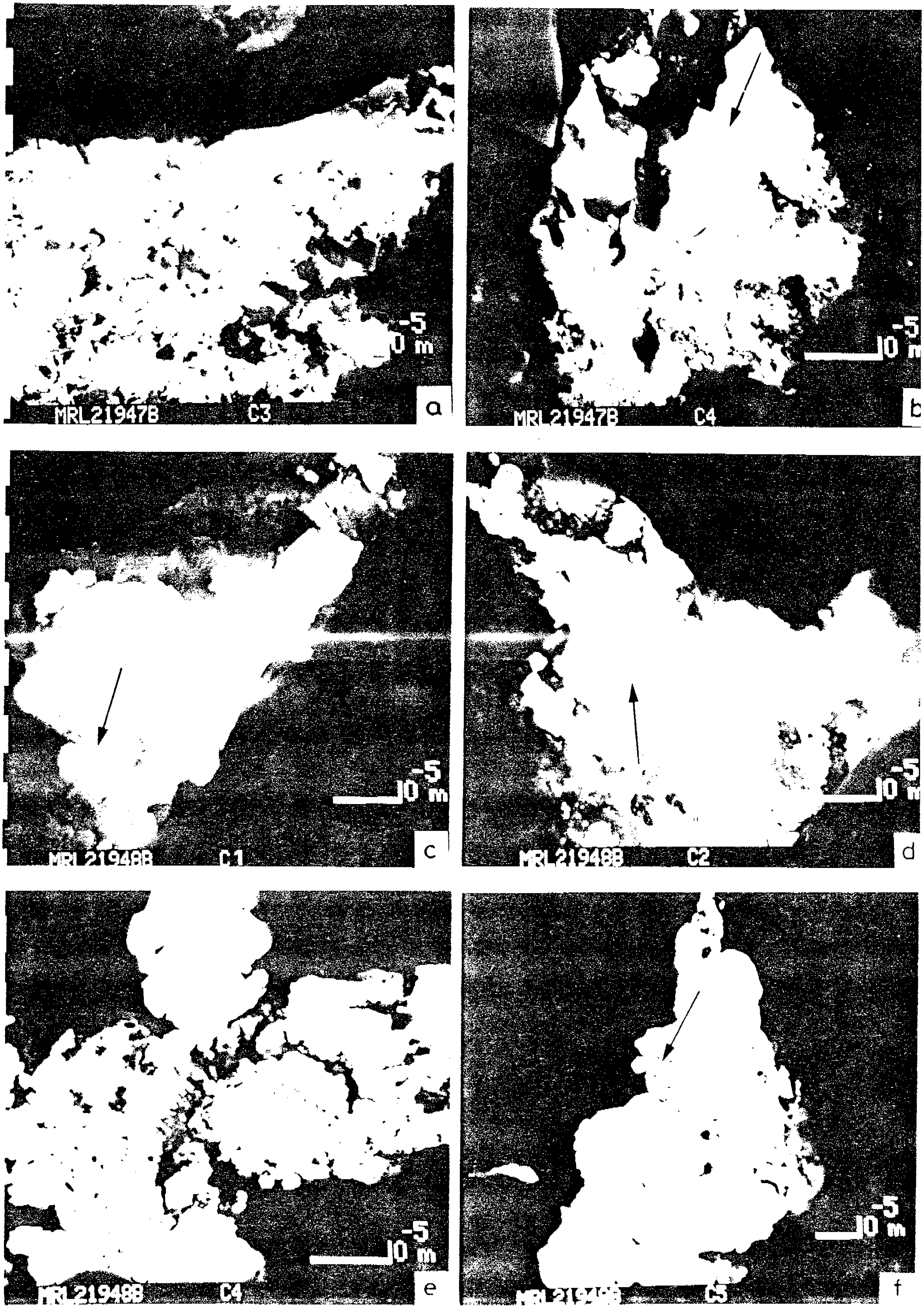
(c) Intergrowth of gold with a trace of silver (white) and native palladium (grey, at arrow). Sample no. 3 (MRL 21948B, C1).

(d) Gold with a trace of silver (white) containing minute inclusions of stibiopalladinite (grey at arrow). Sample no. 3 (MRL 21948B, C2).

(e) Gold with minor to trace silver (white) intergrown with native palladium (grey). Sample no. 3 (MRL 21948B, C4).

(f) Gold with minor silver (white), showing a minute crystal of native palladium (grey at left margin of gold grain) and a palladium gold phase (porpezite?; grey at arrow). Sample no. 3 (MRL 21948B, C5).

3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C3
a
MRL21947B
C4
b
MRL21948B
C1
c
MRL21948B
C2
d
MRL21948B
C4
e
C5
f

PLATE 4

SEM BSE Photomicrographs of Sink Fractions from Heavy Liquid Separation. (SG of liquid = 4.05.)

(a) Zoned gold with a trace of silver containing minute inclusions of stibiopalladinite (grey at arrow). This gold shows a variation in silver content from low silver (white zones) to higher silver (grey zones), where stibiopalladinite grains have apparently been deposited along a higher gold zone. Sample no. 3 (MRL 21948B, C6).

(b) Gold (g) containing minor silver rimmed with native palladium (pd) and minor stibiopalladinite (grey, not visible). Sample no. 3 (MRL 21948B, C7).

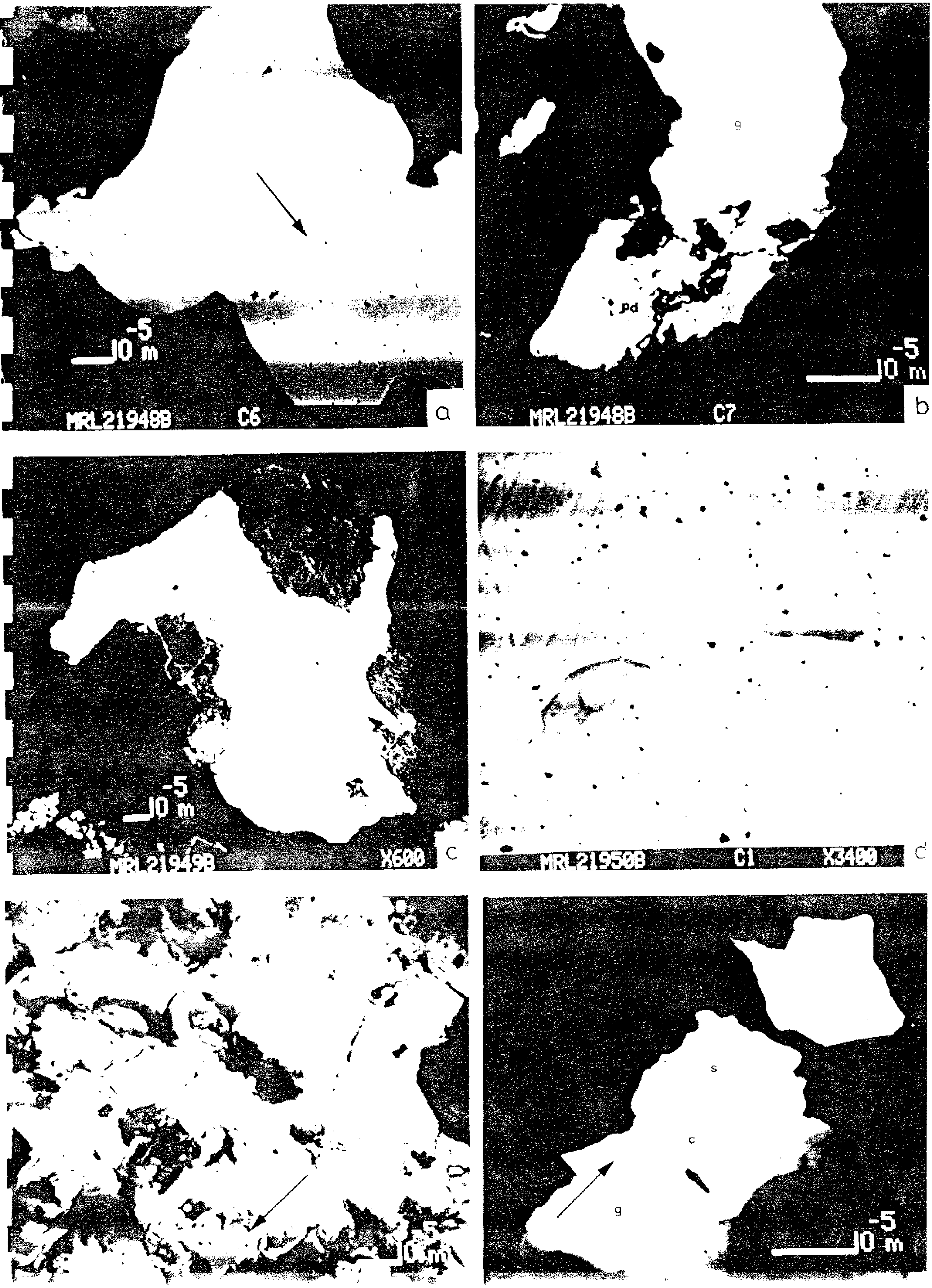
(c) Pure gold (white), surrounded by colloform hematite (dark grey). A fine intergrowth of stibiopalladinite, gold and rare porpezite? forms a rim on the gold. Sample no. 4 (MRL 21949B).

(d) Gold with a trace of silver (white) containing minute inclusions of a bismuth silver selenide phase (dark grey) and a bismuth palladium selenide phase (lighter grey). Sample no. 5 (MRL 21950B, C1).

(e) Uraninite (white) intergrown with tabular hematite. Minute inclusions of chalcopyrite (dark grey at arrow) and pyrite (dark grey) are also present. Sample no. 5 (MRL 21950B, C3).

(f) Intergrowth of gold with a trace of silver (white), stibiopalladinite (s), clausthalite (c) and a palladium mercury selenide phase (minute inclusions in gold, at arrow) all enclosed in quartz (black). Sample no. 5 (MRL 21950B, C4).

4



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10 m
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C6
a
g
Pd
-5
10 m
MRL21948B
C7
b
-5
10 m
MRL21949B
X600
c
MRL21950B
C1
X3400
d
-5
10 m
s
c
g
-5
10 m

PLATE 5

SEM BSE Photomicrographs of Sink Fractions from Heavy Liquid Separation. (S.G. of liquid = 4.05.)

a. Complex intergrowth of galena (bright white), uraninite with a trace of iron (dull white), chalcopyrite (dark grey), pyrite with minor uranium (medium grey), pyrite (dark grey) and rutile (dark grey.) Sample no. 5 (MRL 21950 B, C5).

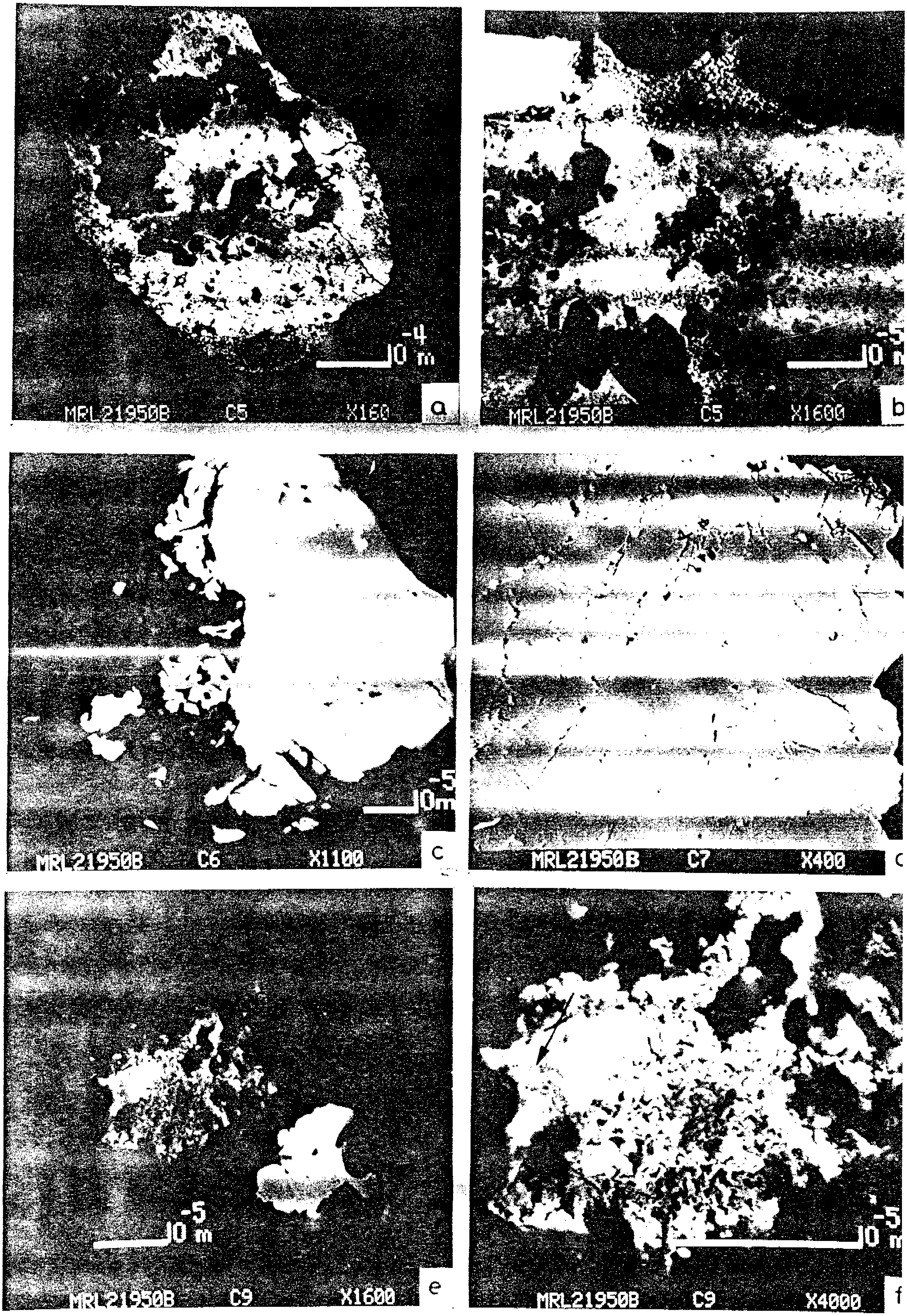
b. Detail as above showing galena (white, top left hand corner), together with a fine intergrowth of uraninite and pyrite, where SEM has detected Fe, U, S and a trace Ni. Pyrite (dark grey) occurs along the top margin and rutile crystals (black) occur towards the bottom margin. Varying contents of Fe, U, S and Ni are present in the iron sulphides, from white (with most uranium) through medium grey (medium uranium) to darker grey (least uranium.)

c. Intergrowth of clausthalite (white) and a nickel cobalt selenide phase (grey). Sample No. 5. (MRL 21950B, C6).

d. Pyrite/marcasite intergrowth (shades of grey) with minute inclusions of uranium silicate phase (coffinite?; white) along the crystal boundaries. Sample no. 5. (MRL 21950B, C7).

e. Gold containing trace to minor silver (white) intergrown with a porous platinum palladium (iron?) phase (beneath and to right of the small gold grain), enclosed in earthy hematite. Sample no. 5. (MRL 21950B, C9).

f. Detail as above showing small silver bearing gold grain (white) embedded in a porous platinum palladium (iron?) phase. The arrow indicates a platinum palladium phase which contains less platinum. The presence of iron may be due to interference from surrounding hematite.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-5
10 m
MRL21950B C5 X1600 b
-5
10m
MRL21950B C6 X1100 c
MRL21950B C7 X400
-5
10 m
MRL21950B C9 X1600 e
-5
10 m
MRL21950B C9 X4000 f

PLATE 6

SEM BSE Photomicrographs of Sink Fractions from Heavy Liquid Separation. (S.G. of liquid = 4.05.)

a. Pure gold (white) intergrown with stibiopalladinite (dark grey) and clausthalite (light grey). Note the very fine microintergrowth of gold/stibiopalladinite. Sample no. 6 (MRL 21951 B, C2).

b. Detail as above showing pure gold (g), clausthalite (c), stibiopalladinite (s) and a very fine intergrowth of gold/stibiopalladinite (gs).

c. Composite precious metal/rutile grain where rutile occurs at the bottom of the grain (black, not visible.) Gold (trace silver, white) is intergrown with clausthalite (light grey) and stibiopalladinite (darker grey.) Sample no. 6 (MRL 21951 B, C4).

d. Pure gold (white) with minute inclusions of clausthalite (grey, at arrow.) Sample no. 6 (MRL 21951 B, C5.)

e. Gold (trace to minor silver; white) rimmed with stibiopalladinite (dark grey) and clausthalite (light grey). Note the fine intergrowth of gold and stibiopalladinite. Sample no. 6 (MRL 21951 B, C6).

f. Detail as above showing gold with trace to minor silver (g), clausthalite (c); stibiopalladinite (s) and a very fine intergrowth of gold/stibiopalladinite (g s).

6

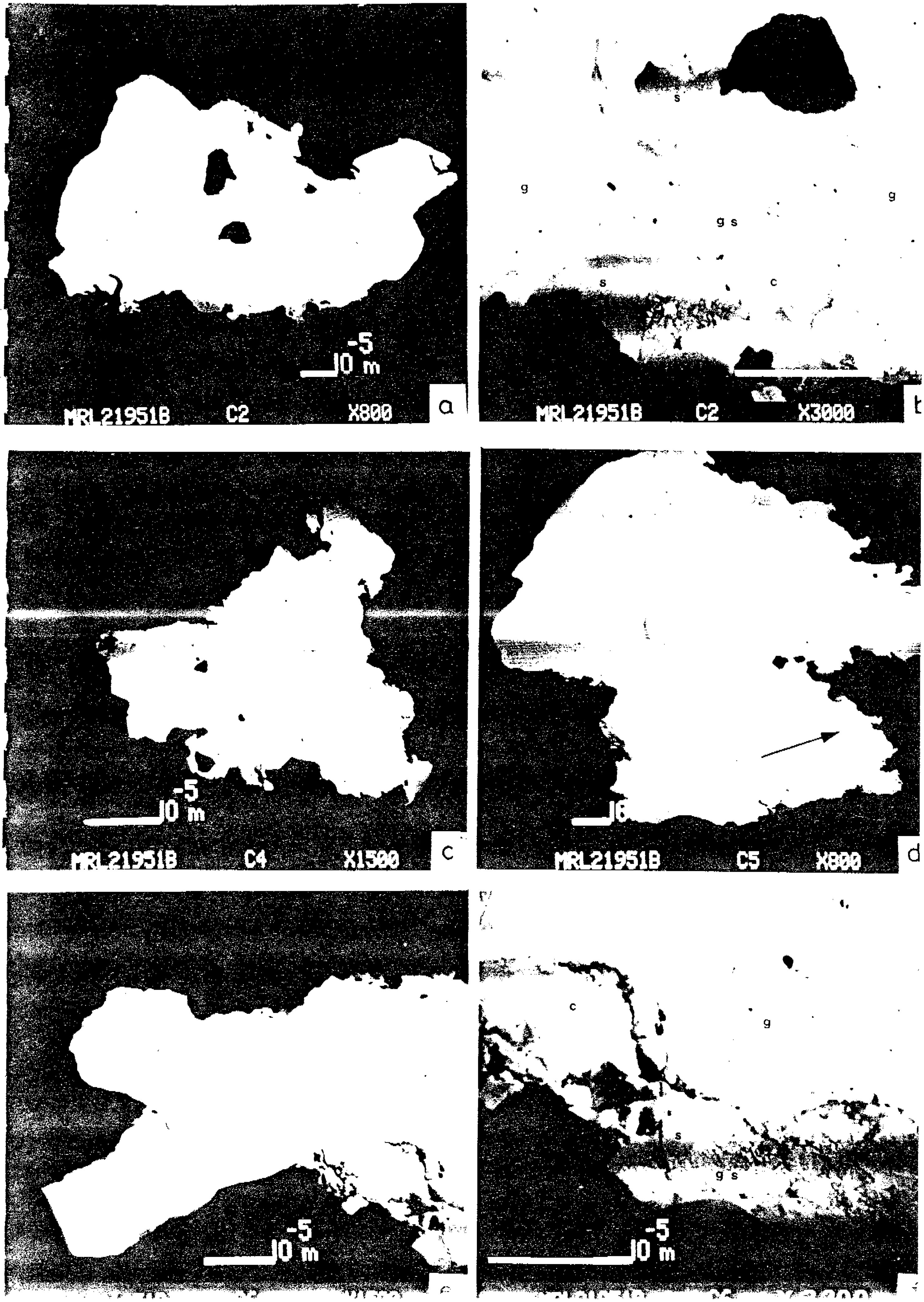


PLATE 7

SEM BSE Photomicrographs of Sink Fractions from Heavy Liquid Separation. (S.G. of liquid = 4.05).

a. Gold (trace silver; white), intergrown with clausthalite (light grey), stibiopalladinite (medium grey) and another palladium antimony phase (dark grey outer rim.). The black square-shaped mineral is florencite, where Ce, La, Ca, Al and P were detected by SEM. Sample no. 6 (MRL 21951 B, C7.)

b. Detail as above showing gold with a trace of silver (white), clausthalite (light grey) and the two palladium antimony phases (medium to dark grey.) The florencite crystal is embedded in the clausthalite. Note the fine inclusions of gold within the palladium antimonide. The curved white zone is an artefact of melted resin.

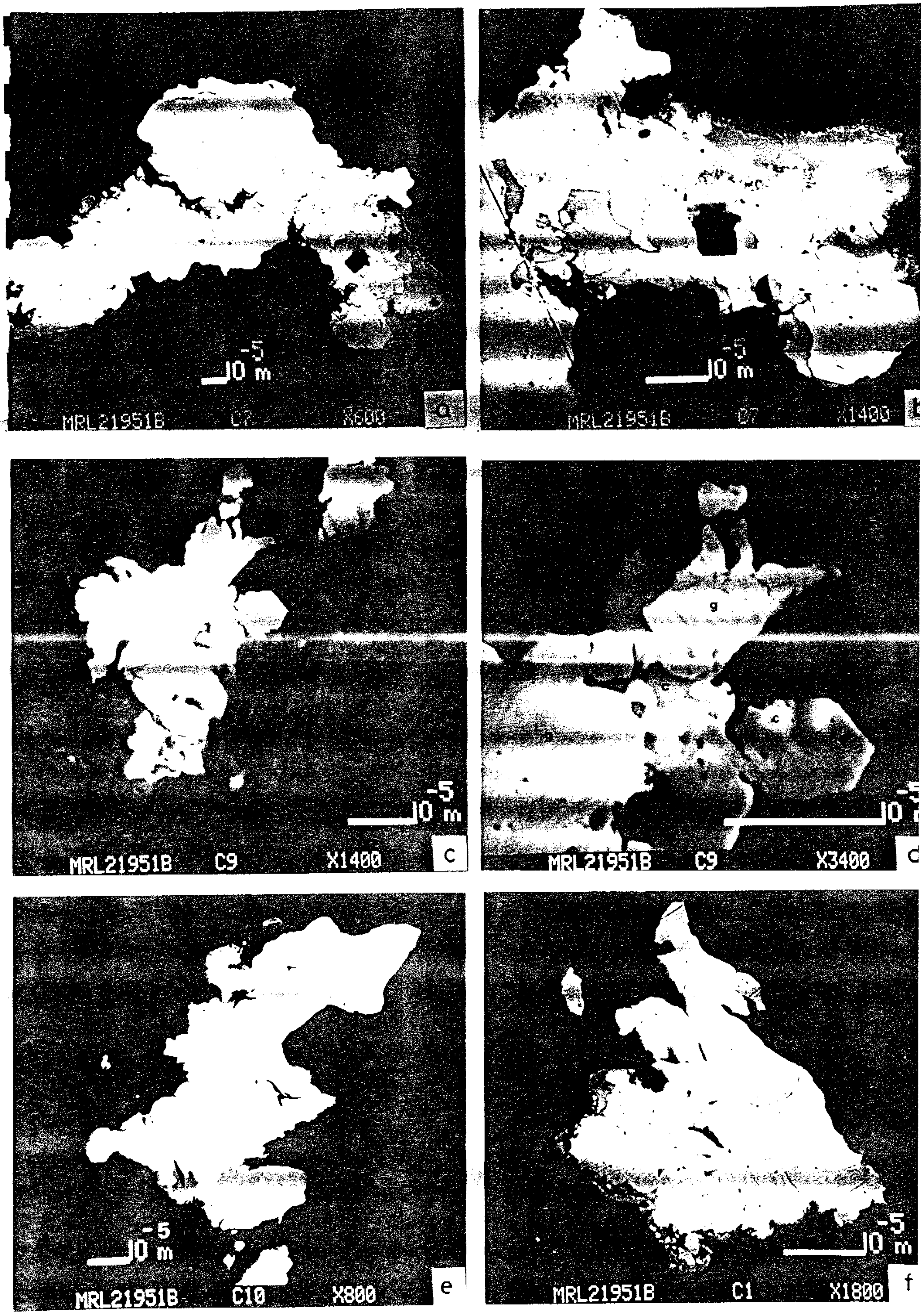
c. Precious metal intergrowth enclosed in hematite (black.) The intergrowth comprises gold (trace silver; white), clausthalite (light grey) and stibiopalladinite (darker grey.). Minute stibiopalladinite inclusions also occur in the gold. The matrix comprises hematite, quartz and mica where SEM has detected major Fe, minor Mg, Al, Si and traces of Cr, K in the hematite, indicating possible replacement of chlorite and ?fuchsitic mica by hematite. Sample no. 6 (MRL 21951 B, C9.)

d. Detail as above showing intergrowth of silver-bearing gold (g), clausthalite (c) and stibiopalladinite (s).

e. Gold (trace silver; white) intergrown with clausthalite (light-grey) and stibiopalladinite (dark grey). The matrix comprises quartz, hematite and micas. Sample no. 6 (MRL 21951 B, C10).

f. Gold (trace to minor silver; white) associated with stibiopalladinite (dark grey) and clausthalite (light grey). The matrix comprises iron stained sericitic mica. Sample no. 6 (MRL 21951 B, C1.)

7


-5
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10 m
MRL21951B C7 X1400 b
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10 m
MRL21951B C9 X1400 c
g
-5
10 m
MRL21951B C9 X3400 d
-5
10 m
MRL21951B C10 X800 e
-5
10 m
MRL21951B C1 X1800 f

PLATE 8

Diamond drill core from DDH5, 107.08-107.13 metres (MRL 21957E).

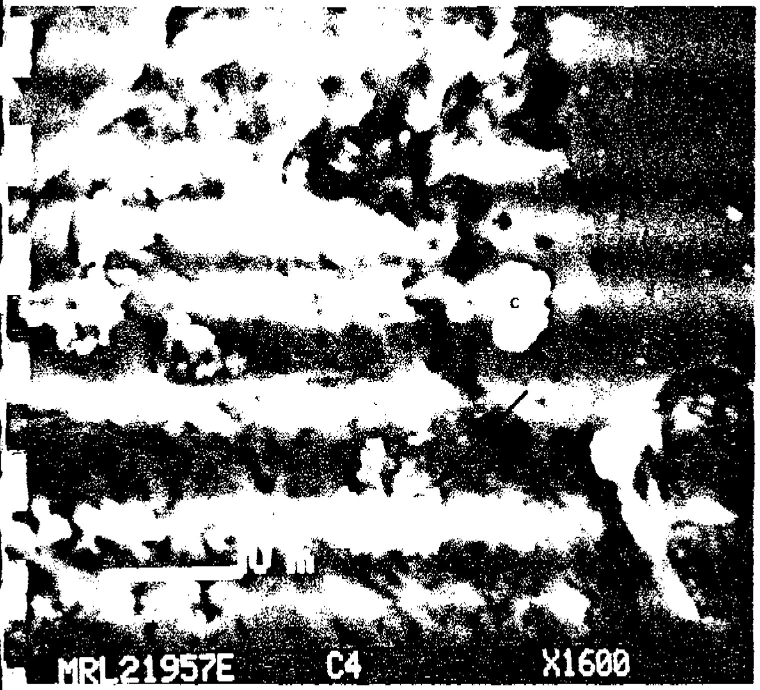
(a) Porous platinum (palladium) selenide phase (at arrow) enclosed in silicate matrix. Note the scattered larger bright white grains of clausthalite (c).

(b) Porous platinum (palladium) selenide phase (at arrow) together with associated clausthalite (c) and stibiopalladinite (sp), enclosed in the silicate matrix (black), where SEM has detected Ca, Mg, Al, Si, Fe together with traces of Ni, S.

(c) Intergrowth of sudburyite (PdSb) marked as "sd" and stibiopalladinite (Pd_5Sb_2) marked as "sp" enclosed in the silicate matrix (black).

(d) Detail of fine grained porous platinum (palladium) selenide phase (white) enclosed in the silicate matrix (black). Many of the individual platinum selenide grains are less than 1 micron in size.

8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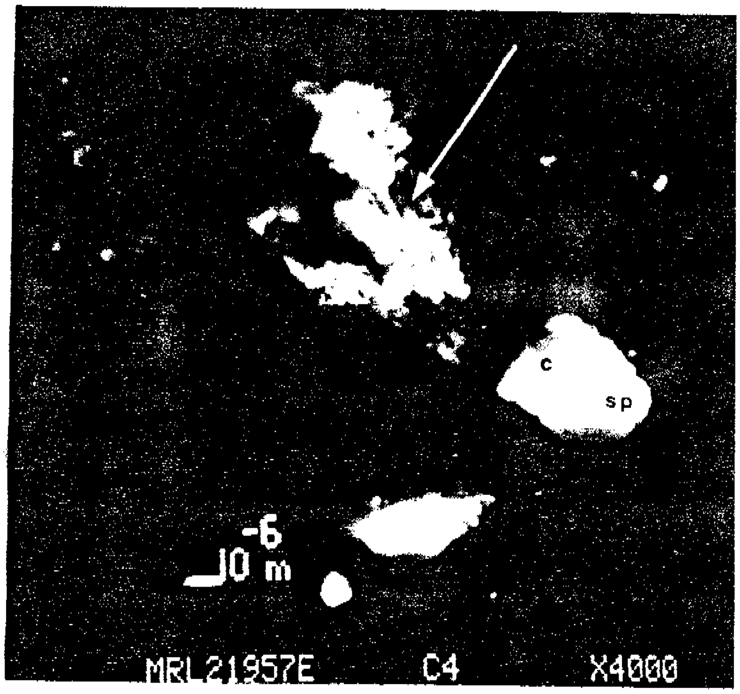
MRL21957E
C4
X1600

a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sp
10^{-6} m
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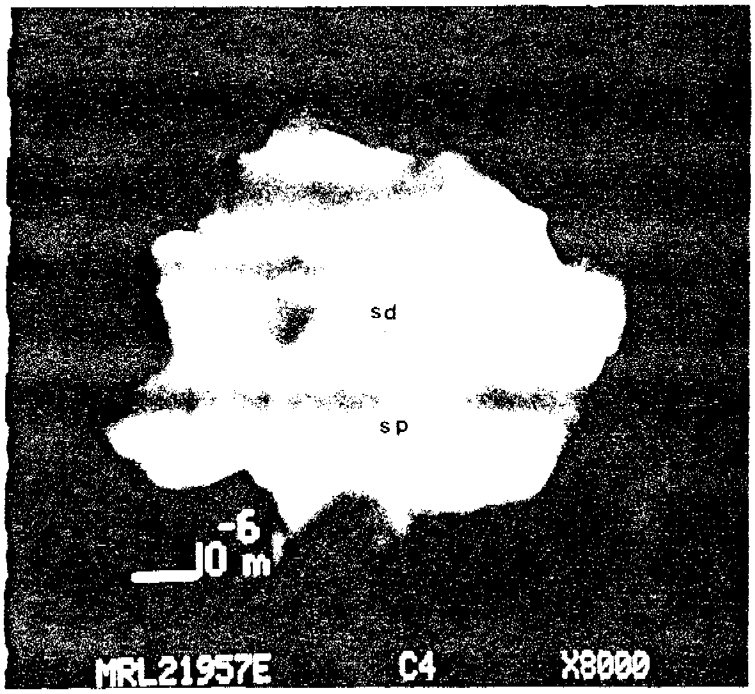
C4
X4000

b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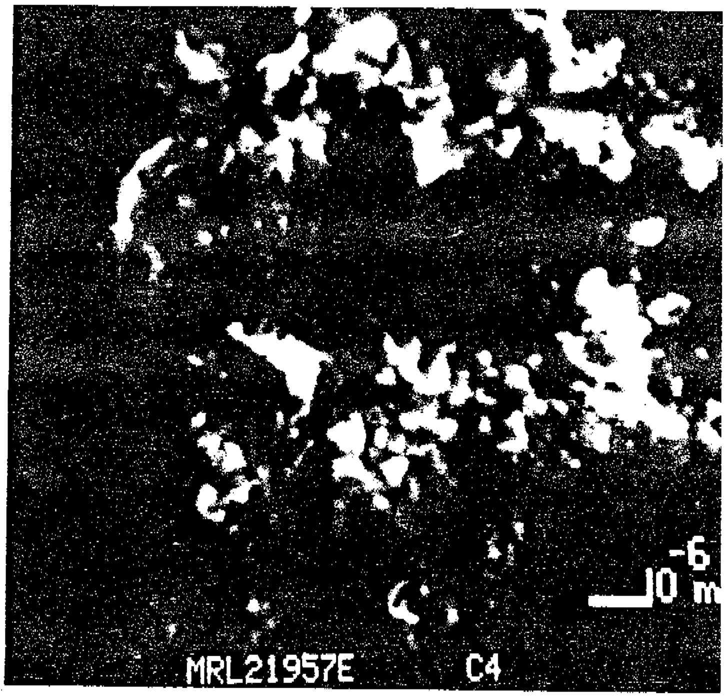
c


10^{-6} m
MRL21957E
C4

d

PLATE 9

Diamond drill core from DDH5, 107.08-107.13 metres (MRL 21957E).

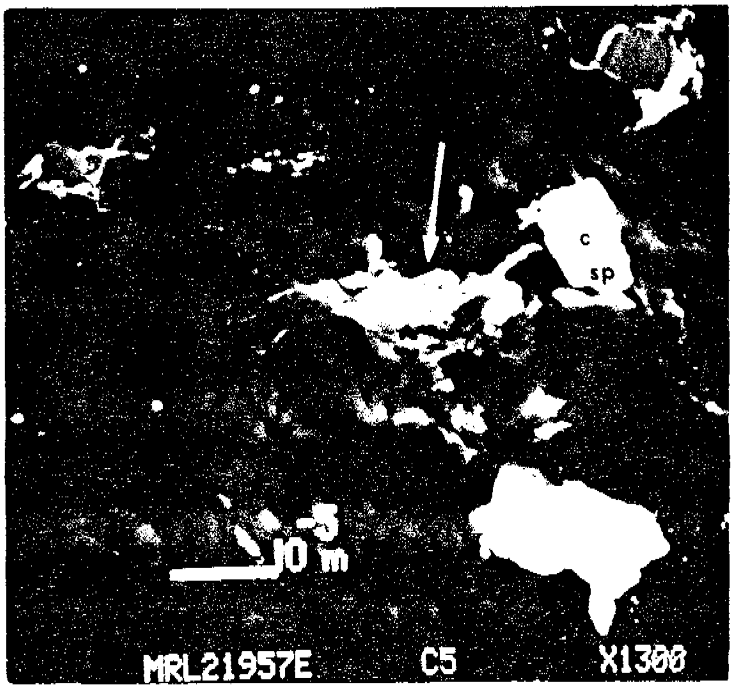
(a) Platinum selenide phase (white at arrow) surrounding florencite (dark grey), embedded in the silicate matrix. SEM has detected quartz (major Si) and chlorite (major Mg, Al, Si, minor Fe) in the silicate matrix. Scattered intergrowths of clausthalite (c)/stibiopalladinite (sp) and larger composites of clausthalite/stibiopalladinite/gold are also evident (lower right). In the top right hand corner, florencite (dark grey) is surrounded by a thin zone of platinum selenide, then by clausthalite. Another similar grain occurs in the top left hand corner.

(b) Detail of grain as above, showing florencite (f), surrounded by a thin zone of platinum selenide (see arrows), then surrounded by clausthalite (c). The composite intergrowth is enclosed in the silicate matrix, where SEM has detected Mg, Al, Si together with minor K, Fe (mixture of chlorite and sericite).

(c) Detail as above showing florencite (f), clausthalite (c) and a zone of platinum selenide (at arrows) which is about 0.5 µm thick.

(d) Florencite (light grey), surrounded by platinum selenide (white at arrow), enclosed in the silicate matrix.

9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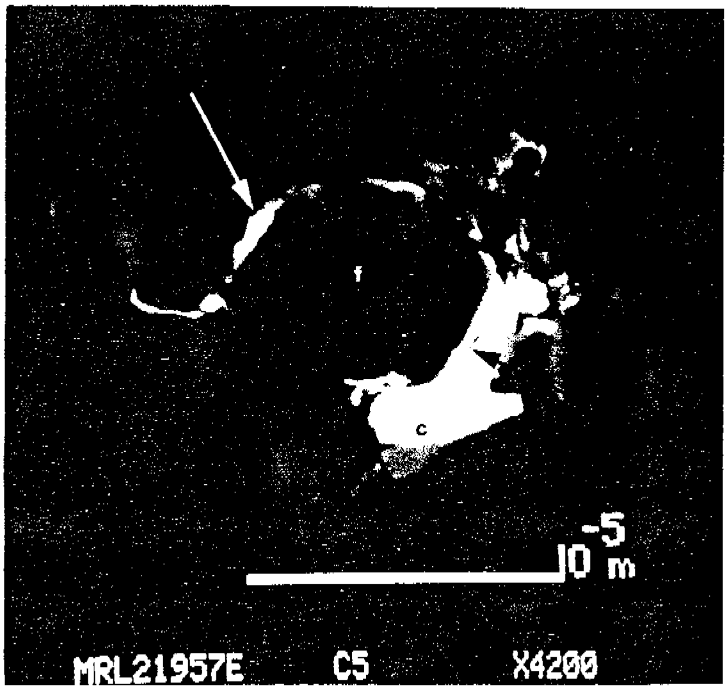
MRL21957E C5 X1300

a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c
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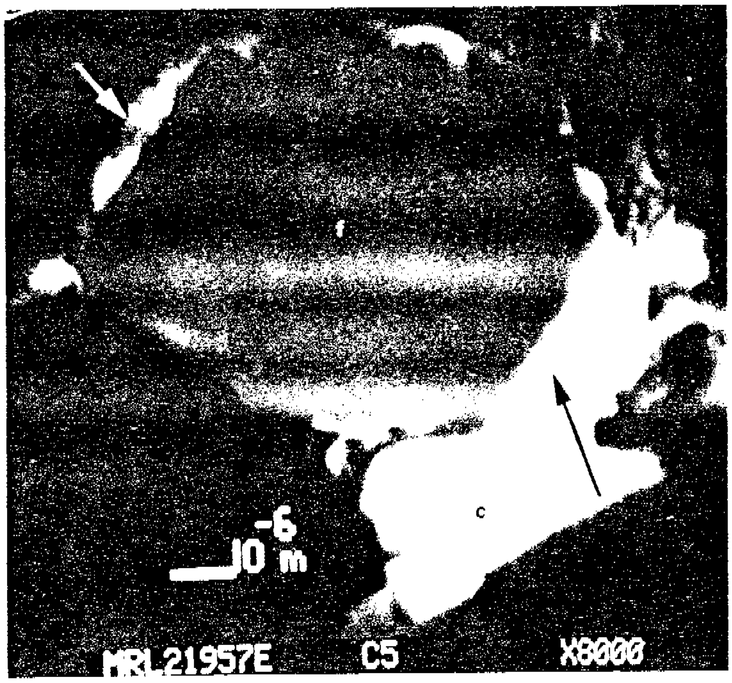
b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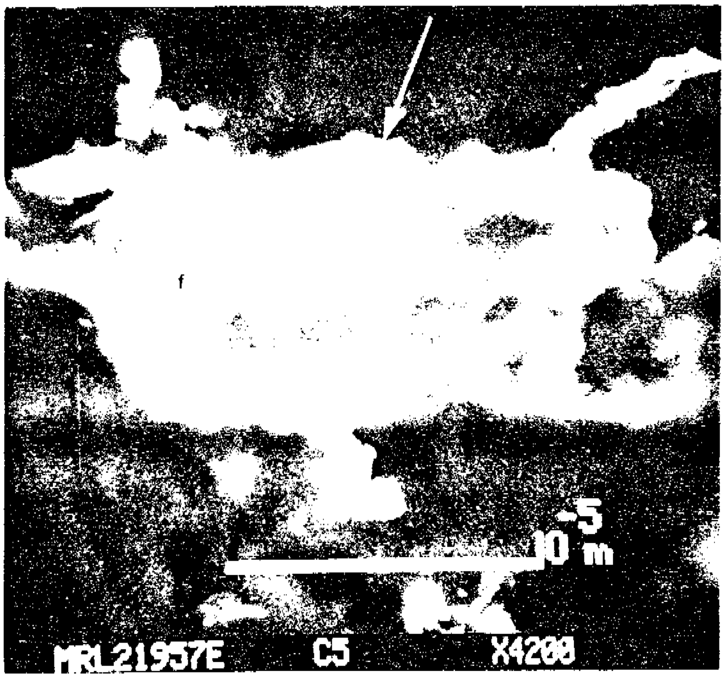
MRL21957E C5 X8000

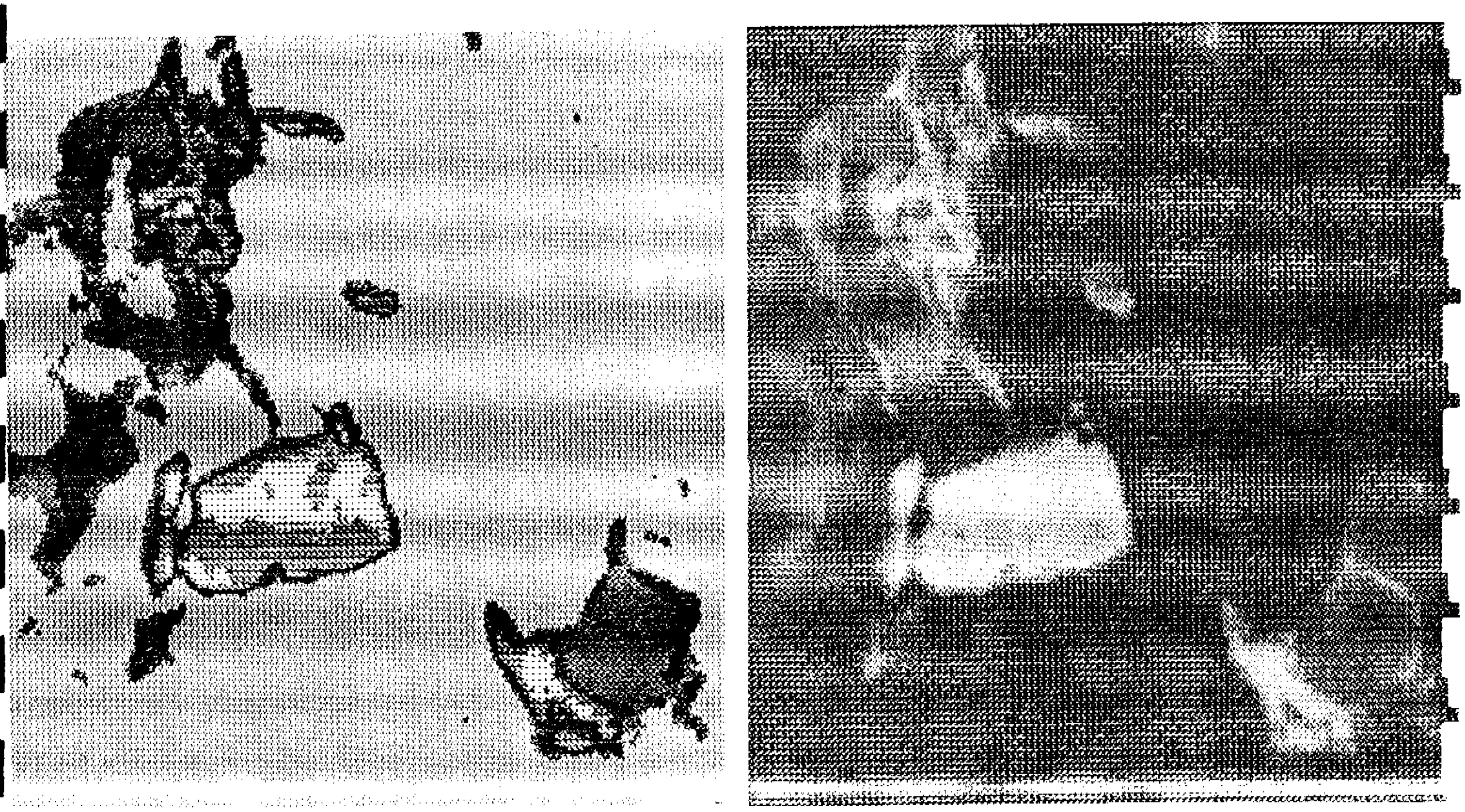
c


f
-5
10 m
MRL21957E C5 X4200

d

PLATINUM SELENIDE OCCURRENCE AT CORONATION HILL, N.T.
DDH5, 107·08 - 107·13 metres. (MRL 21957E)

BSE photographs showing the association of a platinum selenide mineral (red), with florencite (green), clausthalite (blue) and stibiopalladinite (orange). The matrix is chlorite and quartz (grey)



X - ray maps showing distribution of the elements