# WMC RESOURCES EXPLORATION SUCCESSES IN LAKE TERRAINS - APPLICATIONS OF ELEMENT DISPERSION, KAMBALDA W.A.

M L CAREY AND M E DUSCI

*WMC Resources PO Box Kambalda, W.A. 6442 Australia*

Exploration for gold in the Yilgarn Craton is increasingly focusing on covered terrains, with one of the most challenging of these being salt lake systems Since 1992, WMC Resources has concentrated on exploring for gold on Lake Lefroy near Kambalda, Western Australia As a result, a significant geochemical database obtained from drilling now exists. In order to best utilise this database, the controls on gold distribution in the regolith have to be understood Detailed investigation of known orebodies has identified a number of these controls, including the: position of redox fronts; size and nature of mineralised bedrock structures; bedrock lithology; degree of erosion, and depth of transported cover Proximal to a bedrock mineralised structure, supergene gold is distributed throughout the regolith profile and concentrates at the base of weathering Distal to bedrock mineralisation, gold disperses laterally along iron redox fronts that tend to occur higher in the regolith profile. Bedrock lithologies can influence regolith development, thus affecting the distribution of gold The presence of palaeochannels may increase the size of gold dispersion halos through preferential chemical dispersion along the unconformity between the palaeochannel and the underlying regolith Alternatively, incision of the regolith profile associated with palaeochannel development may decrease the extent of a gold dispersion halo

Knowledge of the factors which controls gold distribution is applied to the processing and interpretation of regional aircore drilling data. A number of different processing methods capable of visualising the entire Lake Lefroy database have been tested by WMC at Kambalda. The most effective data processing method proved to be a system of selecting intersections within aircore holes according to set parameters, and subsequently calculating summed gram x metre values for each hole

Geochemical techniques other than aircore drilling have been tested in the Lake Lefroy region The most encouraging of these techniques has been enzyme leach. Enzyme leach orientation studies were conducted over the Santa Ana and Intrepide gold deposits with enzyme leach responses related to bedrock mineralisation observed in both cases

**Key words**: Lake Lefroy, exploration, supergene gold, element dispersion, regolith, enzyme leach, palaeochannel, surficial cover, Kambalda

## INTRODUCTION

Exploration in the Yilgarn Craton has increasingly focused on areas concealed by transported overburden. Salt playas, representing the remnants of palaeodrainage systems, are a prominent physiographic feature and present significant challenges to exploration. WMC Resource's St Ives Gold Operation, Australia's second largest gold producer is located at Kambalda, 60 km south of Kalgoorlie (Figure 1) WMC St Ives has been successfully exploring for gold beneath salt lake systems for the past six years During this time, more than two million ounces of gold resources have been discovered at Lake Lefroy.

Aircore drilling for geochemical and regolith data is currently the main exploration tool used in areas covered by transported overburden. In order to use this data most effectively, regolith landforms and local gold dispersion processes must be understood An understanding of these factors has been gained from the study of known deposits in the Lake Lefroy region In addition, methods are required which enable the processing and presentation of large amounts of data. This permits the study of geochemical dispersion patterns for an entire area (e g. Lake Lefroy), enabling the identification and prioritisation of exploration targets. The data presented in this paper was obtained from company exploration logging and assay results

## ARCHAEAN GEOLOGICAL SETTING

### Regional Setting

The Kambalda-St Ives corridor is located in the south-central part of the Norseman-Wiluna Greenstone Belt within the Yilgarn Craton The corridor forms part of the Kambalda Domain which is bounded by two major NNW trending regional structures; the Zuleika Shear to the west and the Boulder Lefroy Fault to the east (Swager et al 1990)

The region has been polydeformed and metamorphosed, with metamorphic grades ranging from upper greenschist facies to lower amphibolite facies

### Stratigraphy

The stratigraphy of the Kambalda area is well documented (e g Roberts & Elias 1990; Swager et al 1990) and in part correlates with the Kalgoorlie succession to the north The lower part of the succession reflects the volcanic evolution of the region from basal tholeiitic basalts to komatiites and komatiitic basalts through to high MgO basalts The upper part of the succession consists of epiclastic and felsic volcanic-volcaniclastic rocks, unconformably overlain by a conglomerate sequence

### Structural Geology - Lake Lefroy

The Lake Lefroy region (Figure 2) has been folded to produce regional NNW trending folds that plunge shallowly to the southeast (eg the Kambalda Dome to the north and the Delta Island anticline to the south) Major NNW striking, anastomosing shear zones are the main structural features of the lake region The shear zones commonly dip to the east forming a stacked geometry, with a combination of reverse dip-slip and sinistral strike-slip movement (e g Playa Shear Zone) The stratigraphic sequence youngs outwards from fold closures and is juxtaposed against NNW trending structures east of the Playa Shear Zone

## GEOMORPHOLOGY

The present landscape in the Goldfields has been modified by successive climatic changes since the Mesozoic Lake Lefroy represents the semi-arid surface expression of the Lefroy Palaeodrainage system The topography is extremely uniform in comparison with the sub-surface erosional palaeotopography

Lake Lefroy is an extensive salt playa with an maximum length of 59 km and width of 16 km The lake has a surface area of 554 $km^2$ and a mean elevation of 284 m above sea level Numerous small islands occur consisting of gypsum dunes with less than 10 m of relief Water levels vary seasonally from 0 to 1 metres deep

## REGOLITH STRATIGRAPHY AND EVOLUTION

Extensive drilling and mining on Lake Lefroy has revealed a complex sub-surface regolith stratigraphy and palaeolandscape (Figure 3), formed by the combined effects of differential erosion, deposition and chemical modification

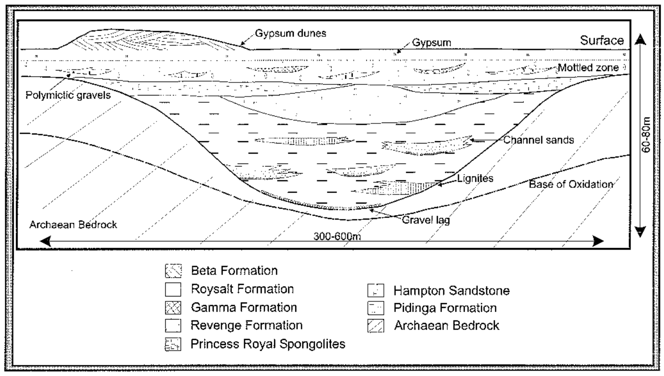


**Figure 3:** *Schematic cross section of the Cainozoic sedimentary sequence, Lefroy Palaeodrainage System (modified after Clarke 1993b)*

### Archaean Derived Regolith

The regolith profile directly derived from weathering of archaean bedrock varies greatly beneath the Lake Lefroy Cainozoic sedimentary sequence Generally the regolith profile is only partly preserved and consists of; a) a lower saprock zone characterised by joint oxidation and minor oxidation of mafic minerals and sulphides, b) an overlying saprolite zone with textures preserved, though mineralogy is dominantly replaced by weathering products, and c) an upper clay zone characterised by the complete replacement of original textures and mineralogy by weathering processes Rarely, a lateritic duricrust is preserved within the uppermost part of the Archaean stratigraphy Horizons of ferruginous saprolite and mottled zones may be present within the profile

## TRANSPORTED OVERBURDEN

### STRATIGRAPHY

The Lefroy Palaeodrainage system forms part of the Eastern Yilgarn Division and is bound to the north and south by the Roe and Cowan Palaeodrainage systems, respectively Lake Lefroy represents the remnants of the Lefroy Palaeodrainage system, which drained east into the Eucla Basin and now contains more than 100 m of preserved Cainozoic sediments (Figure 4) The stratigraphy of the Cainozoic sediments of the Lefroy Palaeodrainage is described in Clarke (1993b) (Figure 5)

## EVOLUTION

The Lefroy Palaeodrainage system was incised by sedimentary processes between the Permian and the Jurassic (Bunting et al 1974; Van de Graaff et al. 1977). During the Late Cretaceous and Early Eocene the channels actively carried bedloads of coarse sand and gravel Two marine incursions occurred during the Middle and Late Eocene, correlated to the Tortachila and Tukeja transgressions, respectively (Clarke et al 1994). These transgressions represent deposition in highstand system tracts and display sequences of basal sands and gravels fining upwards into silts and lignites, capped by marine deposits. The Tortchila transgression flooded the palaeochannels to a modern day elevation of approximately 280 m, and deposited the Hampton Sandstone and Pidinga Formations in a fluvial to estuarine palaeoenvironment The end of the Tortachila transgression resulted in erosion of the upper part of the sequence. Onset of the Tukeja transgression resulted in the deposition of lignitic sediments of the Pidinga Formation and the Princess Royal Spongolite The Tukeja transgression reached a modern elevation of 300 m (Clarke et al 1994)

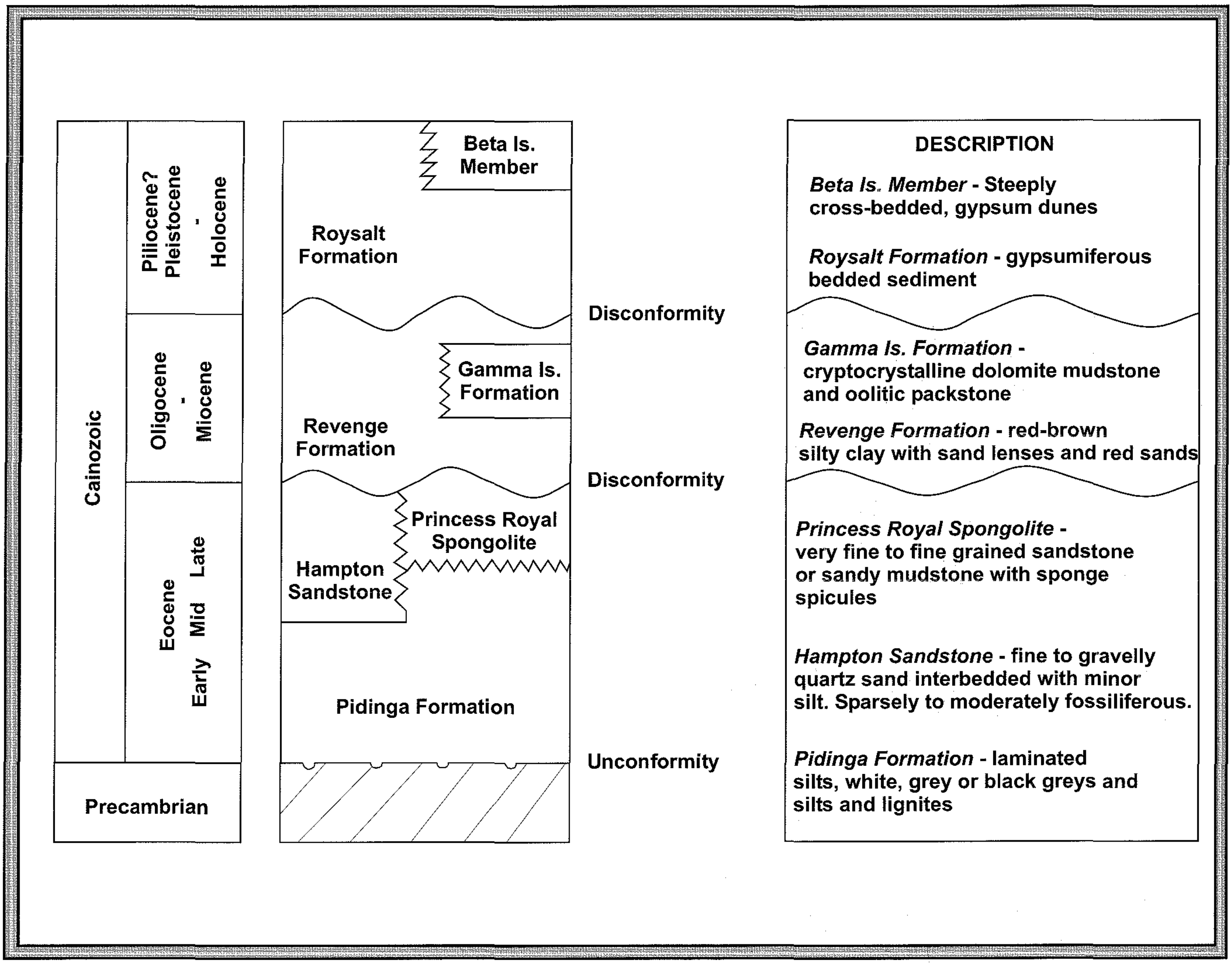


**Figure 5:** *Description of the Cainozoic sedimentary sequence of Lake Lefroy*

An increase in aridity from the Oligocene led to sedimentation and siltation of the palaeochannels, resulting in deposition primarily of the Revenge Formation in a lacustrine palaeoenvironment. Evaporitic sediments of the Roysalt Formation represent a further increase in aridity during either the Pliocene (Clarke 1993b) or Middle Pleistocene (Zheng, 1996). Arid conditions have allowed Cainozoic sediments to be preserved.

### Weathering

Weathering in the region is interpreted to have been a relatively continuous process. Widespread weathering resulting in kaolinisation of the Archaean bedrock is thought to have been Pre-Eocene, prior to sedimentation of the palaeochannel sequence. This interpretation is supported by both a lack of bedrock clasts within the sequence, suggesting a sedimentary source derived from weathered terrain, and by the presence of transported lateritic gravel observed within the Roe Palaeochannel system (Dusci 1994; Ladhams 1994). In addition, the saprolite is partly truncated by the palaeodrainage system and thus formed prior to palaeodrainage incision (Clarke 1994).

The weathering profile within the Lefroy Palaeochannel sedimentary sequence is poorly developed, in comparison to that of the Roe and Cowan Palaeodrainage systems. Weathering is dominantly confined to the upper horizons of the Princess Royal Spongolite and the Revenge Formation, and is characterised by intense mottling of clay horizons.

## DEPOSIT SCALE CASE STUDIES

The aim of the deposit scale case studies is to identify the major controls on gold dispersion in the Lake Lefroy environment, to aid in interpretation of the regional scale geochemical data set.

Gold dispersion studies have been completed for all deposits on Lake Lefroy. The Intrepide and Santa Ana deposits have been selected for discussion because they are good illustrations of the major controls on gold dispersion in the regolith, however conclusions are based on data drawn from all of the deposits.

## INTREPIDE CASE STUDY

### GEOLOGY

The Intrepide gold deposit is 6km southeast of the Kambalda East township, beneath Lake Lefroy (Figure 2). The deposit is currently being mined as an open pit and has a resource figure of 4.8Mt @ 2.3g/t Au (360,000oz). Mineralisation at Intrepide is hosted in lamprophyric intrusive sill within the Kambalda Komatiite, west of the Playa Shear Zone, and is associated with a quartz vein stockwork and an albite alteration system. The orebody is bounded by two major shear zones striking approximately 330° and dipping 40-50° to the west. The eastern shear zone lies along the contact between the intermediate intrusive body and the komatiitic rocks. Shearing along this irregular margin resulted in the formation of dilatant zones and caused brittle deformation of the intrusive.

### REGOLITH PROFILE / WEATHERING HISTORY

The weathered Archaean succession is stripped to the saprolite or saprock horizon which is overlain by Cainozoic sediments of the Princess Royal Spongolite, Revenge Formation and Roysalt Formation. Two weathering events are recorded by the profile. The first, prior to deposition of the Princess Royal Spongolite, only affected the Archaean material. The second event post-dated deposition of the Princess Royal Spongolite, but pre-dated deposition of the Revenge formation, resulting in strong mottling of the Princess Royal spongolite and underlying Archaean regolith.

### GOLD DISPERSION

The gold dispersion halo at a cut off of 100 ppb, within regolith associated with the Intrepide deposit is approximately 1000 m long and up to 500 m wide. Gold distribution is irregular with many patches devoid of significant mineralisation.

The regolith profile developed over the Intrepide deposit shows significant variability from south to north (Figures 6 and 7). In the southern areas of Intrepide, the strongly silicified, albitic nature of the mineralised stockwork has impeded the development of saprolitic material (Figure 6). The resultant residual regolith profile developed over the stockwork consists of a ~15 m zone of saprock. Distal to the stockwork, a more typical saprock - saprolite profile is preserved, over both the intermediate intrusive and the ultramafic protoliths. The truncated profile is overlain by an average of 10 m of lake sediments. It is likely that the presence of the silicified stockwork impeded erosion. This may be the reason that palaeochannel sediments are not as thick here as they are to the north where the stockwork is less developed.

Supergene gold is almost entirely restricted to the saprock material directly overlying bedrock mineralisation, with minor dispersion into the overlying lake sediments in the southern part of Intrepide. An iron redox front occurs higher in the

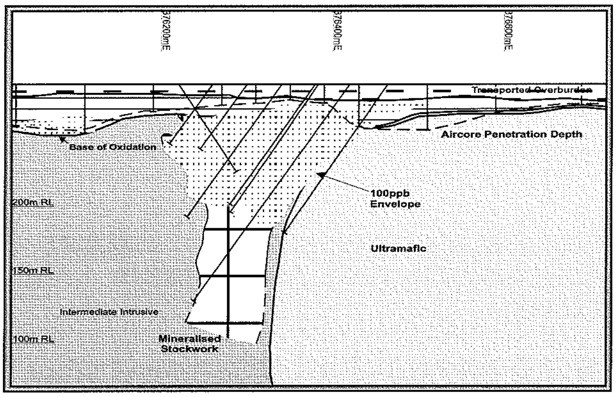


**Figure 6:** *Geology, geomorphology and gold dispersion patterns, Intrepide deposit southern section*

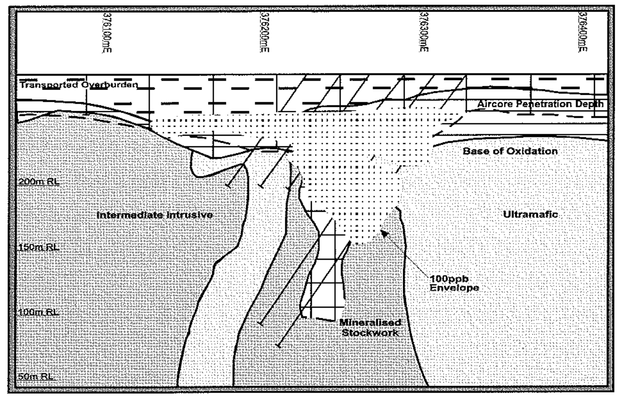


**Figure 7** *Geology, geomorphology and gold dispersion patterns, Intrepide deposit northern section*

regolith profile above the ultramafic rocks, distal to bedrock mineralisation, and has resulted in minor patchy gold dispersion

In the northern parts of Intrepide (Figure 7), the intermediate intrusive body is smaller (50 m wide compared to 200 m in the south) and the mineralised stockwork is not as well developed In the absence of a large silicified stockwork, a relatively thick saprolite zone has developed The regolith profile in the northern areas consists of 5 to 15 m of saprock overlain by approximately 20 m of saprolite The residual profile is truncated by a palaeochannel up to 40 m deep Directly above bedrock mineralisation, a wedge of supergene gold mineralisation extends throughout the residual profile and into the base of the palaeochannel sediments It is probable that the source of this supergene gold mineralisation is partly bedrock material to the south of the section studied, because bedrock mineralisation on the northern section is restricted and sub-economic Distal to the bedrock source, supergene gold is dispersed along the contact between the palaeochannel and the residual saprolite Dispersion along this contact is believed to be the result of concentrated fluid flow along the porous base of the palaeochannel sediments

A significant amount of gold is present at the base of the palaeochannel sediments The continuous nature of gold distribution from the residual regolith into the palaeochannel sediments suggests that the palaeochannel gold is the result of dispersion from underlying supergene mineralisation Properties of the overlying Princess Royal Spongolite suggest dispersion could have been by either physical and/or chemical processes The eroded nature of the top of the Archaean and the coarse sediments at the base of the Princess Royal Spongolite support physical dispersion processes The mottled nature of the Princess Royal Spongolite

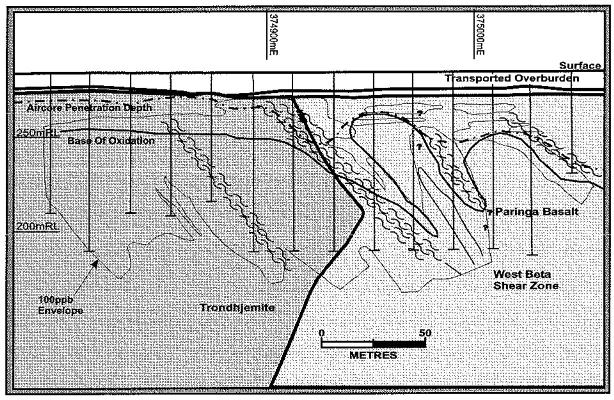


**Figure 8** *Geology, geomorphology and gold dispersion patterns, Santa Ana deposit*

suggests chemical weathering and element dispersion, which could have caused the mobilisation of gold, occurred following deposition

Due to the poor development of saprolite over the mineralised stockwork in the southern parts of Intrepide, penetration of aircore drilling is poor and fails to reach the supergene blanket directly over bedrock mineralisation Identification of an Intrepide - type system from aircore drilling hinges on interpretation of data from the margins of the mineralised system, where the regolith profile is better developed

## Santa Ana Case Study

### GEOLOGY

The Santa Ana gold deposit is located approximately 7 km SE of the Kambalda East township and 1 75 km SW of the Intrepide gold mine (Figure 2) Santa Ana has a total resource of 6 1 Mt @ 2 53 g/t, for 499,000 oz of contained gold Mineralisation is hosted by Paringa Basalt and a large footwall granitoid intrusion The area is also intruded by a suite of lamprophyric dykes

The deposit is structurally positioned on a major NNW trending, east dipping shear zone (West Beta Shear Zone) that is up to 120 m wide and contains parallel subsidiary structures The upper portions of the shear zone are proximal to, or on the contact between, the footwall granitoid and hangingwall Paringa Basalt Two styles of mineralisation are recognised: 1) a broad brittle-ductile shear hosted vein and breccia lode system; and 2) a brittle micro-fractured array, associated with the granitoid intrusion which is infilled with metasomatic albite

## REGOLITH PROFILE / WEATHERING HISTORY

The regolith profile at Santa Ana consists of 12 to 15 m of Cainozoic transported overburden The sequence generally comprises the upper part of the Princess Royal Spongolite (0 to 5 m thick) overlain by the Revenge Formation (7 to 12 m thick) The Revenge Formation is characterised by greyish clay with extensive mottle development, overlain by 1 to 2 m of red to grey, gypsumiferous muds of the Roysalt Formation A thin (2 to 8cm) halite crust is present at the very top of the unit The Archaean regolith has been partially stripped by differential erosion processes with no duricrust or mottled zone preserved The depth of weathering is dependent on the host lithologies and the degree of deformation The granitoid has a shallower weathering front than the mafic hangingwall The main shear zone acted as a conduit to fluid flow resulting in increased depths of weathering (up to 90 m thick)

## GOLD DISPERSION

The Santa Ana gold deposit is characterised by an approximately 1,400 m long, 600 m wide gold dispersion halo defined by a 100 ppb cut off The distribution of supergene mineralisation is relatively complex due to the interference of footwall and hangingwall structures and variations in mineralisation style A simplified cross-section showing the extent of gold dispersion away from the main shear zone is presented in Figure 8 The Tertiary sediments lack supergene mineralisation Secondary mineralisation within the Archaean regolith is distributed asymmetrically, with approximately 70 m of lateral dispersion on the west side of the structure decreasing away from the primary mineralised source The asymmetry reflects the dip of the bedrock structure with supergene mineralisation preferentially developed on the footwall side

To the south, where the dip of the primary mineralised structure steepens, the gold signature displays a symmetric pattern with less lateral dispersion A concentration of supergene mineralisation exists at the base of oxidation, possibly representing an iron redox front

## INTERPRETATION OF REGIONAL AIRCORE GEOCHEMICAL DATA (LAKE LEFROY CASE STUDY)

### Applying Knowledge Gained at Deposit Scale to Regional Scale Exploration

Deposit scale observations have revealed that proximal to mineralisation, supergene gold can be distributed throughout the regolith profile, but is usually focused at the base of weathering Distal to mineralisation, supergene gold tends to be located higher in the regolith profile and can be focused around iron redox fronts and / or the Tertiary - Archaean unconformity

At Santa Ana and Intrepide, the bedrock geology has had a marked effect on regolith development Common features include, restricted weathering over felsic and intermediate intrusive rocks as well as silicified stockworks, and preferential weathering of shear zones When interpreting regional aircore data, lithological factors need to be considered in order to assess the significance of anomalism For example, due to restricted weathering observed over felsic and intermediate substrates, narrow intersections occurring proximal to the base of weathering, are more significant than similar intersections over mafic substrates

The degree of erosion impacts on the size of supergene gold halos For example, if a profile is stripped down to saprock, the preserved supergene halo will be smaller than if the profile is left intact In some instances the basal portions of palaeochannels contain anomalous gold grades This may be the result of dispersion from a bedrock source along the residual - transported unconformity Alternatively, the gold may originate from an unidentified distal source Due to this ambiguity, assay data for transported cover is often excluded from interpretation of regional gold dispersion data

All of the above factors influence the nature of the gold dispersion patterns recorded in aircore drilling The following section outlines how knowledge of the factors controlling gold dispersion is utilised in the processing and interpretation of regional aircore geochemical data

### Processing and Interpretation Techniques

The interpretation of gold dispersion patterns obtained from aircore drilling is a critical regional tool for exploration on Lake Lefroy Years of exploration have resulted in a large geochemical database, thus techniques are required for data processing which enable geochemical dispersion patterns for a large area to be viewed simultaneously Several different processing techniques have been applied to the Lake Lefroy data set, and are described and compared below.

An early data manipulation technique assigned maximum gold values to each aircore hole This provided very little indication of broad, low grade supergene dispersion haloes and gave no consideration to the thickness of anomalous gold intersections or their position within the regolith profile

A more refined technique was later developed which utilised weighted average gold grades in the Archaean regolith Various contours were generated for one or a combination of regolith horizons, enabling the recognition of gold dispersion signatures and mineralised trends However, the weighted average values included all material within the hole, whether it was considered anomalous or not, therefore diluting some values, depending on the thickness of the regolith profile
To overcome these issues, a system has been designed to automatically select anomalous intersections based on a specific set of parameters Summed gram x metres values, for identified intersections are then calculated for all Archaean regolith material within each aircore hole. The resultant value directly represents the grade and thickness of gold anomalism, without being influenced by background material The Lake Lefroy data set processed in this manner is presented in Figure 9

Comparing the gram x metre dataset to the weighted average dataset, a number of advantages of the former can be recognised The orebody footprint observed in the gram x metre plot is broader and has a higher contrast to background when compared to the weighted average plot, due to the lack of dilution in the gram x metre dataset. Also, known mineralised trends are more distinct in the plot of gram x metre values and potential extensions of these trends are easily identified Another advantage of the gram x metre plots is that the values obtained for individual drill holes are an indication of the type of intersection values which should be considered anomalous in regional drilling programmes
In addition to utilising the processed data to uncover new mineralised positions in the Lake Lefroy area, the data can be utilised for regional exploration of similar lake terrains Study of the Lake Lefroy dataset has led to the identification of optimal drill spacings to use in regional drilling campaigns, which are strongly influenced by the degree of regolith development. Additionally, the Lake Lefroy dataset can be utilised as a template to interpret gold dispersion patterns identified in regional exploration programmes

### Proposed Further Modifications to Processing Techniques

Work is underway to further modify the processing of aircore data Presently, knowledge of dispersion controls is mainly utilised in the interpretation of aircore data Methods are being investigated to incorporate these controls into data processing through the application of weightings For example, an intersection will be given a weighting depending on its position in the regolith profile. This is an advantageous alternative to the present method of plotting gold dispersion signatures separately for the different regolith horizons, as all of the data would be present on one plan, aiding in interpretation Other weighting factors related to bedrock lithology and proximity to the base of a palaeochannel will potentially be incorporated.

## INVESTIGATIONS INTO NEW GEOCHEMICAL AND REGOLITH MAPPING TECHNOLOGIES

### Airborne EM - Palaeochannel Mapping in Lake Environments

In interpreting gold dispersion patterns it is important to accurately define the depth of transported cover. In well explored areas, this information is obtained from drill data. In areas of limited drilling, geophysical techniques such as airborne EM have the potential for resolving cover depths

An airborne EM survey was flown over the southern section of Lake Lefroy by Geoterrex Pty Ltd, using the GEOTEM system The aim of the survey was the identification and delineation of palaeochannels beneath saline lake sediments The survey area was chosen primarily because a comprehensive drilling database exists providing known depths of lake sediments Results indicated that certain processing and interpretation products were able to demonstrate a qualitative correlation with known depth of lake sediments The two most useful interpretation tools proved to be contouring single late channel amplitudes and Amplitude Weighted Decay Indexes (ADIs).

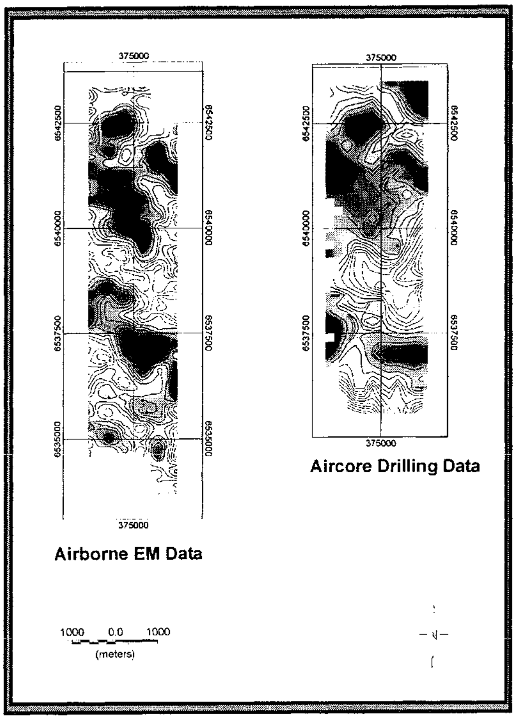


**Figure 10:** *Comparison of airborne EM ADI's to known transported depth cover from drilling.*

Both methods compare favorably with known depths of lake sediments defined from drilling (Figure 10). A single channel is merely a snap shot at one particular time, whereas the ADI is a more diagnostic measure of ground behaviour over a longer period. It is intended that airborne EM will be utilised to assess the cover conditions of regions prior to commencement of surface or drill hole geochemical programme in covered terrains. This will assist in both the planning and interpretation of geochemical data.

## ENZYME LEACH

Presently aircore drilling is the only geochemical tool WMC confidently uses in the exploration of lake terrains. However, there are a number of alternative techniques being tested and utilised in specific circumstances. Of these, one of the most promising to date has been enzyme leach.

The enzyme leach technique has been tested in the lake environment over both gold and nickel orebodies. Prior to the commencement of mining at the Santa Ana and Intrepide gold orebodies, a partial leach orientation line was collected over each deposit. A number of different partial leaches were tested, but only the enzyme leach data appeared to indicate the mineralised positions (Figures 11 and 12). The orientation line lengths were 1,500 to 2,000 m with samples taken at close spacing over the orebodies and at wider spacing distal to mineralisation. Samples were taken in two stages as the initial lines were too short. Seasonal effects were noted between the two sampling periods with adjustments made. Sample collection and handling procedures followed guidelines recommended by Clark (1993a), with the exception that in the absence of a soil B horizon, where possible samples were taken from a black organic rich horizon beneath the salt crust.

The depth of lake cover over the line sampled at Intrepide was 10 m, with mineralisation present 15 m below the surface of the lake. At Santa Ana, the depth of cover on the orientation line tested was 15 m, with the bulk of mineralisation situated 35 m below the lake surface.

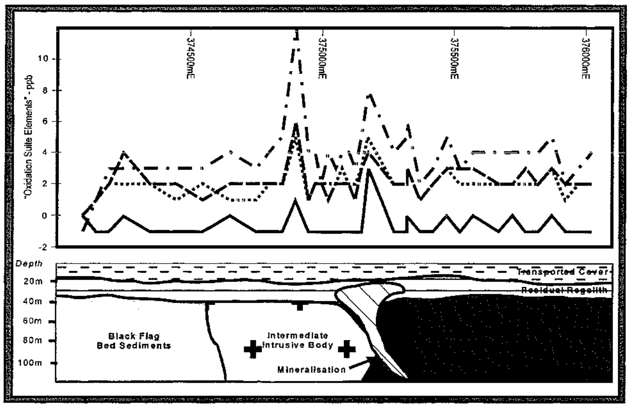


**Figure 11:** *Enzyme Leach response over a mineralised section, Santa Ana gold deposit*

A "rabbit ears" type Enzyme Leach anomaly was recorded on both orientation lines. In both cases the central low between the "rabbit ears" overlay the surface projection of bedrock mineralisation. The anomalous element suite was similar for both deposits and consisted of light rare earth elements (La, Sm, Pr, Nd), from within the "oxidation suite" as described by Clark (1993a).

## CONCLUSIONS

Lake Lefroy represents a series of superimposed landforms whose history dates from the pre-Eocene. The complicated sub-surface regolith stratigraphy and palaeolandscape were formed by a combination of differential erosion, deposition and chemical modification. The use of detailed case studies of known deposits has resulted in a comprehensive understanding of various controls on gold dispersion within the regolith, which include: position of iron redox fronts; style of primary mineralisation; bedrock lithologies; degree of erosion; and thickness of transported cover Proximal to a bedrock source supergene gold is usually focused at the base of weathering, but distal to mineralisation, dispersion of supergene gold is controlled by iron redox fronts located higher in the regolith profile The bedrock geology and style of mineralisation have prominent effects on regolith development and supergene dispersion, with for example, limited weathering over felsic intrusive lithologies and silicified stockworks thus restricting supergene dispersion This knowledge has been applied in interpretation of the processed regional scale data, resulting in the discovery of additional resources.

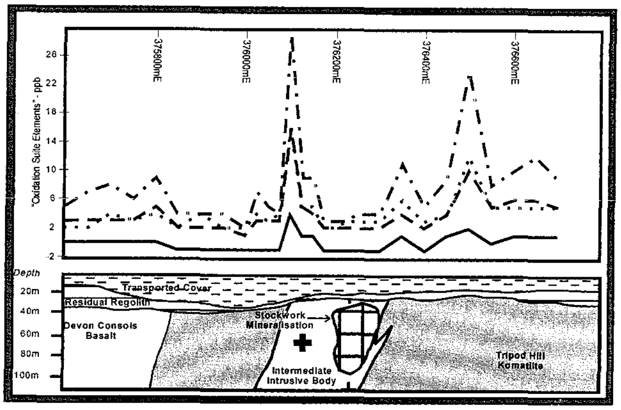


**Figure 12:** *Enzyme Leach response over a mineralised section, Intrepide gold deposit*

Innovative processing schemes and data visualisation tools have been employed to allow management of a large data set, providing optimal targeting and prospect prioritisation The most effective of these schemes is the calculation of summed gram x metre intersections for the archaean regolith within each aircore hole These values represents the undiluted grade and thickness of drill hole gold anomalies WMC Resources is continually trying and implementing new techniques, as well as further developing methods to deal with aircore drilling data Experimental techniques successfully tried include airborne EM and enzyme leach The continual advancements of such techniques and knowledge of the regolith and gold dispersion will lead to the discovery of further gold deposits in covered terrains

## ACKNOWLEDGEMENTS

Thanks are given to the following people for reviewing this manuscript and providing constructive criticism; Jennifer Gressier, Andrew Wellington, Julie Elders, Peter Bewick and Paul Taufen Brad George provided valuable insight into Airborne EM and we are eternally grateful for Shane O'Connell's programming skills Marilyn Ward and Rebekah Jenaway assisted in the drafting of diagrams Nigel Brand and David Grey edited this manuscript for publication

## REFERENCES

BUNTING, J A , VAN DE GRAAFF, W J E , & JACKSON, M J 1974 Palaeodrainages and Cainozoic Palaeogeography of the Eastern Goldfields, Gibson Desert and Great Victoria Desert *Geological Survey of Western Australia, Annual Report* 1973, pp 45-50

CLARKE, J R 1993(a) Enzyme-induced leaching of B-horizon soils for mineral exploration in areas of glacial overburden *Transactions of the Institute of Mining and Metallurgy (Section B: Applied Earth Science),* **102,** 19-29

CLARKE, J D A 1993(b) Stratigraphy of the Lefroy and Cowan Palaeodrainages, Western Australia *Journal of Royal Society of Western Australia* **76,** 15-22

CLARKE, J D A 1994 Geomorphology of the Kambalda Region, Western Australia *Australian Journal of Earth Sciences* **41,** 229-239

CLARKE, J D A BONE, Y ,& JAMES, N P 1994 Marine Incursions into Palaeodrainages at Kambalda and Norseman, Western Australia *12th Australian Geological Convention, Geological Society of Australia, Abstracts* **37,** 63-64

DUSCI, M E 1994 Regolith-Landform Evolution of the Black Flag Area with Emphasis on Upper Reaches of the Roe Palaeodrainage System, *Western Australia BSc (Hons) Thesis, School of Applied Geology, Curtin University (unpubl )*

LADHAMS, B A 1994 Sediments and Regolith Features of the Middle Reaches of the Roe Palaeochannel, near Kanowna, Eastern Goldfields, Western Australia *BSc (Hons) Thesis, School of Applied Geology, Curtin University (unpubl )*

REDDELL, C , & DUSCI, M E 1997 The Success of WMC Resources Ltd Lake Exploration - Case Histories New Generation Gold Mines '97 Case *Histories of Discovery Conference Proceedings, AMF,* 11 1-11 5

ROBERTS, D E & ELIAS, M 1990 Gold Deposits of the Kambalda-St Ives Region In: F E Hughes ed *Geology of Mineral Deposits of Australia and Papua New Guinea Australian Institute of Mining and Metallurgy,* **14:** 479-491

SWAGER, C P , GRIFFIN, T.J., WITT, W.K., WYCHE, S., AHMAT, A L., HUNTER, W.M., & MCGOLDRICK, P.J. 1990. Geology of the Archaean Kalgoorlie Terrane - an explanatory note. *Geological Survey of Western Australia, Record* **1990/12,** 55p

VAN DE GRAAFF, W J E , CROWE, R W A , BUNTING, J A , & JACKSON, M J 1977. *Relict Early Cainozoic Drainages in Arid Western Australia Zeitschrift fur Geomorphologie,* **Vol. 21, No. 4,** pp 379-400.

ZHENG, H. 1996. Palaeomagnetic Data on the Onset of Playa Sedimentation in Lake Lefroy *WMC Resource Internal Report K/3690*

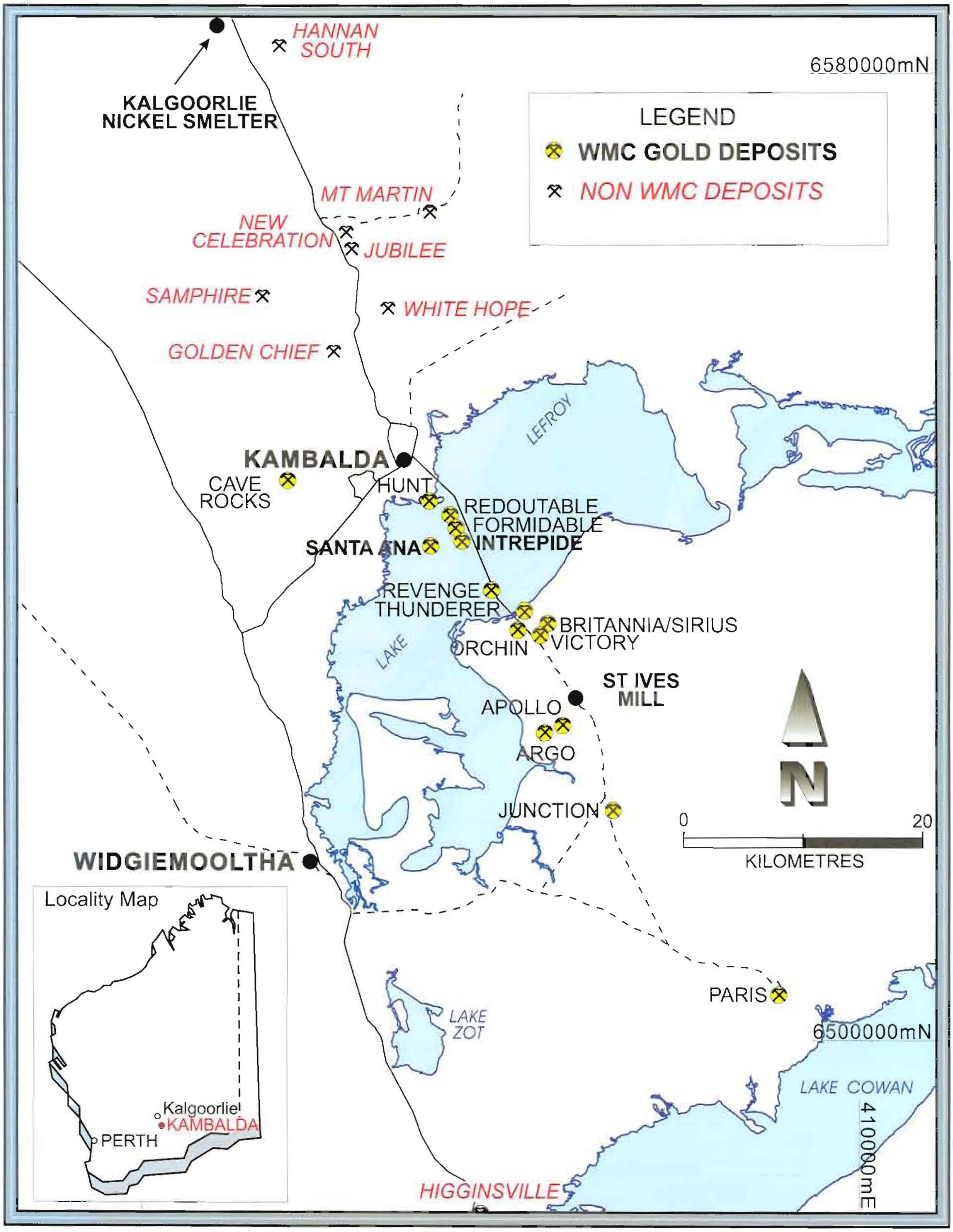


Figure 1: *Location map of the Lake Lefroy area showing gold deposits of the region*

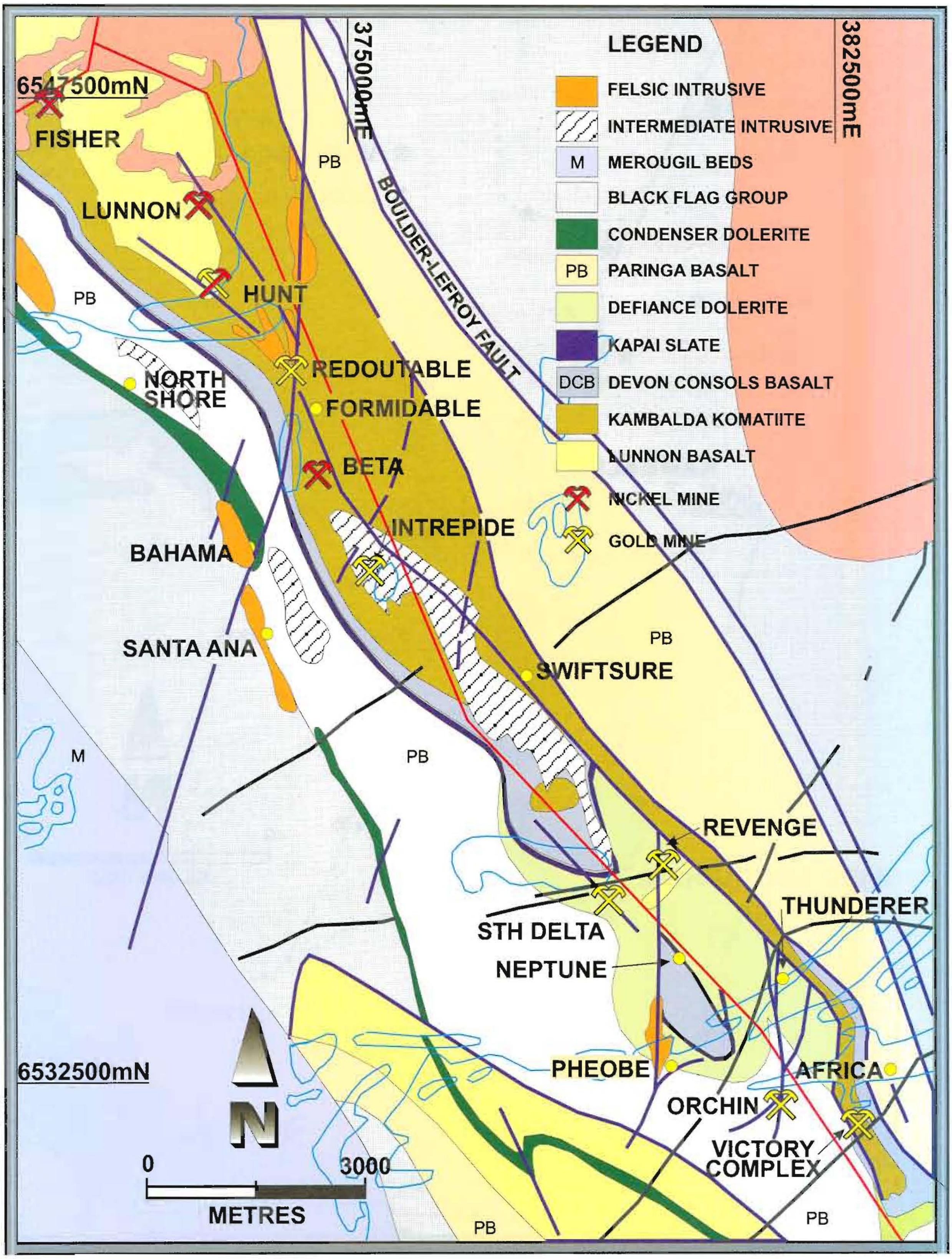


Figure 2: *Simplified regional geological interpretation of the Lake Lefroy area showing locations of both gold and nickel deposits*

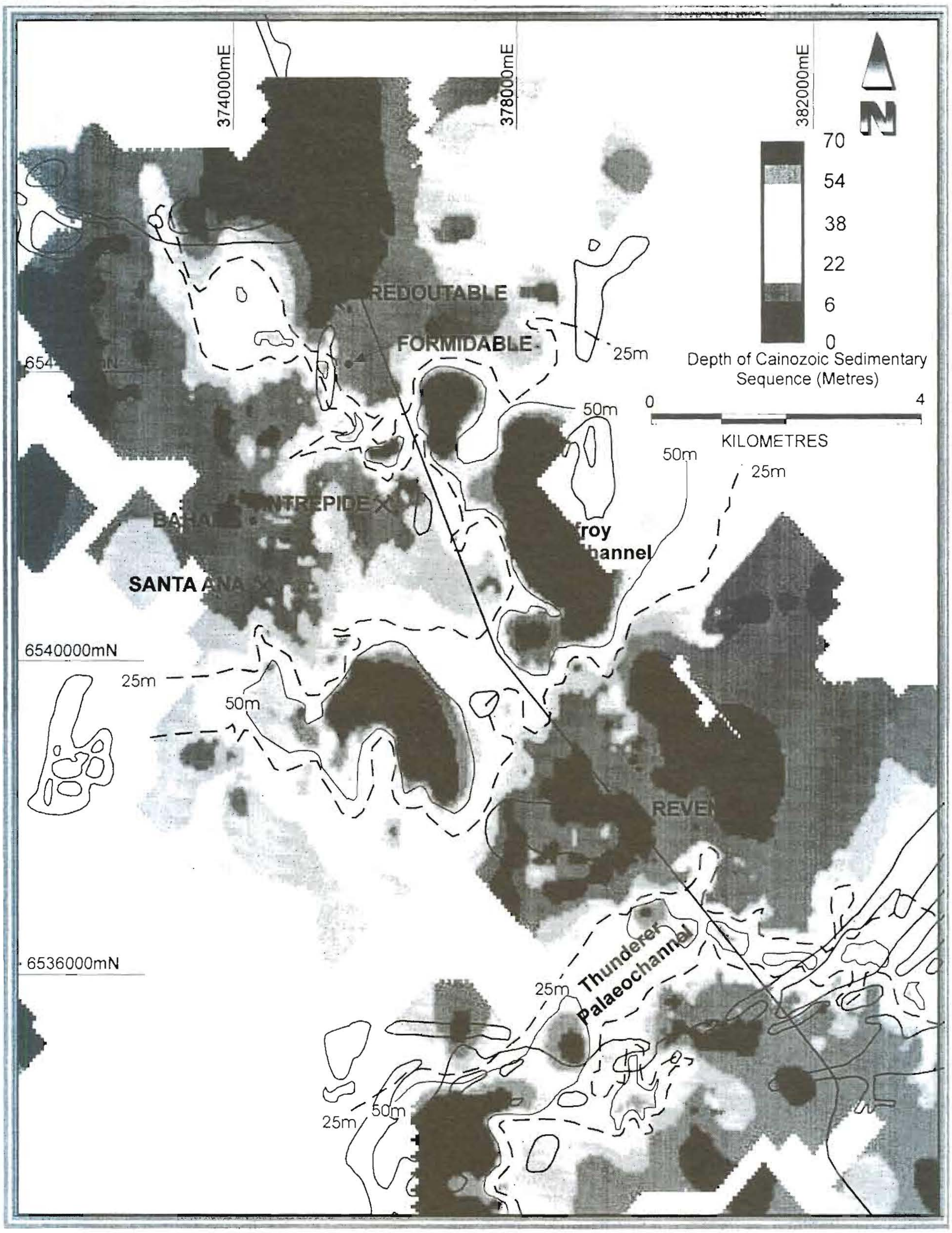


**Figure 4:** *Contour of depth of Cainozoic cover sequence showing the Lefroy and Thunderer Palaeochannels*

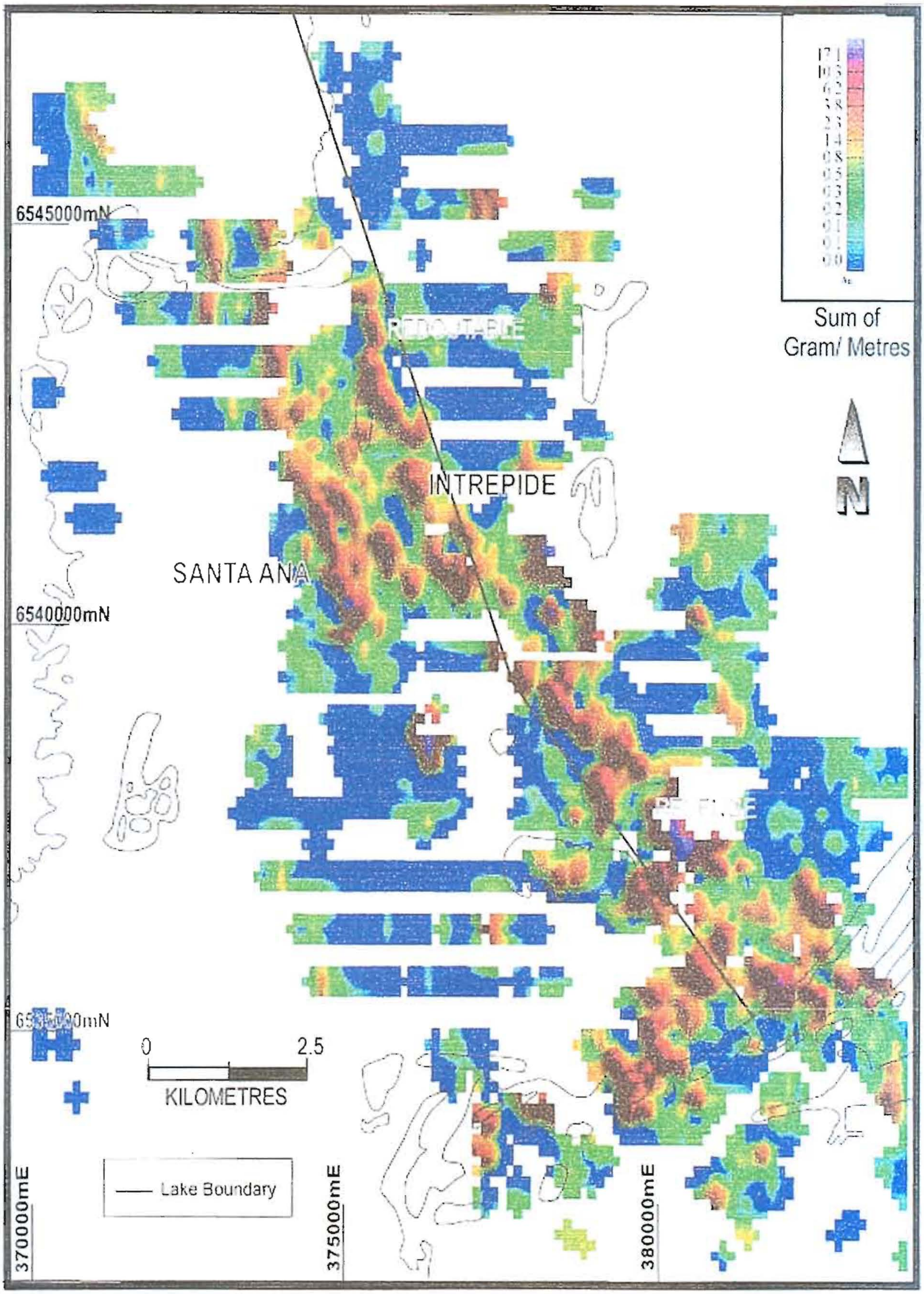


**Figure 9:** *Contours of summed gram x metre values for identified significant intersections in aircore drill holes; Lake Lefroy area.*