EL2/74 : 13 SQ KM

ANNUAL REPORT FOR 1983
KING RIVER DELTA PROJECT

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Elisna Pty Ltd
19 Paterson Street
Launceston 7250

20 November, 1983

493002

Note: to meet regulations this report has been prepared well before year-end. Developments during the last half of the final quarter of 1983 will be described in the fourth quarter report.

SUMMARY

Early in 1983 the exploration licence was restored to Elisna Pty Ltd. Previously it had been held by Union Oil Development Corporation of California, a company we had interested in the cobalt potential of the licence area. Union withdrew following falls in the value of cobalt.

Objectives for 1983 were to investigate lesser known components of Delta sediment with an eye to increasing overall value and the reserve, to explore processing methods of equipment which may have application in treating and extracting useful fractions, and to find a developer as a replacement for Union Oil.

Substantial progress has been made toward realising these goals.

Following indications we had obtained in the past we commissioned Australian Mineral Development Laboratories to carry out a study of the manner in which valuable elements are partitioned between different density fractions of Delta material.

The study has yielded encouraging results.

In specific fractions gold proves to be concentrated to the extent of about 1100 times its average crustal abundance, sulphur 850 x, tungsten and bismuth 150 x, copper 100x, tin 65x, cobalt, silver and barium 30 x and cerium and lanthanum 20x.

Recoveries recorded also are high. Dense fractions comprising 16% of the sediment mass contain essentially all gold present, over 90% of the sulphur and bismuth, about 85% of the tin, 75% of the cobalt and approximately 60% of the zinc and barium.

The densest fraction representing some 3½% of the deposit or approximately 3,500,000 mt of concentrate contains about 45% of the deposit's sulphur barium and tin, more than a third of its cobalt and an estimated 95% of its gold. This fraction assays 4.7 ppm Au.

Amdel has since been asked to conduct further tests to check this gold level and determine to what extent gold may be free. Results should be forthcoming by year-end. Analysis of existing data by Aberdare suggests that the degree of enrichment encountered is likely to prove representative for the deposit as a whole and that gold occurs in a free though finely divided state.

Amdel's data were sent to the Chief Chemist, Dept. of Mines, shortly after receipt, together with weight distribution figures, calculated heads, and comments, all prepared by Aberdare. We have been working closely with his laboratory since inception of the project.

Later in the year this lab was able to confirm Amdel's results, with 110 additional grade determinations. We had previously drawn attention to an apparent concentration of valuable elements in finer grained fractions of

Delta sediment. In pursuit of this idea Mines' lab split sample into eleven size fractions and determined contents of ten elements in each. This study, like Amdel's, has produced encouraging data. Eight of the ten elements investigated, notably Au, Ba, Bi, Co, Cu, S, Zn and, unfortunately, As attain highest concentrations in finer grained fractions. Tin is concentrated in all phases but most conspicuously in the coarsest grained.

A particularly interesting outcome of the study is that the gold concentrate made by Amdel has been not only equalled, in terms of headgrade, but improved upon, a similar amount of gold in this case being confined to a concentrate one-twelfth the mass of Amdel's with an attendant eight-fold rise in grade. This concentrate, equivalent to 0.3% or about 300,000 tonnes of the Delta body, runs 40g Au/t. The determination, by fire assay, should be more dependable than Amdel's AAS measurement. Sample is regarded as representative.

Several other facets of Mines' investigation are noteworthy. Tin grade of the coarsest 300,000 tonnes of Delta sediment proves to be 0.25%, or roughly $2\frac{1}{2}kg/m^3$ for the fraction involved. A fine grained 6% of the sediment body runs over 1% Ba.

We directed our efforts in the field of process technology toward finding means of treating Delta sediment mechanically. Methods involved offer the possibility of allowing pre-concentrate and concentrate to be prepared simply and inexpensively by exploiting distinctive physical characteristics of the Delta's useful minerals, their comparatively high densities and small particle size.

Screens and cyclones used in combination should permit this. Two new types of cyclone have been studied, one water sparged, the other an air-sparged hydrocyclone. With forcefields in the region of 50 to 60 Gs these theoretically are capable of recovering particles in the 5 to 50 µm range.

The water-sparged apparatus holds greatest immediate promise as it is now available commercially. We visited the Kalgoorlie area to assess operation of the first test unit to reach Australia. It meets performance specifications and may well be suitable for use at the King Delta.

Chemical methods of extracting elemental sulphur, cobalt and other valuable constituents of Delta sulphide are being studied in London. A citrate process perfected by the US Bureau of Mines may have application.

In the quest for a developer talks were held with a number of companies in Australia and overseas. Several have expressed interest. Negotiations with one of these groups are advancing fast.

It is anticipated that Elisna will be in a position to turn over licence and project to the latter group early in 1984. In the meantime investigations outlined above concerning treatment methods and the Delta's lesser known constituents continue.

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I BACKGROUND

In a search for modern equivalents of metalliferous black shales begun eleven years ago I conducted surveys over Macquarie Harbour, the estuary of the Gordon River in western Tasmania. The Harbour has the morphology and richly mineralised hinterland probably needed to produce such sediment.

The studies reveal that Harbour sediment is indeed euxenic and is being enriched in metals. The Harbour contains over 1,000,000,000 tonnes of this sediment. Sediment carries several percent of iron sulphide. Sulphide is predominantly authigenic, most of it having been produced by bacterial action. Cobalt, copper, silver and other metals reach greatest concentration in separates high in sulphide and almost certainly occur mainly on or in the sulphide particles.

Though some of these secondary concentrations of metals show scant lateral variation, the majority increase towards the delta of the King River. The delta lies at the northeastern corner of the Harbour and consists chiefly of tailings from Mt Lyell, a mine that, alone, has accounted for well over a third of Australia's output of copper.

About 6% of Delta sediment is composed of sulphide, largely of primary origin. The bulk of the sulphide is pyritic but small proportions consist of chalcopyrite and other types. Primary metal concentrations in clasts augment those of secondary origin forming in Delta and Harbour sediment.

EL2/74, 13 sq km in extent, spans the King River delta from high water mark to toe where water is some 30m deep. Another licence, recently dropped, covered the Harbour.

An American oil company, Cities Service, was brought in by Aberdare's predecessor as potential developer. Cities took over the project in 1974 and later transferred licences to a shell Australian company it had acquired, Elisna Pty Ltd. Cities drilled the deposit, defining a reserve of about 100,000,000 tonnes sediment.

After testwork Cities concluded that the Delta could be exploited as a copper producer at a cost slightly below that of its porphyry mines at Miami in Arizona. Cities held the deposit awaiting a rise in copper price. In 1978 a policy change caused Cities to abandon metals exploration outside the United States. Elisna was ceded to my company, Aberdare, allowing us to resume work on the project in 1979.

Further research by Aberdare revealed that the deposit has added potential because of cobalt concentrations it contains.

Another US company, Union Oil of California, was secured to look into this. The project was made over to Union in 1981. Union began investigations but terminated its interest after temporarily elevated cobalt prices stabilised. Licences again reverted to Aberdare, permitting us to recommence activities at the beginning of this year.

For 1983, Aberdare's and its predecessor's fourth year of tenure, we proposed to hunt substitutes for Union, to examine useful constituents of Delta not previously studied in detail and to investigate ways in which they may be extracted economically.

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II AMDEL TESTS

Relevant data were reviewed. Fourteen elements which earlier research had shown to be concentrated in Delta sediment were selected for analysis. They are Ag, As, Au, Ba, Ce, Co, Cu, La, Mo, Pb, S, Sn, W and Zn. Six others were added; Bi, Cd, In, Nb, Sb and Y. Titanium and Zirconium though not concentrated in head sample of Delta material were included because minor concentrations of rutile and zircon have been recovered from the sediment.

Australian Mineral Development Laboratories of Adelaide were appointed to measure levels of these elements in five fractions of bulk sediment. Bulk sample was lodged at Amdel some years ago by Cities Service. The sample is said to be a composite made up of material from Delta drillholes. Fractions were prepared by centrifuging head feed at SG 2·96 and decanting float as Fraction 1; grinding the sink fraction to - 75μm and removing grains of −38μm as Fraction 2; and by centrifuging grains of −75 + 38μm at specific gravities of 2·96 and 4.3 to yield Fraction 3 of SG 2·96, Fraction 4 of SG ≥ 2·96 ≤ 4.3, and Fraction 5 of SG ≥ 4.3. Grinding was undertaken to liberate valuable heavy mineral from attached particles of low density which otherwise would have acted as diluents. Dense fines were isolated so as not to interfere with subsequent separations.

Amdel's results are shown at Appendix A, together with distribution data and head values computed by Aberdare. Inspection of the results reveals numerous aspects that merit discussion.

Comparing average crustal abundances and calculated head values shows the deposit to be impoverished or not appreciably enriched in Nb, Ti, Y, Zn and Zr. Cd, In and Sb were undetectable though it should be noted that detection minima of the procedure used are considerably greater than levels these elements reach in average crustal rock. All fourteen other elements are concentrated in Delta sediment, some quite markedly: for example, Mo 95x; S 65x; Au 45x; Cu 25x.

In dense fractions far higher concentrations occur. Gold is concentrated 1175x in the densest fraction and sulphur 850x. This fraction also contains the highest concentrations attained by Ag, As, Bi, Co, Sn, Y and Zr.

The fraction of intermediate density contains the highest values of Ce, Cu, La, Nb and W.

Concentrations in the dense fines fraction generally lie between those of the two fractions above. It appears that about one third of the dense fines fraction consists of high density material and two third of material intermediate in density.

Low density material constituting 84% of the sediment is enriched in Cu and contains minor concentrations of Ag, Ba, La, Pb and S. In relation to other fractions however, it is depleted in Ag, Ba, S, Sn and Zn.

The following observations concerning grade and distribution of specific elements are thought worthy of record.

Sulphur reaches a concentration of 45% in the densest fraction of the sediment. Collectively, dense fractions representing a mere 16% of the sediment mass contain some 92% of the total sulphur.

Gold, unlike sulphur, appears confined almost entirely to the densest fraction. This indicates that the metal probably occurs in the native state. The Grade of 4.7 ppm Au or roughly one-seventh ounces/tonne in a fraction representing 3.63% of the sediment body is of considerable interest.

The fact that no gold is discernible in dense fines suggests either that gold is relatively coarse grained or that it is very fine grained and platy, being floated during wet screening and redeposited on coarser material retained. The latter explanation is preferred. Chances of a single small assay sample containing one or more gold particles >38µm in size are low. Furthermore, such an inclusion would be likely to assay above the 4.7ppm Au detected. The fact that this figure reduces to a head value close to that derived previously for the entire deposit is more consistent with the idea that gold occurs as very fine grained platy flakes. Gold of this nature would account for the broad uniformity of head values.

Silver, attaining a grade of about one-tenth ounce/tonne in the densest sediment fraction and one-fifteenth of an ounce in dense fines, partly follows the distribution of lead and of sulphur, but a major fraction also occurs in low sulphur, low density material. Much of the silver probably exists in some unknown secondary form. Metalliferous sediment of the Delta and indeed of the Harbour as a whole has a curious property of blackening within a short interval - tens of seconds? several minutes? - of exposure. Whether the change is caused by light or air is uncertain. If by light, considered more likely because the effect is essentially surficial, the underlying process may repay study.

Cobalt distribution follows that of sulphur fairly closely, attaining its highest grade, that of 0.7 kg Co/mt, in the densest fraction of sediment. However, earlier research indicates that approximately 60% of the cobalt is likely to be of secondary origin. There is significant evidence for this. Unlike the majority of metals concentrated in the Delta, cobalt is most highly concentrated in finer grained fractions of the sediment body, found in deeper water. In 1979 when the metal price was high it was estimated that cobalt worth about $16,000 was being precipitated in Delta sediment daily. The activity is not new. Secondary sulphide encasing lignitic material in Paleocene beds which crop out at Strahan runs several hundred ppm Co.

Copper in the Delta is distributed in anomalous fashion, also as a result of secondary mineralisation. Dense fractions of sediment, though the hosts of most of its sulphur, contain only one third of the total copper. Altogether about a quarter of the total is primary: the other 75% is secondary. Primary copper reaching a grade of 5kg Cu/mt occurs principally in the medium density fraction and in dense fines, probably in the two-thirds thought to consist of medium density material. Copper in other fractions is considered secondary in the main : prior research has shown this to be the case.

Molybdenum, too, behaves anomolously. All fractions of Delta sediment are enriched 50 to 100 times the element's crustal abundance. The implication is that molybdenum occurrences are for the most part secondary. Molybdenum concentrations of this nature extend over much of Macquarie Harbour as well.

Arsenic, also, is dispersed widely in Macquarie harbour. At the Delta arsenic in the densest fraction of sediment runs 0.2kg As/mt and could complicate treating iron sulphide with which it is associated.

Tin is appreciably concentrated in densest and dense finer grained fractions of Delta sediment suggesting that it is resident chiefly in cassiterite, part of which occurs as rather small particles.

Tungsten is concentrated over 100x its crustal abudnance in medium and high density fractions of the sample analysed. These fractions representing over 5% of the Delta body, run about 0.120 kg W/m^3. The element may be occurring in the form of scheelite, or in some other form, rather than as wolframite.

The rare earth cerium and lanthanum are concentrated in medium-density fractions of Delta sediment to the extent of about 35x their joint content in average crustal rock. Ce: La ratios are about 2:1, suggesting that the elements occur as monazite. However, as only about half the total amount of these elements present in bulk sediment occurs in dense fractions it seems that monazite, if the main species, is extremely fine-grained, poorly liberated and for the time being, unlikely to be recoverable. Perhaps in outer parts of the Delta where grain size falls monazite exists in unlocked state. Whether or not ultrafine monazite can be separated is unknown.

Barium, like cerium and lanthanum, reports in both high density and low density fractions and thus is likely to be fine grained and little more than two-thirds liberated. On the other hand, fine grained barite ordinarily prepared by expensive wet grinding is substantially more valuable than coarser varieties. The densest fraction of Delta sediment runs over 1% Ba/mt.

Later in 1983 Amdel was commissioned to undertake further work. The gold content described is to be checked. Other tests are to be run. These are aimed at determining the state in which gold occurs. Results are expected within the next few weeks.

III TDM TESTS

Several visits were made to Tasmanian Mines Department laboratories in Launceston where research results, processing means and other subjects bearing on the Delta project were discussed with the Chief Chemist and his staff. The labs are routinely supplied with all relevant technical information we obtain and this year have received from us the Amdel test results of Appendix A, accompanying data prepared by Aberdare, and reports on the topic of sulphur production.

During the year the labs carried out a sizing analysis on samples of Delta sediment. Ten of the elements the Amdel study had shown to be pronouncedly concentrated in density splits of the sediment were then sought in each of the eleven size fractions produced. Elements investigated are: Au, As, Ba, Bi, Co, Cu, Pb, S, Sn & Zn. Details of the study are given in Appendix B.

The results are of considerable interest. Though weight distribution data are not available, study of the figures suggests that fractions of 500 to 50 µm accounting for an estimated 88% of the sediment mass contain only modest proportions of its cobalt, bismuth, tin and sulphur and virtually none of its gold. Barium, copper, lead and zinc proportions in these fractions are somewhat higher, but, as in the case of the other four elements listed, highest grades found occur in coarse or fine grained fractions, predominantly in the latter.

Implications of this distribution pattern are important. By screening, alone, much of the relatively low grade material comprising the bulk of Delta sediment can be rejected quickly and inexpensively. Most heavy minerals, containing the higher grades of valuable elements present in the Delta are thus isolated as pre-concentrate.

Sulphur distribution follows the double peak discerned by Mt Lyell. In 1972 Mt Lyell measured pyrite content of surface layers covering inshore parts of the Delta. Lyell's histogram in which pyrite grade is plotted against grain size shows a skewed curve tapering through finer size ranges. The mid section of the curve, formerly a single peak, is replaced by a trough lying between two lesser peaks showing coarse and fine grained components respectively. The missing section represents size fractions removed in processing from which the tailings resulted.

Screening at, say, 500 and 100 µm would allow some 75% of bulk sediment to be rejected with a loss of under 5% of the sulphur. Most of the sediment's sulphur is associated with particles 15 to 75 µm in diameter. This fraction, comprising only 6% of the sediment mass, contains over 70% of its sulphide.

Gold is found in a single size fraction in which it assays 40g Au/t. The impressive grade in this concentrate, equivalent to about 1¼ ounces gold/m^3, is about eight times higher than that previously detected by Amdel, but being confined to one-twelfth the mass of sediment reduces to a head grade similar to that calculated for the Amdel concentrate. The head calculated from Amdel's results is + 0.17g Au/t, that calculated from TDM results 0.12g Au/t. The TDM determination is by fire assay and is thus more reliable than Amdel's AAS measurement.

Though sulphur content of the fraction in which gold occurs is high, bracketing fractions also high in sulphur contain no gold. This endorses the idea that gold is probably free. The improved concentration obtained by Mines while working with approximately the same head grade as Amdel supports the idea yet further. For the cyclosizer fraction in which it was isolated, gold if free would have a particle size of about 15 µm. This, also, matches the outcome of earlier theorising which indicates that Delta gold probably is very fine grained.

There are no data on silver but it has been requested that if possible its distribution between the eleven size fractions separated be determined.

Cobalt distribution follows that of sulphur quite closely,except in the case of coarsest and finest grained components of Delta sediment. The low grade of cobalt in the former may be caused by increase in mass relative to surface area in coarse grains. If largely secondary, as most Delta and Harbour cobalt is believed to be, its content should be related to the gross surface area of sulphide available for it to be precipitated upon. Where surface areas are high in relation to mass, higher cobalt grades should result,and vice versa. Why cobalt content falls in the finest of all size fractions investigated, despite the fact that this contains adequate sulphur, is unclear.

Tin grades reported by the Chief Chemist are promising, particularly that of one-quarter percent Sn/t in the coarsest 0.3% of the Delta body, a fraction representing 300,000 tonnes of sediment. Tin in cyclosizer fractions also is high, running about 0.5 kg/m^3. The Delta contains at least 2,000,000 tonnes of sediment in this size range. Most of the fine grained tin is likely to occur in grains of cassiterite which are wholly liberated. However, recovering grains of the sizes involved, ten to thirty microns approximately, could pose problems.

Tungsten contents haven't been measured yet.

Barium, running about 4,000 ppm in bulk sediment, some ten times its crustal abundance, comprises over 1% of the 6,000,000 tonnes or more of Delta sediment lying in the 15 to 75 micron range. This is the range in which sulphur, also, is concentrated. However, the parallelism depends more upon the high density of pyrite and barite than it does upon shared sulphur. Because particles in Delta sediment are well sorted and graded, it follows that minerals of similar density tend to occur in the same size fractions.

In general, head values calculated by Mines' labs correspond well with those we prepared from Amdel's results. Copper, zinc, and tin are exceptions. In the case of copper the difference results from error in the TDM computation. The correct value we calculate to be 1232 ppm Cu. It agrees with that derived from Amdel's data.

The two sets of figures are:

Lab	As	Au	Bi	Co	Cu	Pb	Sn	Zn	Ba	S
	ppm								%	
AMDEL	30?	+0.17	1.8?	68	1263	97	16	63	0.40?	3.55
TDM	21	0.12	4	64	1232	100	50	216	0.42	3.65

Cities Service put the average copper value for the entire Delta at 1266ppm. On this basis sample being examined at TDM labs and Amdel may be taken as representative.

Appreciation is expressed to the Chief Chemist for his continuing support and for the high calibre of research on the project being conducted at his establishment.

IV PROCESS TECHNOLOGY

Testwork reviewed demonstrates that, on the whole, higher grades of useful elements are confined to the denser, finer grained seventh of Delta sediment. This fraction, comprising particles with specific gravities of 3 or more and sizes of 75 microns or less, can be separated from the comparatively barren 85% of the sediment by screening. Below 75 µm, screening becomes progressively less effective as finer and finer material is encountered. In this realm cyclones and, to some degree, flotation offer better prospects.

Cyclones are preferred because with high force fields they generate they can handle much finer particles than flotation does. Also, cyclones normally have higher capacities and are more economical than flotation cells, treating material faster in less space with lower energy consumption and lower initial cost than flotation equipment.

Two new varieties of cyclone are under investigation. One model, being perfected at the University of Utah, is not yet available commercially but holds promise for the future. It is a vertical-walled hydrocyclone, air sparged. Air is introduced through pores in the cylinder wall. In operation the resultant froth carries off hydrophobic fractions of the feed. Hydrophilic fractions descend with water and are removed or recovered at the downstream port.

The apparatus successfully separates ash and sulphur compounds from coal slurry and currently is being adapted to handle porphyry copper ore. Theoretically, it is capable of treating particles with sizes as low as one to ten microns, in a few seconds.

The other machine studied is being produced in Canada and already is in use at several mines in North America. It is water parged via high pressure jets in the drum wall. The jets prevent compaction and ensure constant trade-off between concentrate and particles of higher density introduced in feed. The largest version of the machine handles 40 cu yd/hr and retains the densest quarter percent to one percent of the feed, say 350lb of material of SG 5. This cyclone may be capable of separating most of the gold and tin from finer grained fractions of Delta sediment, assuming the elements occur mainly in liberated particles of native metal and cassiterite respectively.

It is estimated that five of the largest version of this cyclone feeding preconcentrate to a single representative of the smallest sized model would keep pace with the rate at which it is anticipated the Delta will be exploited. Mining spread over a 20-year period at an operational rate of 66% calls for extraction at the rate of 900 mt/operating hour. This would yield about 150 mt minus 38 micron material per operating hour.

The first of these cyclones to reach Australia was tested recently near Kalgoorlie. We attended tests. The apparatus meets performance claims recovering very high proportions of gold in the ten to thirty micron size range. Conventional gravity techniques lose much of this gold, especially platier forms of it. Chemical methods of extracting cobalt and sulphur from sulphides are currently being studied at the Geological Museum and elsewhere in London. Processes of interest include the Westcott, Outokumpu and Cymet.

One route possible is to convert Delta pyrite to pyrrhotite from which elemental sulphur can be recovered by a ferric chloride leach procedure. Sulphur dioxide resulting from the pyrite/pyrrhotite conversion then could be treated by a citrate process which the US Bureau of Mines has developed. This latter process, using recyclable low cost non-toxic reagents appears economic and produces high grade sulphur, suitable for most industrial applications without need for further refining. The process requires a source of hydrogen sulphide however. Though the compound can be generated on site from sulphur produced, costs of the operation then rise.

V PROPOSAL

In order to improve prospects of exploiting the King River Delta's concentrations of copper and cobalt, prospects on which previous proposals were based, Aberdare first reviewed and assessed all records available, then embarked upon research described in preceding pages. A major gain stemming from the assessment lies in recognition of the Delta's potential as a source of element sulphur.

Earlier studies by Mt Lyell and Cities Service had discussed possibilities of using Delta sulphide as feed for acid production, but neither company pursued these. Commonwealth production of sulphuric acid is already over capacity, quite apart from legitimate environmental concerns that confront each plan to establish new plant.

Our interest, though, is in producing elemental sulphur, not acid.

Neither New Zealand nor Australia has significant reserves or production of elemental sulphur. Together, the countries import between 600,000 and 900,000 tonnes per year, mainly from North America.

Before the great rise in oil and gas prices, sulphur cost about $40/tonne and imports probably were the best way of meeting local needs. Since then costs of both Frasch sulphur and that produced from sour gas have risen dramatically: so have shipping costs. As a result the two countries now spend a total of $750,000,000 to $1,125,000,000 overseas, annually, importing the material, expenditure more than 200% above that of earlier decades. Unlike normal fluctuations in other mineral prices, which seldom amount to more than a few tens of percent at most, these highly elevated sulphur prices must almost certainly be taken as permanent.

On this basis domestic production of elemental sulphur from sulphides becomes highly attractive. Finland, Japan and other countries without appreciable quantities of elemental sulphur have long met the bulk of their needs in this manner, so both technology and economic justification exist.

Tasmania,with its large production of sulphides and proximity to principal demand centres of Melbourne, Sydney and Auckland is well situated to take advantage of the situation. An enterprise of this nature could well be founded on the sulphide reserve of the King River delta.

The Delta contains over 6,000,000 tonnes of sulphide which, treated, should yield some 2,500,000 tonnes of elemental sulphur, that is, about 125,000 tpa over a twenty-year mine life. Production at this rate would meet a quarter of current Australian annual demand, and a greater fraction if raw material from the Delta were to be augmented by sulphide derived from other West coast mines.

Economics look promising. Delta sulphide is pre-milled, as it were, and easily separable, with high recovery possible at low cost. Mechanical methods employed in producing this preconcentrate should also recover some gold, cassiterite and barite as valuable bonuses it appears. Subsequent treatment of the sulphide fraction to produce sulphur should, in turn, yield copper, cobalt, silver and probably iron oxide as well.

Aberdare's existing summary and proposal are being rewritten to incorporate prospects regarding sulphur, gold and other valuable constituents of the Delta not emphasized before.

VI DEVELOPMENT

About sixty organisations active in exploration and mining within the Commonwealth were selected as possible targets. Some are overseas groups with Australian subsidiaries. Close study of each candidate's commodity interests, corporate aims and present commitments then allowed the list to be narrowed.

Meetings were held in Australian cities, New York and London with board members of companies found most prospective.

Interest proved hard to generate. Depressed metals prices, diminishing demand, ever rising costs and taxes, the price of financing capital expenditure and borrowed funds, and disruptive effects of strikes and labour unrest are some of the very real concerns facing and discouraging the industry. A number of large mainland companies expressed mounting dissatisfaction with Government policy, regulations, performance and growth, the majority with particular reference to Tasmania. Threat of opposition by environmental sects is yet another of the deterrents to investing in new development ventures.

Eventually three groups were found, willing to continue discussions and look into information on the Delta deposit more closely. The first, with holdings in New South Wales and Victoria, has interests in hydrocarbons, other minerals and marine work. Another mines and treats gold and rare metals in Western Australia. The third is a US/Australian group active in metals exploration and electronics. All remain candidates.

One has made a firm offer. In principle Aberdare and this group agree to terms involved. Fundamentally, termsprovide for the group to take over the project early in 1984, after application to transfer the exploration licence has been lodged and approved.

The group appears keen to set up and operate pilot plant. It is understood that initially this would be used to investigate recovery of cobaltiferous pyrite, gold, cassiterite and barite from Delta sediment by physical means.

VII REPORTING

Mines Department headquarters in Hobart were visited in May and June. Progress and goals were described to Director, his staff and Chief Geologist,and were discussed. As noted elsewhere, Mines' Chief Chemist in Launceston also is kept informed of advances and research objectives.

Quarterly returns and reports have been prepared and submitted.

In addition time was spent writing a final report required following relinquishment of an associated exploration licence, 16/73. Interior parts of EL 16/73 which formerly extended over Macquarie Harbour were investigated by Cities Service in connection with the Delta project.

Further time has gone into production of this annual report, and into Mines Department requests for yet more data. Information the Department claims to lack essentially all concerns activities of prior licencees.

Taken overall the years' reporting load is deemed to have been disproportionately large,the excess time needed to meet requirements having reduced that available for research and project development.

VIII ADMINISTRATION

Elisna's Annual General Meeting was held in Launceston. Other meetings with the Company's Secretary, bank officers, accountants, legal counsel and auditors were attended.

Similar meetings were held overseas with Aberdare's directors, officers and shareholders.

Accommodation and travel arrangements, plus travel, undertaken in connection with the Australian/Tasmanian visit, with visits to the prospective developers on the mainland and in New York, lastly with visits to equipment trials near Kalgoorlie and research establishments in the United Kingdom consumed more time.

For an extended itinerary and programme of this nature, both costs and time involved in maintaining contact with US & Australian headquarters become considerable. Locating and using unfamiliar office services en route also complicates and slows operations.

An eight-year accounting summary has been commenced.

IX TIME & COST

Approximately twenty-four man-weeks time has been put into the project this year.

Expenditure for 1983 is calculated to be $34,173 made up as follows:

Travel	$4,391
Services	26,294
Office	2,408
Communications	254
Miscellaneous	826

Time and cost figures given cover the period 1st January through 15th November. They are expected to increase 15 to 18% by 31 December.

Aberdare's expenditure on the project for the period 1st January 1979 through 15th November 1983 amounts to approximately $135,335.

Figures for 1983 and consequently the cumulative total may require adjustment once the present tour ends and prorated costs such as those of travel can be apportioned exactly between ventures involved.

X 1984 PROGRAMME

With the advent of a new developer likely early in the coming year it is difficult to lay out a programme that will be adhered to with certainty. Aberdare cannot make commitments for independent parties. However, the group with which we are negotiating has been informed of existing regulations concerning the exploration licence, and Aberdare will not enter into any contract without a specific provision that Government requirements be fully met by co-signatories.

Indications are that such safeguard, while legally required, will prove unnecessary. It appears highly probable that if agreement is reached and the group obtains control of licence and project, minimum expenditure and research requirements will be far exceeded. The group is enthusiastic about prospects and declares itself ready to pursue these vigorously.

Until agreement is reached Aberdare will continue its present endeavour, directed toward:

- enhancing the deposit's value through additional research on valuable components such as sulphur, gold, tin and barium, previously overlooked

- investigating and defining applicable extractive technology

In the event that present negotiations end unsuccessfully the programme will be expanded to include continuation of the hunt for developers.

APPENDIX A

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The Australian Mineral Development Laboratories

amdel

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24 December 1982

GS 6/625/0

26/3/84

Mr R. Harvey,
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U.S.A.

REPORT GS 2132/83

YOUR REFERENCE: Letter of 20 September 1982

MATERIAL: King River delta sediment

LOCALITY: Tasmania

IDENTIFICATION: Drum A

DATE RECEIVED: 5 October 1982

WORK REQUIRED: Heavy liquid separation and analysis

Investigation and Report by: Dr Keith J. Henley

Chief - Geological Services Section: Dr Keith J. Henley
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jd/2

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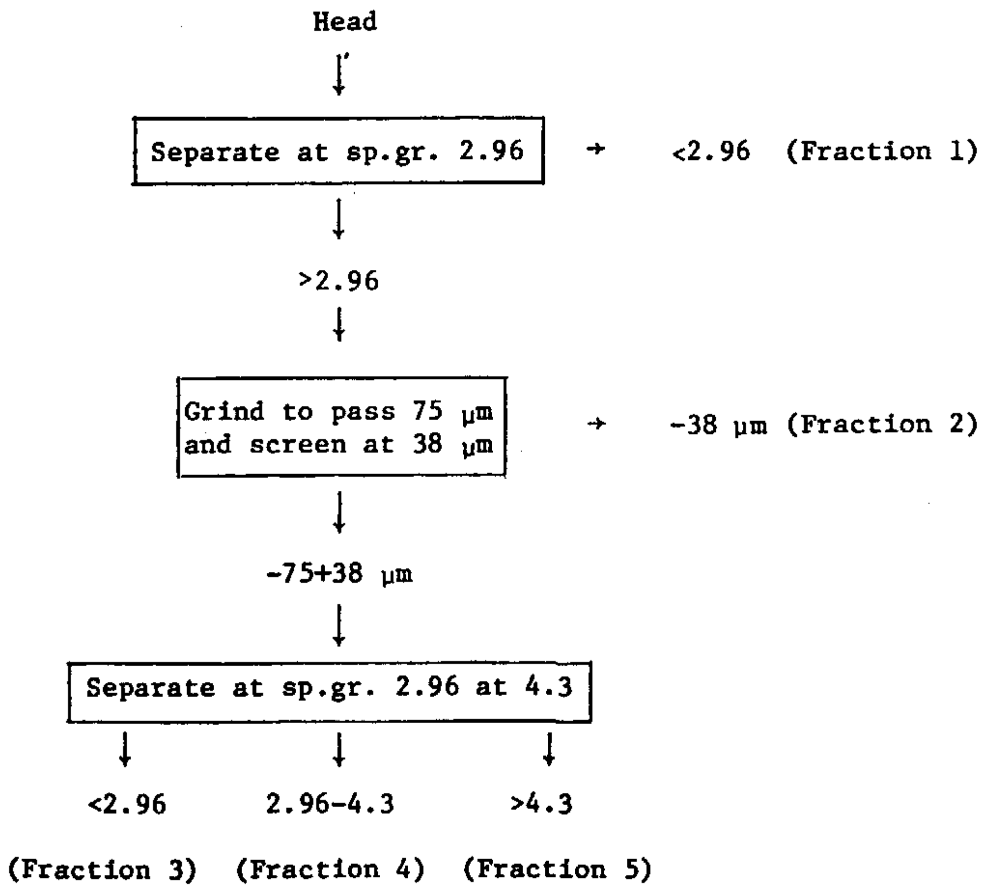
SEPARATION AND ANALYSIS OF KING RIVER DELTA SEDIMENT

1. INTRODUCTION

A request was received from Mr R. Harvey for further work on King River delta sediment held at AMDEL (Drum A). The work programme was specified by Mr Harvey.

2. PROCEDURE

A riffled portion of material from Drum A (from job GS 802/82) was separated statically at sp.gr. 2.96 in tetrabromoethane. The >2.96 sp.gr. product was hand-ground to pass 75 µm (200 mesh BSS) and wet-screened at 38 µm (400 mesh BSS), the -38 µm fraction being retained. The -75+38 µm fraction was then separated centrifugally at specific gravities of 2.96 and 4.3. The products were labelled as follows:



The five fractions were then analysed using the following AMDEL codes:

Code A1: Ba, Ce, Co, La, Mo, Nb, Ti, W, Y, Zr.

Code A2: Ag, As, Bi, Cd, Cu, In, Pb, Sb, Sn, Zn.

Code E4: S

Code K3/1: Au

3. RESULTS

The results are given in Table 1.

TABLE 1: WEIGHT DISTRIBUTION AND ANALYTICAL RESULTS

	Fraction				
	1	2	3	4	5
Wt. % in Head	83.38	9.60	0.77	2.62	3.63
Element					
Ba, ppm	2000	5000	4000	2000	>10000
Ce, ppm	<300	500	<300	1000	700
Co, ppm	20	250	25	70	700
La, ppm	100	250	100	400	300
Mo, ppm	100	70	60	70	70
Nb, ppm	<20	30	20	40	<20
Ti, ppm	1500	3000	2500	3000	1500
W, ppm	<50	50	50	150	100
Y, ppm	10	50	40	70	100
Zr, ppm	150	300	200	200	1000
Ag, ppm	0.2	2	0.1	1	3
As, ppm	<50	<50	<50	<50	200
Bi, ppm	<1	6	<1	<1	30
Cd, ppm	<3	<3	<3	<3	<3
Cu, ppm	1000	2500	500	5000	1500
In, ppm	<10	<10	<10	<10	<10
Pb, ppm	70	250	50	250	200
Sb, ppm	<30	<30	<30	<30	<30
Sn, ppm	3	60	3	20	200
Zn, ppm	30	300	40	250	70
S, %	0.33	16.6	0.16	1.35	45.2
Au, ppm	<0.05	<0.05	<0.05	<0.05	4.7

ELEMENTAL DISTRIBUTION IN PERCENT,
CALCULATED FROM RESULTS IN AMDEL'S TABLE 1

Fraction	1	2	3	4	5
Wt. % in Head	83.38	9.60	0.77	2.62	3.63
Element					
Ba (4000?)	41.7	12.0	0.8	1.3	~44.2
Ce (160?)	~38.4	29.5	~0.4	16.1	15.6
Co (68)	24.5	35.2	0.3	2.7	37.3
La (130)	64.4	18.5	0.6	8.1	8.4
Mo (95)	87.8	7.1	0.5	1.9	2.7
Nb (10?)	~ 49.5	34.1	1.8	12.4	~2.2
Ti (1700)	74.1	17.0	1.1	4.6	3.2
W (30?)	~56.7	16.3	1.3	13.4	12.3
Y (20)	42.7	24.4	1.6	12.9	18.4
Zr (197)	63.5	14.6	0.8	2.7	18.4
Ag (0.49)	33.7	38.8	0.2	5.3	22.0
As (30?)	~62.8	~ 7.2	~ 0.6	~ 2.0	27.4
Bi (1.8?)	~9.1	31.3	~ 0.1	~ 0.3	59.2
Cd (<3)	x	x	x	x	x
Cu (1263)	66.0	19.0	0.3	10.4	4.3
In (<10)	x	x	x	x	x
Pb (97)	60.4	24.9	0.4	6.8	7.5
Sb (<30)	x	x	x	x	x
S (16)	15.6	35.6	0.1	3.3	45.2
Zn (63)	39.6	45.5	0.5	10.4	4.0
S (3.55)	7.8	44.9	tr	1.0	46.3
Au (0.18?)	minor	minor	minor	minor	~95

( ) Calculated head, in ppm   x indeterminate

APPENDIX B

M 1588

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DEPARTMENT OF MINES—TASMANIA

TELEPHONES:
Metallurgical Research .. .. }
Laboratory .. .. .. } 44 2431-2
Mines Inspection .. .. .. } (2 lines)
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LAUNCESTON OFFICES
287 WELLINGTON STREET
SOUTH LAUNCESTON 7250

5th September, 1983

Mr S.R.M. Harvey,
C/- Jahn and Levit,
524 Hay Street,
PERTH W.A. 6000

Dear Sir,

R797 - King River Delta Sediments

Thank you for your letter dated 28th August, 1983 and the enclosed information on sulphur recovery using the U.S.B.M. citrate process and the Miller (Wemco) sparged hydro cyclones.

2. As mentioned to you in my letter dated 17th March, 1983 we have now done the sizing analysis and assayed the products for the elements indicated. The size fractions have been supplied to David Green for Mineralogical examination but unfortunately this project, not being a revenue earner, has a low priority and has not yet been done although we hope to get it done in November. From the enclosed copy of the sizing and assays you will note:-

2.1. the gold content of C/S1 at 40 g/t Au confirms the Amdel gold occurrence you have reported and also the general head value of 0.1 g/t Au for the delta sediments. Hopefully the mineralogy will reveal the nature of this gold occurrence and hence answer your questions.

2.2. also we regard the tin concentration in the coarse material as note worthy and look forward to knowing how this occurs.

3. We believe this sizing analysis of the head sample has produced some of the most useful information to date on the delta sediments and when the mineralogical examination results are to hand should allow a reappraisal of how to concentrate the values.

Yours faithfully,

(H. K. Wellington)
Chief Chemist & Metallurgist

Encl.

R797

KING RIVER DELTA SEDIMENT - MACQUARIE HARBOUR.

Sizing Analysis - For information of Dr. D. Green Re possible mineralogy of sized fractions.

Fraction	% Mass	% Ba	Assays: Grams Per Tonne Sn	Cu	Co	Pb	Zn	As	Bi	Au	% S
+2.36mm	Trace										
+1.18mm	0.1	0.29	* 0.25%	1600	33	490	690	89	10		3.42
+600µm	0.2										
+300 "	3.7	0.21	31	1400	18	71	240	<15	<10		0.92
+150 "	52.1	0.26	17	1200	17	52	160	<15	<10		0.79
+ 75 "	27.3	0.58	15	900	105	67	190	22	<10		5.44
+ 38 "	5.4	1.10	23	1200	350	70	210	51	<10		17.5
C/S 1	0.3	1.70	510	4700	800	210	200	150	37	≃40	36.8
2	0.3	1.07	460	4600	340	130	430	57	21		16.4
3	0.8	0.57	260	3300	150	105	390	49	21		8.67
4	0.5	0.56	360	3200	110	140	570	40	12		5.47
5	0.3	0.56	630	2500	80	210	740	47	12		3.71
O/F	9.0	0.44	210	1800	21	490	540	31	26		5.46
C. Head	100.0	0.42	50	1040	64	100	216	21	4	0.1	3.65

* Note: Sn as percentage this fraction

Research Officer.................

(H. K. Wellington)
Chief Chemist & Metallurgist