

RESTRICTED INVESTIGATION REPORT 1409R

Collection

CSIRO

INSTITUTE OF ENERGY AND EARTH RESOURCES

Division of Mineralogy

MICROFILMED

LEAD ISOTOPE INVESTIGATION OF THE LAKE SELINA PYRITE PROSPECT,
TASMANIA

OPEN FILE

Brian L. Gulson and Patricia M. Porritt

AMIRA Project 78/P97A

73-976

73-976

*Tyndall
Lake Selina
Pyrite*

MINES	
File Ref. E.L. 9/66	
- 9 APR 1990	
Doc. Ref.	
Action Officer	Initials
Refer to Fowd	
44 (File No 10)	
Resubmit to	Date

GOLD FIELDS	
No.	0 EF2 LC
MENT No.	
LOCATION	Bx T5

P.O. Box 136
North Ryde NSW
Australia 2113

April, 1983

Distribution List

Mr. L. Newnham, Goldfields Exploration Pty. Ltd., P.O. Box 835 Burnie
7320

Mr M. Jones, Goldfields Exploration Pty. Ltd., 1 Pirie St., Fyshwick
A.C.T.

Mr I. Newnham, Director, CSIRO IEER

Mr A. Gaskin

Dr R.A. Binns

Dr B.L. Gulson

Dr M. Vaasjoki

Mrs P.M. Porritt

Records

OPEN FILE

TABLE OF CONTENTS

	Page
SUMMARY	1
1. INTRODUCTION	2
2. SAMPLING (TECHNIQUES)	3
3. RESULTS	3
3.1. Initial Study	3
3.2. Later Study	5
4. DISCUSSION	6
4.1. Exploration Aspects	6
4.2. Genesis	6
4.3. Isotope Systematics	7
5. FUTURE WORK	7
6. ACKNOWLEDGEMENTS	8
7. REFERENCE	8

LIST OF TABLES

- Table 1. Lead isotopic parameters for samples from Lake Selina
- Table 2. Pb, U, Ba and P concentrations for whole rock samples from Lake Selina.

LIST OF FIGURES

- Figure 1 Location of diamond drill holes in the Lake Selina prospect
- Figure 2 $^{207}\text{Pb}/^{204}\text{Pb}$ vs $^{206}\text{Pb}/^{204}\text{Pb}$ diagram for analyses from Lake Selina. Group 3 denote separated pyrites and Group 1 denote bulk samples. The dashed line is the average growth curve for massive sulfides. The bars in the upper left corner represent the 2 sigma errors given in the text. The boxes are the reference points from Rosebery and Que River.
- Figure 3 $^{208}\text{Pb}/^{204}\text{Pb}$ vs $^{206}\text{Pb}/^{204}\text{Pb}$ diagram for analyses from Lake Selina.

SUMMARY

Lead isotopic analyses have been completed of bulk samples and pyrite from seven diamond drill holes covering a strike length of about 6km from the Lake Selina pyrite prospect, Tasmania. The isotopic data for the bulk samples and separated pyrite are similar and so bulk samples are satisfactory for such investigations.

Two samples have radiogenic isotopic compositions with $^{206}\text{Pb}/^{204}\text{Pb}$ ratios of 18.56 and 18.86 and are probably the result of radioactive decay. A third sample has ratios which have closer isotopic affinities with later vein-style mineralization.

The remainder of the 31 samples have isotopic compositions which lie within the range for massive sulfide deposits in the Mt Read Volcanics, i.e. with $^{206}\text{Pb}/^{204}\text{Pb}$ ratios from 18.26-18.34. These results indicate that the Lake Selina mineralization forms part of a major hydrothermal system, similar to that which formed the massive sulfide deposits such as Rosebery and Mt Lyell.

The lead isotopic data are highly encouraging from an exploration viewpoint and it is disappointing, as it is for the companies, that no major base metal accumulations have been intersected.

Apart from the more radiogenic samples in the shallow parts of two diamond drill holes, no drilling vectors can be established, particularly in a lateral direction.

The lead isotopic data indicate that the ultimate source "age" of the volcanics and mineralization is more than 1000 Ma.

1. INTRODUCTION

Our knowledge of the isotopic characteristics of massive iron sulfide and disseminated base metal sulfide systems is limited. Following a field trip to Mt Lyell and an AIMM meeting in 1981, it was suggested by Russell Meares and Peter Komysan of Mt Lyell Mining and Railway Co. that the Lake Selina prospect would constitute a worthwhile case history. It is part of the AMIRA project 78/P97A on behalf of the sponsors Goldfields Exploration and Getty Minerals. This prospect, 10km due east of the Hercules deposit was considered to be an extensive zone of disseminated and veinlet pyrite (700 x 150m) in strongly sheared and chloritized felsic lavas and tuff (Reid and Meares, 1981). The Selina zone occurs in a belt about 100m wide over a strike length of some 6 km. Its surface expression consisted of old workings on disseminated pyrite-chalcopyrite and veinlet pyrite-magnetite mineralization. The mineralization produced a strong I.P. anomaly but a weak soil geochemical anomaly (Reid and Meares, 1981). Eight diamond holes, to depths of about 300m, were drilled into this prospect.

Ten samples were initially analysed, but upon finding that six contained a Rosebery-type isotopic signature, it was considered necessary to do a follow-up investigation of the interesting holes. This was achieved by analysing three samples from each hole to check the isotopic homogeneity over a wider interval. The reasoning behind the additional study was that even though isolated galena-rich mineralization of the Rosebery-style would produce the target signature, the signature obtained from disseminated base-metal mineralization should be different, reflecting the variable U/Pb ratios in chalcopyrite, pyrite, iron oxides and the host rocks.

This investigation now assumes a more important role in view of the necessity of the Goldfields-Getty Joint Venture to relinquish about 75% of their exploration licence.

2. SAMPLING/TECHNIQUES

Seven pyrite-rich samples from diamond drill holes and 3 surface rock chip samples over a strike length of about 6 km were initially investigated. Because of the nature, and our limited knowledge of this style of mineralization we analysed both pyrite separates and the bulk samples. Additional samples from the interesting holes were kindly supplied by Gerald Purvis; only bulk samples were analysed as little difference was noted between the isotopic ratios in the bulk sample and pyrite in most cases.

Lead from pyrite was separated using our standard techniques of ion exchange and electrodeposition. The whole rocks were leached using 7N HNO₃/7N HCl and separated as for pyrite.

All isotope ratios were measured on the Isomass 54E and a precision of $\pm 0.1\%$ (2σ) for the $^{208}\text{Pb}/^{206}\text{Pb}$ and $^{206}\text{Pb}/^{204}\text{Pb}$, and $\pm 0.05\%$ (2σ) for the $^{207}\text{Pb}/^{206}\text{Pb}$ ratios has been assigned to the data based on over 400 measurements of the international standards NBS SRM 981 and Pb 18 and natural samples. The 2 sigma error bars are given in the ratio plots. The data given in Table 1 have been normalized to "absolute" using a correction of + 0.08% a.m.u. Lead concentrations were obtained by A.A.S. and uranium by delayed neutron activation analysis.

3. RESULTS

3.1. Initial Study

Except for samples 27393 and 27398, the isotopic ratios in pyrite and the bulk sample are similar, and consequently it is not worthwhile separating pyrite for this type of study. The discrepancy in 27393 may be due to contamination of the bulk sample during crushing as it only contains 20 ppm Pb and the ratios for the pyrite are similar to the target signature.

For purposes of discussion, the samples are grouped into two belts, an easterly one incorporating 27403-27393-27347-27384 and a westerly one covering 27401-27400-27399-27402-27397-27398.

Three of the four samples (27347, 27384, 27393) from the easterly belt are surface rock chip samples and have isotope ratios which lie within the range we have measured for Rosebery-style mineralization including Que River, Rosebery, Hercules and the Lyell-Comstock lode. In view of the low Pb concentrations in 27347 (50 ppm) and 27393 (20 ppm), the high Pb concentrations in 27384 (1900 ppm), the overall isotopic homogeneity, and the fact that three of the four samples are surface chips, indicates that this belt warrants further exploration.

The deviating sample, 27403, has significantly more radiogenic isotope ratios and in view of its high Pb concentration is unlikely to be the result of radioactive decay.

The isotopic pattern for the westerly belt is more complex. Samples 27397-27398-27400 have the target isotopic signatures even in the case of 27398 which contains only 20 ppm Pb and 4.2 ppm U. Samples 27397 and 27398 are the most southerly samples and are located more than 1km from 27402. With their target signatures, these samples from the Rolleston sheet form an interesting group.

Sample 27402 contains 1700 ppm Pb and its isotopic ratios are much more radiogenic than those of the target. With $^{206}\text{Pb}/^{204}\text{Pb}$ ratios of 18.42 in both pyrite (3400 ppm Pb) and the bulk sample (1700 ppm Pb), the mineralization in this intersection has closer isotopic affinities with vein-style mineralization we have measured in the Mt Read volcanic belt.

Samples 27399 and 27401 have even more radiogenic isotopic compositions with $^{206}\text{Pb}/^{204}\text{Pb}$ ratios of 18.56 and 18.86. However, they contain significant amounts of U relative to Pb and their radiogenic nature may be due to radioactive decay.

3.2 Later Study

Confronted with a number of samples with isotopic compositions within the range of the target signature of Rosebery-style mineralization, further high-Pb samples from the interesting holes were requested and analysed.

Most of the new samples have isotopic compositions which lie within the target range from 18.26 to 18.34, including the "fill-in" samples (259...series) between LS1 and LS7. It is of interest that in each hole one sample has the most radiogenic ratios (e.g. highest $^{206}\text{Pb}/^{204}\text{Pb}$ ratio). However, no correlation with depth in the holes, mineralization or Pb concentration could be deduced.

A single sample of baryte ore from Rosebery has isotope ratios which are similar to the more radiogenic samples ($^{206}\text{Pb}/^{204}\text{Pb}$ 18.34) in the Selina holes. All new samples were analysed for Ba and P (Table 2) in order to establish if the Selina samples were associated with a Ba-rich or apatite-rich horizon, but no correlation between Ba-P-isotopic composition was obvious.

It was stated above that three of the initial samples contained radiogenic isotope ratios; 27401 from LS 6, 27399 from LS 4 and 27402 from LS 7. The low Pb and relatively high U concentrations in 27401 and 27399 may explain the radiogenic nature of these two samples but it is highly unlikely that the ratios in 27402 could be affected by radioactive decay. 27402 is possibly later vein-style mineralization as we have found radiogenic veins in a massive sulfide deposit in Tasmania. That the radiogenic nature of 27401 and 27399 results from radioactive decay is supported by the additional drill core samples from LS 4 and LS 6, whose isotopic compositions lie within the target range.

Although the data are limited, it would seem that the higher U/Pb samples with their more radiogenic ratios are found in the shallower parts of the drill holes.

008

4. DISCUSSION

4.1 Exploration Aspects

Except for 27402 from LS 7 (? possibly vein-style) and the two samples (27401, 27399) whose ratios may be explained by radioactive decay, the isotopic compositions of the drill core and the surface samples from the eastern pyrite belt lie within the target range for Rosebery-style mineralization. This indicates that the Selina mineralization forms part of a major hydrothermal system, similar to that which gave rise to the massive sulfide deposits but different to that of the later vein mineralization such as Mt Farrell, Murchison River and Queen Hill.

Even though the isotopic compositions are highly encouraging and are indicative of a large-scale hydrothermal system, no major base-metal accumulation has been intersected to date. If future exploration is similarly negative, it would appear that the limitation of the Pb isotope technique has been reached as at Harnet and Breadalbane. Apart from the less interesting isotopic compositions in the shallower parts of the drill holes, it is not possible to establish other drilling vectors, particularly in a lateral direction.

4.2 Genesis

It has been suggested that the mineralization at Selina was derived by groundwater circulation in the host rocks in response to granitic intrusion (M. Hutton, pers. comm., 1982). Because of the similarity in isotopic composition of the Selina mineralization and Rosebery-style, it is necessary that any hydrothermal system involves Cambrian granites rather than Devonian granites or a post Cambrian metamorphism, as in the latter two cases the leads could be expected to be more radiogenic and different to those of the massive sulfide ores in the Mt Read Volcanics.

4.3 Isotope Systematics

When plotted on the conventional $^{207}\text{Pb}/^{204}\text{Pb} - ^{206}\text{Pb}/^{204}\text{Pb}$ diagram (Fig. 2a) representing the U-Pb system, the data define a linear trend. This may be interpreted to indicate that all samples were formed within the same limited time interval (probably at least 50 Ma). An apparent "age" can be calculated from the slope of this array or from the intercept on a $^{207}\text{Pb}/^{206}\text{Pb} - ^{204}\text{Pb}/^{206}\text{Pb}$ plot. On the latter plot, the apparent "age" is ~ 1100 Ma (MSWD 0.4). This is, of course, not the stratigraphic age, which should be Cambrian, but represents a minimum estimate of the ultimate source "age" of the Pb. We have determined similar estimates at Que River and Elliott Bay.

On diagrams representing the Th-U-Pb system such as the $^{208}\text{Pb}/^{204}\text{Pb} - ^{206}\text{Pb}/^{204}\text{Pb}$ plot (Fig. 2b), both the pyrite and bulk samples for 27399 and 27401 do not lie on the same linear trends as the other samples. This may be interpreted to mean that these samples were derived from sources with different Th/U ratios or that there was differential mobility of Th and U between the extraction from source material and emplacement. In both cases, these samples are from the shallowest depths and it may be that the rocks and inherent pyrite were derived from a different source to that mineralization occurring in deeper parts of the pile.

5. FUTURE WORK

Little can be achieved by further Pb isotopic analyses from Selina at the present time. It may be worthwhile to analyse some of the pyrites for S isotopes.

The analyses of sulfide separates from Mt Lyell are nearing completion and should permit valuable comparisons with prospects such as Selina.

Other studies at Red Hills, Henty Fault zone and Clarke Valley are proposed.

6. ACKNOWLEDGEMENTS

We wish to thank G. Hansen and his group for the mineral separations and rock crushing; J. Eames and his group for the Pb, Ba, and P determinations; Michael Korsch for maintenance of the mass spectrometer and excellent software developments; and Russell Meares, Murray Hutton, Gerald Purvis, Peter Komysan and Mel Jones for the samples and geological discussions.

7. REFERENCE

Reid, K.O. and Meares, R.M.D., 1981. Exploration for volcanic-hosted sulfide deposits in Western Tasmania. *Econ. Geol.* 76, 350-364.

Lead isotopic analyses have been completed of bulk samples and pyrite from seven diamond drill holes covering a strike length of about 6km from a massive pyrite prospect, in the Goldfields-Getty Joint Venture area, Tasmania. The isotopic data for the bulk samples and separated pyrite are similar and so bulk samples are satisfactory for such investigations.

Two samples have radiogenic isotopic compositions with $^{206}\text{Pb}/^{204}\text{Pb}$ ratios of 18.56 and 18.86 and are probably the result of radioactive decay. A third sample has ratios which have closer isotopic affinities with later vein-style mineralization.

The remainder of the 31 samples have isotopic compositions which lie within the range for massive sulfide deposits in the Mt Read Volcanics, i.e. with $^{206}\text{Pb}/^{204}\text{Pb}$ ratios from 18.26-18.34. These results indicate that the mineralization forms part of a major hydrothermal system, similar to that which formed the massive sulfide deposits such as Rosebery and Mt Lyell.

The lead isotopic data are highly encouraging from an exploration viewpoint.

Apart from the more radiogenic samples in the shallow parts of two diamond drill holes, no drilling vectors can be established, particularly in a lateral direction.

The lead isotopic data indicate that the ultimate source "age" of the volcanics and mineralization is more than 1000 Ma.

TABLE 1: ISOTOPIC PARAMETERS FOR SAMPLES FROM LAKE SELINA

Sample	208/206	207/206	206/204	207/204	208/204	Pb(ppm)
LAKE SELINA PYRITE						
27347	2.0872	0.8534	18.311	15.626	38.219	10
27393	2.0886	0.8551	18.261	15.615	38.140	10
27397	2.0857	0.8532	18.316	15.627	38.203	1,000
27398	2.0904	0.8566	18.243	15.627	38.135	190
27399	2.1042	0.8411	18.592	15.638	39.121	10
27400	2.0867	0.8542	18.280	15.615	38.145	1,700
27401	2.0332	0.8331	18.780	15.646	38.183	420
27402	2.0833	0.8512	18.360	15.627	38.248	3,400
27403	2.0794	0.8480	18.419	15.620	38.302	2,260
LAKE SELINA WHOLE ROCKS						
27347	2.0876	0.8531	18.292	15.604	38.186	50
27384	2.0863	0.8545	18.248	15.593	38.071	1,900
27393	2.0945	0.8596	18.133	15.587	37.978	20
27397	2.0845	0.8531	18.302	15.613	38.152	390
27398	2.0826	0.8507	18.346	15.607	38.207	20
27399	2.1414	0.8419	18.561	15.626	39.747	20
27400	2.0865	0.8541	18.272	15.606	38.125	850
27401	2.0267	0.8302	18.858	15.656	38.219	550
27402	2.0788	0.8479	18.423	15.621	38.297	1,700
27403	2.0827	0.8511	18.356	15.622	38.230	3,900
LS2 600'	2.0822	0.8522	18.327	15.618	38.160	500
LS2 665'	2.0868	0.8546	18.268	15.612	38.122	500
LS2 680'	2.0873	0.8549	18.266	15.616	38.127	900
LS3 265'	2.0851	0.8539	18.268	15.599	38.091	11,600
LS3 275'	2.0868	0.8547	18.266	15.612	38.117	21,300
LS3 360'	2.0811	0.8511	18.343	15.612	38.174	10,100
LS4 790'	2.0705	0.8442	18.496	15.614	38.296	300
LS4 975'	2.0800	0.8517	18.299	15.585	38.062	500
LS5 480'	2.0844	0.8535	18.272	15.595	38.086	3,100
LS5 655'	2.0819	0.8520	18.335	15.621	38.172	960
LS5 835'	2.0856	0.8539	18.272	15.602	38.108	1,600
LS6 275'	2.0816	0.8514	18.338	15.613	38.172	700
LS6 915'	2.0852	0.8533	18.292	15.609	38.142	800
LS6 920'	2.0862	0.8540	18.258	15.592	38.090	1,100
LS8 21.0m	2.0859	0.8539	18.272	15.602	38.114	840
LS8 225m	2.0815	0.8504	18.375	15.626	38.248	1,150
LS8 345m	2.0870	0.8538	18.281	15.608	38.152	920
2590	2.0888	0.8555	18.264	15.625	38.150	
2591	2.0867	0.8549	18.257	15.608	38.097	
2592 Gn	2.0885	0.8553	18.255	15.614	38.126	
MT READ MIN REF PTS						
QUE RIVER	2.0820	0.8520	18.337	15.623	38.178	
ROSEBERY	2.0842	0.8538	18.276	15.604	38.091	

TABLE 2 Pb, U, Ba and P concentrations for whole rock samples from Lake Selina

Sample No.	Pb ppm	U ppm	Ba ppm	P ppm
27347	50	0.3		
27384	1900	6.6		
27393	20	0.7		
27397	390	2.2		
27398	20	4.2		
27399	20	3.1		
27400	850	4.8		
27401	550	35.1		
27402	1700	4.9		
27403	3900	2.3		
LS 2 600'-605'	500		2280	305
LS 2 665'-670'	500		417	462
LS 2 680'-685'	900		832	471
LS 3 265'-270'	1.16%		2780	140
LS 3 275'-280'	2.13%		1690	227
LS 3 360'-365'	1.01%		1520	157
LS 4 680'-685'	400		1190	209
LS 4 790'-795'	300		1940	593
LS 4 975'-980'	500		3530	279
LS 5 480'-485'	3100			
LS 5 655'-660'	960		3570	166
LS 5 835'-840'	1600			
LS 6 275'-280'	700		1030	148
LS 6 915'-920'	800		970	977
LS 6 920'-925'	1100		1390	567
LS 8 21.0-23.6m	840		2490	524
LS 8 225-226m	1150		875	628
LS 8 345-350m	920		513	52

Mt Murchison

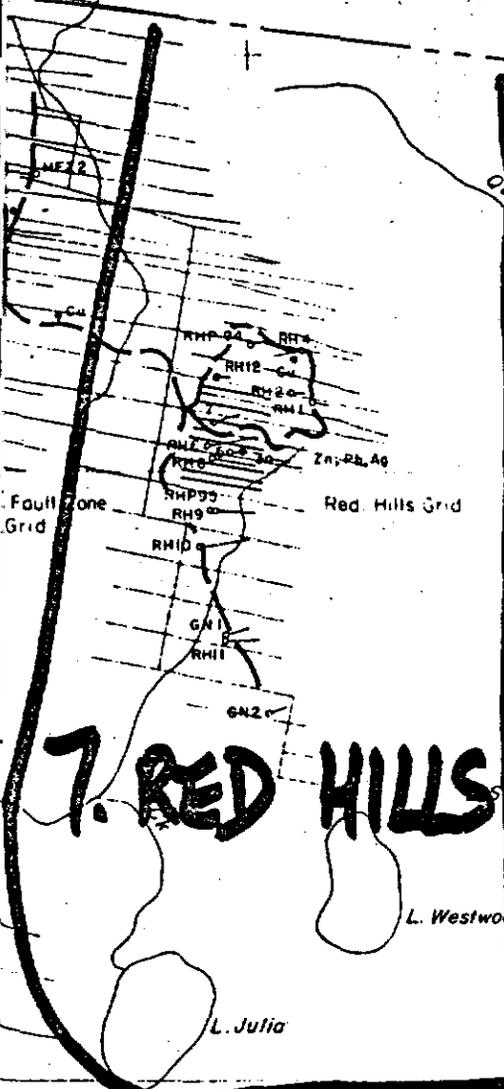
5 cm

014

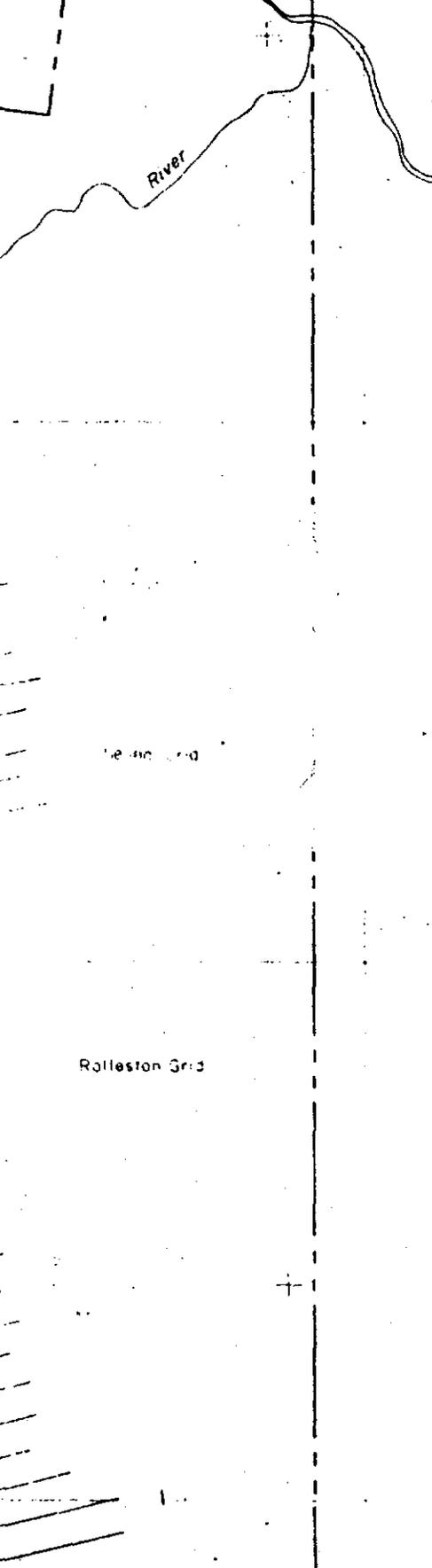
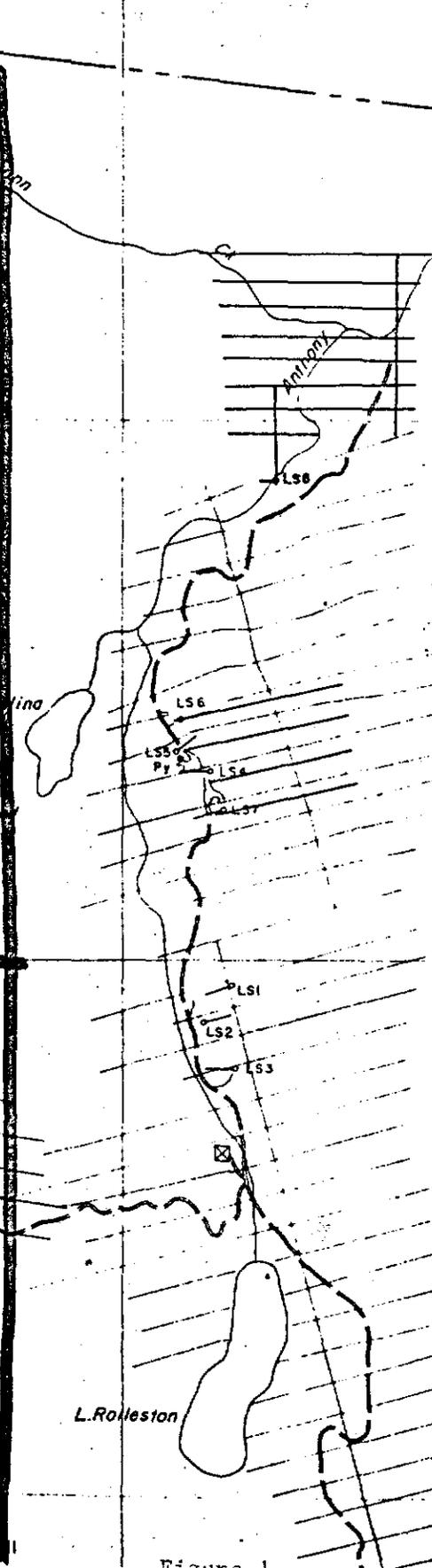
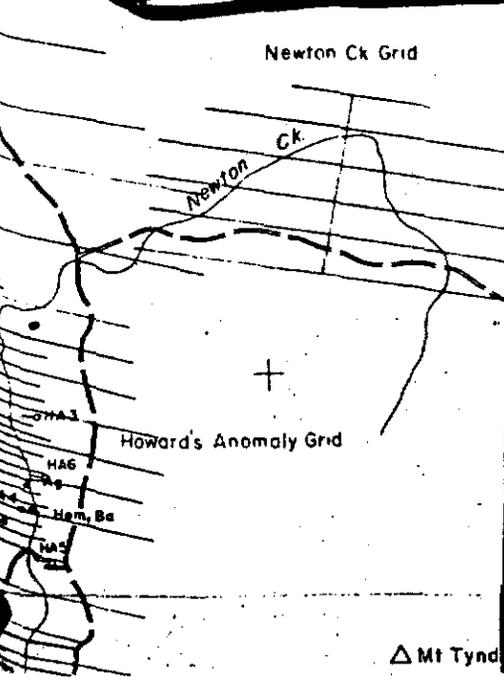
658015

Fig 1.

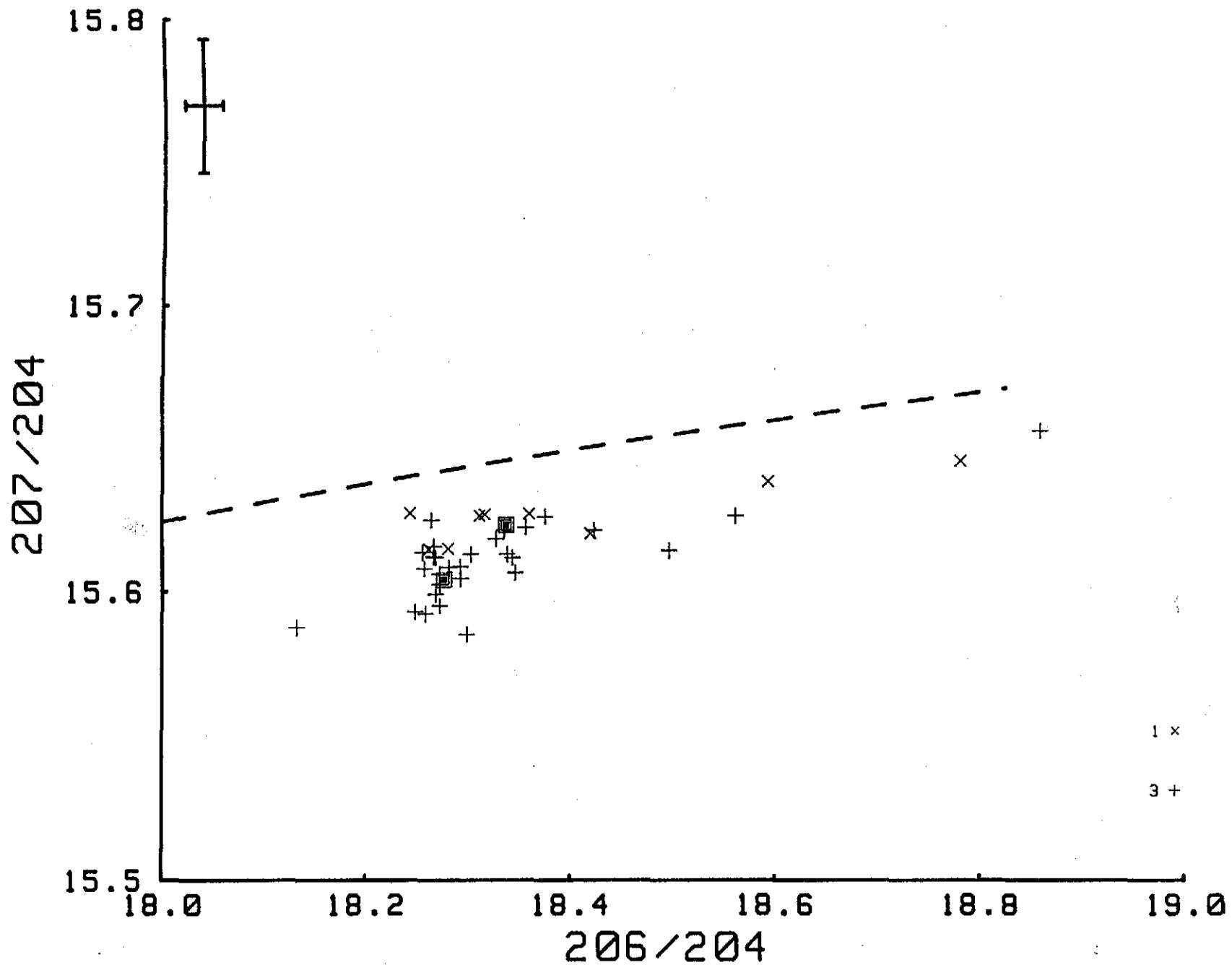
EL9/66A



7. RED HILLS



△ Mt Tyndal



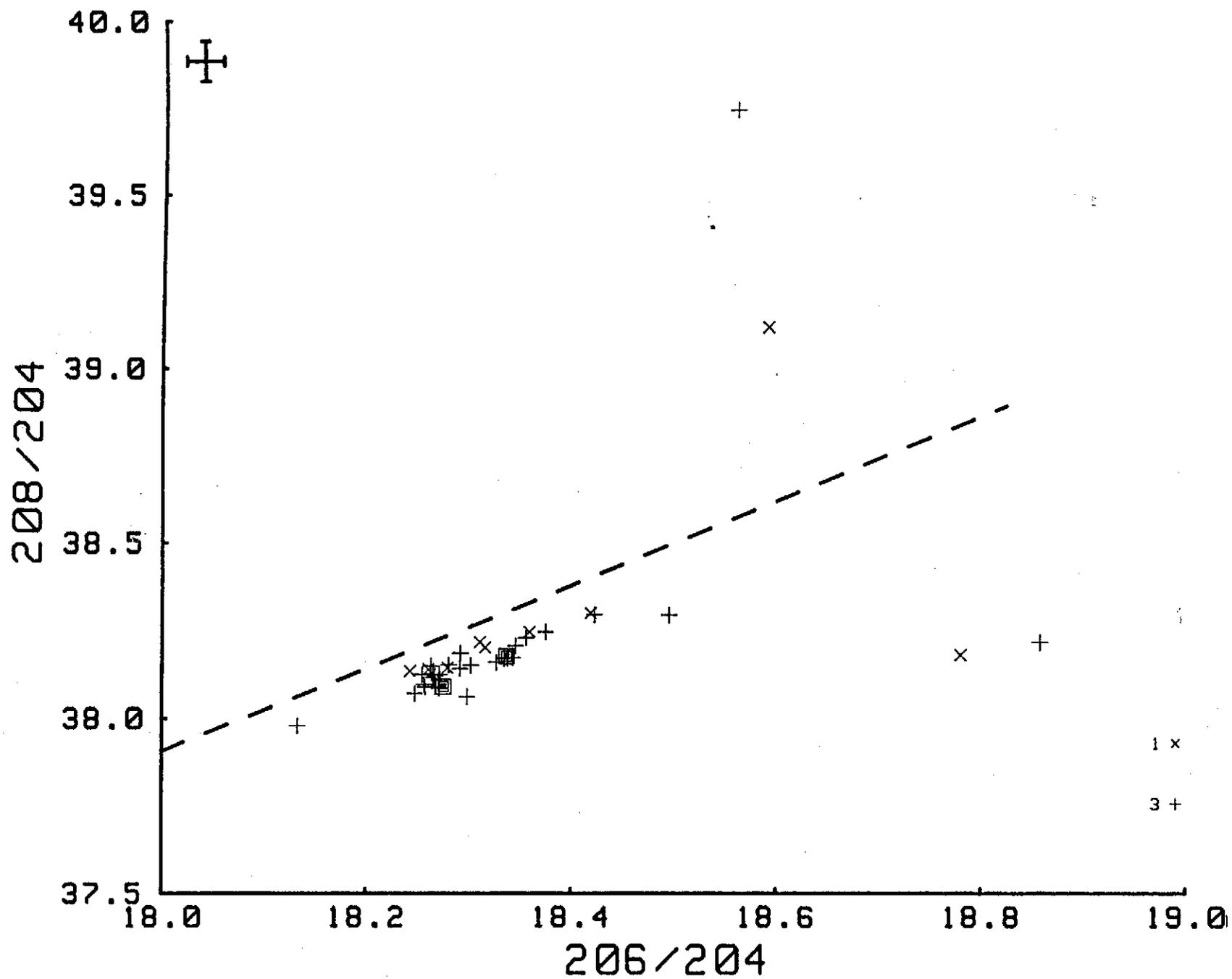


Figure 3