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MINERAL RESOURCES AND PROSPECTIVENESS OF THE PROPOSED WORLD HERITAGE LISTING OF WET TROPICAL RAINFORESTS AREA

BY

Y. MIEZITIS & I.S. McNAUGHT

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INTRODUCTION

The proposed World Heritage Listing Area (proposed WHL) of 9,300km^2 is contained within a 40km wide strip along the north Queensland coast from Townsville to Cooktown (Fig 1).

The Commonwealth Government's intention to proceed towards nomination for listing was announced on 5 June 1987 and maps showing an approximate boundary incorporating an area of 12 000km^2 were made available and used by the community as a de facto World Heritage Listing Area. This boundary was the one used by the Australian Heritage Commission to illustrate its proposals for listing the region on the Register of the National Estate. Subsequently on 20 August 1987, the Department of the Arts, Sport, the Environment, Tourism, and Territories released maps showing the boundaries of the proposed World Heritage Listing Area of 9,300km^2, and sought public comment by 22 October.

This submission briefly describes the past and present known mineral resources of the proposed WHL and provides a broad assessment of the mineral prospectiveness of the area which is illustrated on Figures 3, 4 and 5 and summarised in Figure 1.

A glossary of selected technical terms is appended to this report.

GEOLOGICAL AND MINERAL RESOURCE INFORMATION FOR NE QUEENSLAND

In preparing this assessment, The Bureau of Mineral Resources (BMR) has used both published and commercially obtainable information. The most recent published regional geological maps covering the proposed WHL are at 1:500 000 scale and are accompanied by publications giving a comprehensive description of the geology and an account of the known mineral deposits. The northern part of the proposed WHL is described by de Keyser and Lucas (1968) and the southern part by Levingston (1981). Another publication describes the Herberton tinfield, to the west of the proposed WHL (Blake, 1972). These publications condense the information in 1:250 000 scale regional maps and their associated explanatory notes published by BMR over the period 1963-1968.

These maps resulted from joint BMR/Geological Survey of Queensland mapping. The Geological Survey of Queensland has published, since 1980, 1:100 000 scale geological maps and notes of the Cairns and Townsville environs.

Additional regional and local information was provided by papers published by BMR, Geological Survey of Queensland, academia and industry reporting on both completed and ongoing work. To supplement its knowledge of known mineral occurrences in North Queensland, BMR purchased a data package containing limited details of mineral deposits and occurrences extracted from published literature and exploration reports on open file at the Geological Survey of Queensland.

Other organisations hold data which, because of confidentiality or time restraints, were not drawn upon for this submission. Some of these data sources are: mineral exploration companies, which have accumulated confidential detailed geological information for parts of the proposed WHL; the Queensland Department of Mines, which holds company reports on relinquished exploration areas on open file and company reports on other exploration areas on confidential files; and the Queensland Geological Survey which is currently remapping, inter alia, the central part of what is now the proposed WHL; the full details of their most recent work were not available for this submission.

ADDITIONAL WORK FOR A MORE DETAILED ASSESSMENT OF THE MINERAL RESOURCES AND PROSPECTIVENESS OF THE PROPOSED WHL

A detailed assessment of the prospectiveness of the proposed WHL would require study of all existing reports on the region to obtain a more detailed knowledge of its geology and the distribution and characteristics of known mineral occurrences and deposits in the region. The main source of relevant information would be company reports on relinquished exploration areas, held by the Queensland Department of Mines. Such a study would take about six person-months.

The assessment could be refined further by conducting field investigations to rectify significant gaps in knowledge revealed by the literature studies. This would enable prospective zones to be delineated with more confidence. The time required for such work would depend on the information sought and the required degree of confidence; it is likely to be several years.

Further exploration conducted by companies within and outside the proposed WHL would improve the quality of future assessments of the prospectiveness of the proposed WHL.

GEOLOGICAL FRAMEWORK

The presence of thick alluvium along coastal rivers and plains, and dense tropical rainforests along the escarpment and throughout much of the region, has severely restricted the development of a detailed knowledge of the region's geology. Existing geological knowledge is based principally on broad-scale 1:250 000 mapping by BMR and the Geological Survey of Queensland in the 1960s and early 1970s. The Geological Survey of Queensland is remapping a region which includes the northern half of the proposed WHL, but little of this information is published.

The proposed WHL comprises two broad geological regions: the Hodgkinson Basin in the north and the Broken River Embayment and Lolworth-Ravenswood Block to the south; the Palmerville Fault running from Ingham, up the Herbert River, and northwest towards Mt Garnet divides the two regions.

The rocks in the Hodgkinson Basin in the proposed WHL area are dominantly the Hodgkinson Formation (a folded sequence of deepwater mudstone, siltstone, quartz-feldspar greywacke, minor spilitic pillowed basalt, conglomerate, limestone and chert, deposited in Silurian and Devonian times). East of Mareeba, the Hodgkinson Formation passes into a geological unit (the Barron River Metamorphics) where the same rock types have been slightly metamorphosed. On the coast, more highly metamorphosed rocks comprise the Barnard Metamorphics and the Babalangee Amphibolite. In Carboniferous and Permian times, granite bodies intruded these sediments and their metamorphic equivalents. In the Tertiary, particularly south of Atherton, extensive sheets of basalt were outpoured.

In the Broken River Embayment and the Lolworth-Ravenswood Block, south of the Palmerville Fault within the proposed WHL, the geology is dominated by felsic Carboniferous and Permian granites and related volcanic rocks. Limited exposures of much older, Precambrian, metamorphosed sediments occur in the Kangaroo Hills area. Faulting is more common south of the Palmerville fault in the proposed WHL.

The proposed WHL was subject to prolonged weathering, erosion and peneplanation after the Permian, enabling the development of widespread alluvial deposits which contain particularly cassiterite and gold. Sediments formed during this time were partly covered by Tertiary basalt flows prior to a broad regional uplift and tilting towards the west which rejuvenated and altered drainage patterns; these effects have persisted to the present day.

THE MAIN MINERALISING EVENTS IN NE QUEENSLAND

The geological events which led to the formation of mineral deposits in NE Queensland can be summarised as follows:

1. Stratiform exhalative sulphide deposits containing copper, lead, zinc, silver and gold are related to mafic volcanic activity in the Silurian and Devonian (435-345 million years ago) eg Mt Molloy. This volcanic activity occurred during the deposition of the Hodgkinson Formation. Mafic volcanics are known to occur in the proposed WHL but their areal extent is poorly known.

2. About 350 million years ago the sediments and volcanics of the Hodgkinson Formation south of Cairns were deformed and metamorphosed to form the Barron River Metamorphics. Some elements in the sediments, such as gold and antimony, were remobilized and then deposited in rock fissures and fracture zones to form gold-bearing quartz veins possibly such as those in the Mt Peter goldfield.

3. The most important event for mineral resource accumulation in the proposed WHL occurred during late Carboniferous and Permian times (about 330 to 230 million years ago) when the sediments and lavas of the northeast Queensland region were intruded by granitic rocks. Periods of intense tin mineralisation at this time led to the formation of the NE Queensland tinfields. The granites were accompanied by felsic volcanic activity. eg the Featherbed Volcanics which contain minor gold, tin, tungsten and base metal mineralisation. A similar volcanic unit, the Glen Gordon Volcanics and other felsic volcanics occur in the southern part of the proposed WHL.

The mineral deposits were formed near the margins of granite bodies, in both the granite and the surrounding rocks, and in the upper parts (or roof-zones) of the granites. Tin-tungsten and base metal deposits occur as veins, segregations and disseminations in the younger parts of granite bodies or their surrounding sediments. The deposits range from small but rich shoots, veins and pipes which characterised the Herberton and Kangaroo Hills tinfields to the larger disseminations and segregations within greisen, and vein swarms, pipes and irregular bunches within the Cooktown-Annan River tinfields. Much of the alluvial production from the Cooktown-Annan River tinfield has been by sluicing deeply weathered veins and broad, greisen zones.
Disseminated low grade copper and molybdenum mineralisation is also known to occur in granites, as at the Eureka, Carbonate Creek and the Yamanie deposits. Copper, lead and silver occurrences related to granites are also known in the Kangaroo Hills mineral field and molybdenum and bismuth is often associated with tungsten in this field. Gold mineralisation is also evident in the granites and in the Featherbed Volcanics west of the proposed WHL.

4. Erosion after the Permian (from about 230 million years ago) has lowered the ground surface to the mineralised roof-zones of granite bodies and their adjoining vein systems and weathering has disintegrated the various deposits which have been exposed. The gold, tin, and tungsten minerals, being more resistant to weathering than the host rock, often remained in the original location as eluvial mineral deposits or were transported by streams and concentrated in alluvial mineral deposits. The Tertiary basalt flows (which began about 5 million years ago), covered some of the alluvial mineral deposits, forming deep leads. Erosion has continued, forming further shallow alluvial deposits. The lava flows and regional tilting changed the drainage patterns, so that present streams do not necessarily coincide with those of earlier times. The former valleys (and their alluvial deposits) are difficult to delineate, because they are deeply buried by sediments and basalt flows.

MINERAL PRODUCTION AND RESOURCES

The principal form of mineral production has been tin mining (Table 1). The proposed WHL contains virtually all of the Cooktown and Annan River tinfields (total field production approximately 14 000t cassiterite concentrate, ie about 10 000t of tin), the eastern margin of the Herberton tinfield (total field production approximately 140 000t cassiterite concentrate, ie 100 000t of contained tin) and part of the Kangaroo Hills tinfield (total field production approximately 8000t cassiterite concentrate, ie 5500t tin). The Herberton, Kangaroo Hills and Cooktown tinfields also produced tungsten concentrates. The tin has been won mainly by alluvial mining, and the tungsten by hardrock mining. The deposits in these mineral fields are spatially related to granite intrusions.

Gold has been produced mostly from alluvial deposits in the proposed WHL, from the Russell River, Jordan Creek, Mt Peter, Mulgrave River and Bartle Frere Goldfields, in a belt south of Gordonvale. Gold and tin have been won elsewhere within the proposed WHL from both alluvial and hardrock sources.

Production of copper, lead, zinc and silver has occurred in its own right and as by-products from hardrock tin mining, mainly in the Herberton and Kangaroo Hills tinfields and copper with by-product gold and silver has been produced on its own account from the Mt Molloy copper mine north of Mareeba.

Other metals such as antimony, bismuth, molybdenum and silver have been produced in minor amounts, commonly as by-products, from various parts of the proposed WHL.

The following important mineral deposits and mines occur within or adjacent to the proposed WHL:

- China Camp alluvial tin deposit (within)
- Collingwood tin deposit (possibly partly within)
- Mt Carbine tungsten mine (adjacent)
- Ben Lomond uranium-molybdenum deposit (adjacent)
- Watershed Grid tungsten deposit (adjacent).

Within the proposed WHL at least 170 mineral deposits and occurrences have been identified. Most of these deposits have been only minor producers.

EXPLORATION AND MINING TENEMENT COVERAGE

Exploration and mining tenement coverage since June 1982 within the proposed WHL is illustrated in Figure 2 and demonstrates the extent of interest by exploration companies in the area. Companies have been prepared to spend exploration funds despite the difficulties of exploring in this area.

Within the proposed WHL, the Queensland Mines Department has recognised 21 current groupings of mining lease tenure, including lease applications around the Collingwood tin deposit. These areas of interest are broadly illustrated on Figures 6, 7 and 8.

Exploration techniques exist and are continually being improved which would minimise the impact of exploration in an environmentally sensitive area such as the proposed WHL. The mineral deposits that might be discovered in the proposed WHL include a variety of types and sizes, and a range of methods might be used to mine such deposits. Any mining operation would be required to meet the environmental conditions which would be imposed by the relevant authorities after a detailed examination of the proposal.

THE PROSPECTIVENESS FOR UNDISCOVERED MINERAL RESOURCES IN THE PROPOSED WHL

THE DEFINITION AND CONCEPTS OF 'PROSPECTIVENESS'

For the purposes of this submission, an area is considered to be prospective for mineral resources if existing geological evidence suggests that mineral exploration may discover an economic mineral deposit. The terms high, moderate and low prospectiveness are qualitative assessments based on professional judgement.

An area is considered to have a **high prospectiveness** for a specified mineral commodity if there is strong geological, geophysical or geochemical evidence that mineral concentration has taken place and that there is a strong possibility of finding an economically workable mineral deposit.

An area is considered to have a **moderate prospectiveness** if the available evidence indicates that there is a reasonable possibility of finding an economically workable mineral deposit.

An area is considered to have a **low prospectiveness** if there is a low possibility of finding an economically workable mineral deposit.

The distribution of prospective zones in a given region is **unknown** if there is not sufficient information to delineate the boundaries of areas of high, moderate or low prospectiveness, even though regional information indicates that the geological environment is favourable for the accumulation of certain types of mineral deposits.

The geological evidence for prospectiveness of some areas is simply a zone of known mineral occurrences and deposits exposed at the surface, as in the mineral fields of Cooktown, Herberton and Kangaroo Hills. Because most of the deposits in these fields were found by rudimentary prospecting methods, it is very probable that additional similar mineral deposits, not exposed at the surface, will be found in the future by using more advanced exploration techniques. Such areas may also contain large low-grade deposits which could be mined profitably using lower cost mining methods. These known mining districts are well documented in published reports and are also recorded on standard 1:250 000 scale regional geological maps issued 15 to 20 years ago.

The prospectiveness of the proposed WHL outside the established mining fields is described only in broad terms in this submission. BMR did not have sufficient detailed geological information to classify these areas into zones of high, moderate, or low prospectiveness for the evaluation of the proposed WHL.

The assessment of the prospectiveness of a region is often attempted by combining knowledge of its geology with current theories of geological factors governing the emplacement of mineral deposits. Opinions on the prospectiveness of a region will change as the geological knowledge improves and geological theories evolve. The areas of a region which are considered as most prospective therefore change in time with the introduction and abandonment of geological concepts, and better knowledge of where mineral deposits are found and how they are formed. Advances in exploration techniques and changes in commodity prices also influence the prospectiveness of an area. Consequently, with ongoing exploration, areas are repeatedly subjected to geological, geophysical and geochemical assessment by different exploration companies using evolving geological concepts and improved exploration techniques to determine where mineral deposition may have taken

place and to delineate and quantify that mineralisation with the aim of identifying an economic mineral deposit. Areas can be repeatedly explored for different types of mineral deposits for decades before an economic mineral deposit is discovered.

Areas in the proposed WHL considered as prospective are not confined to the known mining districts. This is illustrated in Figure 2 which show that most of the proposed WHL has been of interest to mineral exploration companies during the past five years.

DELINEATED AREAS OF PROSPECTIVENESS IN THE PROPOSED WHL

The areas which have been delineated as prospective generally occur in those parts of the proposed WHL which include the established mineral fields. These areas are discussed below, and are highlighted in Figures 3, 4 and 5 and illustrated in more detail in Figures 6, 7 and 8. BMR considers it probable that within those parts of the proposed WHL outside the prospective zones delineated in Figures 6, 7 and 8 there are other zones of moderate to high prospectiveness which cannot be delineated at the present time.

The Cooktown Mineral Field

The Cooktown mineral field has produced about 14 000 tonnes of tin concentrates. The largest known tin deposit in this field, with a possible resource of 20 000 tonnes of tin (White, 1987), is Collingwood, on the boundary of the proposed WHL. The proposed WHL within the Cooktown mineral field has a moderate to high prospectiveness for additional hardrock tin deposits. An area of moderate prospectiveness for alluvial and hardrock tin deposits extends southeast to the China Camp deposit.

The Mt Peter, Mulgrave River, Bartle Frere, Russell River and the Jordan Creek Goldfields

The combined recorded gold production of the five goldfields under this heading is estimated by BMR to be about 60,000 ounces. The gold was won from deep leads and recent alluvial deposits and gold-bearing quartz veins. All of these fields occur in a broad north-south belt between Gordonvale and the South Johnstone River west of Innisfail. This belt has a moderate prospectiveness for further discoveries of vein-type gold

deposits in the Barron River Metamorphics. Vein-type gold deposits may be present in or close to granite bodies and additional deep leads may be found under the Atherton Basalt.

The Kangaroo Hills Mineral Field

The Kangaroo Hills mineral field is reported to have produced about 8000 tonnes of tin concentrates from Recent alluvial deposits, from Tertiary deep leads, from the tin and tungsten-bearing quartz and greisen veins in granite, and from tin-bearing veins in the adjoining sedimentary rocks. Production of antimony, bismuth, molybdenum, copper, lead, zinc, gold and silver has also been reported. The proposed WHL includes the eastern portion of the Kangaroo Hills mineral field eastwards to the old Ollera tungsten-molybdenum-bismuth mines. This part of the mineral field has a moderate prospectiveness for further discoveries of fracture-controlled tin and tungsten deposits, and moderate prospectiveness for alluvial and deep lead tin.

Mt Carbine - Watershed Grid Area

The Mt Carbine tungsten mine occurs as sheeted quartz veins in metamorphosed sediments near a granite close to the western boundary of the proposed WHL. About 14 000 tonnes of tungsten concentrates have been produced from this deposit. Another tungsten deposit - the Watershed Grid deposit - is about 25km northwest of Mt Carbine and tungsten, tin and base metal occurrences are also known to occur in this area. Parts of the proposed WHL which border this area have a moderate prospectiveness for tungsten, tin and base metals.

Eastern Margin of the Herberton Tinfield

The Herberton tinfield has a wide variety of tin, tungsten, base metal and precious metal deposits. The eastern margin of this field within the proposed WHL has a moderate prospectiveness for tin.

THE PROSPECTIVENESS OF THE PROPOSED WHL OUTSIDE THE KNOWN MINERAL FIELDS

Due to the lack of detailed geological information and other factors discussed previously, it is not possible to differentiate the proposed WHL outside the mineral fields into detailed zones of high, moderate and low prospectiveness for as yet undiscovered mineral resources. Because of the difficult terrain and thick rainforest in the proposed WHL, past exploration may not have been as effective as that in the more open country to the west.

In broad terms, the regional geology of the immediate region to the west extends eastwards into the proposed WHL. The overall regional prospectiveness of the proposed WHL is therefore broadly similar to that of the more accessible and better explored region lying immediately to the west. The knowledge of the geology of the mineral deposits west of the proposed WHL can be used as a guide to the types of deposits likely to be present in the proposed WHL.

In general terms, the prospectiveness of the proposed WHL can be related to the regional geology and structure.

The main rock types in the proposed WHL between Cooktown and Cardwell are the sediments and the metamorphics of the Hodgkinson Formation and the Barron River Metamorphics which are intruded by the late Carboniferous and Permian granites. The areas occupied by the Hodgkinson Formation and the Barron River Metamorphics could contain:

- zones of moderate prospectiveness for stratiform sulphide deposits (copper, lead, zinc, silver and gold) such as Mt Molloy; and
- zones of moderate prospectiveness for vein-type gold and antimony deposits such as those of the Hodgkinson Goldfield, west of Mareeba.

The margins of granite bodies and partly preserved roof zones of granitic intrusions are the most likely places where highly prospective zones for tin, tungsten, bismuth, copper and molybdenum deposits may occur. The various deposit types include:

- Small fracture-controlled tin, tungsten, bismuth and molybdenum deposits as veins and pipes, either in the granites or in the adjacent sedimentary rocks.
- Large low grade greisen tin deposits such as the Collingwood deposit and the Sailor tin deposit.
- Large low grade stockwork replacement deposits in porphyry dykes such as the Baalgammon tin/base metal deposit.
- Sheeted tin or tungsten bearing quartz veins in sediments near granite, as at Cannibal Creek and Mt Carbine.
- Irregular quartz pipes in granite or along the contact of greisenised granite with sediments, which carry tungsten, molybdenum, and bismuth, as at Ollera and Wolfram Camp.

- Tungsten in calc-silicate skarn, as at Watershed Grid deposit, and Tinaroo.
- Carbonate replacement tin deposits.
- Low grade porphyry-type copper and molybdenum mineralisation disseminated and in fractures, veins and breccias, as at Eureka, Carbonate Creek, and Yamanie Creek deposits.

Between Ravenshoe and Townsville the proposed WHL is underlain mostly by granitoids and related felsic volcanic rocks. The area is characterised by numerous northwest trending fault systems, quartz veins, dykes and other linear features.

The margins of the granite bodies are again the places most likely to contain undiscovered mineral deposits. In addition to the types of deposit associated with granites listed above, these southern areas may contain deposit types which include:

- Large low grade gold deposits in acid volcanic breccia pipes, as at Kidston and Mt Leyshon
- Uranium and molybdenum in fractures and joints in acid volcanics as at Ben Lomond.

In addition to the various types of deposits listed above, the proposed WHL is prospective for alluvial and eluvial tin, gold and tungsten deposits and possibly for platinum group elements and gemstones.

The zones which are prospective for these various types of deposits can be delineated only by more detailed studies and ongoing mineral exploration.

CONCLUSIONS

1. The regional geological environment in the proposed WHL is recognised by BMR and the mining industry as prospective for several minerals, particularly tin, tungsten and gold.

2. Areas of moderate and moderate to high prospectiveness are known to be present within those parts of the proposed WHL which generally overlap established mineral fields. Undiscovered economic mineral deposits are probably present in some of these areas.

- The northern part of the proposed WHL includes parts of the Cooktown mineral field. This area has a moderate to high prospectiveness for hardrock (lode) tin and a moderate prospectiveness for alluvial tin. A moderate prospectiveness zone for both hardrock and alluvial tin extends southeast to China Camp (Fig 6).
- The proposed WHL includes a north-south trending belt of gold mineralisation in which are the Mt Peter, Mulgrave River, Bartle Frere, Russell River and Jordan Creek Goldfields. This area has a moderate prospectiveness for gold (Fig 7).
- The proposed WHL includes the eastern part of the Kangaroo Hills mineral field which has a moderate prospectiveness for tin, tungsten, and antimony (Fig 8).
- The part of the proposed WHL adjacent to the Mt Carbine - Watershed Grid area is moderately prospective for tungsten, tin and base metals (Fig 6).
- The eastern margin of the Herberton tinfield in the proposed WHL is moderately prospective for lode tin (Fig 7).

3. It is probable that areas of moderate to high prospectiveness, containing undiscovered economic mineral deposits, are present within those parts of the proposed WHL which are outside the established mineral fields. On current knowledge the mineral deposits most likely to be found are tin, tungsten and gold. More detailed studies and additional exploration would be needed to delineate these areas.

4. It seems possible that at least part of one known important mineral deposit (Collingwood) lies within the proposed boundaries of the proposed WHL.

5. It is probable that within the proposed WHL there are significant undiscovered mineral deposits within and outside the known mineral fields.

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TABLE 1

MINERAL PRODUCTION AND RESOURCES WITHIN AND IN THE VICINITY OF PROPOSED WORLD HERITAGE LISTING

Property/Field	Past Production	Published Resources	Reference
Collingwood	?	4Mt @ 0.7%Sn includes 2MT @ 1.0%Sn	White, 1987
Mt Carbine	13 650t WO_3 conc	9Mt @ 0.1%WO_3	Murray 1986, BMR estimate
Mt Molloy	over 3 870t Cu	?	Murray 1986
Baal Gammon	?	11.5Mt @ 0.25%Sn	Murray 1986
China Camp	?	0.57Mm^3 @ 1.2kg/m^3 cass	Southern Venturers 1983
Watershed Grid	Nil	14Mt @ 0.3%WO_3	White 1987
Ben Lomond		1.93Mt @ 0.209%U + 0.159%Mo	Minatome 1983
Cooktown-Annan R Tin Field	14 000t cass		Murray 1986
Herberton Tin Field (incl Mt Garnet, Irvinebank)	140 000t cass 3 950t WO_3 8 165t Cu 11 830t Pb 101 330kg Ag		
Kangaroo Hills Tin Field	8 000t cass 420t WO_3 conc		Levingston 1981
Ollera	240t WO_3 conc		Murray 1986
Russell River Goldfields	26 780oz Au		de Keyser and Lucas, 1968
Jordan Creek Goldfields	12 650oz Au		
Mt Peter Goldfields	11 000oz Au		
Mulgrave River Goldfields	5 580oz Au		
Bartle Frere Goldfields	520oz Au		

GLOSSARY OF SELECTED TECHNICAL TERMS

Alluvium - a relatively young deposit of gravel, sand, silt and mud formed by flowing water in river beds, flood plains, lakes or at the foot of mountain slopes.

Alluvial mineral deposit - deposit formed by concentration of valuable minerals, commonly gold or tin, by action of running water as in a stream channel or alluvial fan.

Deep lead - alluvial mineral deposit buried below a considerable thickness of later sediments or lava.

Eluvial mineral deposit - deposits resulting from decomposition of rock in place without much movement of the fragments. The material may have slumped or washed downslope a short distance but has not been transported by streams.

Greisen - an altered granitic rock sometimes containing tin and other valuable minerals.

Hardrock deposit - a term used to indicate material which cannot be excavated without blasting as opposed to soft sand clay and gravel.

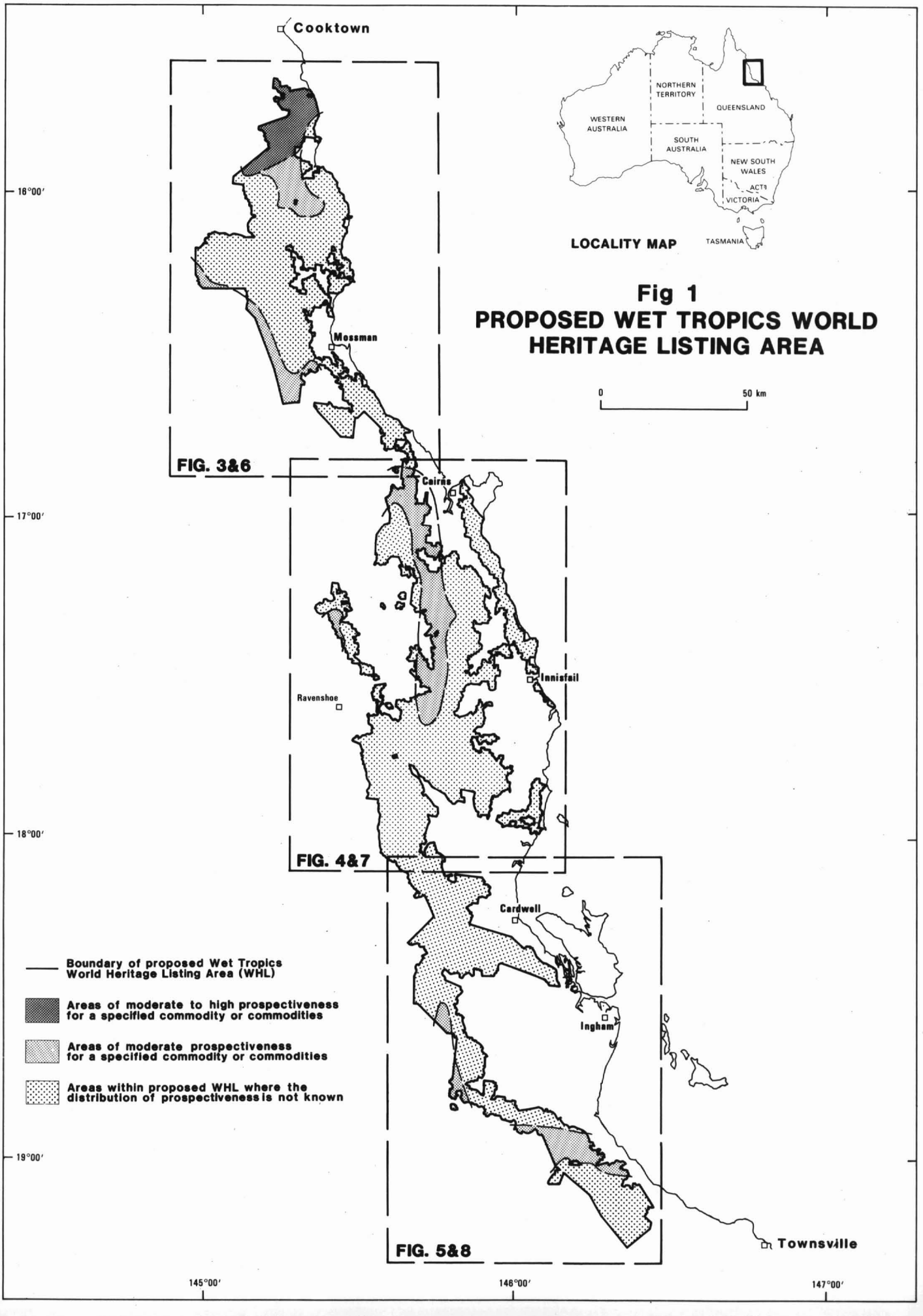
Lode deposit - valuable mineral or minerals contained in a fissure in country rock, with or without quartz.

Mineral deposit - naturally occurring material containing a mineable accumulation of one or more valuable minerals. If any of these minerals can be extracted at a profit, the deposit is considered to be economic.

Mineral field - an area or a region where many workable mineral deposits are found. If one type of mineral is dominant in a field, it can be used as a prefix eg tinfield, goldfield.

Mineral occurrence - The presence of valuable minerals at a locality. A mineral occurrence may comprise only traces or a small volume of a valuable mineral which will never be economic to mine; or its full size may not be known in which case it is sometimes called a 'prospect'. Even a small mineral occurrence is significant as it indicates that deposition of valuable minerals has occurred and therefore undiscovered economic mineral deposits may be present in the area.

Prospectiveness - an area is considered to be prospective for mineral resources if geological evidence suggests that mineral exploration may discover an economic mineral deposit.


Cooktown
Mossman
Cairns
Innisfail
Ravenshoe
Cardwell
Ingham
Townsville
FIG. 3&6
FIG. 4&7
FIG. 5&8
18°00′
17°00′
18°00′
19°00′
145°00′
146°00′
147°00′
NORTHERN TERRITORY
QUEENSLAND
WESTERN AUSTRALIA
SOUTH AUSTRALIA
NEW SOUTH WALES
ACT
VICTORIA
TASMANIA
LOCALITY MAP
Fig 1
PROPOSED WET TROPICS WORLD HERITAGE LISTING AREA
0
50 km
Boundary of proposed Wet Tropics World Heritage Listing Area (WHL)
Areas of moderate to high prospectiveness for a specified commodity or commodities
Areas of moderate prospectiveness for a specified commodity or commodities
Areas within proposed WHL where the distribution of prospectiveness is not known

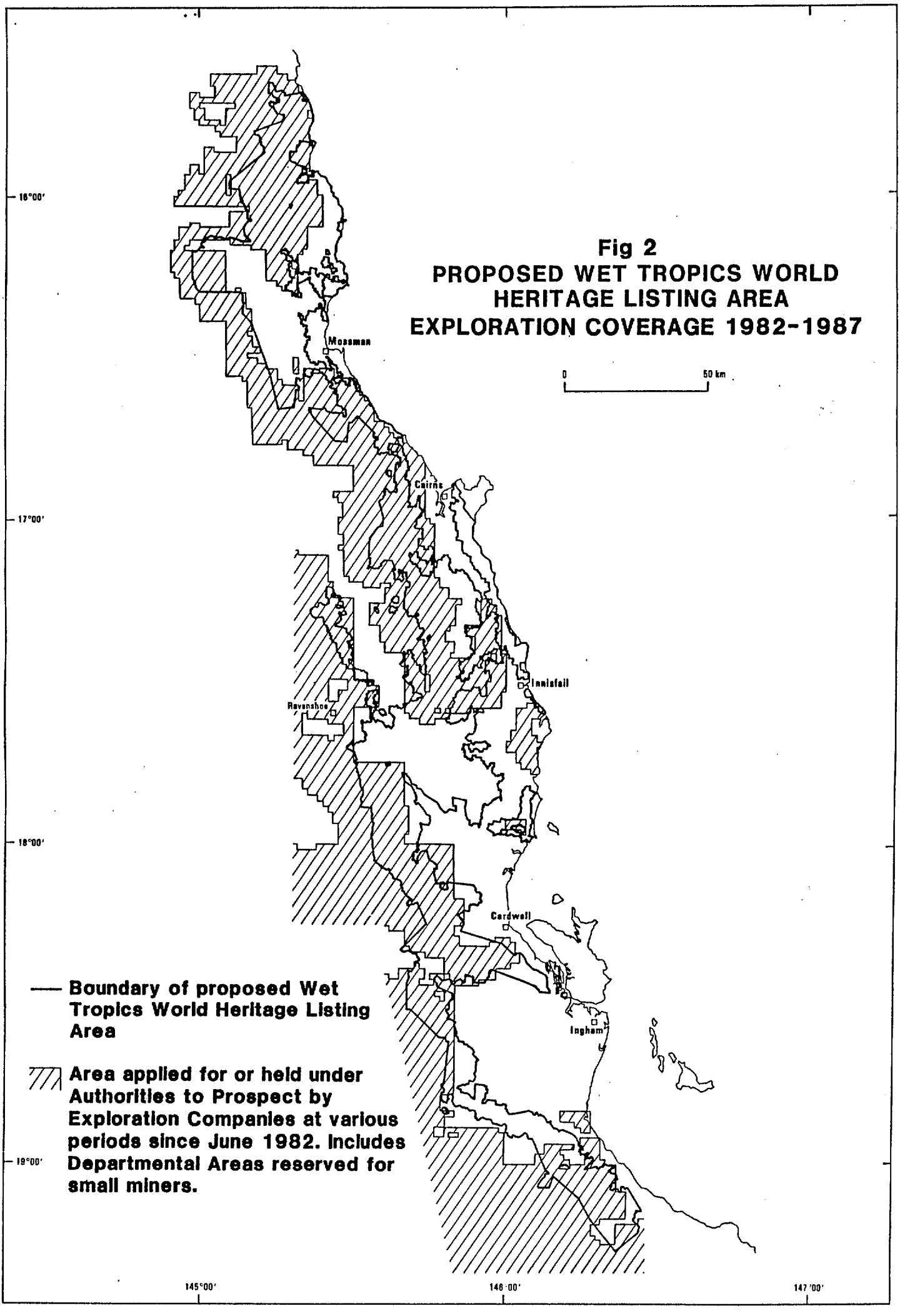
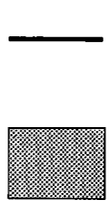


Fig 2
PROPOSED WET TROPICS WORLD HERITAGE LISTING AREA
EXPLORATION COVERAGE 1982-1987
0
50 km
Mossman
Cairns
Innisfail
Ravenshoe
Cardwell
Ingham
16°00'
17°00'
18°00'
19°00'
145°00'
146°00'
147°00'
Boundary of proposed Wet Tropics World Heritage Listing Area
Area applied for or held under Authorities to Prospect by Exploration Companies at various periods since June 1982. Includes Departmental Areas reserved for small miners.

LEGEND FOR FIGS 3, 4 & 5



Boundary of proposed Wet Tropics World Heritage Listing Area (WHL)

Areas of moderate to high prospectiveness for a specified commodity or commodities

Areas of moderate prospectiveness for a specified commodity or commodities

Areas within proposed WHL where the distribution of prospectiveness is not known

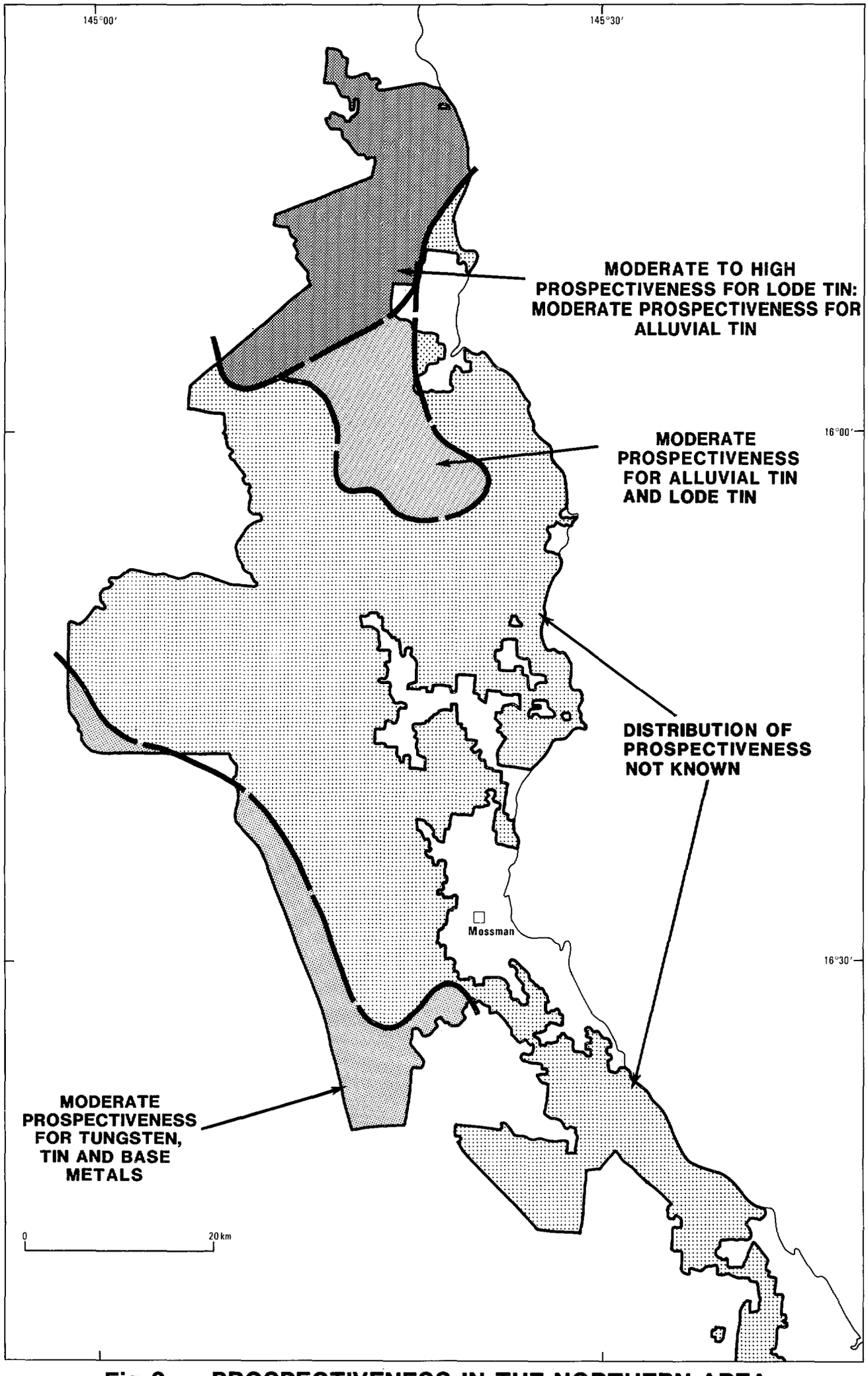


Fig 3 PROSPECTIVENESS IN THE NORTHERN AREA

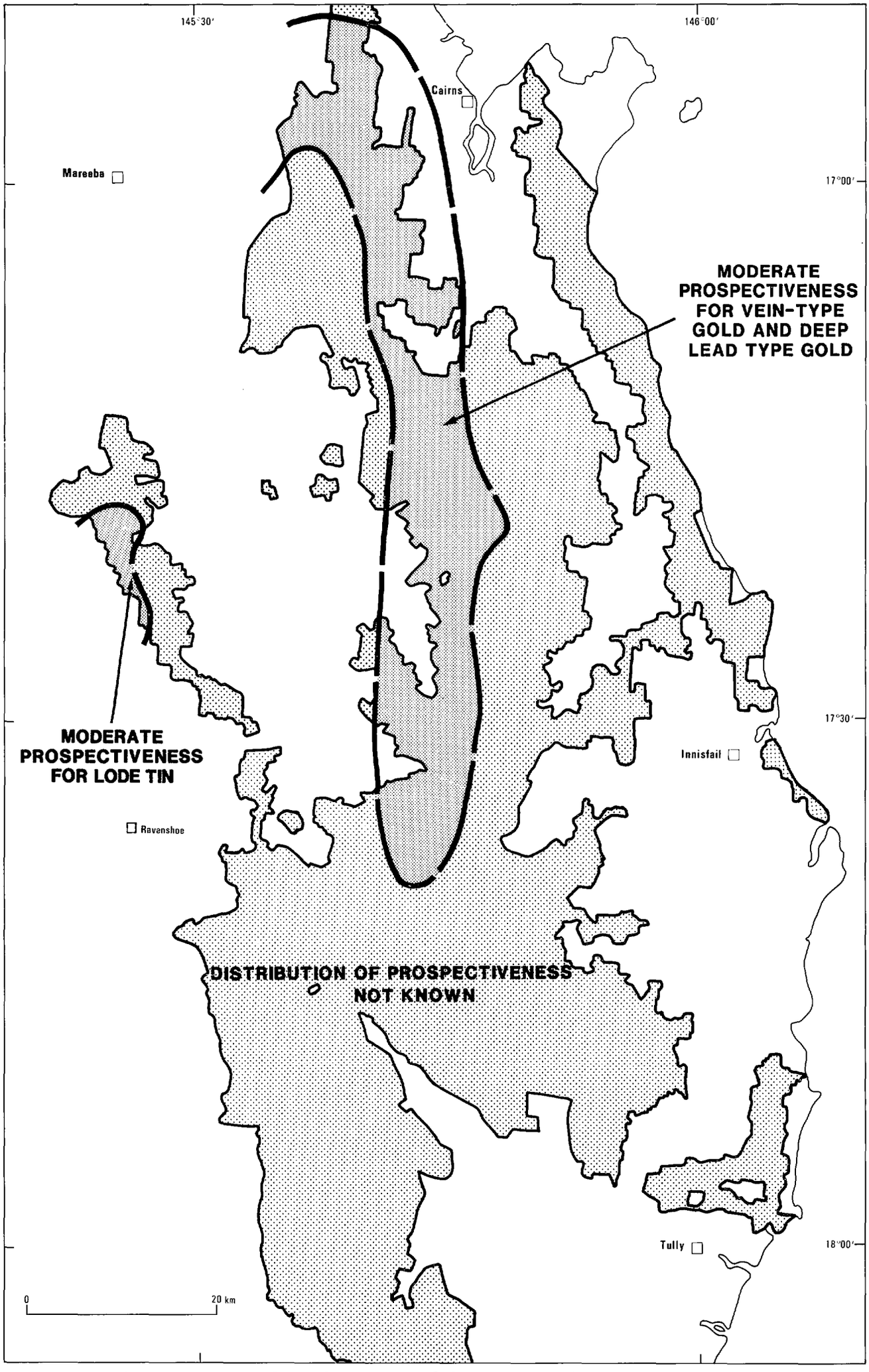


Fig 4 PROSPECTIVENESS IN THE CENTRAL AREA

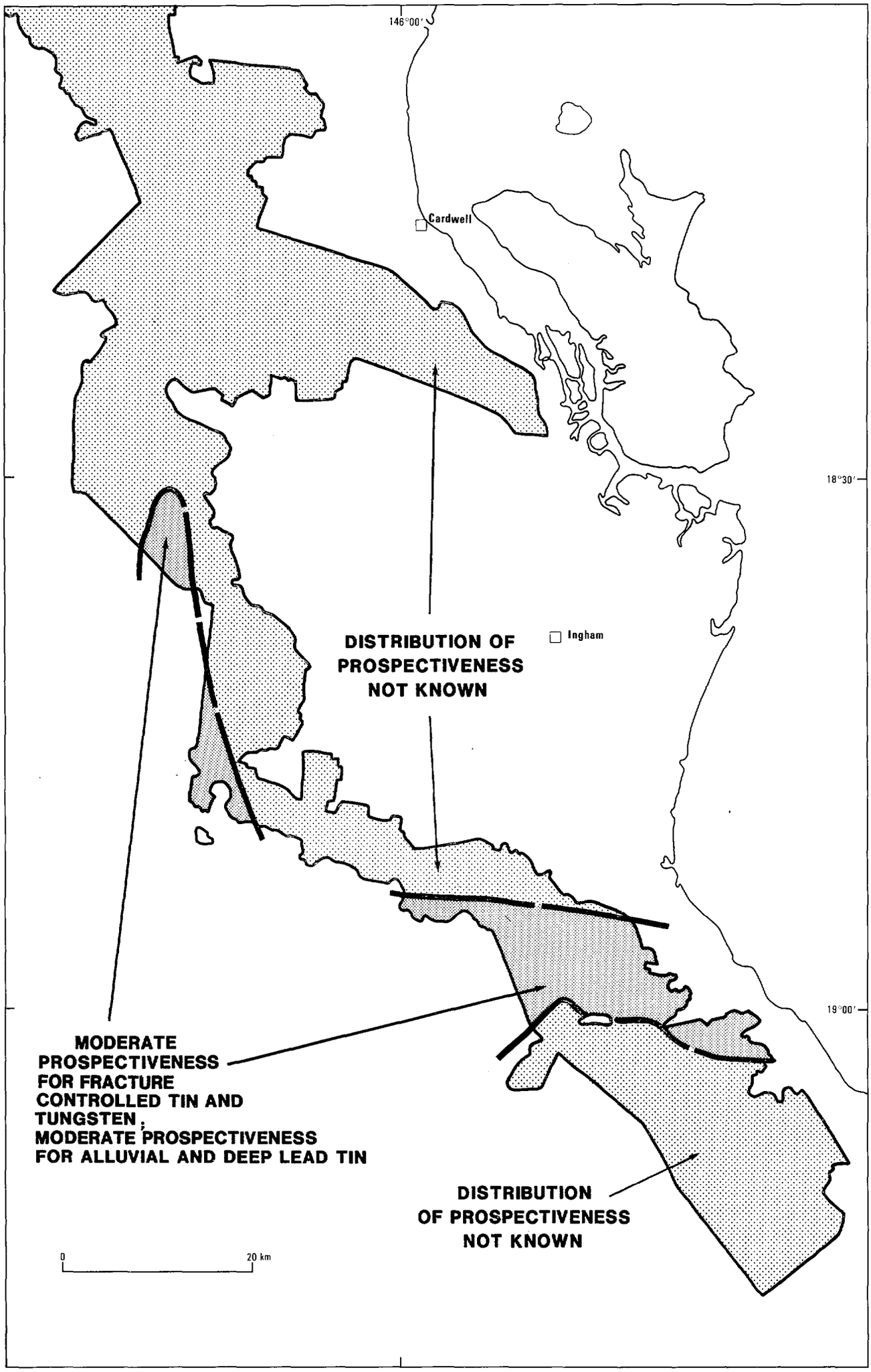


Fig 5 PROSPECTIVENESS IN THE SOUTHERN AREA

LEGEND FOR FIGS 6, 7 & 8

——— Boundary of proposed Wet Tropics World Heritage Listing Area (WHL)

▬▬ Boundary of areas of prospectiveness within the proposed WHL area

..... Boundary of goldfields and tinfields

 Granite boundary

----- Queensland Mines Department designated "areas of known mineral potential and mining leases" (ML's)

Mineral occurrences and deposits

ELEMENT		ALLUVIAL	HARDROCK
Tin		▲	△
Tungsten			□
Gold		●	○
Other(e.g.Zinc)			× Zn
Copper	Cu		
Lead	Pb		
Zinc	Zn		
Manganese	Mn		
Antimony	Sb		
Silver	Ag		
Bismuth	Bi		
Fluorine	F		
Molybdenum	Mo		
Iron	Fe		
Coal	C		
Clay	Cl		
Rock(gravel)	Rc		
Pozzolan	Pz		
Limestone	Lst		

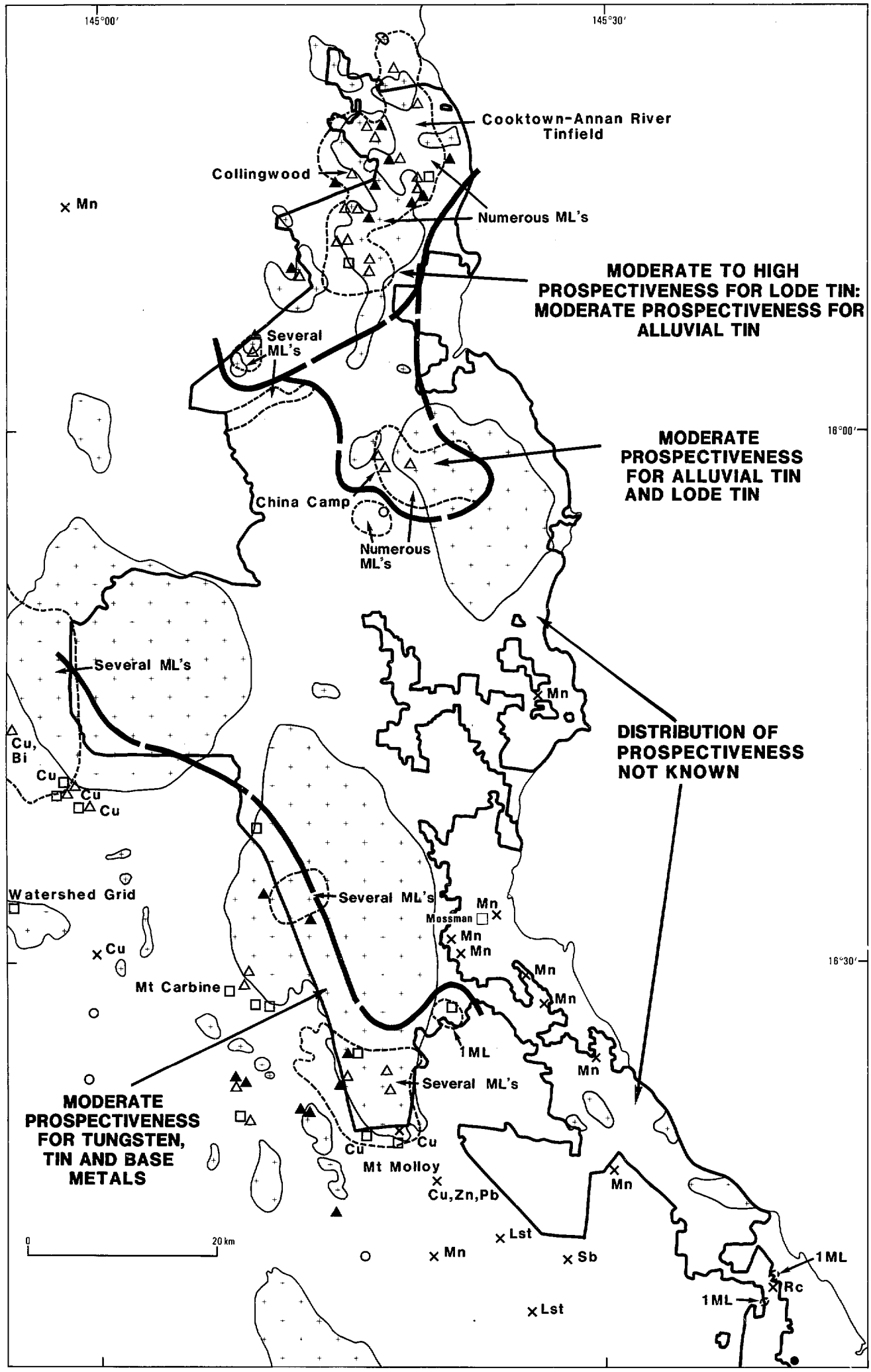


Fig 6 NORTHERN AREA - MINERAL OCCURRENCES AND DEPOSITS

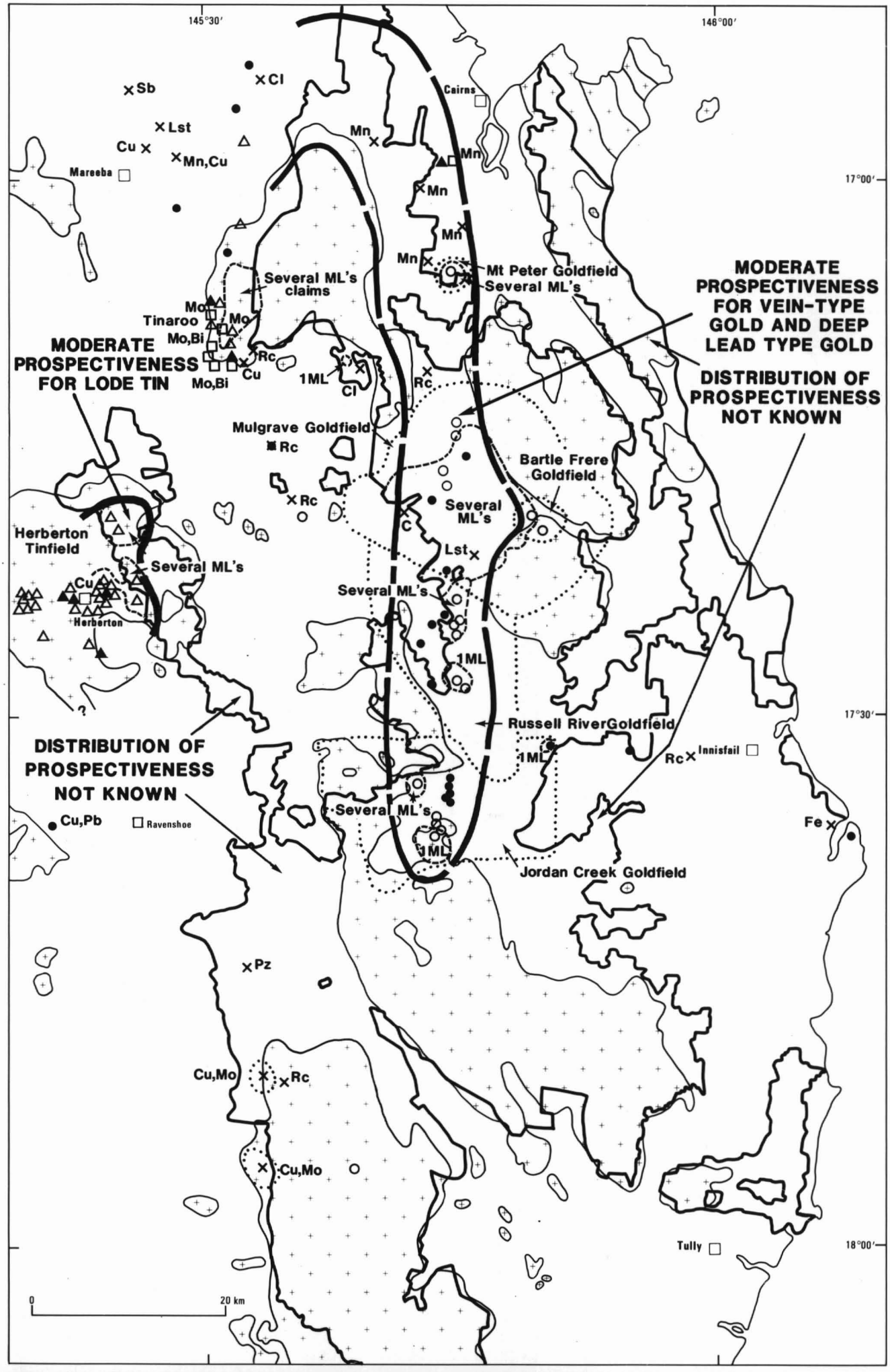


Fig 7 CENTRAL AREA - MINERAL OCCURRENCES AND DEPOSITS

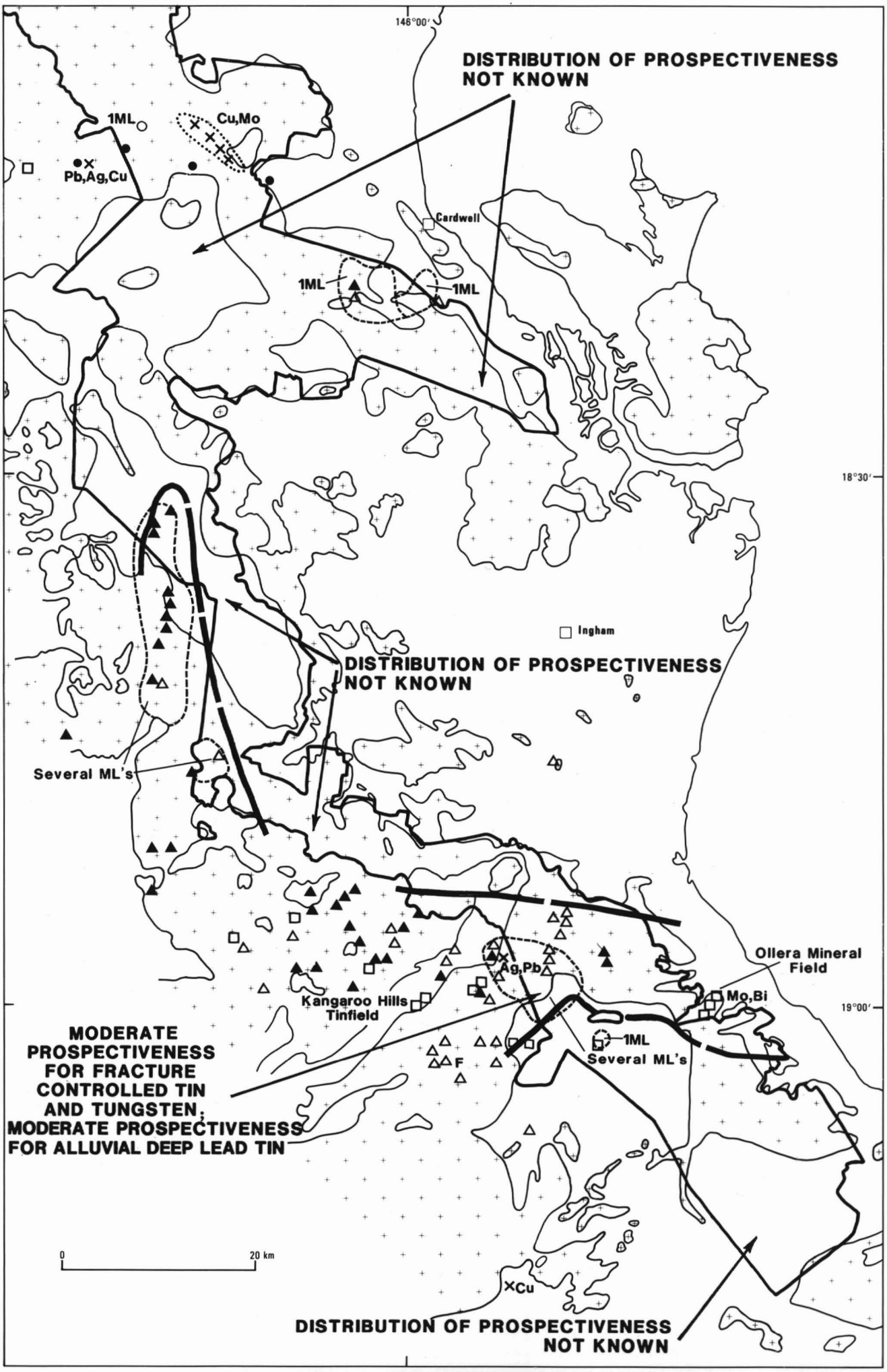


Fig 8 SOUTHERN AREA - MINERAL OCCURRENCES AND DEPOSITS