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LEAD ISOTOPE ASSESSMENT OF ADDITIONAL GEOCHEMICAL ANOMALIES IN THE ELLIOTT BAY AREA, S.W. TASMANIA

Brian L. Gulson and Patricia M. Porrit

P.O. Box 136
NORTH RYDE, NSW
AUSTRALIA 2113

APRIL 1983

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R.A. Binns
Assistant Chief
Division of Mineralogy

September, 1982

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SUMMARY

New lead isotopic analyses from the Elliott Bay area have led to a reinterpretation of the data from the pilot study in which no anomalies were found to exhibit the Rosebery-Que River isotopic signature.

Voyager 29 and 34 are each characterized by homogeneous and almost identical isotopic populations which are very similar to the target signature for the Mt Read volcanics exemplified by the Rosebery and Que River deposits. At Voyager 29, the area around costean 3 would appear to be the most favourable drilling site.

The spread in isotopic data for Voyager 9 lessens its importance for Pb-rich mineralization in this area, relative to Voyager 29 and 34.

Analyses of massive sulfides from lens A and B at Voyager 19 indicate they are either part of a complexly-zoned system or exotic to this environment.

The three sulfide samples from the granite at Voyager 30 have the same isotopic ratios as Voyager 29 and 34 and this implies that they were derived from the same source and are of similar Cambrian age.

The soils from the Sassy Creek Argillites (Voyager 33) have homogeneous isotope ratios but which are more than 1.3% more radiogenic than the target signature. They are, however, consistent with the ratios found in the Pb-Zn-Ag-As vein mineralization at Voyager 31 with which they have been compared.

The data for Au-Pb-Zn mineralization at Voyager 24 obtained during the pilot study may be reinterpreted in light of the new data. Two populations occur in the drill core material: one similar to Voyager 29 and 34 and another more radiogenic. One interpretation of these data would be that the gold mineralization is derived from the same source and part of the same system which led to the potential massive sulfide mineralization in Voyager 29 and 34.

1. INTRODUCTION

The assessment of geochemical anomalies in the Elliott Bay area of S.W. Tasmania forms part of the Division of Mineralogy's research into the evaluation of isotopic methods in exploration.

The allocation of drilling priorities to numerous geochemical anomalies in the Elliott Bay area is complex for two main reasons:

(i) the varying styles of mineralization give rise to similar geochemical anomalies, and

(ii) the limited applicability of geophysical techniques.

The difficulties are exacerbated by the extreme remoteness of the area which results in very costly exploration.

In our pilot study (Gulson et al., 1982), which was based on very limited geological input, particularly with regard to sampling locations, we assessed the anomalies at Voyager 2, 19, 24 and 31. Some of these data can now be reassessed in light of the new analyses from other anomalies and detailed knowledge of sampling locations.

Important reinterpretations are necessary for Voyager 19, which has a dramatically different isotopic signature to that of Rosebery-style mineralization. In the previous report this led to an erroneous conclusion that unless other anomalies could be found in the Elliott Bay area with the target signatures, orebodies of Que River-Rosebery size are unlikely to occur in this area.

2. RESULTS

Lead isotopic analyses for 48 samples from 7 new geochemical anomalies in the Elliott Bay area have been completed. All new anomalies tested occur either within or at the margins of the geologically most favourable unit, the Wart Hill Pyroclastics (Fig. 1). Sampling media varied from sulfides, soils, bedrock auger to rock chip samples from costeans.

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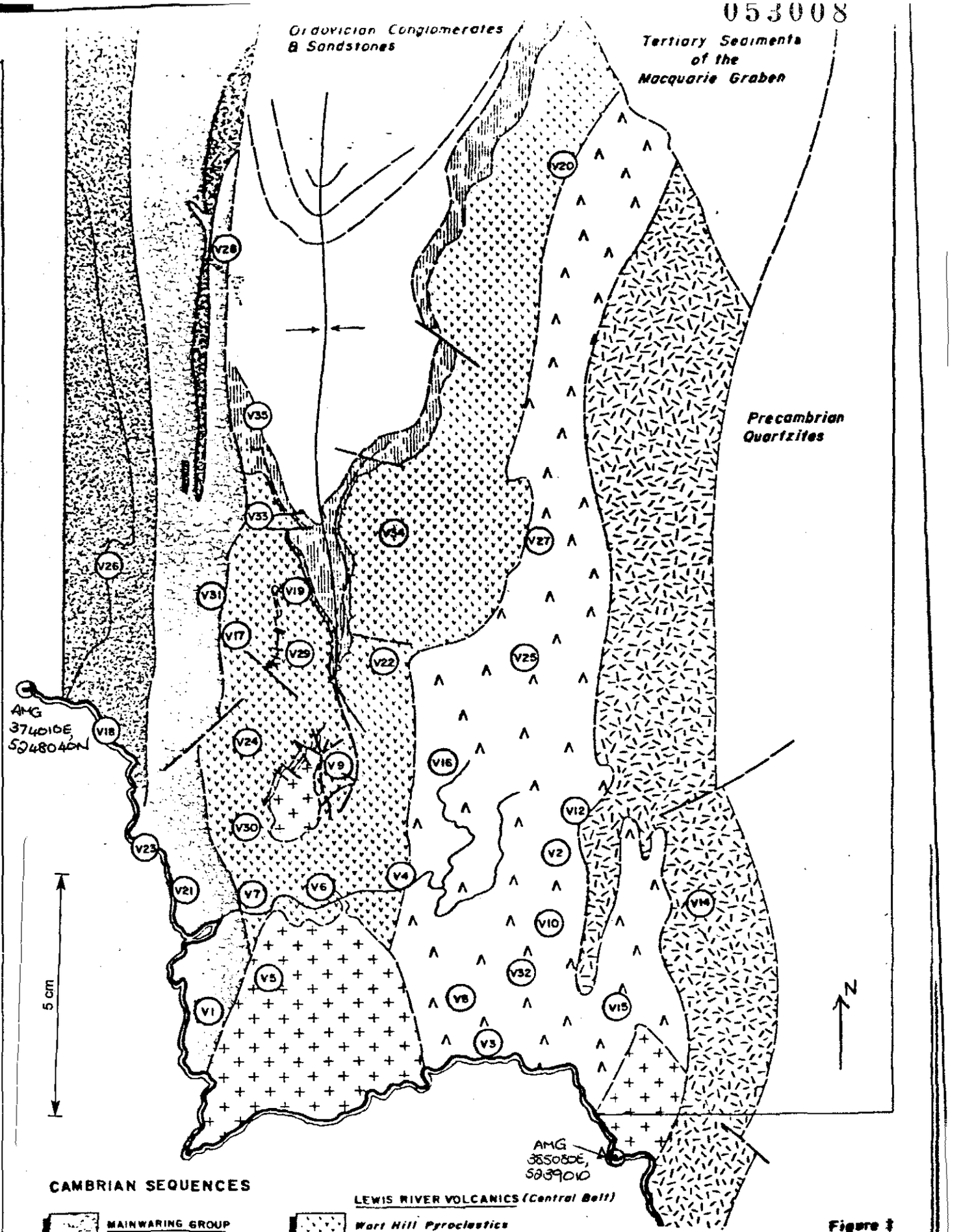

CAMBRIAN SEQUENCES

- MAINWARING GROUP
- MT READ CORRELATES
  - Western Sequence
  - Tyndal Group Correlates

LEWIS RIVER VOLCANICS (Central Belt)

- Wart Hill Pyroclastics
- Hudson River Pyroclastics
- Elliott Point Porphyry

V19 Voyager Prospect Location

Pb Isotope Samples.

AMG REFERENCE POINTS ADDED

Figure 1

E.L.27/76
ELLIOTT BAY, TASMANIA
GEOLOGY & PROSPECT LOCATIONS

0 1 2 3 4
KILOMETRES

GEOPEKO-DEVONPORT BASE

2.1 Voyager 19

These samples are massive sulfides from costeans across the main mineralized zone. Three samples are from lens A, a bedded galena-sphalerite-pyrite ore, and three from lens B, a bedded galena-sphalerite ore, 250m south of lens A. The mineralized tuff samples from the pilot study at Voyager 19 are located 100m south of lens A.

The isotopic data (Table 1) for each locality are internally homogeneous but slightly different:

	Lens A	Mineralized tuffs	Lens B
Northing	13300N	13200N	13050N
208/206	2.0986±7	2.0967±12	2.0964±3
207/206	0.8630±2	0.8619±5	0.8612±1
206/204	18.080±14	18.094±6	18.128±12

Although the differences are small, there would appear to be some form of zoning of less to more radiogenic Pb from north to south. We are unaware of such isotopic zoning in other Pb-rich orebodies of this type and the differences may indicate that the lenses are discrete exotic entities. The isotopic similarities between Voyager 2 and 19, the limited size of these lenses and 0.7% difference to the target isotopic signature would appear to favour an exotic origin.

A sample of mineralized tuff, KR 7549, located about 10m west of lens A, has isotope ratios which are almost identical with the average for the mineralized tuffs 100m south on line 13200N.

2.2 Voyager 29 Soils

This anomaly occurs about 1km south of Voyager 19. The seven soils samples from this major Zn-Pb anomaly, centred on 10400N-10100E, contain Pb concentrations ranging from 255 to 1750ppm.

Four of the six samples have similar ratios and these are almost identical with those for Rosebery:

	Voyager 29	Rosebery
208/206	2.0896±10	2.0842 - 2.0848
207/206	0.8557±3	0.8538 - 0.8541
206/204	18.263±15	18.276 - 18.289

Thus the difference in 207/206 between Rosebery and Voyager 29 is less than the difference between Rosebery and Que River and enhances the favourable assessment of this anomaly.

Three samples (TS 15250, 16614, 16615) come from the anomaly near costean 3 (10400N, 10100E) and have the same ratios.

Three samples (TS 15243, 15242, 15240) from near costean 4 exhibit a variability in their Pb concentrations from 1650 to 530 and 255 ppm respectively and this is also reflected in a change in the isotope ratios from 18.24 to 18.31 to 18.36. Thus this locality would be given a second drilling priority relative to costean 3 although the isotopic variations are those which could also characterize a Pb-poor, Cu rich system.

The sample, TS 16637, from about 50m north of costean 4 contains 1500 ppm Pb and has the target isotopic signature.

2.3 Voyager 29 Rocks

These are rock chip samples from costeans over mineralized tuff between 100 and 300 m east of the soil localities.

Two samples closest to the costean 3 soil anomaly have Pb concentrations of >6.2% and 8150 ppm and their isotope ratios are similar to those of the soils.

The sample KR 11955 from Pit 1, 200 m east of costean 2, contains 2250 ppm Pb but its isotope ratios are consistent with those found in vein systems in this area and other parts of the Mt Read Volcanics.

The two samples KR 11951 and 11953 from costean 1 about 200m south of Pit 1 contain 7750 and 50 ppm Pb respectively. Sample KR 11951 has

isotope ratios similar to those of the target but the tuff with <50 ppm Pb has highly radiogenic ratios consistent with a high U/Pb system.

The single sample from Pit 2, 100 m north of Pit 1, contains 3700 ppm Pb and has isotope ratios almost identical with the target.

2.4 Voyager 30

Three samples from this anomaly are sulfide veins in weakly chloritized granite and have Pb concentrations ranging from 950 to 5200 ppm Pb. Their isotope ratios are almost identical with those of the target signature and this is consistent with a minimum Cambrian age for the granite. The Mt Read Volcanics at Que River have been dated by whole rock Pb-Pb methods at 540±30 Ma and the rock data pass through the Que River ore values, suggesting but not necessarily proving, a common source for the Pb in the volcanics and ore. The similarity in isotopic ratios for the Voyager 30 granitic sulfides and volcanics/ore from the northern part of the Mt Read belt suggest that the granite is also Cambrian.

The three other samples from Voyager 30 come from an anomaly about 800 m west of the granite. Two of these samples KR 11957 and 11958 are quartz veins containing galena-sphalerite and galena. The isotope ratios in the galena from both samples are very similar but highly radiogenic and are consistent with those in vein systems from other parts of the Mt Read Volcanics.

A soil sample TS 16774, supposedly from the same locality as KR 11957-11958, has high Pb values at 1700 ppm and radiogenic isotope ratios. This sample is heterogeneous in its isotopic composition as two separate analyses gave varying isotopic ratios.

2.5 Voyager 34

This is a Pb-Zn anomaly in the Wart Hill Pyroclastics (Fig. 1) and soils were collected at 25 m intervals on two traverses about 200 m apart. Lead concentrations varied from 520 to 3950 ppm on the 13200N traverse and 1700 and 3050 ppm on the 13400N traverse.

The isotopic ratios for the seven soils are homogeneous and identical, within experimental error limits, to those from Voyager 29.

	Voyager 34	Voyager 29
208/206	2.0893±17	2.0896±10
207/206	0.8555±9	0.8557±3
206/204	18.241±13	18.263±15

This anomaly would be rated highly on any drilling program involving lead isotopes and is consistent with the geological evidence which indicates Voyager 29 and Voyager 34 are within the same volcanic stratigraphy folded around the Osmond Syncline (R.R. Large, pers. comm., 1982).

2.6 Voyager 9

This is a Pb-Zn anomaly over a chlorite alteration zone in the Wart Hill Pyroclastics (Fig. 1). Soil samples were analysed from a 45 m traverse (10420-10465E) at 11250N. Lead concentrations range from 285 to 3000 ppm.

The isotopic ratios for these relatively closely spaced samples exhibit considerable variation of 0.7% in their 207/206 ratios c.f. Voyager 29. There is a poor correlation with Pb concentration e.g. both TS 15258 and 15264 contain about 290 ppm Pb but the 206/204 ratios are 18.24 and 18.34 respectively.

This anomaly would be rated a lower priority than Voyager 29 or Voyager 34.

2.7 Voyager 33

This Pb-Zn soil anomaly is located in the Sassy Creek Argillites at the western boundary of the Wart Hill Pyroclastics (Fig. 1). It occurs in a sequence of volcaniclastics, with a major sedimentary component, black shales and sandstones. It is thought to be in a

similar stratigraphic position with Voyager 31, analysed during the pilot study.

Soil samples containing 285 ppm to 1.65 % Pb were analysed from two traverses at 14000N and 13800N. The isotopic ratios are surprisingly homogeneous but more than 1.3% different in their 207/206 ratios from Voyager 29.

	Voyager 33	Voyager 31
208/206	2.0752±18	2.0772±22
207/206	0.8445±8	0.8462±11
206/204	18.499±14	18.473±14

The ratios are, however, very similar to Voyager 31 and this is consistent with their possible stratigraphic equivalence. On the other hand, the isotopic ratios for Voyager 33 are similar to vein-style mineralization in other parts of the Mt Read volcanics and are completely different to the massive sulfide deposits. In view of the facts that Voyager 31 is vein Pb-Zn-Ag-As mineralization along a fault and the similarity in isotopic ratios for Voyager 31 and 33, it is suggested that the anomaly at Voyager 33 is of vein origin and drilling would not be recommended.

3. DISCUSSION

3.1 Drilling Priorities

At Voyager 29, an extensive anomaly with the Rosebery isotopic signature covers an area of perhaps 200 x 200 m. The most favourable drilling site, based on our limited number of analyses, would be around costean 3.

Voyager 34 also has a favourable isotopic signature of similar extent to Voyager 29.

In view of these Rosebery-type isotopic signatures, lens A and B of high-grade bedded sulfide mineralization at Voyager 19 are of lesser interest, as has been shown by drilling. They would appear to be exotic

to this location and have similarities with the Hudson River Pyroclastics.

Because of the isotopic variations over a very short distance in Voyager 9, this anomaly would rate a lower priority than Voyager 29 and 34 for Pb-rich Rosebery-style mineralization.

3.2 Re-Interpretation of Voyager 24 Data

Samples of crushed core with disseminated sulfides and soils were analysed from Voyager 24 during the pilot study. The four soils with 40 to 345 ppm Pb exhibit surprising isotopic homogeneity and the ratios are fairly similar to the Rosebery-Que River massive sulfide deposits. The drill core material may be subdivided into two groups: Samples KR 7465, 7466 and 7469 constitute one group with less radiogenic ratios which are similar to the soils (208/206 2.0867±23, 207/206 0.8528±19, 206/204 18.315±39) whereas the other group of samples KR 7464, 7467 and 7468 are more radiogenic and surprisingly homogeneous both isotopically and in contained Pb levels of about 700 ppm (208/206 2.0786±4, 207/206 0.8478±2, 206/204 18.412±3).

The previous interpreation of Voyager 24 was based on the fact that no massive sulfide mineralization with the Rosebery-Que River signature had been found so far at Elliott Bay. In light of our present knowledge from Voyager 29, 34, 9 and 30 it would appear that at least part of the Pb in Voyager 24 has the same source as the most encouraging anomalies at Voyager 29 and 34, i.e. they are part of the same hydrothermal system(s).

No explanation can be given at this time for the more radiogenic ratios in the drill core as these would appear to have closer affinities with vein-style mineraliation in other parts of the Mt Read Volcanics. On the other hand, such radiogenic isotopic ratios are found in the low-Pb, Cu-rich stockworks of Pb-rich massive sulfide deposits. Further consideration of the sampling localities may unravel the enigma.

A similar source for the Pb in the gold mineralization at Voyager 24 and 29 is compatible with current Geopeko ideas (R.R. Large, pers. comm., 1982) and should be further evaluated isotopically.

3.3 Apparent Age of Volcanic rocks and Mineralization

Although preliminary and in need of further evaluation, the small dispersion in the isotopic ratios for some samples (e.g. TS 16774, KR 11957, KR 11953) is sufficient to allow a very approximate age to be calculated for the volcanics and their relationship with the mineralization to be assessed.

On a 207/206 - 204/206 plot, all Elliott Bay data lie on a well-fitted line and from the intercept of this line on the 207/206 axis an apparent age of about 530 Ma can be calculated (Fig. 2). This apparent age is consistent with the Cambrian age for the volcanics and granites. The intercept of this line with the growth curve for massive sulfide deposits (outside of Tasmania!!) is about 1000 Ma and is considered to represent the approximate minimum age of the ultimate source of the mineralization and host rocks as discussed in Gulson et al. (1982).

A fact of critical importance on most of the plots is the apparent linearity of the galena data from Voyager 30 with that of the other anomalies, assuming that the most radiogenic low Pb rock (<50 ppm) from Voyager 29 (KR 11953) is unrepresentative of the data populations. This may be interpreted to indicate the galena mineralization formed at much the same time as the massive sulfide style but a more precise evaluation is limited by large errors in the calculated ages arising from small dispersions in the data.

Another problem arises from the linearity of the data for the vein-style and massive sulfide mineralization which would tend to suggest that the vein-style mineralization was derived from the volcanics rather than an external source.

If the granites at Elliott Bay are Cambrian and there are no underlying Devonian granites, then derivation of vein-systems from

disseminated sulfides in the volcanics in response to granitic intrusion is not tenable. To explain the radiogenic nature of these vein systems requires a time span of about 100 Ma from crystallization to remobilization (but this also depends on the U/Pb ratio of the source material) and it is necessary to appeal to some other mechanism which would promote fluid movement. Remobilization could occur during metamorphism and the location of the vein systems along linear features such as faults and fractures may account for the formation of the veins.

4. RESEARCH

The following lines of investigation should be pursued:

(i) Further analyses of the freshest volcanics available from the Wart Hill and Hudson River Pyroclastics to try and establish if major isotopic differences exist in these two units. Such differences are implied in the data from the Pb-rich anomalies.

(ii) These should be complemented by analysis of another anomaly from the Hudson River Pyroclastics e.g. Voyager 25.

(iii) These studies should be supplemented by Sr and Nd isotopic analyses which are relevant to the ultimate source age(s) of the area.

(iv) Analyses of samples from Voyager 5 in the granite to establish if a genetic link exists with the granite at Voyager 30.

(v) Analyses of the freshest granite samples from Voyager 30 to establish if there is a genetic link between the granite and mineralization and then between the granites and volcanics.

(vi) Analyses from Voyager 22 to ascertain the extent of the horizon with the favourable isotopic signature.

(viii) Analyses from anomalies between Voyager 19 and 29 to establish their identify with either one of these anomalies.

5. ACKNOWLEDGEMENTS

Our thanks to Ross Large and Paul Wilson of Geopeko for the sample material and geological enlightenment and to Judy Hadley for the Cu-Pb-Zn analyses for Voyager 29 rocks.

6. REFERENCES

Gulson, B.L., Porritt, P.M., and Large R.R. (1982). Lead isotope investigations of varying styles of mineralization in the Mt Read Volcanic belt (Tasmania) and their exploration significance. CSIRO RIR 1346.

TABLE 1 Lead isotopic ratios and lead concentrations for samples from Elliott Bay

Sample	208/206	207/206	206/204	207/204	208/204	Pb(ppm)
ELLIOTT BAY VOYAGER 19B						
KR 7542	2.0992	0.8631	18.081	15.605	37.956	
KR 7543	2.0987	0.8628	18.093	15.610	37.971	
KR 7544	2.0978	0.8631	18.066	15.593	37.900	
KR 7545	2.0967	0.8611	18.142	15.622	38.039	
KR 7546	2.0961	0.8613	18.120	15.607	37.981	
KR 7548	2.0963	0.8613	18.121	15.608	37.987	
KR 7549	2.0963	0.8619	18.097	15.597	37.937	
ELLIOTT BAY VOYAGER 29 S						
TS 15240	2.0848	0.8517	18.355	15.633	38.265	255
TS 15242	2.0880	0.8538	18.307	15.631	38.225	530
TS 15243 A	2.0894	0.8560	18.240	15.614	38.112	1,650
TS 15243 B	2.0890	0.8560	18.234	15.607	38.091	1,650
TS 15250	2.0906	0.8557	18.271	15.635	38.199	1,750
TS 16614	2.0899	0.8557	18.266	15.630	38.174	1,050
TS 16615	2.0883	0.8553	18.273	15.629	38.160	1,150
TS 16637	2.0881	0.8547	18.267	15.613	38.143	1,500
ELLIOTT BAY VOYAGER 29 R						
KR 11951	2.0885	0.8549	18.263	15.613	38.142	7,750
KR 11952	2.0874	0.8556	18.231	15.599	38.055	62,000
KR 11953 A	2.0536	0.8031	19.524	15.680	40.093	50
KR 11953 B	2.0534	0.8025	19.544	15.685	40.131	50
KR 11954	2.0881	0.8555	18.246	15.609	38.099	8,150
KR 11955 A	2.0763	0.8453	18.488	15.629	38.385	2,250
KR 11955 B	2.0770	0.8454	18.492	15.634	38.409	2,250
KR 11956	2.0881	0.8550	18.270	15.620	38.149	3,700
ELLIOTT BAY VOYAGER 30						
TS 16709	2.0846	0.8540	18.264	15.598	38.073	1,000
TS 16714	2.0887	0.8555	18.247	15.611	38.112	920
TS 16715	2.0877	0.8547	18.263	15.609	38.127	5,200
TS 16774 A	2.0571	0.8183	19.131	15.656	39.355	1,700
TS 16774 B	2.0401	0.8154	19.210	15.664	39.190	1,700
KR 11957	2.0653	0.8375	18.673	15.638	38.565	
KR 11958	2.0677	0.8383	18.673	15.654	38.610	
ELLIOTT BAY VOYAGER 33						
TS 16163	2.0775	0.8459	18.468	15.623	38.367	1,000
TS 16164	2.0727	0.8436	18.504	15.611	38.353	2,500
TS 16166	2.0734	0.8439	18.506	15.617	38.370	1,250
TS 16167	2.0765	0.8449	18.506	15.635	38.428	570
TS 16288	2.0745	0.8441	18.501	15.616	38.380	445
TS 16293	2.0752	0.8444	18.508	15.629	38.407	16,500
TS 16294	2.0767	0.8445	18.499	15.623	38.418	285
ELLIOTT BAY VOYAGER 9						
TS 15256	2.0892	0.8569	18.195	15.592	38.013	3,000
TS 15257	2.0894	0.8561	18.221	15.599	38.071	725
TS 15258	2.0867	0.8546	18.242	15.589	38.064	295
TS 15260	2.0849	0.8523	18.310	15.606	38.175	470
TS 15261	2.0856	0.8526	18.309	15.611	38.185	535
TS 15264	2.0834	0.8509	18.341	15.605	38.212	285
TS 15265	2.0893	0.8559	18.253	15.622	38.135	1,000
ELLIOTT BAY VOYAGER 34						
TS 17682 B	2.0862	0.8536	18.248	15.577	38.067	1,700
TS 17684	2.0900	0.8562	18.243	15.621	38.129	3,050
TS 17686	2.0888	0.8557	18.240	15.607	38.100	795
TS 17687	2.0923	0.8560	18.250	15.622	38.184	520
TS 17688 A	2.0877	0.8558	18.223	15.595	38.045	2,000
TS 17688 B	2.0907	0.8566	18.222	15.608	38.096	2,000
TS 17690	2.0885	0.8552	18.260	15.615	38.135	725
TS 17693 A	2.0885	0.8561	18.223	15.601	38.063	3,950
TS 17693 B	2.0875	0.8560	18.208	15.587	38.010	3,950

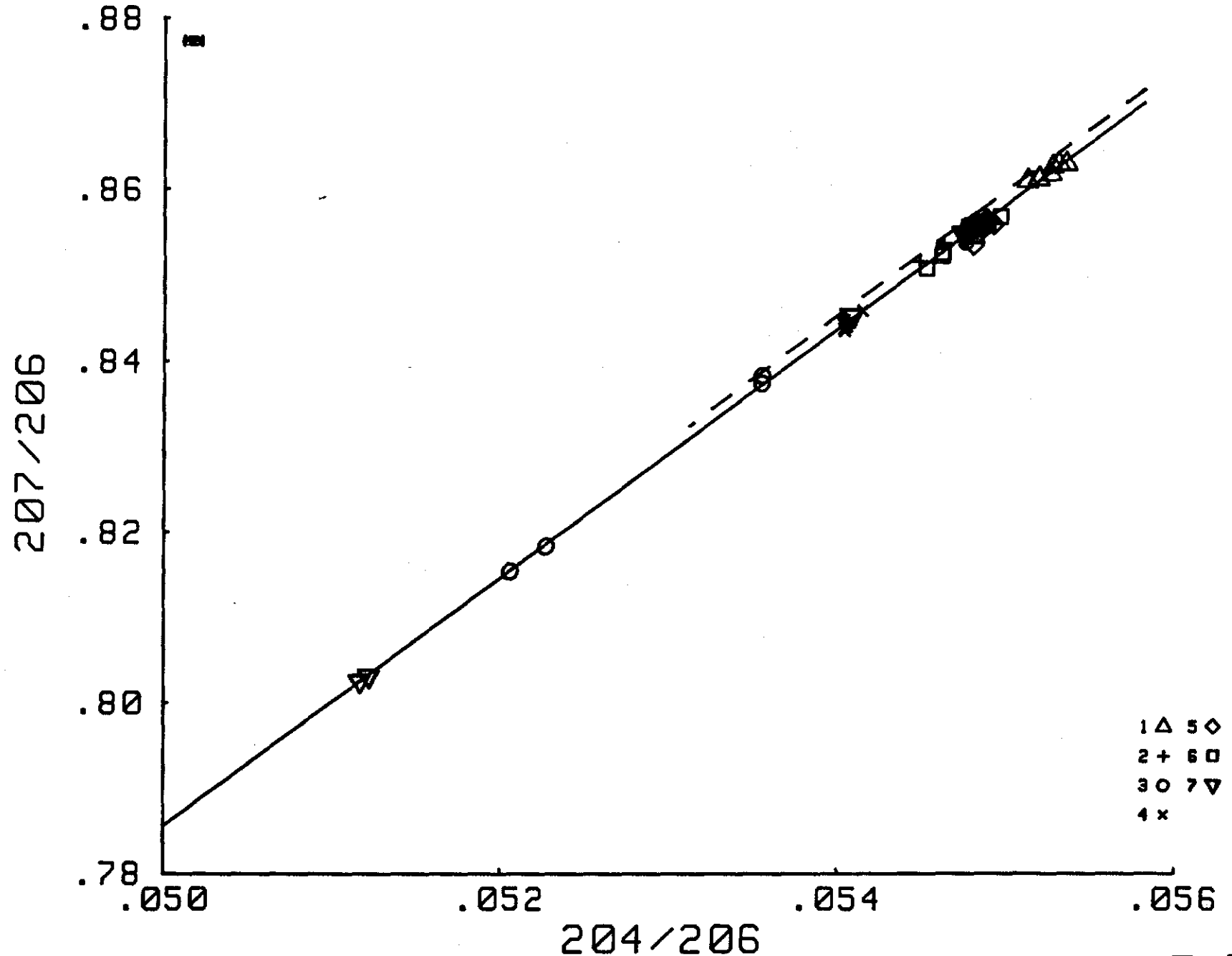

Fig. 2.