



# SMEDG Presentation

Thursday, November 27, 2014

## Exploration Mines and Money



Tony Hope







# Mount Morgan Copper-Gold Mine

## Queensland 1882-1981



50 million tonnes ore treated at average  
grade of 5.9 g/t gold and 0.7% copper

## c1888. Mount Morgan Gold Mine Queensland

The mine founded in 1882 was the largest gold mine in the southern hemisphere.











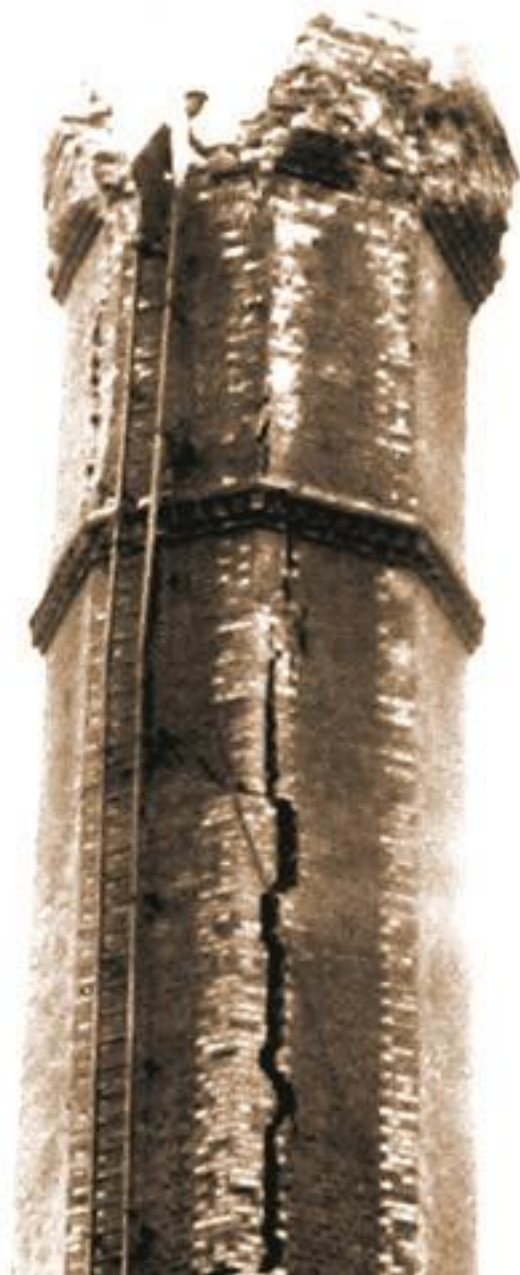
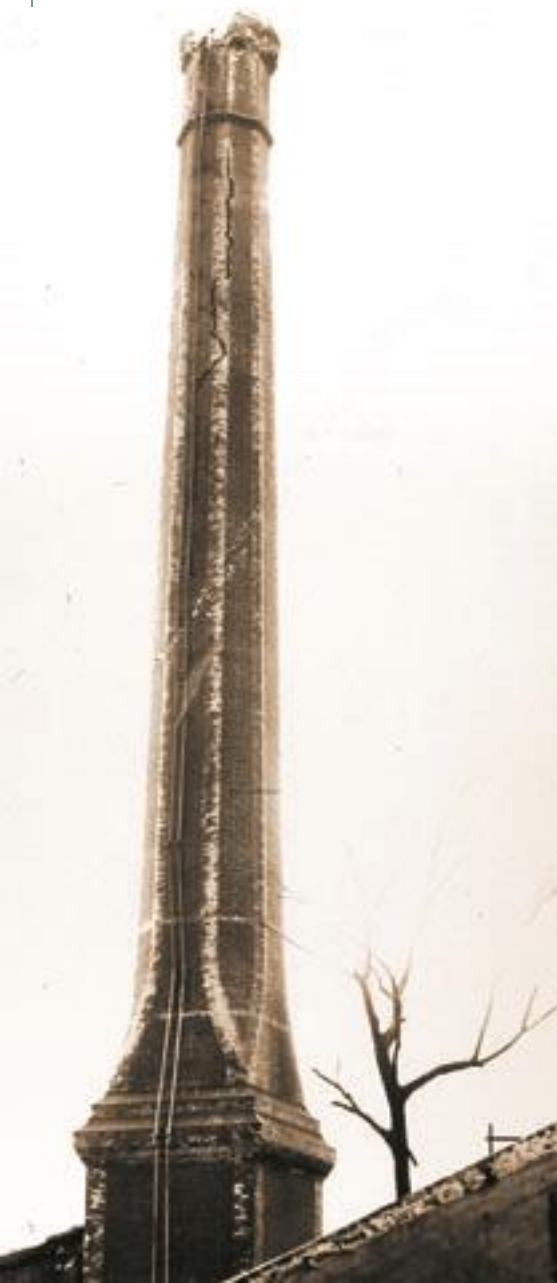
1974



## Some early Mount Morgan identities

**Kelso King, G A Richard, Walter Hall, and R G Casey. c1909**







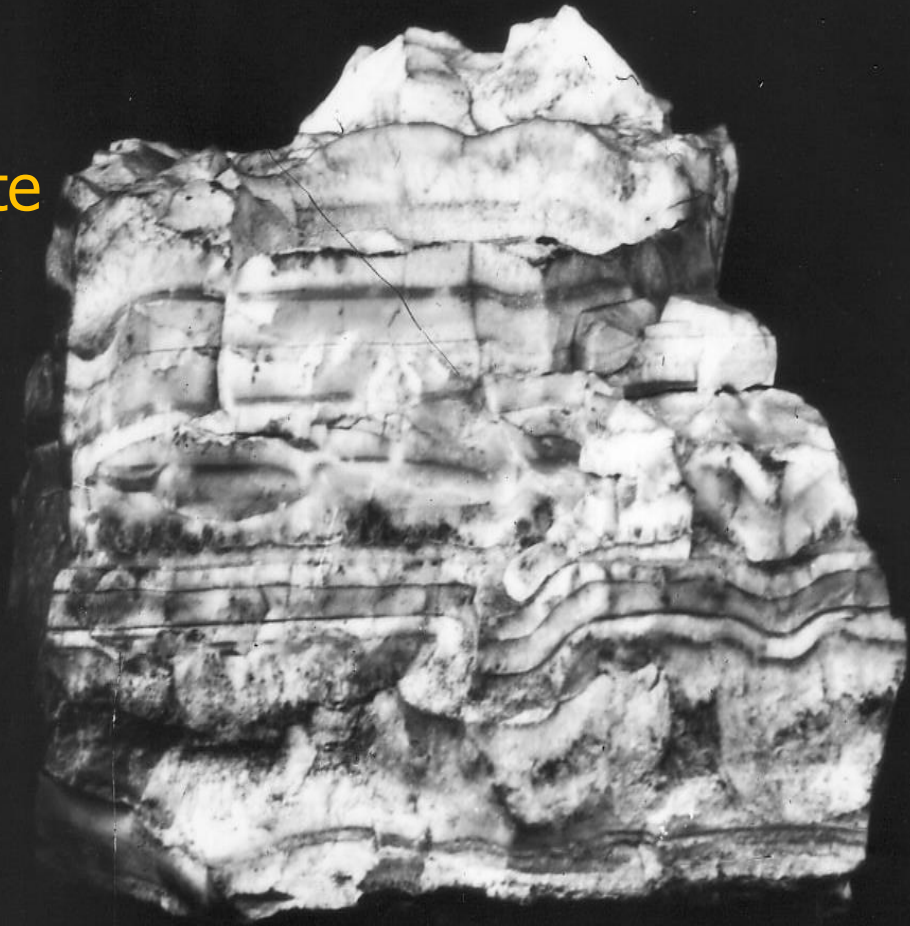




Comparative rock samples from  
Mount Morgan and Rotorua, c late  
1880's



Bacon Ore  
Mt Morgan



Geyserite  
Rotorua N.Z.





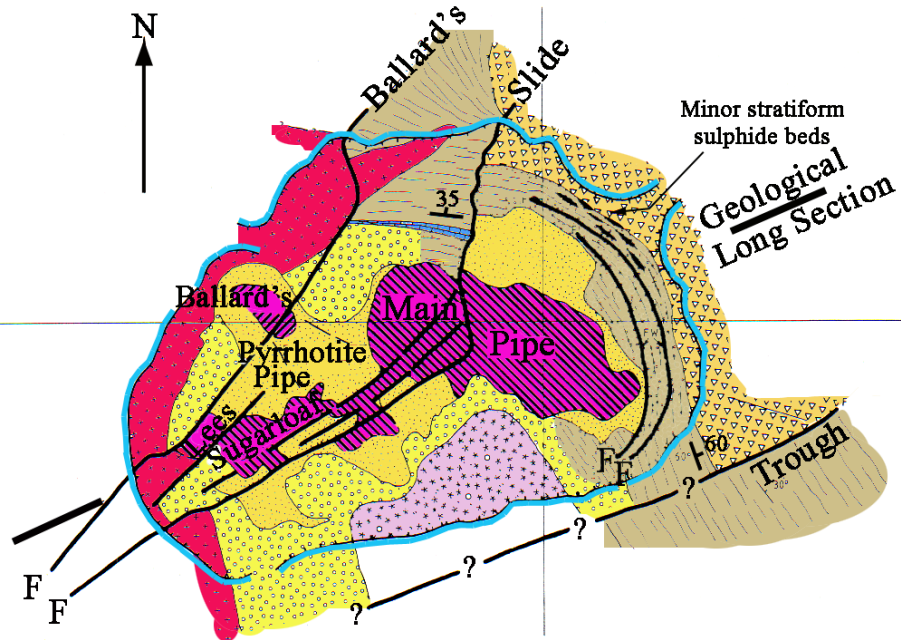
Massive sulphide with  
quartz veining



Quartz-pyrite







#### LEGEND

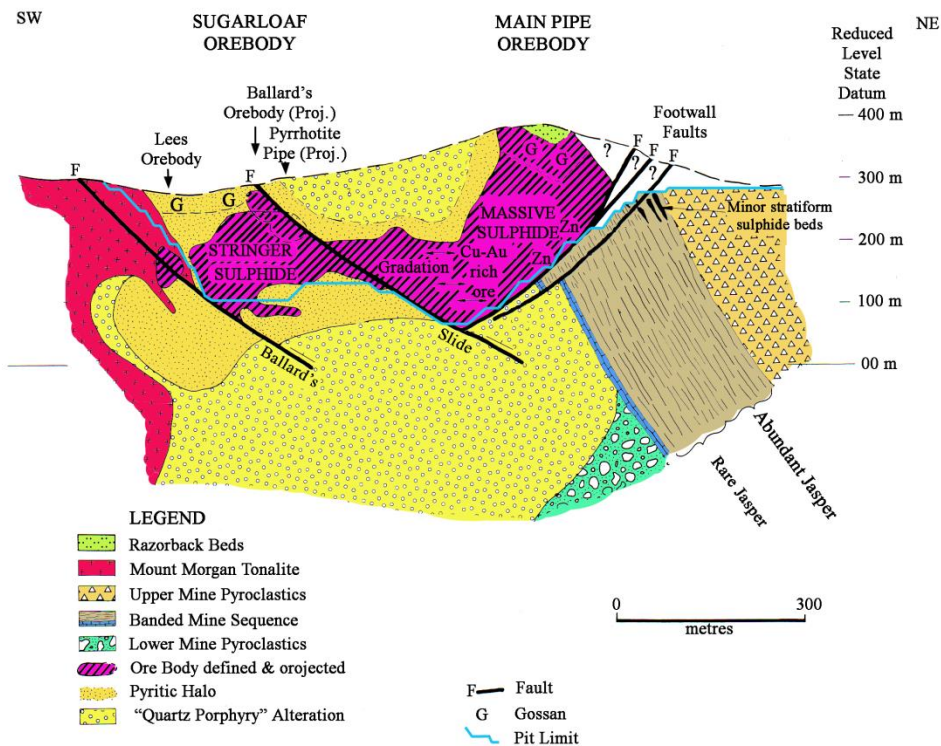
- Mount Morgan Tonalite
- Upper Mine Pyroclastics
- Banded Mine Sequence
- Quartz Feldspar Porphyry
- Qtz Porphyry Alteration
- Orebody defined & projected
- Pyritic Halo

0 300  
metres

- Fault
- Pit Outline
- Stratiform Sulphide Beds

## Mount Morgan geological plan and section

### Alex Taube 1990



#### LEGEND

- Razorback Beds
- Mount Morgan Tonalite
- Upper Mine Pyroclastics
- Banded Mine Sequence
- Lower Mine Pyroclastics
- Ore Body defined & projected
- Pyritic Halo
- "Quartz Porphyry" Alteration

0 300  
metres

- Fault
- Gossan
- Pit Limit

# William D'Arcy father of oil in Persia (Iran).



**May 26, 1908: Mideast Oil Discovered — There Will Be Blood**

By Randy Alfred





# Mount Morgan c 1904



No. 2 steam shovel on Grasstree level, 1906







Gold ingots-183 kg each  
worth AUD \$9 million per ingot at  
2012 prices.





## Australasian Institute of Mining & Metallurgy (Inc.)

### First Ordinary Meeting 1952, Mount Morgan

Photo taken at Swimming Baths, Mt. Morgan  
Tuesday Morning, 28.8.1952.

FRONT ROW—left to right—O. A. Wilson, Miss G. Meyers, R. R. Neal, Mrs R. R. Neal, W. J. Cuming, Mrs W. J. Cuming, N. S. Kirby, Mrs N. S. Kirby, J. J. Whitelaw, Mrs J. J. Whitelaw, Mrs J. W. Westaway, Mrs L. B. Haney, Mrs A. D. Mackay, Mrs C. Blyth, K. B. Gross, Mrs K. B. Gross, Mrs D. I. Izatt, Mrs G. Sheil, J. Kruttschnitt, Mrs Kruttschnitt, G. Sheil, Miss B. E. Jacka, G. B. O'Malley, I. W. Morley, Mrs S. S. Pullar, Mrs R. B. Lawrie, Mrs J. J. Topping, Mrs J. M. Horsburgh, Mrs B. W. Lennon, Mrs J. G. Hart, Mrs A. E. Dainton, A. A. McLeod, K. A. Rowell, L. E. Elvey, Mrs P. L. Adams, P. L. Adams.

Second Row—Dr. J. C. Nixon, Mrs J. C. Nixon, R. A. Holliday, D. Gallagher, L. I. Goff, C. Reynolds, Mrs M. Glen, M. Glen, H. A. Steane, B. W. Lennon, J. A. B. Forster, H. R. Brown, D. F. Branagan, P. O. Alston, Dr. J. A. Dunn, A. E. Dainton, E. L. Hardy, R. A. Palmer, J. B. Evans, J. J. Kelly, A. L. Lloyd, J. G. Hart, R. E. Le Messurier, A. R. Curry, G. F. Clark, W. Mc. A. Manson, J. K. Dreverman, N. A. Wilson, L. Golomb, S. A. Mackay, C. E. Caldwell-Wearne, R. Davey, C. C. Morton, Dr. O. A. Jones, J. J. Topping.

Third Row—K. S. Blaskett, G. W. Heyes, J. M. Silver, A. White, G. H. Jennings, Mrs P. M. Wreford, P. M. Wreford, P. M. J. Gray, R. I. Rankin, J. F. Ivanac, G. F. Whitten, L. G. Hetherington, J. R. Trezise, H. W. Whitford, L. W. Parkin, H. E. Jensen, A. D. Mackay, L. S. McEachern, C. Blyth, L. S. Jones, J. Ferguson, L. L. Johns, J. T. Woodcock, A. C. A. Seen, R. F. Bennett, C. T. Crawford, R. O. K. T. Moodie, O. Andersen, F. L. Bett, N. M. Worner, R. A. White, E. L. Richard, B. Gibson, R. B. Mills, R. A. Palmer, Miss T. Christie, H. A. Donegan, J. W. Westaway, D. I. Izatt.

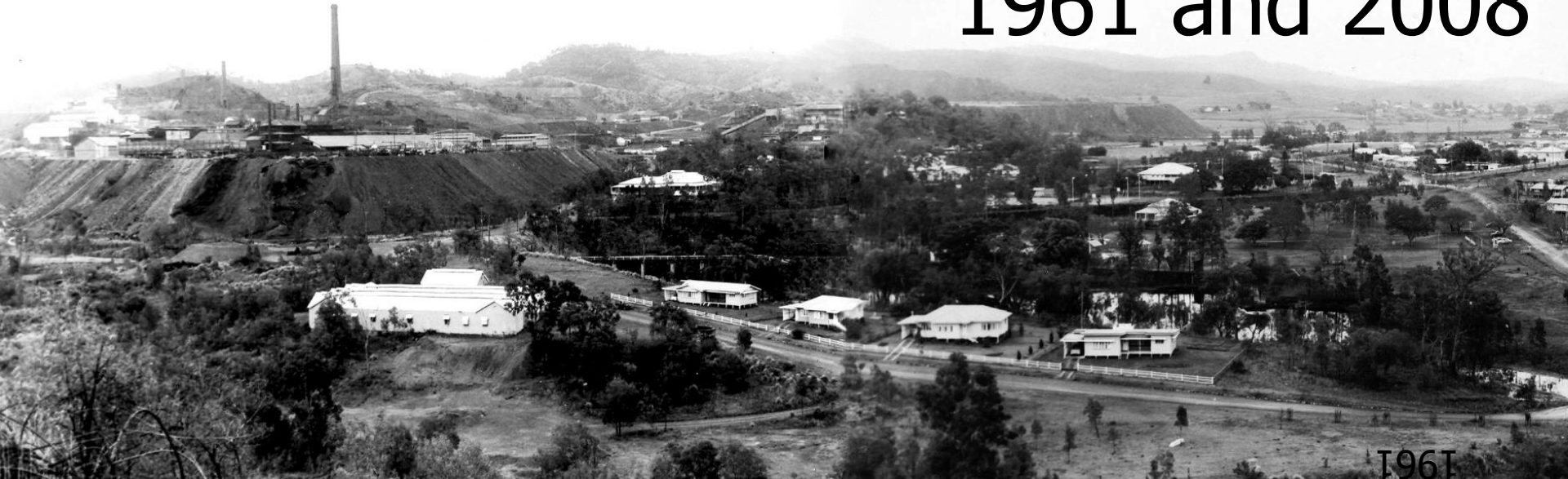
Fourth Row—J. Greer, P. Lloyd, C. Kaiser, R. A. Brown, C. Rowley, E. Williams, C. H. Warman, K. Chapman, O. D. Paterson, A. E. Kruger, G. Pitcher, A. W. Cameron, D. H. Watson, B. Hopkins, C. C. Maynard, G. H. Matheson, L. B. Fry, M. G. McAuley, K. C. Williams, R. F. Kable, D. G. Walker, G. M. Willis, R. A. Eaton, B. M. Beattie, C. W. Hoffmann, R. V. Jorgeson, J. Waring, N. J. Keys, F. K. Aylmer, I. R. McLeod, R. G. Hallowell, B. G. Hiskens, Miss J. Jefferson, K. A. Lamin, W. J. Murray, N. Underwood, Dr. A. B. Edwards.

Fifth Row—A. G. Hay, C. R. Foster, R. B. Shiel, R. B. Lawrie, B. G. Patterson, R. F. Allen, J. M. Rose, S. G. Salamv, J. K. Mercer, H. Niemann, J. F. Rigby, B. Hamilton, D. F. Heinjus, J. A. Uscinski, E. Barnes, J. N. Nilsen, H. L. Williamson, D. E. Cartwright, G. P. Newton, R. J. Hilditch, C. J. Hamdorf, S. R. C. Jewell-Thomas, Miss M. E. Evans, Miss J. M. Fisher, R. A. Coucho, K. L. Ridley, Miss M. Anderson, J. D. Greenwood, J. I. Black.

Back Row Standing—V. J. McSweeney, I. McPherson, A. E. Wyatt, L. B. Haney, A. Ponniah, D. R. Moyses, E. W. Schröder, P. B. Moffitt, B. G. Polkinghorne, J. R. May, F. Cunningham, B. E. Trone, S. K. Pennycuik, H. R. E. Staines, I. G. Whitcher, J. N. Haugiton, B. M. Mathias, D. C. Short, P. D. Barlow, R. J. Gluyas, Miss A. M. Moss, Mrs J. S. Purves, J. S. Purves, Mrs C. H. Martin, C. H. Martin, G. Hillier, Dr. N. R. Srinivasan, S. S. Pullar.



# 1961 and 2008

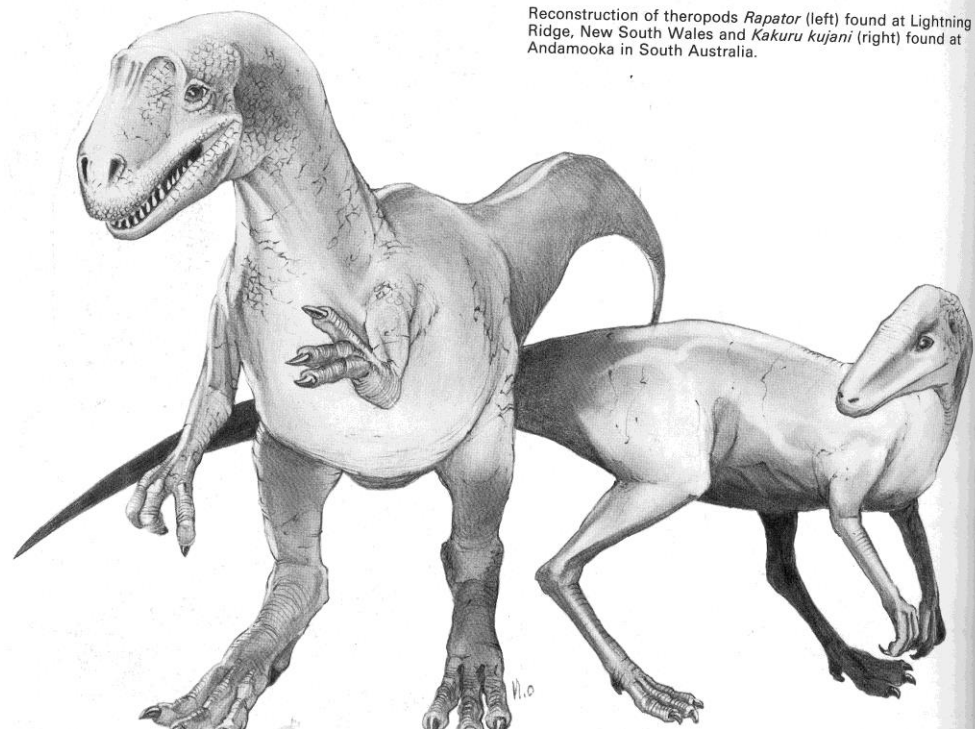




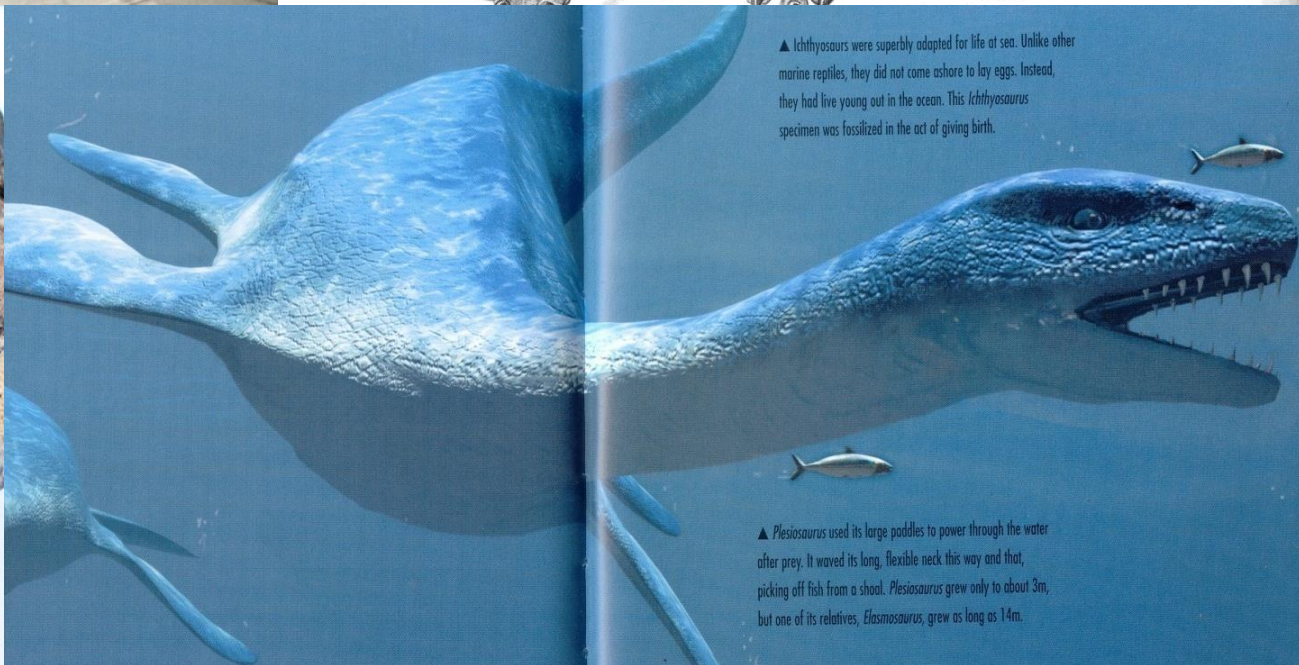


Mount Morgan fireclay mine and dinosaur foot print





Reconstruction of theropods *Rapator* (left) found at Lightning Ridge, New South Wales and *Kakuru kujani* (right) found at Andamooka in South Australia.



▲ Ichthyosaurs were superbly adapted for life at sea. Unlike other marine reptiles, they did not come ashore to lay eggs. Instead, they had live young out in the ocean. This *Ichthyosaurus* specimen was fossilized in the act of giving birth.

▲ *Plesiosaurus* used its large paddles to power through the water after prey. It waved its long, flexible neck this way and that, picking off fish from a shoal. *Plesiosaurus* grew only to about 3m, but one of its relatives, *Elasmosaurus*, grew as long as 14m.



# Murphyores heavy mineral exploration Queensland 1963 to 1965.



- The HM comprises ilmenite, leucoxene, rutile, zircon and monazite



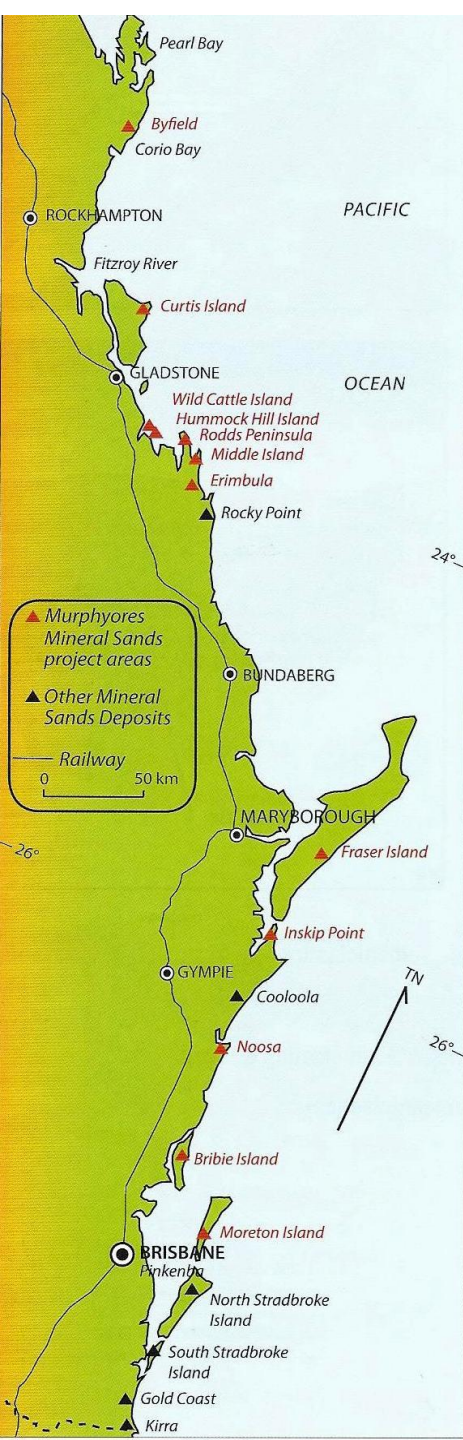


c1935. Hauling black sand from beach by horse and dray  
at Yamba NSW

*Illust. 11. Hauling black sand from beach by horse and dray, Yamba, circa 1935.  
(By courtesy late W. H. Derrick)*



# Murphyores' exploration sites Eastern Queensland







**ABOVE: Hand augering on Fraser Island main Beach. 1964.**

**RIGHT: Sludging Eurimbula south of Gladstone 1963**





# Fraser Island 1979. Rehabilitated part of mining area



Illust. 46. Fraser Island, mid-1979. One of the older rehabilitated parts of the DM area. (By courtesy Murphyores Incorporated Pty Ltd, R. L. Anthony – photographer)





Murphy Star.  
Ex fishing boat  
used for  
prospecting





Moreton Island. Wind  
blown sand dunes.  
1963



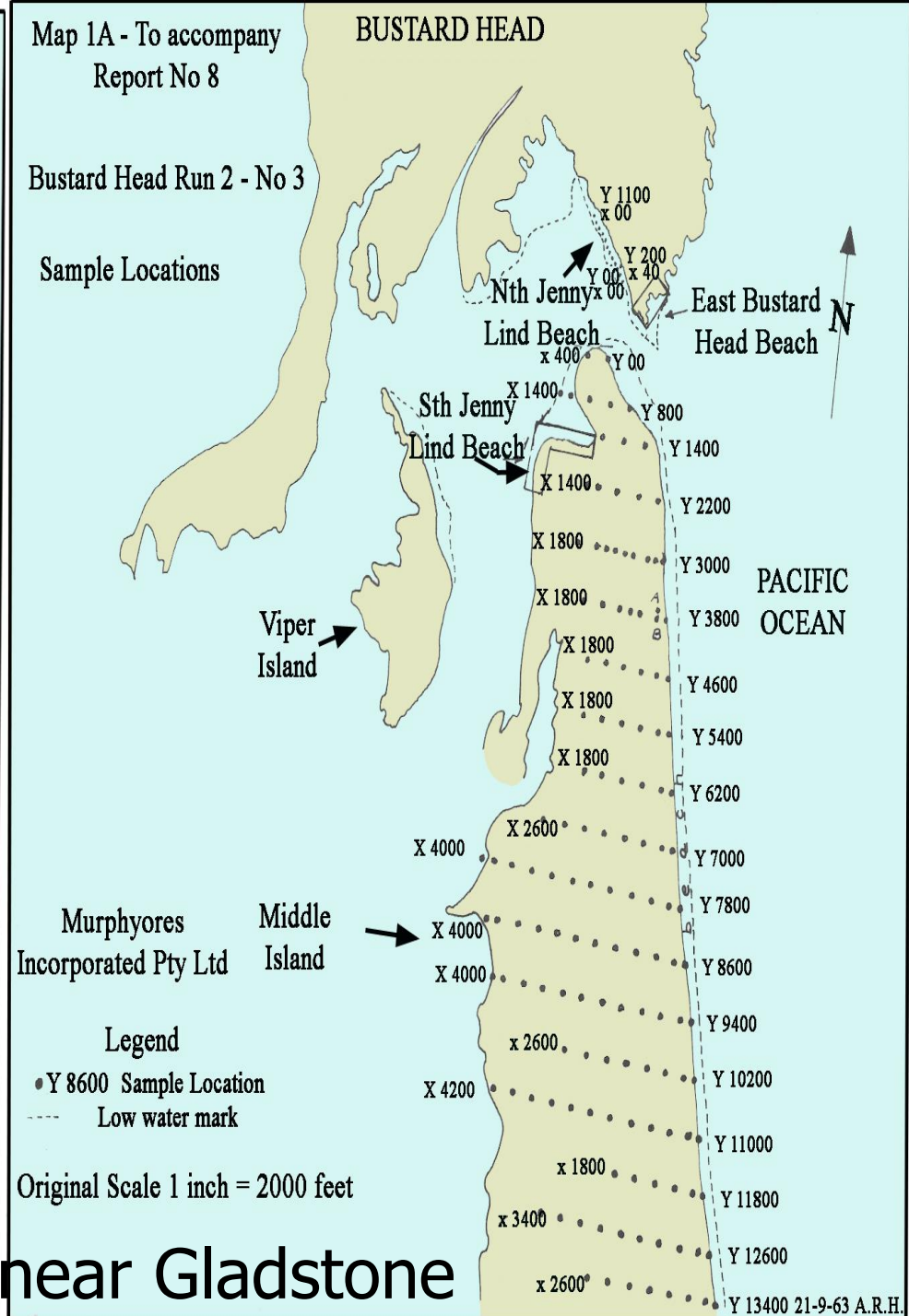
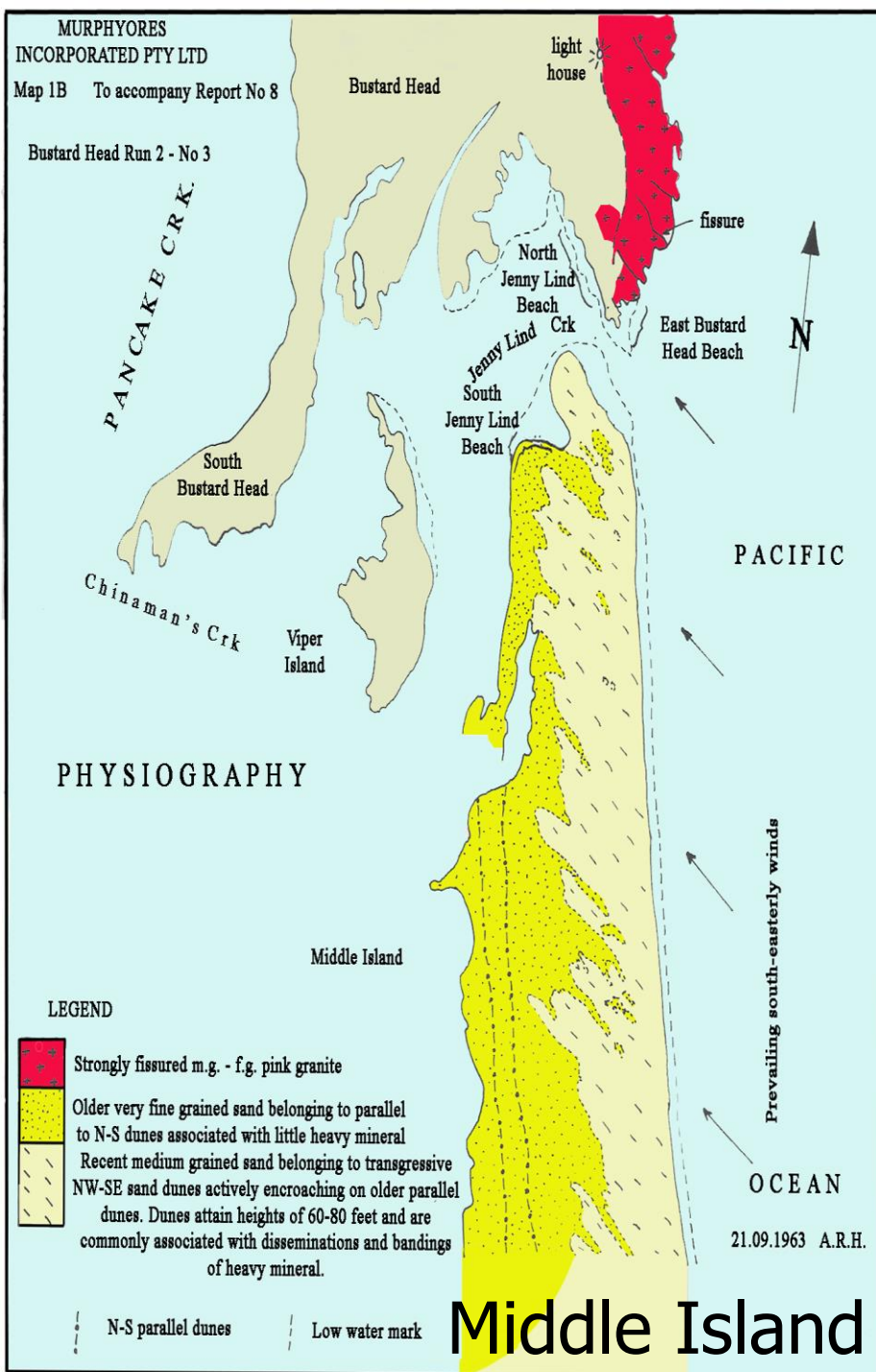


1963. Middle island from Bustard Head (named by Captain Cook).

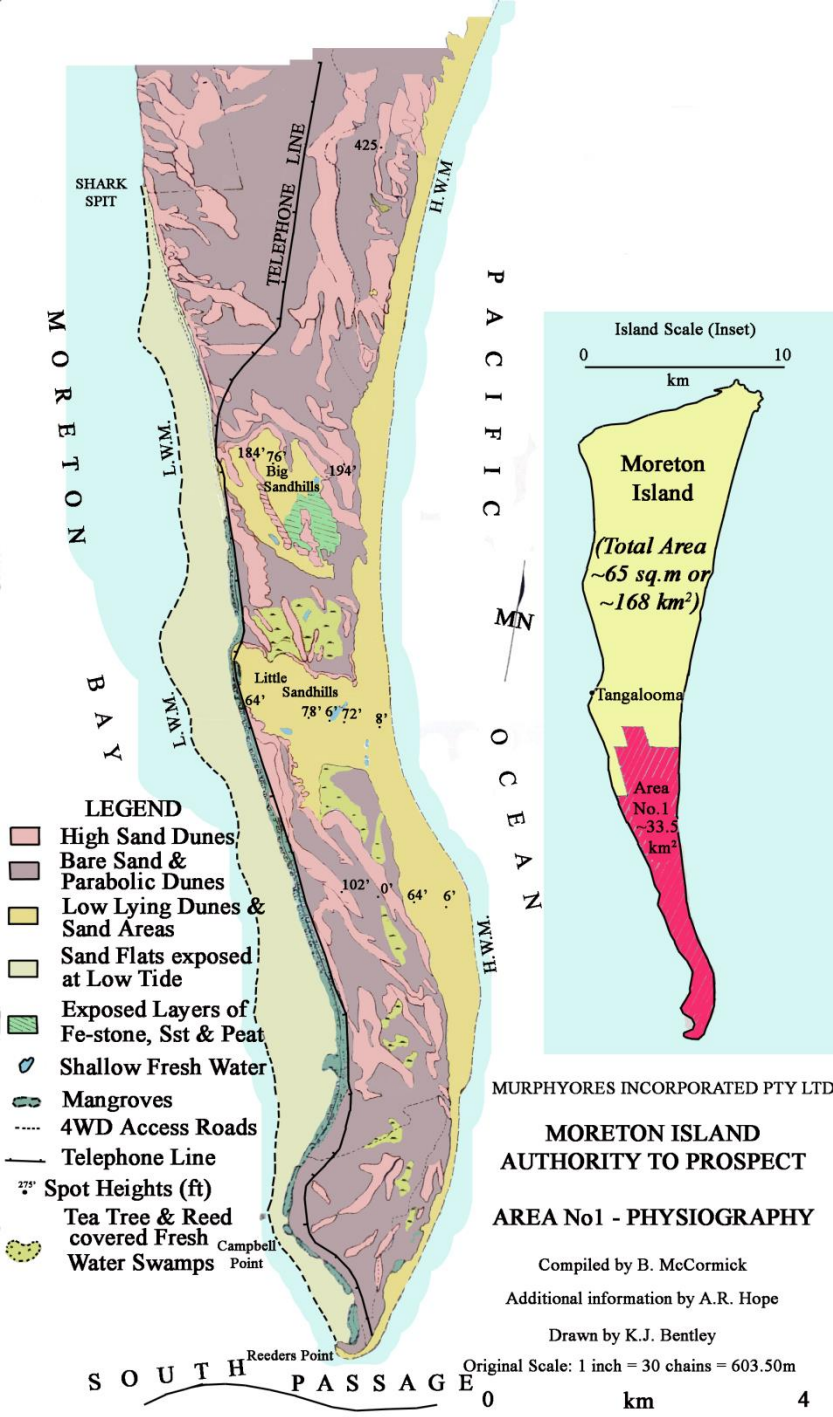


Field camp Moreton  
Island 1963









# Moreton Island from the air. 2011





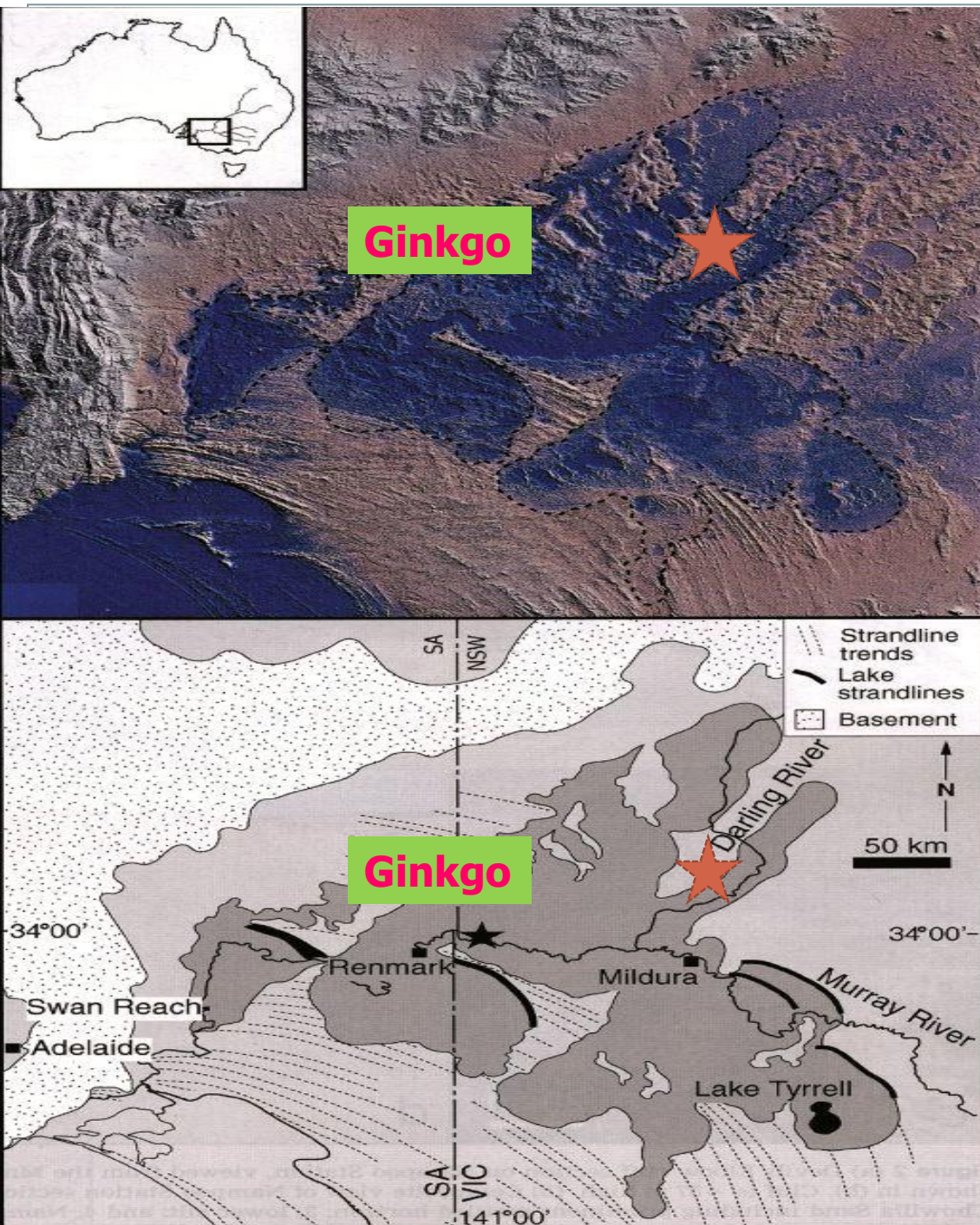
# Ginkgo Heavy Mineral Mine

## New South Wales 2005 to present



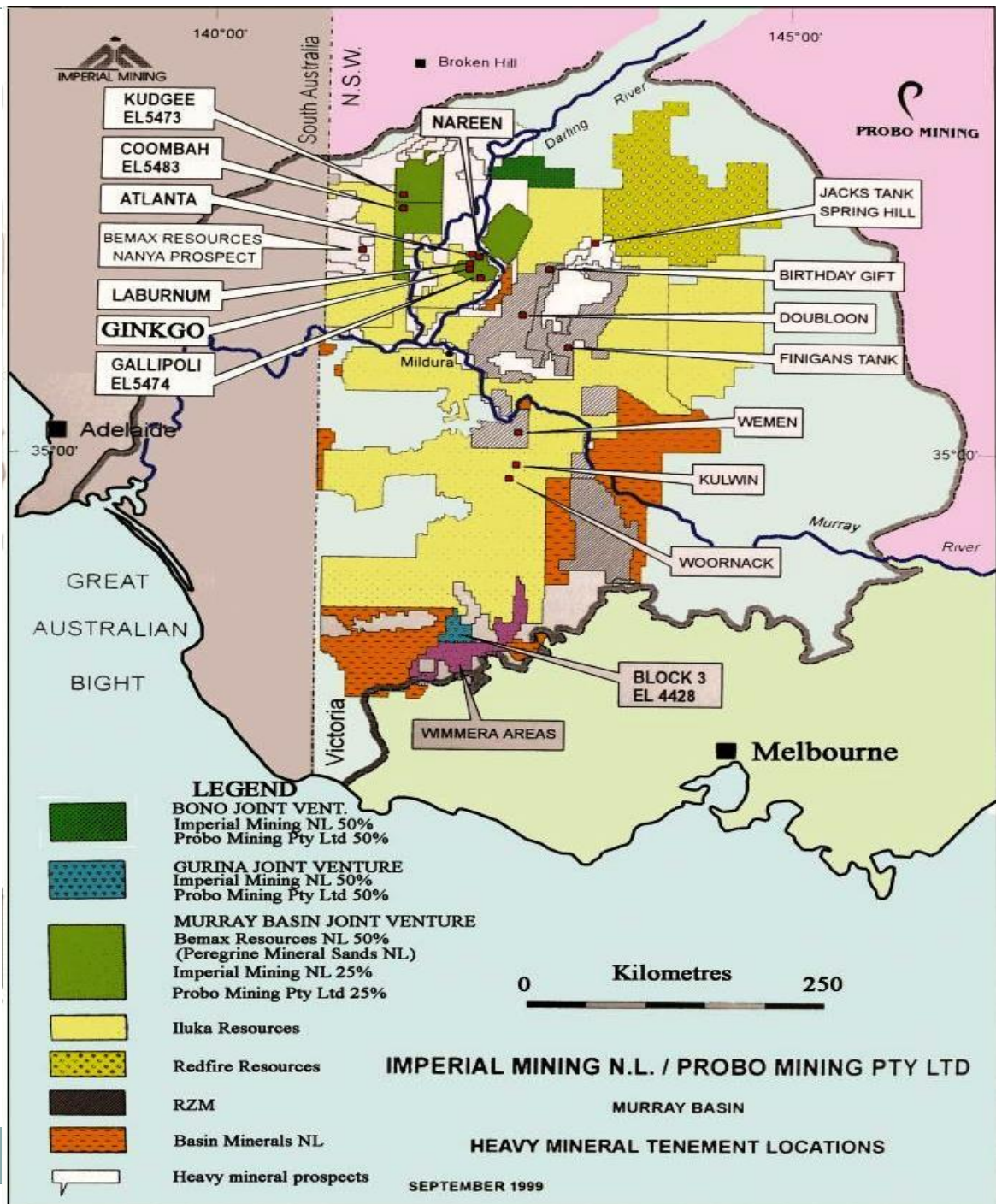
- 161 million tonnes at 2.68% HM
- The HM comprises 46% ilmenite, 8% leucoxene, 13% rutile and 10% zircon





Murray Basin from Landsat imagery showing strand lines tens of kilometres long, an ancient lake and location of Ginkgo deposit







# Ginkgo heavy mineral mine in the Murray Basin, NSW. 2006





# GINKGO PROSPECT Sections

**BEMAX**  
RESOURCES NL  
A.C.N. 009 247 858

Ginkgo  
Extended

vertical  
depth (m)

0 —

20 —

40 —

60 —

38m@2.88%HM

FACING EAST

36m@3.98%HM

34m@9.42%HM

32m@3.07%HM

31m@5.28%HM

Ginkgo

vertical  
depth (m)

0 —

20 —

40 —

60 —

FACING SOUTH-EAST

32m@2.69%HM

40m@2.60%HM

% H.M.

■ >5

■ 2-5

■ 1-2

■ <1

200m





Geologist Ian Browne  
and visitors, 1998

Prof. Ian Plimer







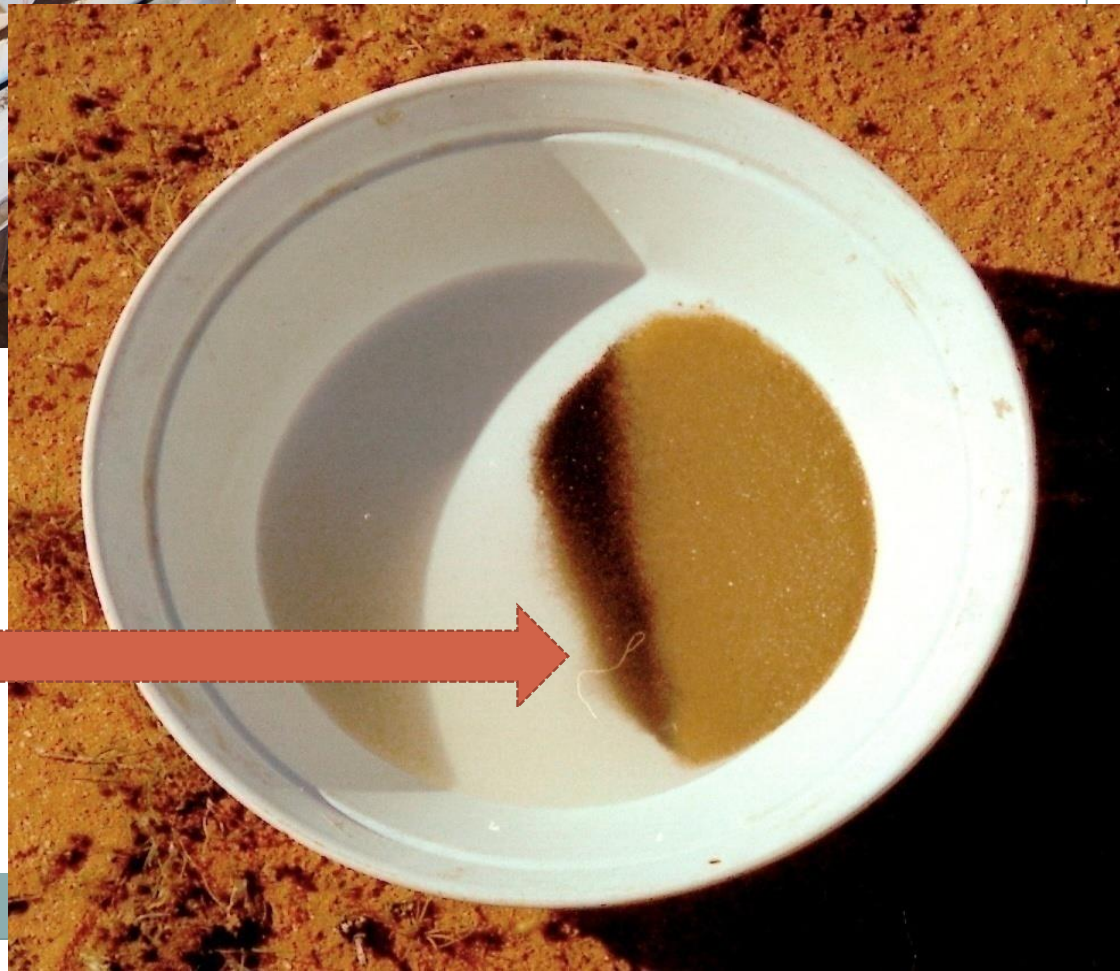
Exploration field team  
1999 outlining Ginkgo  
deposit.





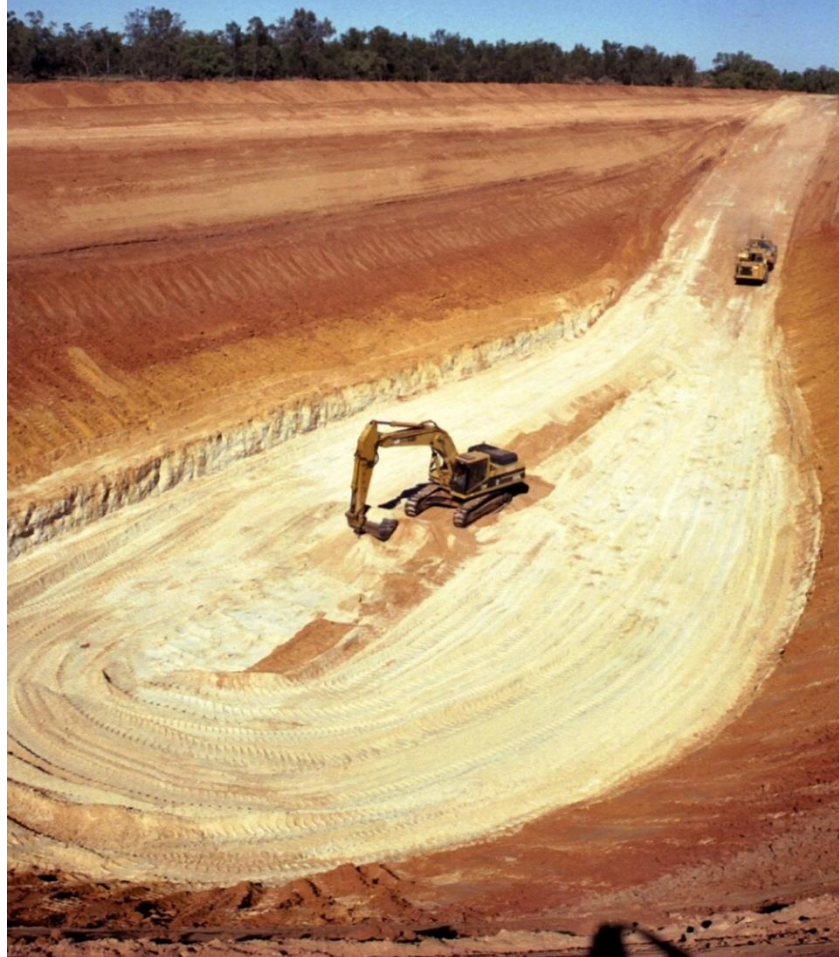


HM panned from RC  
drill hole sample.  
L to R. Zircon,  
ilmenite/rutile, ancient  
beach sand.





# Ginkgo test pit 2001







Spud dredge with cutter raised 2009







Ginkgo strandline from dredge pond 2008

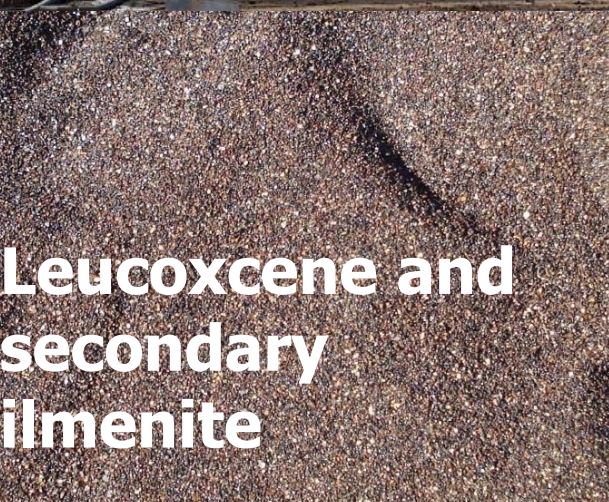


# Ginkgo mine manager and dredge operator

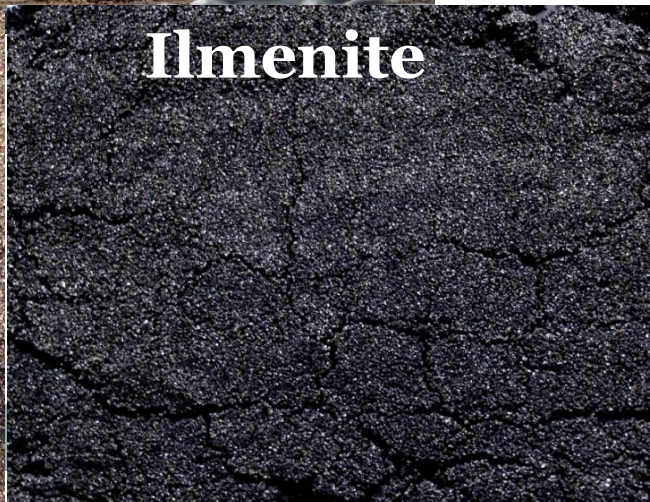




# Ilmenite heap Gingko mine site



**Leucoxene and  
secondary  
ilmenite**



**Ilmenite**



**Zircon and rutile**





Road train used to transport HM from Ginkgo Mine to Broken Hill treatment plant.



Newly constructed treatment plant at Broken Hill, 2006.



# Panguna Copper–Gold mine Bougainville Papua New Guinea.1972 to 1989

- Produced 3.1 million tonnes copper, 10 million ounces gold and over 25 million ounces silver.
- Original reserves in 1968 were 230 Mt at 0.63% copper and 0.98 g/t gold.









- Author's drainage sediment field gear. 1963





Consolidated Zinc exploration field team 1961 and 1962







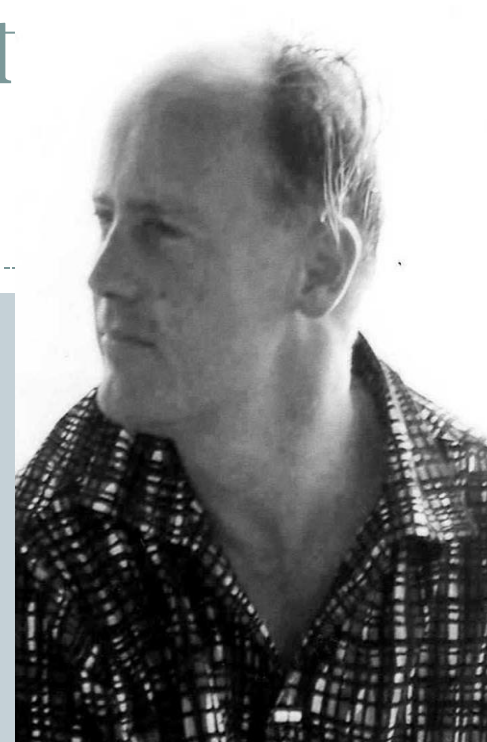
Bulman Arnhem Land NT 1961



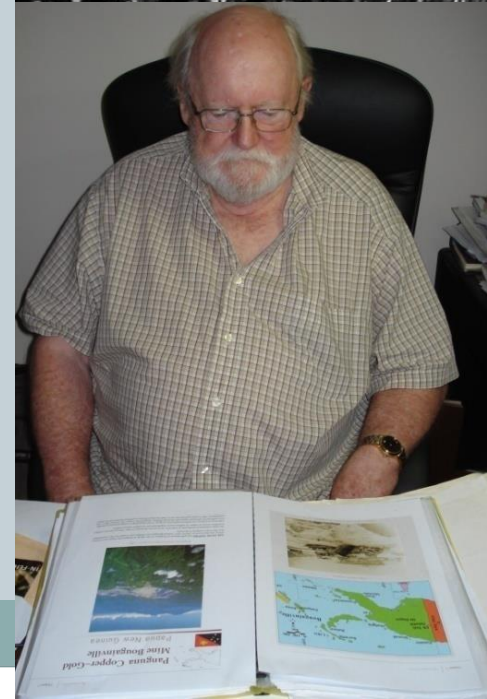


Bougainville and Mt Bagana





Ken Phillips  
early 1970's



2012





Geologist Phil  
Macnamara





Top. Ken Phillips and Rex Brooks providing rations and pay to locals. 1964.



Surveyor Fred Pratt on helipad. 1965.





# Flooding at Bougainville site. c1970





Aerial view of developing open pit. c1972.





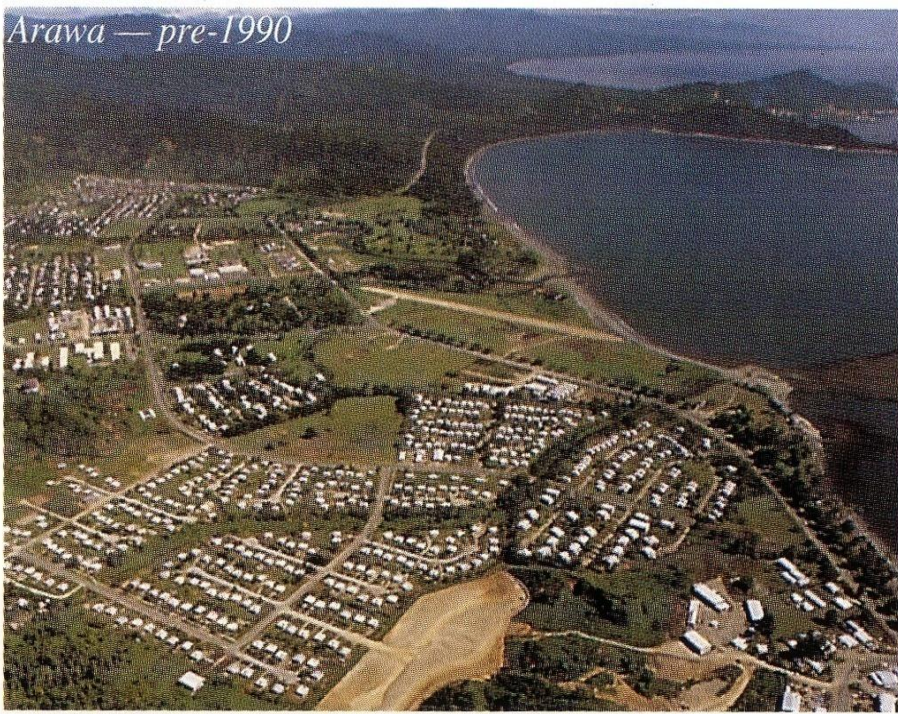


Overburden  
removal. 1971.





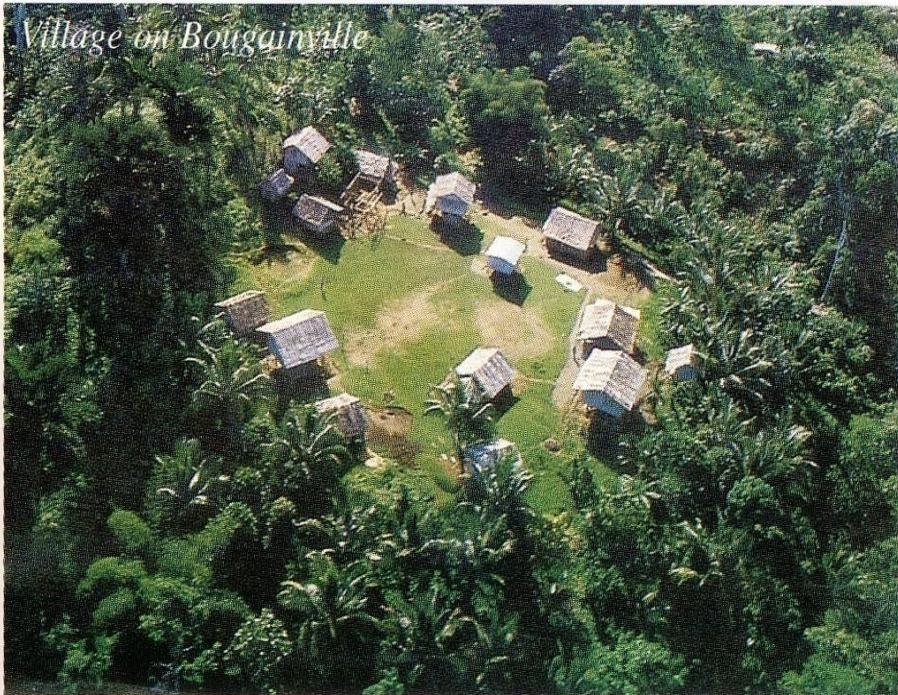
*Arawa — pre-1990*



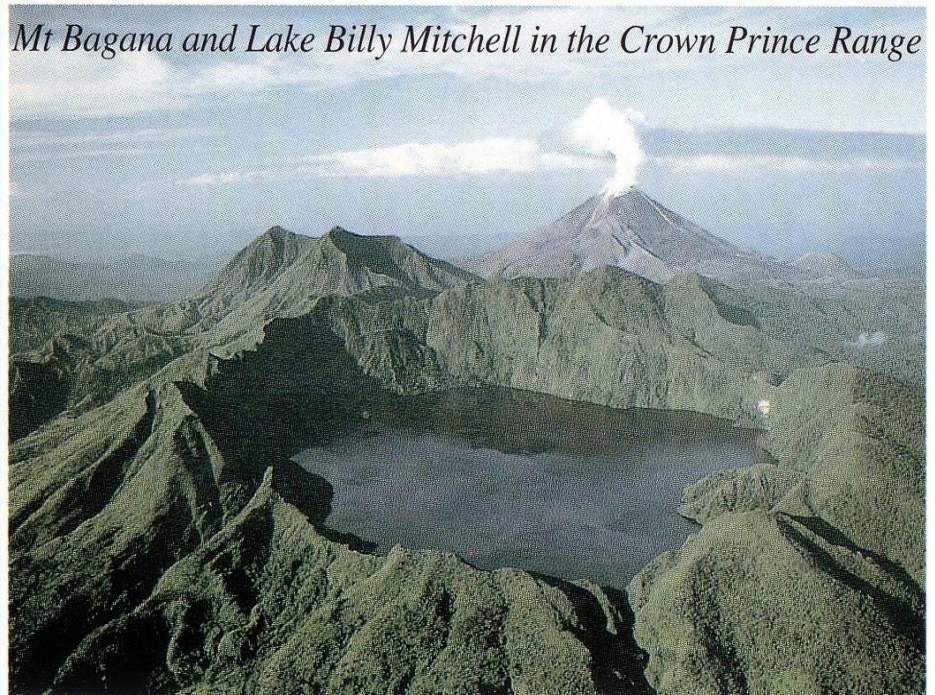
*Panguna — pre-1990*



*Village on Bouguinville*



*Mt Bagana and Lake Billy Mitchell in the Crown Prince Range*







- Open pit 1986







Peter Hobday top. 2010.  
Pit control room. 1975.





Bougainville field assistants Stuart Golu and Augustine Gomona.  
c 1967





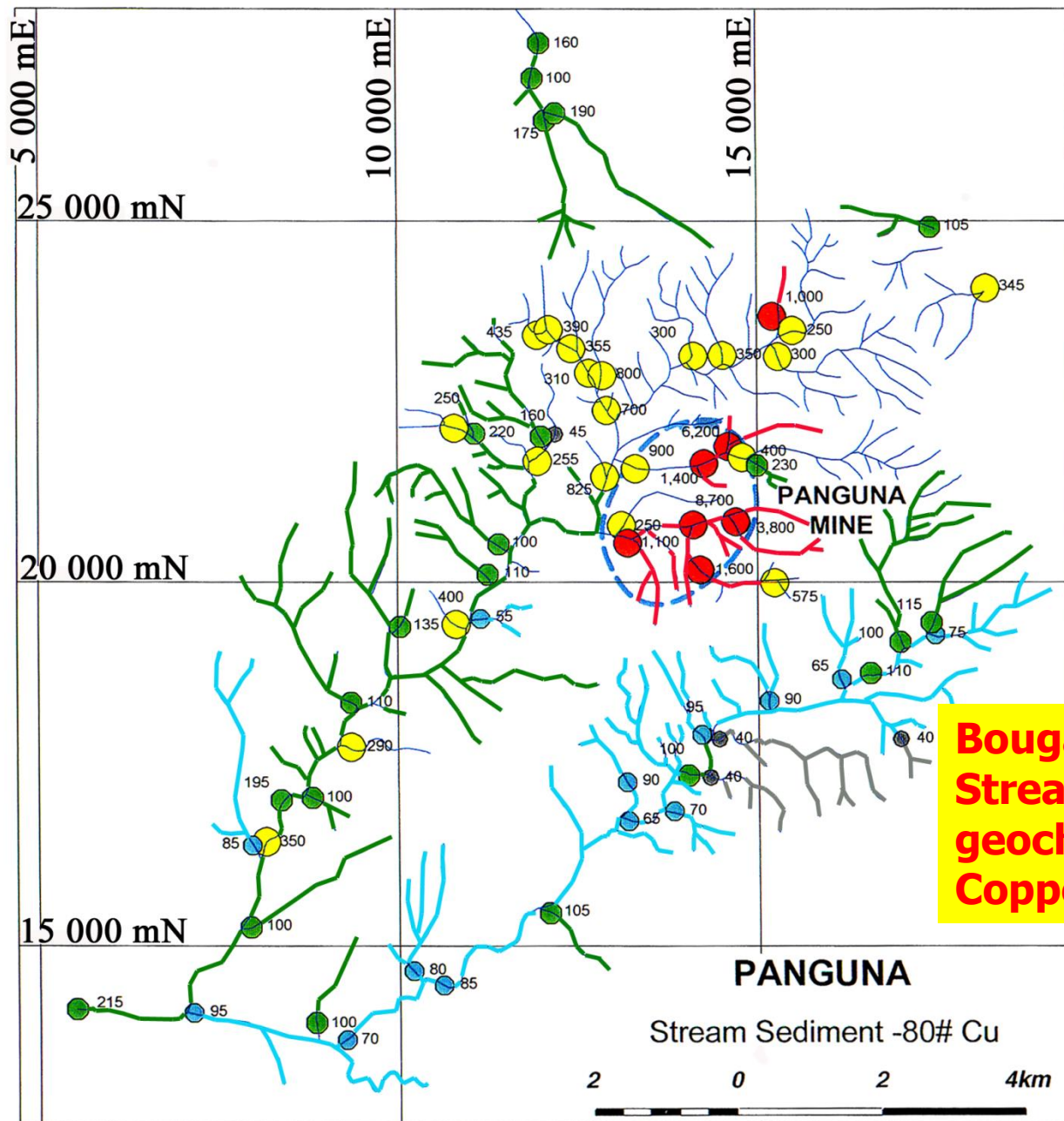




Above. Breccia pipe

Left. Bougainville intrusive containing quartz veinlets and limonite after pyrite and chalcopryite. Photo R. Lord 1970.

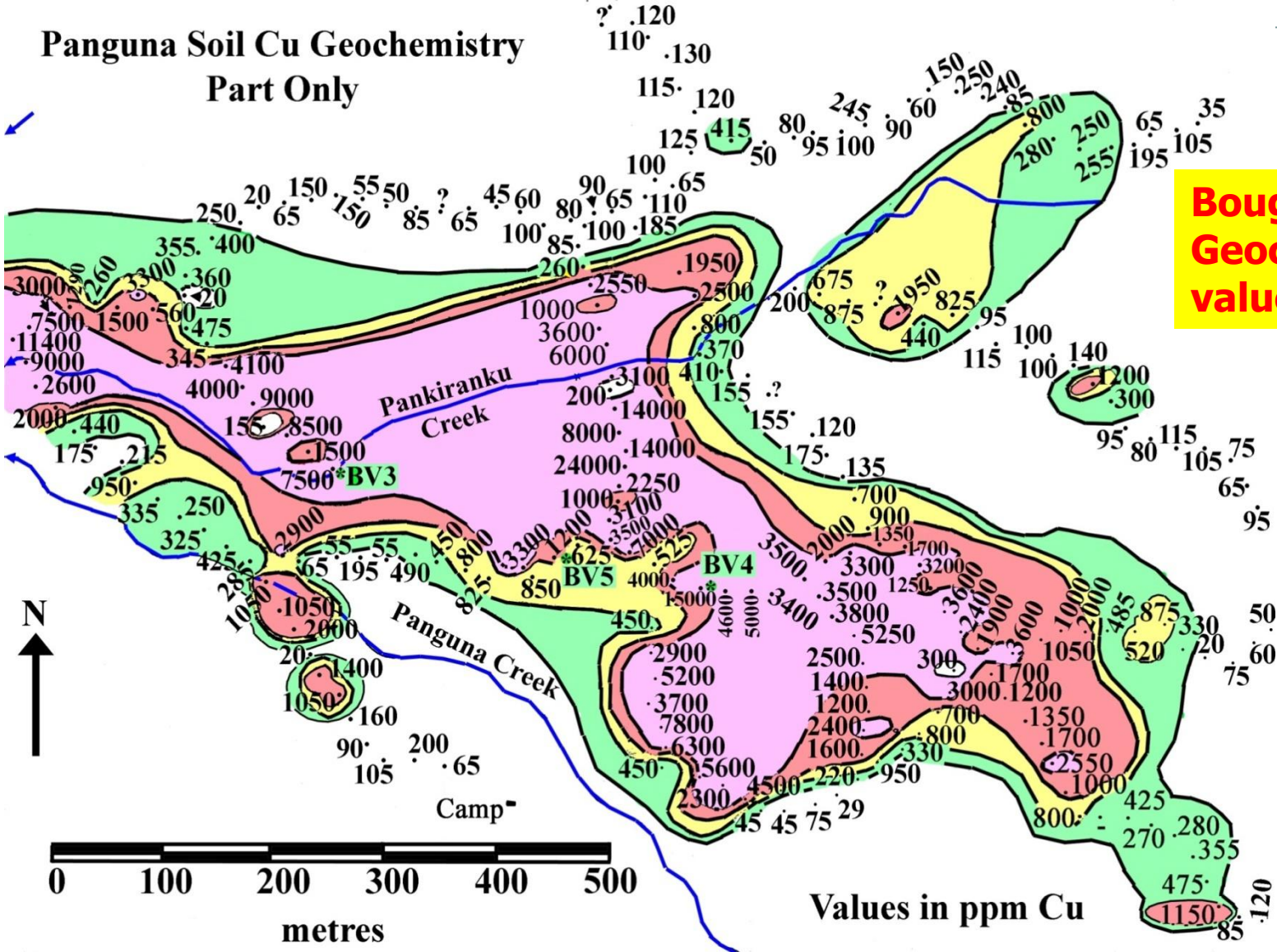




**Bougainville.  
Stream  
geochemistry.  
Copper values**



# Panguna Soil Cu Geochemistry Part Only





# Ok Tedi Copper–Gold mine

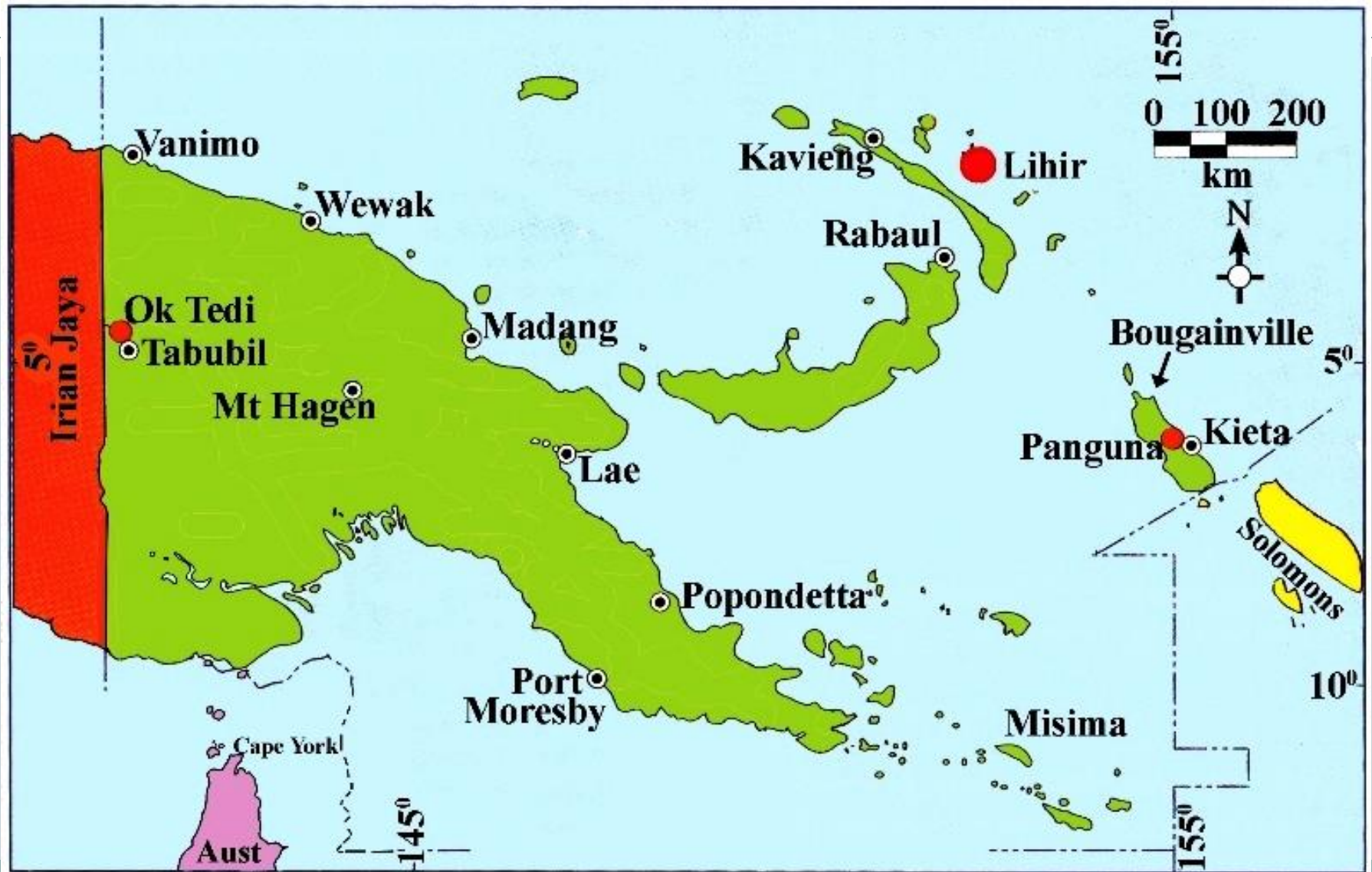
Papua New Guinea

1982 to present

- By end 2007 the mine had produced 3.6 million tonnes copper and 10.5 million ounces gold.
- Mineable reserves in May 1988 were 355 Mt at 0.67% copper and 0.61 g/t gold. In addition to leached cap ore of 2.7 Mt at 2.08 g/t gold.



# Ok Tedi-copper/gold







Kennecott geologist Gerry Rayner with 'locals' on the Strickland River, 1968.





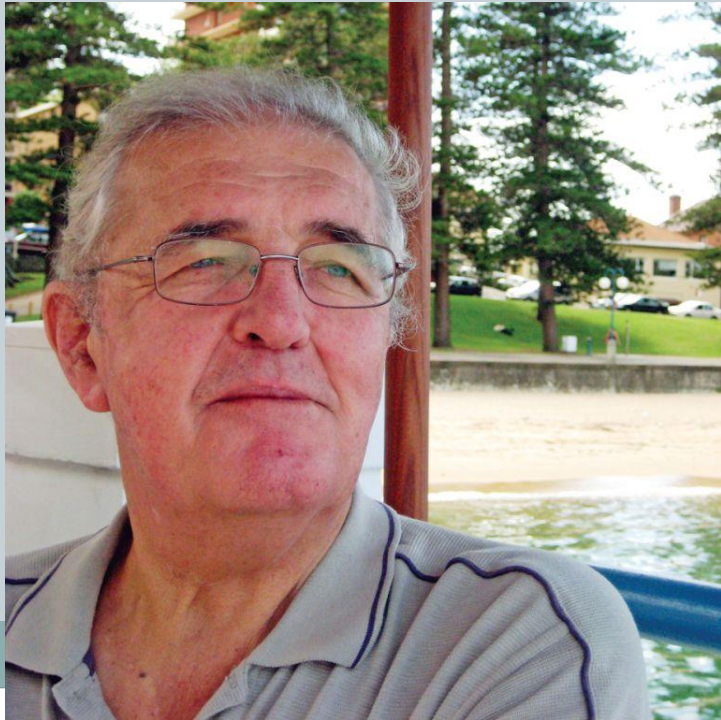
Old camp 1968. Shower  
and "self flushing" toilet







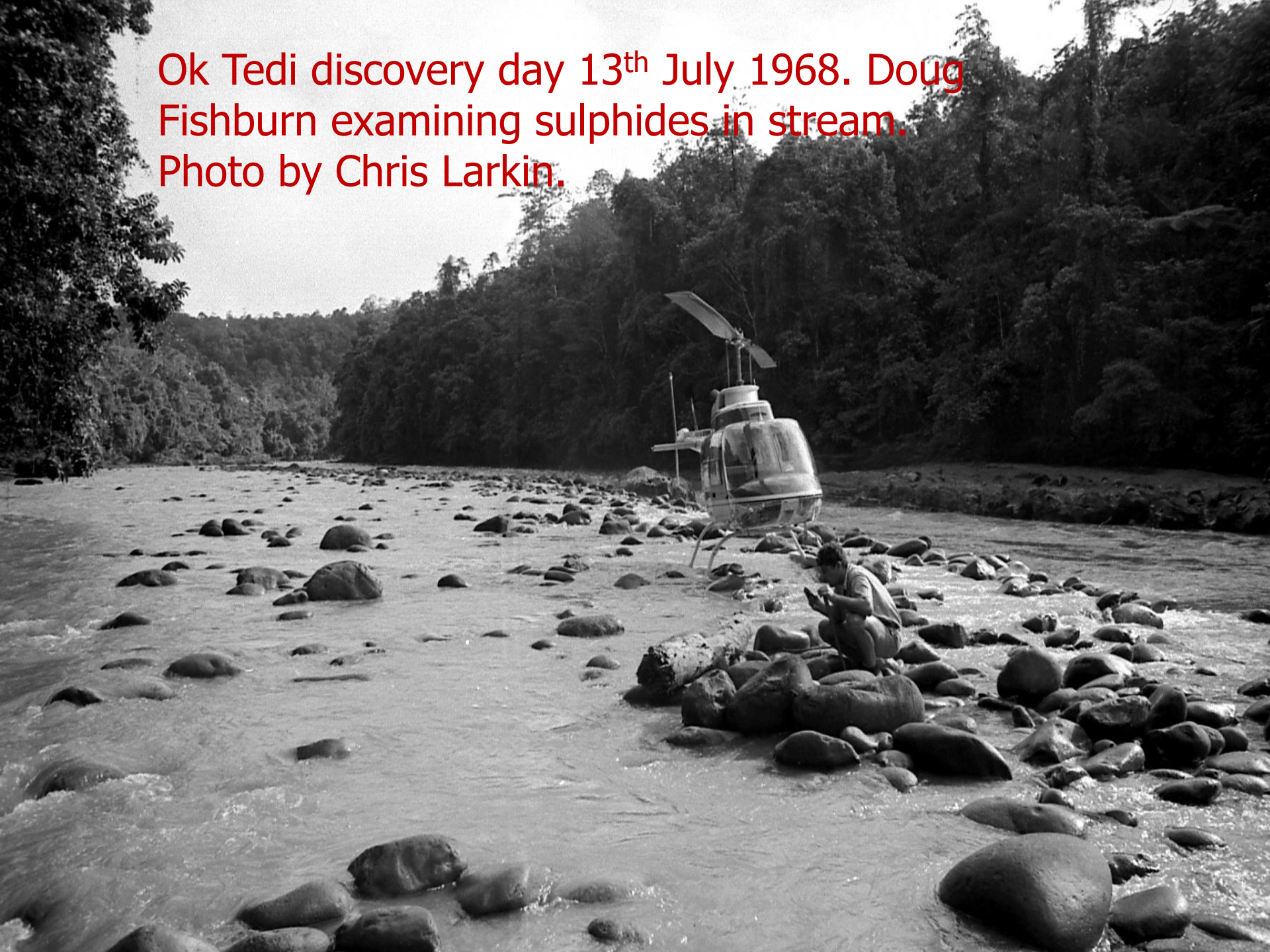
Geological exploration, Star Mountains



23 year old Geologist Doug Fishburn. Co-discoverer of Ok Tedi. 1968 and 2008.



Ok Tedi discovery day 13<sup>th</sup> July 1968. Doug Fishburn examining sulphides in stream.  
Photo by Chris Larkin.





Ok Tedi co-discoverer John  
Felderhoff 1968. Photo by  
Chris Larkin.



19 year old field assistant  
Chris Larkin







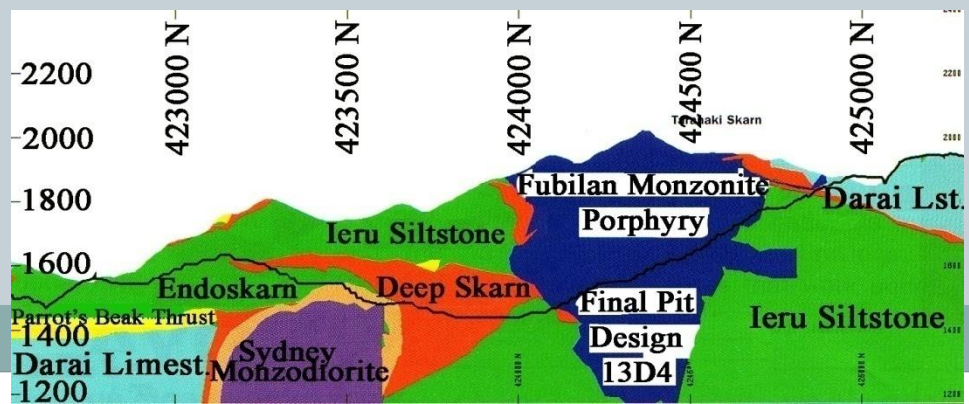
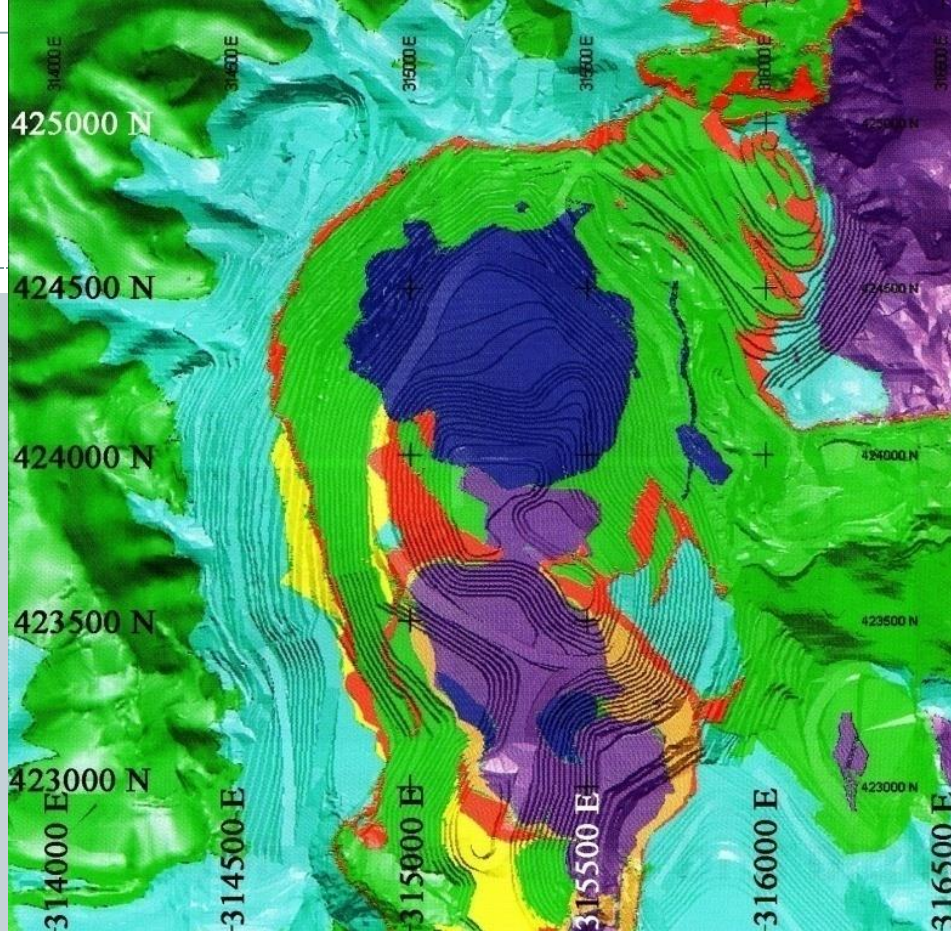
Mount Fubilan. C 1972 (photo by  
Russ Lord)



Diamond drill rig. 1969



**Ok Tedi geological  
plan and section,  
2008. (Smith and  
Shephard)**







Tabubil plateau 1971 and 2004





Ok Gilor in flood beside  
old camp, 1968





Contact between endoskarn and mineralised quartz porphyry.







3D model of Ok Tedi drill holes, 1978.



DDH-113 331.4-337.0





# Ok Tedi mine complex. 2008







Gold medallion struck from the first gold pour at Ok Tedi, 1984.





# **Lihir Gold mine**

Papua New Guinea 1982 to present



- **60 million ounces gold.**
- **1991. Sulphide resource 421 MT  
at 2.77g/t gold and oxide  
resource 4.3 MT at 2.55 g/t gold**



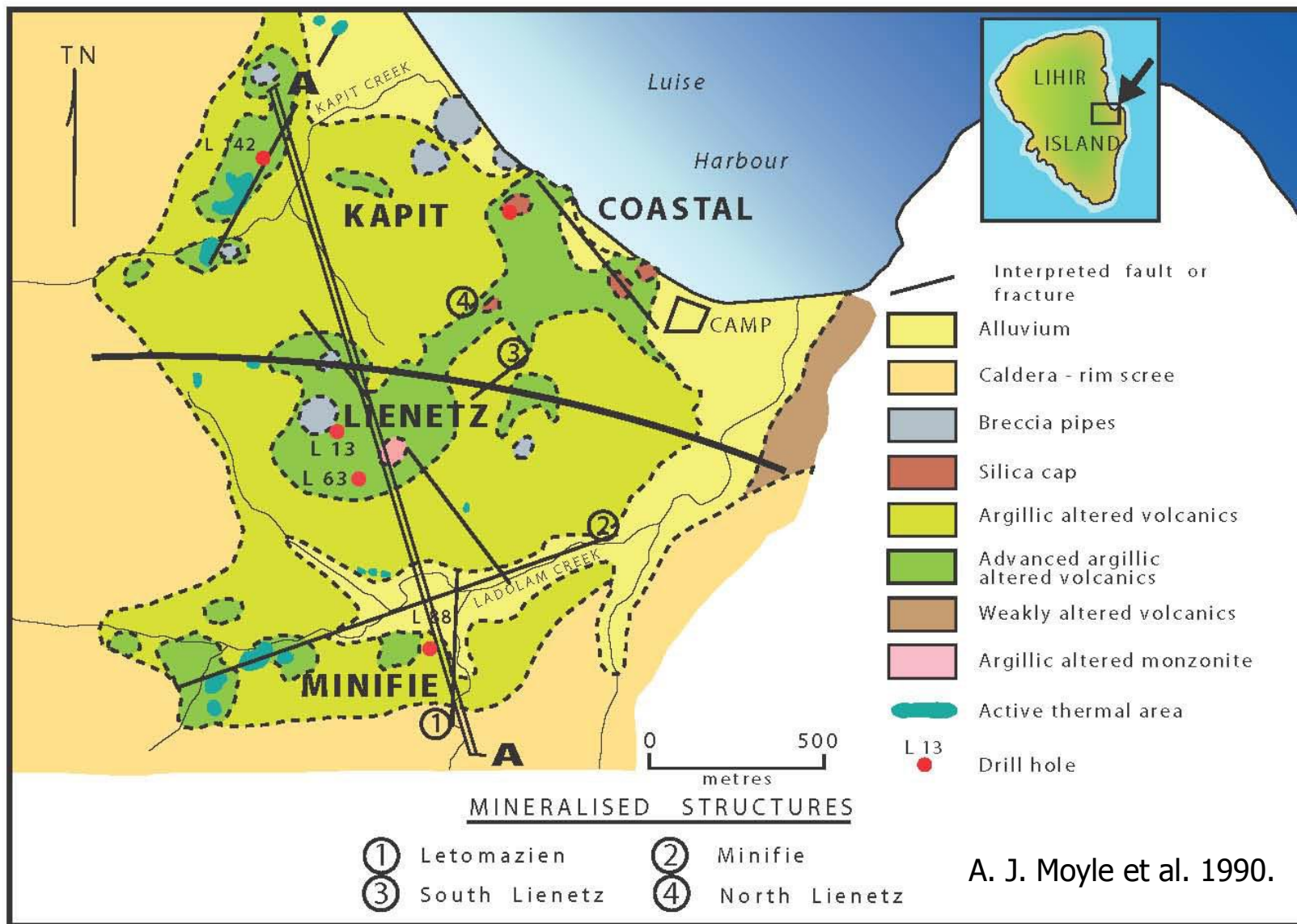
# Lihir-Gold















c 1987

## Louise Harbour before and during mining



c 2009



# First campsite on Lihir 1983







Aerial view of base camp, c1987





Kennecott Geologist Gavin Thomas panning gold at Lihir for Sir Julius Chan (PNG Prime Minister) and family. 1983







Discovery outcrop Lihir



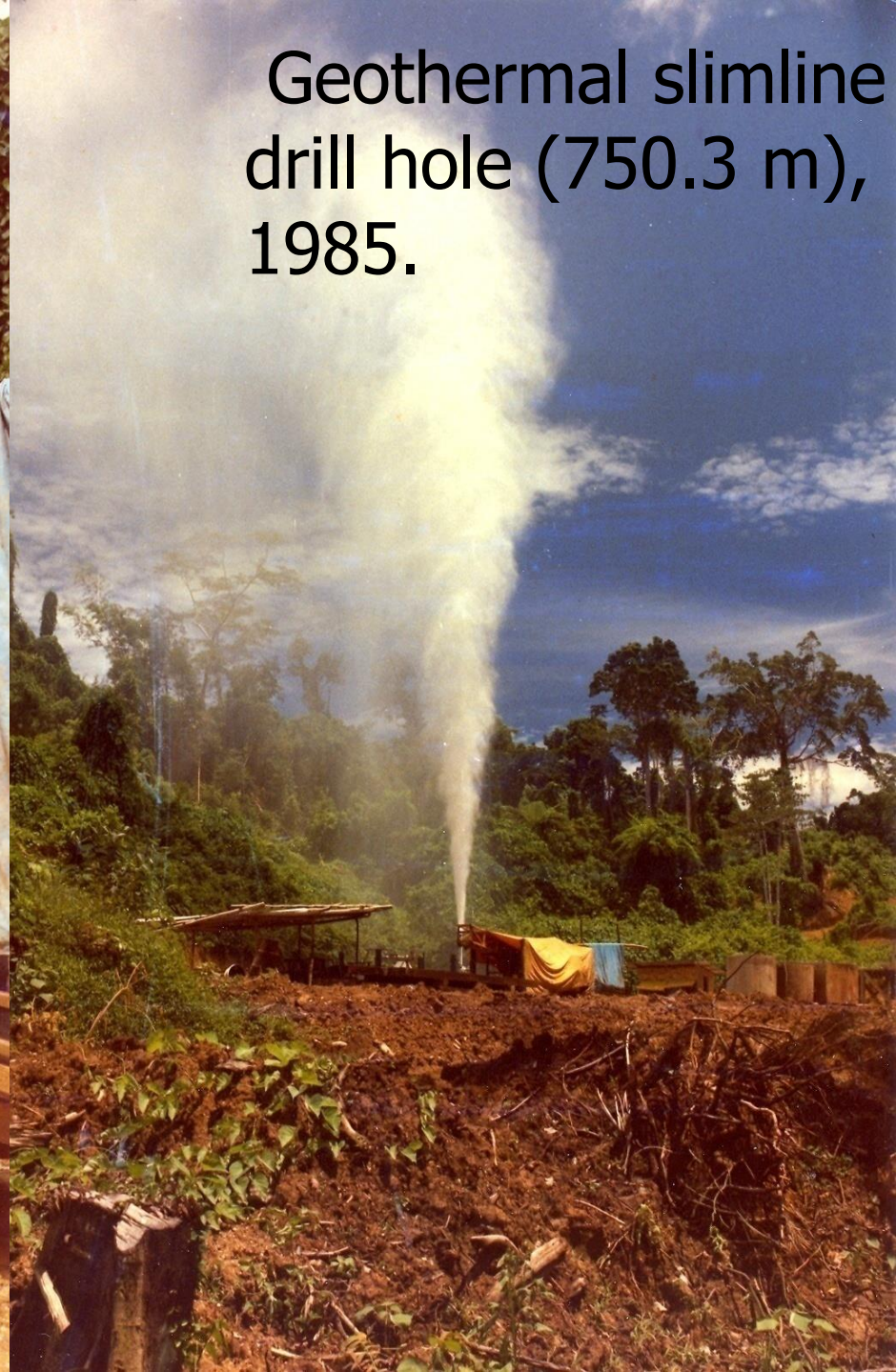
L-R: Gavin Newman, Russell Madigan, Peter McNab, Ken Rehder. Kainantu, c1980s





Beginning of discharge

Geothermal slimline  
drill hole (750.3 m),  
1985.







Geologist Sandy Moyle at hot spring used by locals for cooking c1984





One of many active geothermal sites, Kapiti 1986





A typical family prior to mining on Lihir, 1986





Greg  
Corbett,  
Mike  
Turbott  
& Rod  
Davies,  
c1986



Kennecott  
President – Frank  
Joklik, 1988

Graeme Minifie,  
c1985







Track mounted reverse  
circulation air core  
drill, c1987



Atop a drilling  
rig, c1985





Aerial view of  
Lienetz and  
Minifie Pits,  
2007

Londolovit town  
site, 2007







Local village  
(Putput),  
processing plant  
and mine, 2007

← Lihir plant site

Lihir  
processing  
plant, 2007







Alaia Rock



Luise Harbour

Lienetz Pit

Minifie Pit





Operating in area of geothermal activity, Lihir





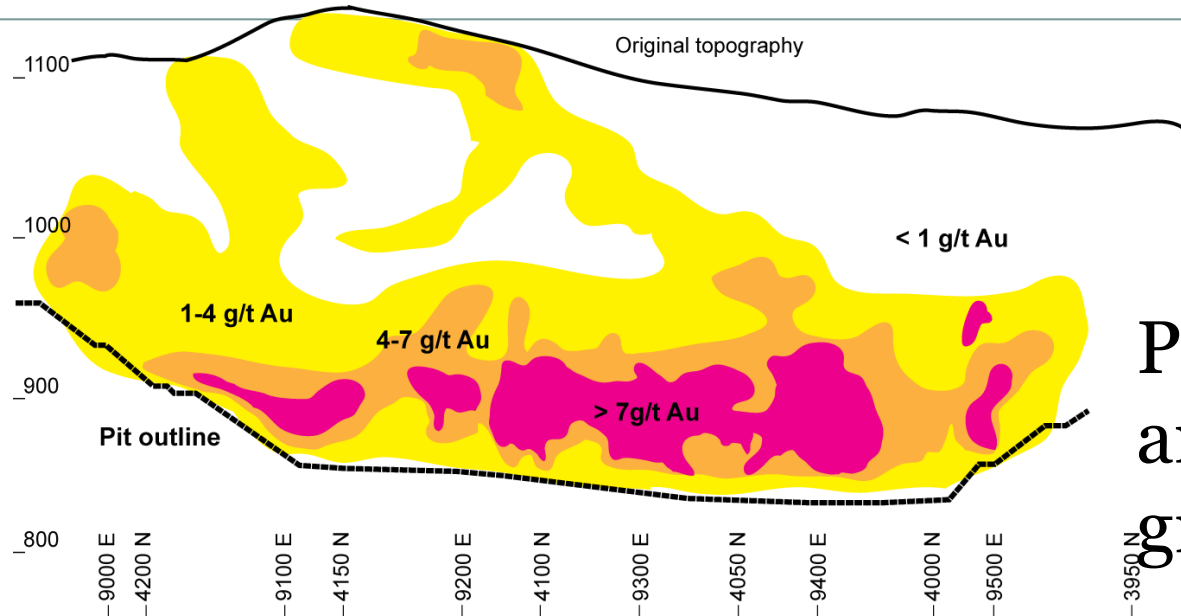
Damage caused by the geothermal outburst of 30 April 2006



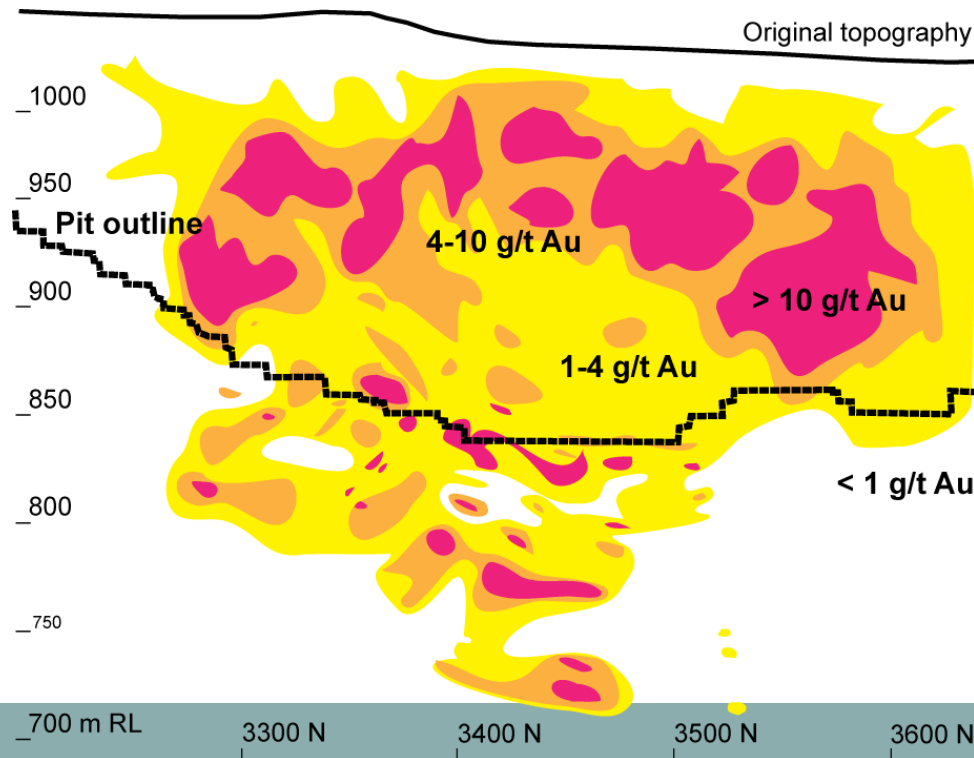


Geothermal outburst





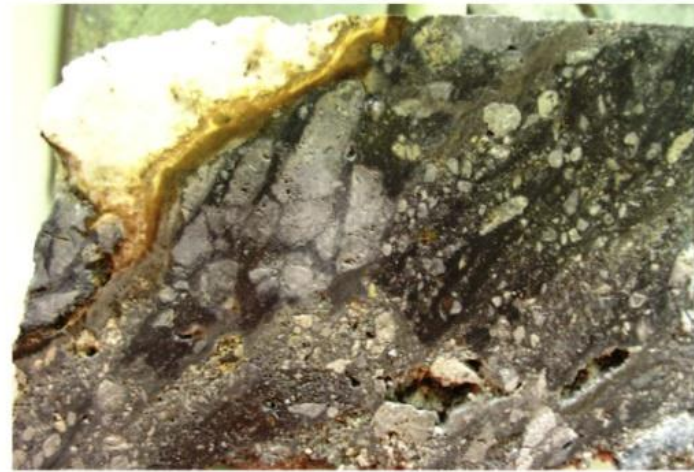
Pit sections  
and gold  
grades, c2008







Anhydrite crystals



Crackle and fluidised breccia



? Tree clast in breccia



Diorite with pyrite selvages and potassic alteration





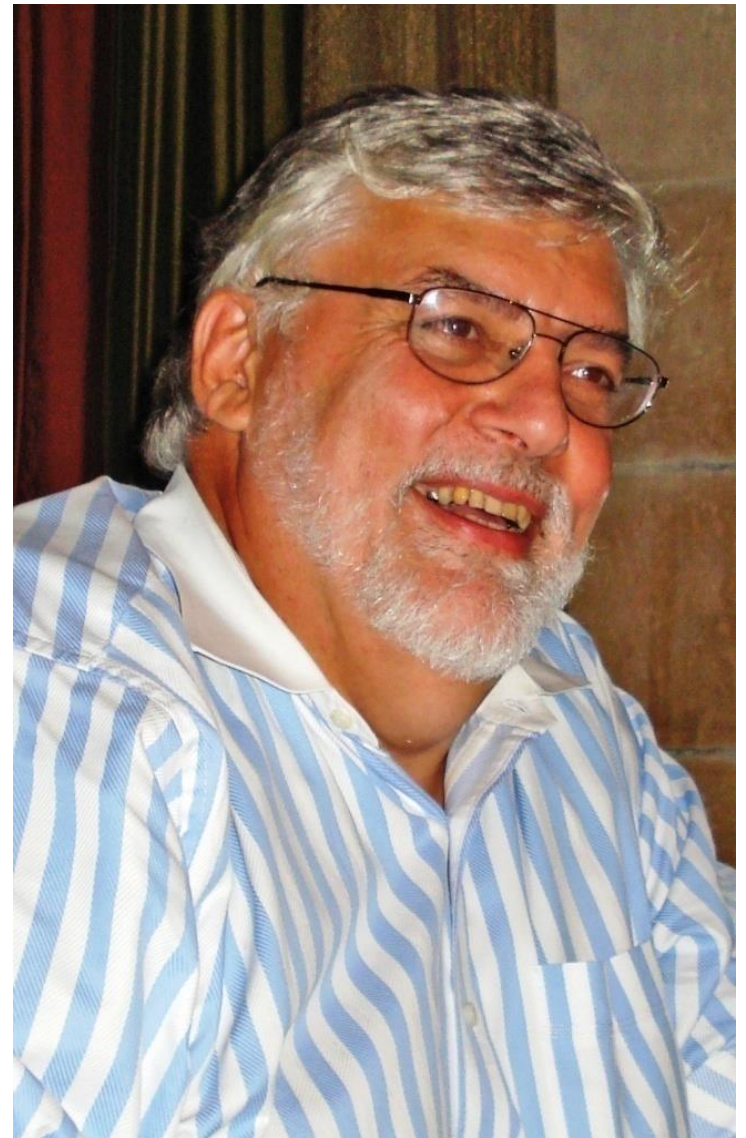
Drill hole L188, 129-134.5m showing intense potassic alteration, crackle breccia and quartz-filled structures associated with high gold grades, 1989





Lihir project reunion in Sydney, December 2010





Pioneers of the Lihir discovery – Michael Turbott and Gavin Thomas. Photos 2010.





Working on Lihir geology.  
PhD students at CODES,  
University of Tasmania,  
2009.





# THE END

