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THE GEOCHEMISTRY OF TRANSPORTED SOILS AND WEATHERED BEDROCK AT POLICE CREEK, DRUMMOND BASIN, QUEENSLAND - A PROGRESS REPORT

K.M. Scott

CRC LEME OPEN FILE REPORT 124

April 2002

(CSIRO Exploration and Mining Report 157R, 1995.
2nd Impression 2002.)

CRCLEME

CRC LEME is an unincorporated joint venture between CSIRO-Exploration & Mining, and Land & Water, The Australian National University, Curtin University of Technology, University of Adelaide, University of Canberra, Geoscience Australia, Bureau of Rural Sciences, Primary Industries and Resources SA, NSW Department of Mineral Resources-Geological Survey and Minerals Council of Australia, established and supported under the Australian Government's Cooperative Research Centres Program.

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CSIRO/CRC LEME/AMIRA PROJECT P417
GEOCHEMICAL EXPLORATION IN REGOLITH-DOMINATED TERRAIN, NORTH QUEENSLAND 1994-1997

In 1994, CSIRO commenced a multi-client research project in regolith geology and geochemistry in North Queensland, supported by 11 mining companies, through the Australian Mineral Industries Research Association Limited (AMIRA). This research project, "Geochemical Exploration in Regolith-Dominated Terrain, North Queensland" had the aim of substantially improving geochemical methods of exploring for base metals and gold deposits under cover or obscured by deep weathering in selected areas within (a) the Mt Isa region and (b) the Charters Towers - North Drummond Basin region.

In July 1995, this project was incorporated into the research programs of CRC LEME, which provided an expanded staffing, not only from CSIRO but also from the Australian Geological Survey Organisation, University of Queensland and the Queensland Department of Minerals and Energy. The project, operated from nodes in Perth, Brisbane, Canberra and Sydney, was led by Dr R.R. Anand. It was commenced on 1st April 1994 and concluded in December 1997. The project involved regional mapping (three areas), district scale mapping (seven areas), local scale mapping (six areas), geochemical dispersion studies (fifteen sites) and geochronological studies (eleven sites). It carried the experience gained from the Yilgarn (see CRC LEME Open File Reports 1-75 and 86-112) across the continent and expanded upon it.

Although the confidentiality period of Project P417 expired in mid 2000, the reports have not been released previously. CRC LEME acknowledges the Australian Mineral Industries Research Association and CSIRO Division of Exploration and Mining for authority to publish these reports. It is intended that publication of the reports will be a substantial additional factor in transferring technology to aid the Australian mineral industry.

This report (CRC LEME Open File Report 124) is a second impression (second printing) of CSIRO, Division of Exploration and Mining Restricted Report 157R, first issued in 1995, which formed part of the CSIRO/AMIRA Project P417.

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PREFACE

The CSIRO-AMIRA Project"Geochemical exploration in regolith-dominated terrain of North Queensland"(P 417) has, as its overall aim, to substantially improve geochemical methods of exploring base metals and gold deposits under cover or obscured by deep weathering. The Project has two main themes which are *Regolith characterisation* and *Geochemical dispersion for detection of concealed deposits,* the latter is addressed by this report, which focuses on the Police Creek prospect in the Drummond Basin .

A variety of sedimentary materials comprise the transported cover in the Charters Towers- Drummond Basin region. Because of the abundances of these cover sequences, there is considerable interest in the use of transported material as a sampling medium in the region.

The geochemical orientation study at Police Creek was based on multi-element analysis of transported and residual soils. Transported soils and their constituent size fractions were physically examined, analysed for 30 elements and assessed for suitablility for geochemical prospecting. A geochemical anomaly occurs within soils overlying bedrock-hosted mineralisation at Police Creek. In transported soils, the Au anomaly is best defined by the kaolinite-rich <75 μm fraction and by As, Sb and Mo in the ferruginous >2 mm fraction. In residual soils, the anomaly is characterised by Au, As and Sb within the > 2 mm fraction. Probable mechanisms of geochemical dispersion are discussed.

R.R.Anand, Project Leader
I.D.M. Robertson, Deputy Leader

26th April, 1995

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

SUMMARY

Two distinct anomalies occur in the soils at the Police Creek epithermal gold deposit. The major geochemical anomaly occurs within transported soils overlying bedrock-hosted mineralization. It is best defined by the occurrence of >100 ppb Au (and elevated S) in the -75 μm kaolinite-rich fraction of the soils and by As >400 ppm (and elevated Sb and Mo) in the +2 mm Fe-rich fraction of the soils. The second type of anomaly in thin residual soils directly overlying bedrock is characterized by anomalous Au plus As and Sb within the +2 mm of the soils. Although use of -75 μm fraction of the soils gives a larger anomaly than the previously used -80 mesh (-180 μm) fraction, use of only that material would not identify the second type of anomaly. Thus a strategy of analysing both the fine and coarse material in soils in the region is recommended if the origin of the soils is not known.

Study of the bedrock in a number of profiles also reveals that Au is likely to be separated from pathfinders like As and Sb during weathering process. Under very acid conditions (reflected by the presence of alunite in rocks), Au is depleted but the pathfinders (As, Sb, Mo and W) are retained. However under more alkaline conditions where near-surface dolomite is present Au is present but pathfinder contents are low. Analysis of bedrock material for Au, As, Sb, Mo and W is thus recommended with knowledge of the mineralogy also important to understand the acidity of the environment and hence why different suites of elements occur.

1. INTRODUCTION

Because of the abundance of cover sequences like the Campaspe Formation, Southern Cross Formation and Suttor Formation in the Charters Towers-Drummond Basin region, there is considerable interest in the use of transported material as a sampling medium in the region. The work by Granier et al. (1989), reporting Pb in the Campaspe Formation above mineralization at Thalanga has greatly contributed to such interest. Furthermore the fact that the two major epithermal deposits of the Drummond Basin, Pajingo and Wirralie, were both partially obscured by Tertiary cover sequences which may be mineralized (Porter, 1990; Fellows and Hammond, 1990) adds to such interest.

Within the Drummond Basin, at Police Creek, 6 km northeast of Mount Coolon (Figure 1), work conducted by Australian Consolidated Minerals Limited indicated that Au >100 ppb in the -80 mesh (-180 μm) fraction of transported soils outlines the zone of mineralization in the underlying volcanics. This study reports results from a study of various soil fractions along a traverse across mineralization and details obtained from shallow profile studies in the same area.

2. GEOLOGY

Quartz latite ignimbrites of the Carboniferous Silver Hills Volcanics form the basement to the area. These rocks are characterized by the presence of 5-10% quartz phenocrysts and are stratigraphically equivalent to the Bimurra Volcanics (Hutton et al., 1991). They also host the primary Au mineralization of the area (R. Mustard, pers comm., 1994). During the Early Tertiary these rocks were overlain by the sandstones of the Suttor Formation with some incorporation of locally derived material (viz. epithermal quartz vein material and quartz phenocrysts from the underlying volcanics) into the unit. In the Police Creek area the Suttor Formation is generally ~10 m thick. During the Middle to Late Tertiary period lateritization processes affected the Drummond Basin (Wells et al., 1989). In the Police Creek area this results in surface ferruginization of the Suttor Formation and mottled and clay zone development in the underlying bedrock (Silver Hills Volcanics). Subsequently the lateritic profile has been incised to a depth of 15-20 m thereby exposing the mottled and clay zones within the Silver Hills Volcanics before deposition of up to 6 m of alluvium. This alluvium (generally referred to as TQ_r on maps, e.g. Hutton et al., 1991) can be overlain by up to two metres of quartz-rich sheetwash. Incision of these alluvial and colluvial units by the current streams has followed with several periods of Quaternary fluvial deposition in the lowest parts of the landscape.

The sequence of erosion and deposition is shown schematically in Figure 2. The major geomorphic feature is the development of a stepped landscape with the alluvial units occurring ~10 m below the top of the Suttor Formation and ~2 m above the current streams (see Figure 2). Only a very thin veneer of quartz-rich sheetwash is present in the prospect area at Police Creek. Thus the alluvium which appears to be subjected to pedogenic processes (e.g. incipient formation of Fe concretions) forms the main surficial material. However the soil just below the level of outcropping Suttor Formation is thin and is residual (derived from underlying bedrock).

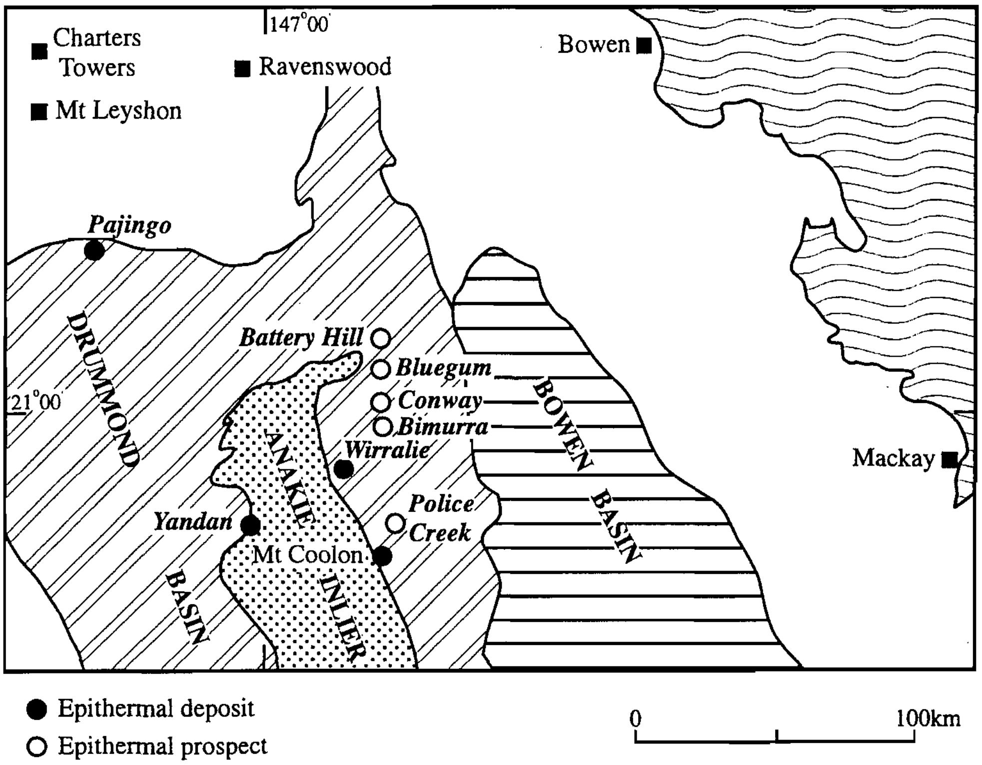


Figure 1 Regional geological setting of epithermal gold deposits, Drummond Basin, Qld.

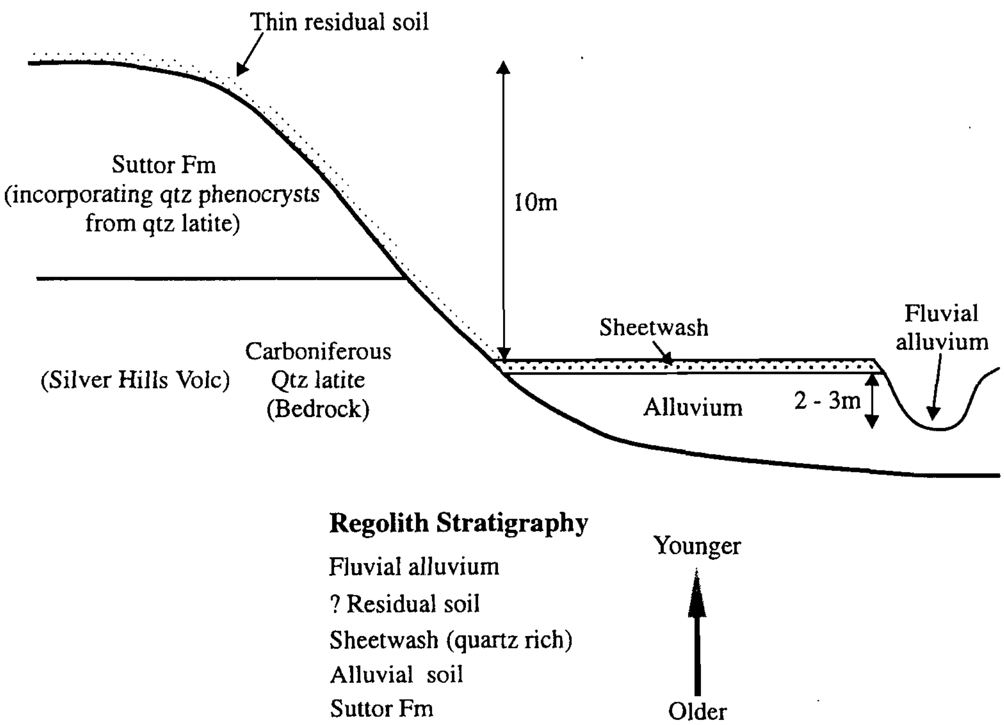


Figure 2 Schematic representation of the landscape and stratigraphy in Police Creek prospect area.

3. MINERALIZATION

Within the northern portion of the Drummond Basin mineralization occurs at Yandan, Mount Coolan, Wirralie and in the Bimurra-Conway area, all within 50 km of Police Creek (Figure 1). All of these deposits are characterized by sericitic alteration assemblages which are frequently overprinted by kaolinite. Adularia is locally present as an alteration mineral with pyrophyllite and alunite also common minor associates (Wood et al., 1990). The Au:Ag ratio is ~10:1 at Yandan and between 2:1 and 3:1 at Wirralie and Mount Coolan but Ag contents are much higher in the Bimurra-Conway area with ratios locally 1:10 or more (Wood et al., 1990; Seed, 1995). The gold in these deposits tends to be fine grained, e.g. 50% of the gold at Yandan is less than 5 microns and 92% less than 30 microns (Seed, 1995).

At Police Creek the Silver Hills Volcanics are the host to pervasive silica-pyrite alteration which contains discrete zones of quartz+pyrite±marcasite breccia (up to 10 m wide) and narrow quartz-carbonate veins. Such mineralization grades up to 0.5, 3 and 10 g/t Au respectively (R. Mustard, pers. comm., 1994). The silica-pyrite alteration is surrounded by successive zones of illite and chlorite/carbonate typical of epithermal mineralization (e.g. Hayba et al., 1986). Obvious base metal sulfides are not developed in the alteration zones.

As indicated above, the Silver Hills Volcanics are affected by the mid-late Tertiary lateritization event and subsequent weathering events. Complete weathering of sulfides occurs to a depth of 30 m, with partial weathering extending for another 10-20 m. Within the zone of partial weathering (transitional zone) there is some supergene Au enrichment to grades ~1 g/t. Gold is however depleted in the saprolite above the supergene zone except where the gold is armoured by quartz. It is however present in the alluvium which overlies the mineralized Silver Hills Volcanics (Figure 3).

4. SAMPLES AND METHODS

A suite of 19 samples were taken at 50 m intervals to form a south to north traverse across the mineralization at 20050E (Figures 4 and 5). Samples were collected from the top 10 cm of soil. A brief description of the soils and their coarse (+2 mm) fraction is presented in Appendices 1 and 2. The major feature of the soils are - 9350N-9450N grey soils with quartz and/or lithic pebble sized fragments, 9500N-9850N brown soils with some pebbles, 9900N-10250N grey and fawn-brown soils with only rare pebbes. Magnetic testing with a hand magnet indicates significant magnetic response between 9500N and 9800N (Appendix 1).

The +2 mm fractions are lithic in the initial soils to 9450N and then Fe rich or Fe stained to 9900N. Quartz-rich fragments predominate to 10050N then kaolinitic fragments with some boxworks occur between 10100 and 10150N. Sandstone and quartz fragments occur between 10200 and 10250N. The proportion of coarse material is quite low between 9800 and 10000N (Appendix 2).

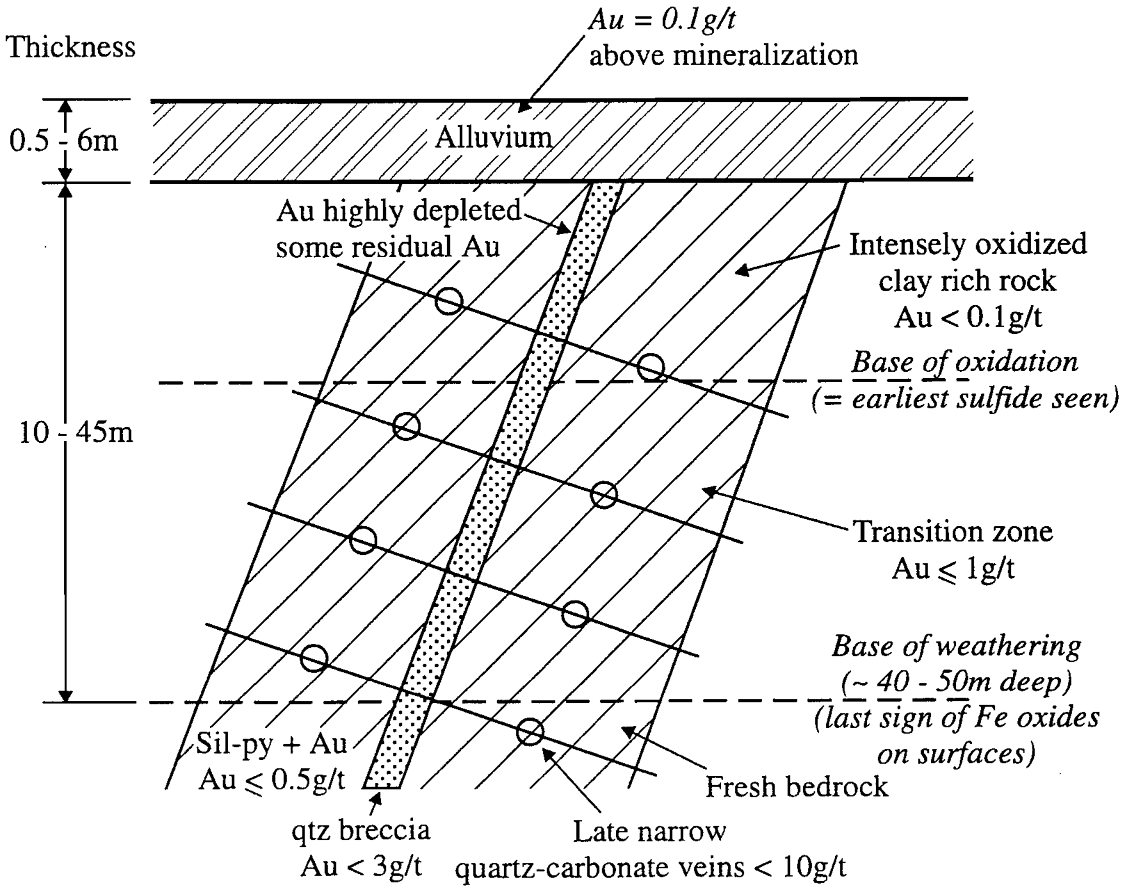


Fig.3 Profile through weathered mineralization Police Creek

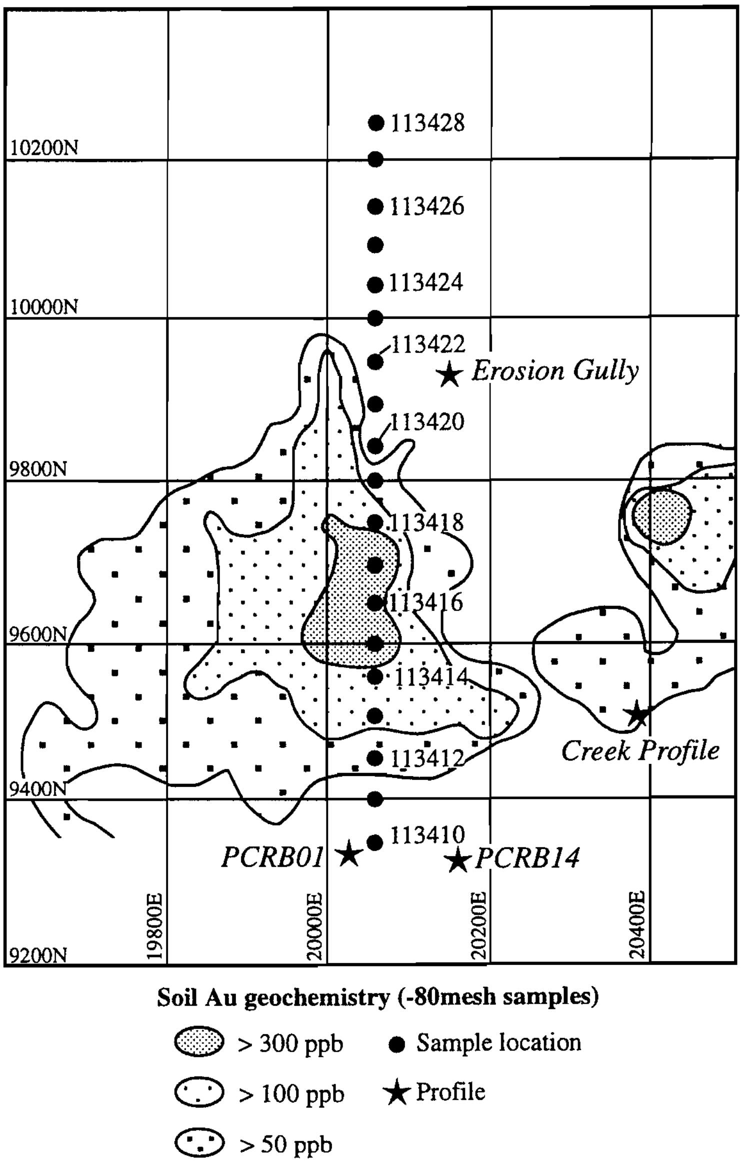
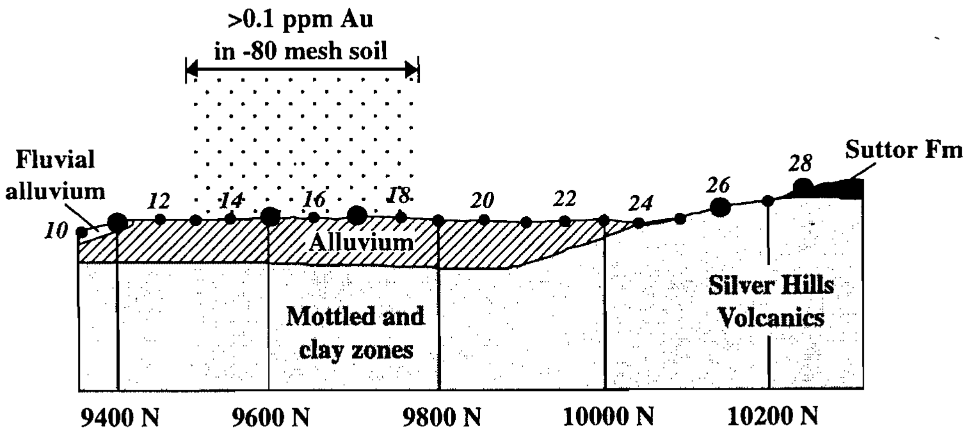


Figure 4 Plan of the Police Creek anomaly, showing locations of samples and ACM's - 80 mesh Au geochemistry.



Section along 20050E showing location of samples

(Orientation samples shown in bolder symbols, all sample nos preceded by 1034..)

Figure 5 Section along 20050E showing location of samples.

To provide information in the vertical plane samples were collected from hydrothermally altered Silver Hills Volcanics exposed in a creek bank at 20380E/9500N and the nearby ferruginous lag. A 2 m profile through barren material provided by an erosion gully to the east of the mineralized zone at 20150E/9930N and two 5 m profiles provided by RAB drilling along the 9340N line have also been studied.

An orientation study was conducted on a group of five soils over mineralized and barren portions of the traverse. Approximately 400g of these soils were seived into six fractions (A) +2 mm, (B) -2mm + 710 μm, (C) -710 μm + 500 μm, (D) -500 μm +250 μm, (E) -250 μm + 75 μm and (F) -75 μm and the amount of material recorded. Except for the -170 + 500 μm fraction (for which there was insufficient sample for analysis), the various fractions were crushed to -75 μm in a Mn-steel mill for analysis where necessary. Ground samples were analysed mineralogically by X-ray diffractometry using graphite-crystal monochromatal Cu radiation. Chemical analysis was by neutron activation analysis (using the Au + 28 package of Becquerel Laboratories) with some additional elements (majors plus Cl, Cu, Ga, Nb, Pb, Sr, V, Zn and Zr) determined by X-ray fluorescence (XRF) at the Perth Laboratories of the Division.

After the orientation study, other soil samples were seived into 3 fractions +2 mm, -2 mm + 75 μm and -75 μm with the coarsest and finest being analysed by neutron activation analysis.

Whole rock samples from the profiles were ground and analysed by XRD and neutron activation analysis (NAA).

5. RESULTS

5.1 Orientation Study 20050E

Five samples from along the traverse were studied in detail.

Figure 6 shows that when divided into six size fractions, with the exception of sample 113411 (in which there is abundant sand), the -75 μm fraction accounts for 40-50% of the total sample weight. The coarsest fraction (+2 mm) generally accounts for 10-20% of the sample but, as indicated above, the -710 μm +500 μm fraction generally comprises <5% of the sample and often did not provided sufficient sample to analyse chemically.

X-ray difractometry on the coarsest and finest fractions of the soils reveals the major components to be quartz, kaolinite, ± hematite, muscovite, ± feldspars ± anatase. Hematite is only present in the coarest fractions and these fractions also contain less kaolinite than the finest fractions. When present anatase is in the finest fractions. Plagioclase is present in both fractions of 113411 and is reflected by its elevated Na contents (see Table 1).

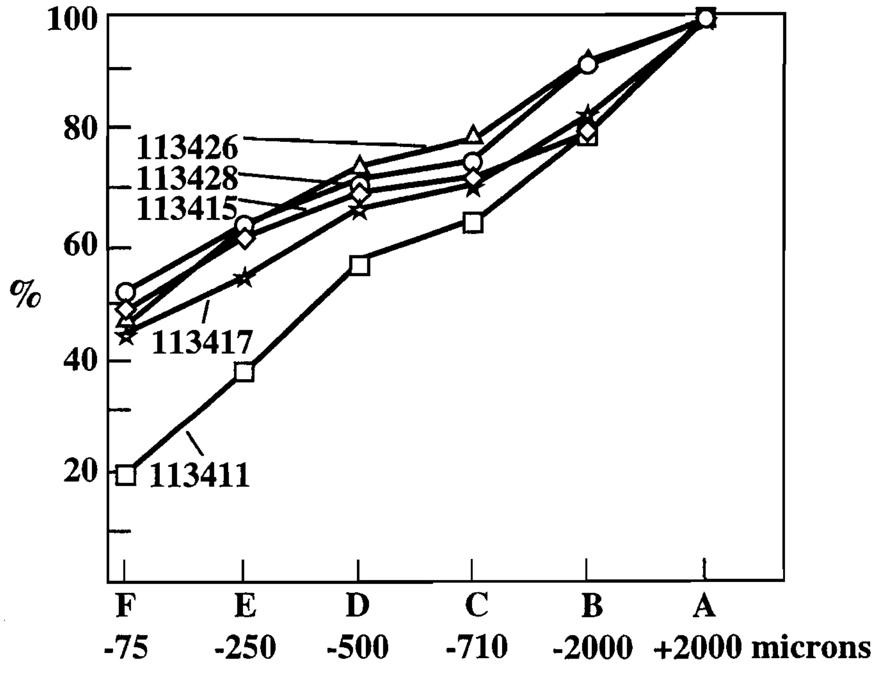


Figure 6 Cumulative weight fraction for soils, Orientation Study, Police Creek.

Results of the chemical analysis of the five different size fractions of the five samples along the traverse are shown in Table 1. The major features of the data are the occurrence of the maximum Fe contents with As, Sb and V in the coarsest fractions and the highest Ti, S, Au, Ce, (Cs), Cu, Nb, (Zn) and Zr in the finest fractions of each sample. The occurrence of maximum Fe in the coarsest fraction reflects the strong partitioning of the hematite into that fraction whereas the high Ti and Zr reflect the occurrence of anatase and zircon with the kaolinite-rich finest fraction. The Ce enrichment in the kaolinitic fraction probably also represents concentration of monazite/bastnaesite in such material. Other features to note are the general association of K, Ba and Rb, e.g. lowest values of all three elements in the 113426 fractions (Table 1). Although W and/or Mo are often associated with gold at Pajingo (Porter, 1990) and Mt Leyshon (Scott, 1987), no clear trend is obvious in the W contents of these samples and only 113415A had Mo greater than the detection limit. The low abundance of the base metals, Cu, Pb and Zn, in any fraction, even in the two samples from above mineralization where Au is anomalous, confirms ACM's finding that these elements are not useful as pathfinders. Furthermore, the strong association of As and Sb with Fe in the coarest fraction and Au in the finest fraction of each sample suggests that using the Au + 28 Neutron Activation Analysis package may be a cost effective analytical procedure.

5.2 Full 20050E Traverse

Results of analysis of coarse and fine fractions from the soils along the 20050E traverse are presented in Tables 2 and 3 with salient features being shown diagrammatically in Figs. 7-11. It is important to note that from 10050N to 10200N the soil is less than 0.2 m thick and directly overlies weathered bedrock (i.e. is residual) and the sample at 10250N is from soil over the Suttor Formation (Figure 5).

The coarsest hematitic samples show a zone 350 m long for which the As content is consistently >400 ppm. This zone also contains most of the samples with Sb > 10 ppm and all of the samples with Mo > 5 ppm (Table 2, Figures 7-9). However, this zone does not have elevated Au contents in the coarse fraction. Indeed the greatest Au in coarse fraction material occurs with elevated As and Sb contents between 10050 and 10150N i.e. in the soil directly above bedrock (Table 2, Figures 7-9). Tungsten contents up to 20 ppm are present in the coarse material along the traverse but the highest values actually appear to occur in the interval between the two anomalous zones (Figure 10).

For the kaolinitic (finest) material, the 350 m anomalous zone is characterized by Au > 100 ppb and some As contents ≥ 30 ppm. These As contents do not however define the zone as well as the coarsest fraction material (Figure 8). Antimony, Mo and W may display isolated higher values along the traverse with those for Sb and W actually occurring in the anomalous zones (Table 3, Figures 9 and 10) but such values are too low/too intermittent to be useful in exploration programmes. Although S data are restricted to the orientation samples, S does appear to define the larger anomaly (Figure 11). Apart from some As > 30 ppm and Sb > 10 ppm, the kaolinitic samples do not define the anomaly at 10050N-10150N.

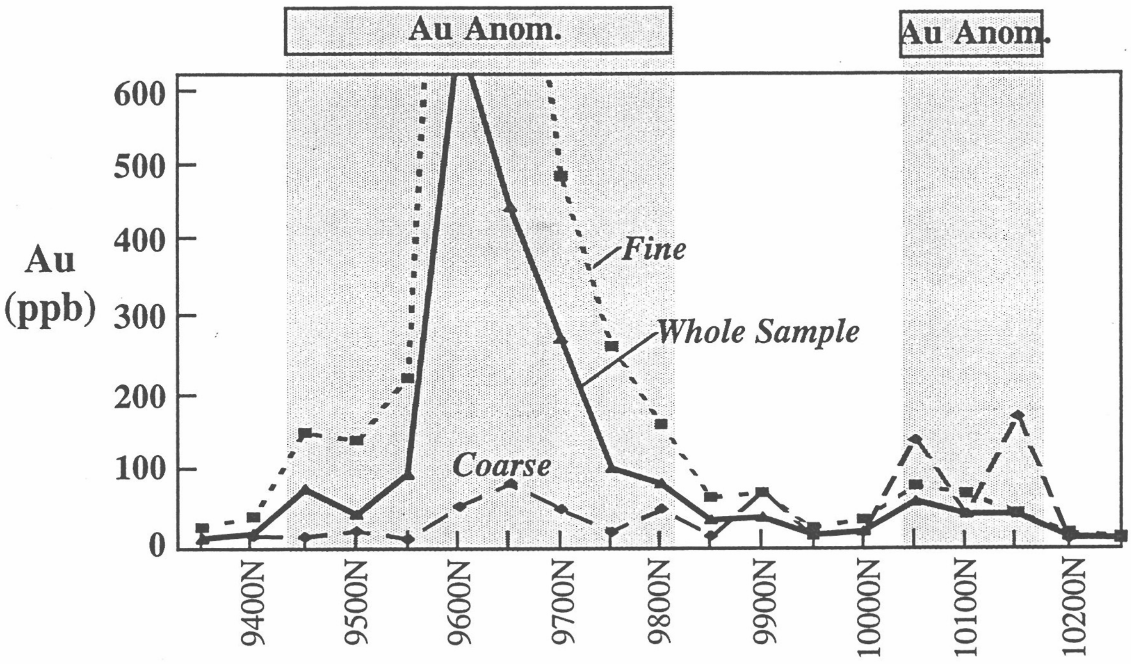


Figure 7 Distribution of Au in various fractions of soil along 20050E Traverse.

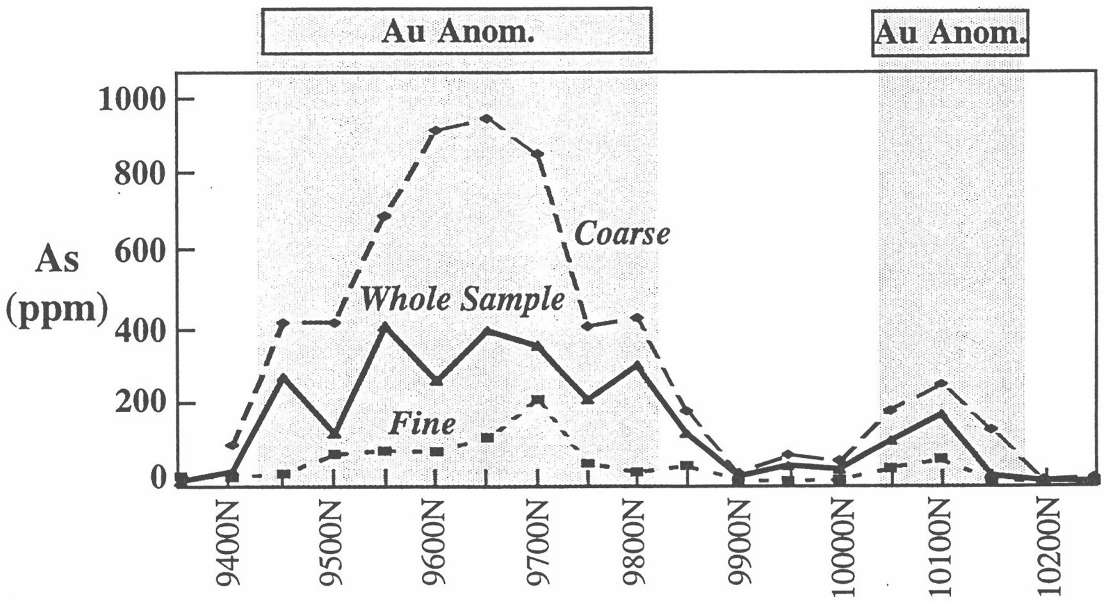


Figure 8 Distribution of As in various fractions of soil along 20050E Traverse.

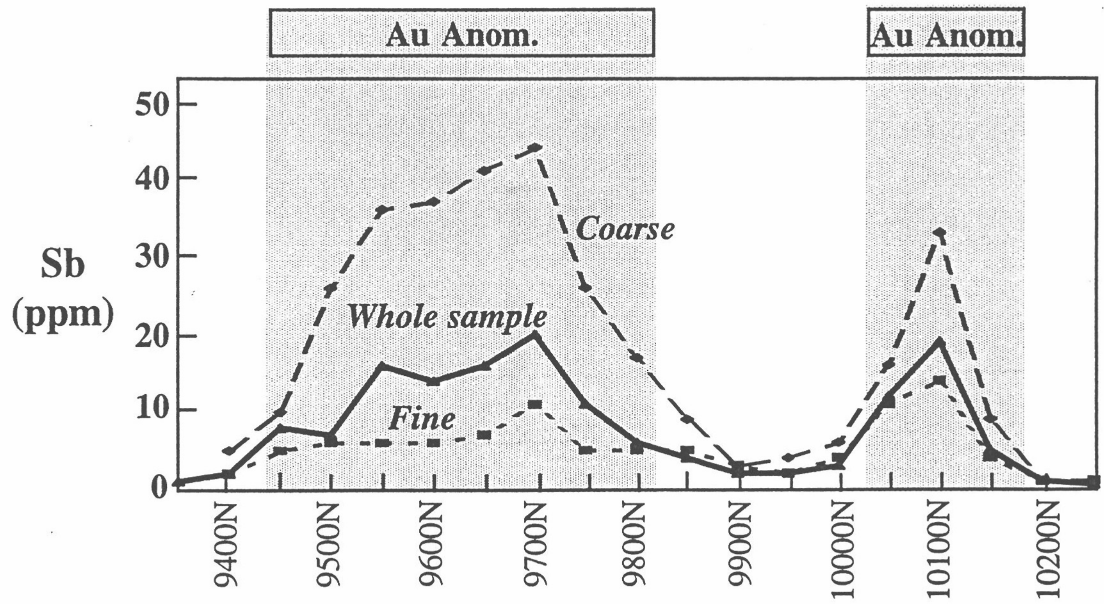


Figure 9 Distribution of Sb in various fractions of soil along 20050E Traverse.

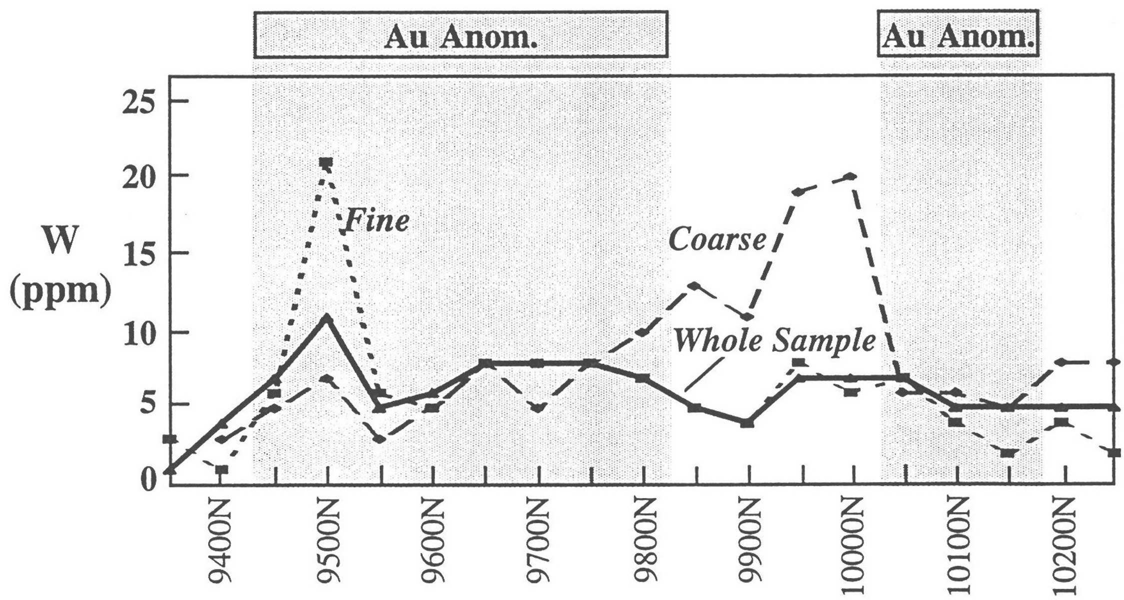


Figure 10 Distribution of W in various fractions of soil along 20050E Traverse.

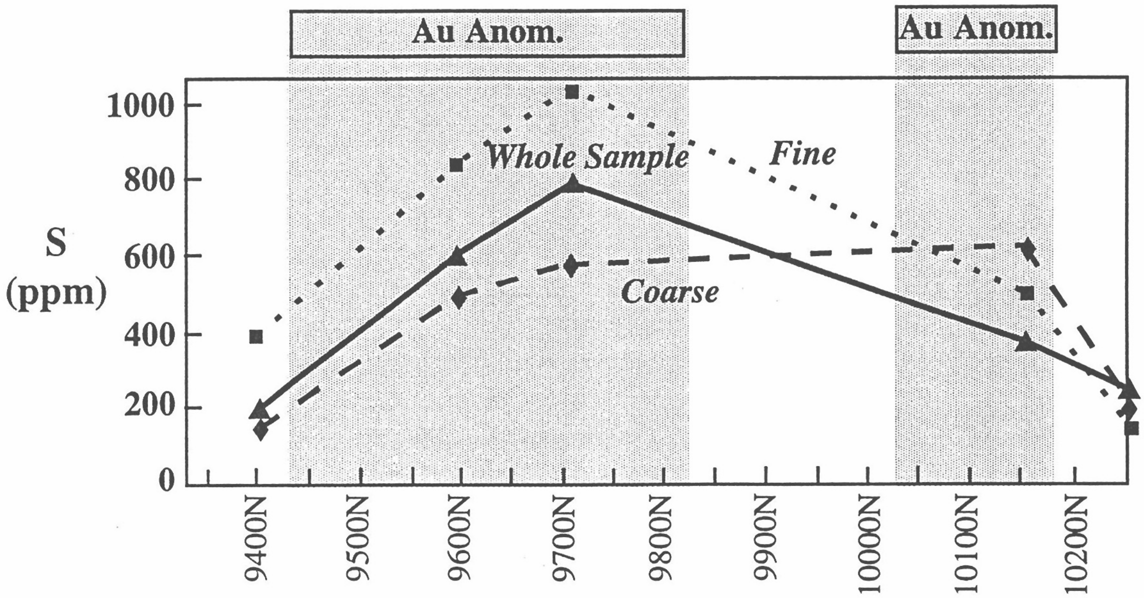


Figure 11 Distribution of S in various fractions of soil along 20050E Traverse.

Because the -75 μm fraction generally comprises 40-50% of the total material in the soil samples (Appendix 1), the major anomalous Au zone is also revealed by whole sample Au contents. However, due to the lesser proportion of coarse material in the soil samples (Appendix 2), the northern Au anomaly is quite difficult to see in whole sample Au contents (Figure 7). Despite this lower abundance of coarse material in the whole sample, the magnitude of the As anomalies in the coarse material does enable them to be seen in whole sample material (Figure 8). The Sb anomaly is also still present in whole sample analyses but again much more subdued than in the coarse material (Figure 9). Molybdenum and W contents do not show significant variations within the whole sample (e.g. Figure 10).

5.3 Creek Profile

Four samples from the creek bank at 20380E/9500N and its vicinity have been analysed. Two adjacent samples of weathered altered volcanics consisting of white kaolinitic and more reddish ferruginous stained material (112838 and 112839 respectively) were sampled from the creek bank. Both samples consist of assemblages of quartz, muscovite, hematite and anatase with kaolinite, alunite and halite also present in the white kaolinitic sample and some hematite in the more ferruginous sample. The kaolinitic sample thus has higher Al (reflecting kaolinite and alunite), Na, Cl, Br (reflecting halite), S and ?Sr (reflecting alunite) with Ti and Zr reflecting anatase and zircon. Although As is greater in the more ferruginous sample, other differences eg slightly higher K and Rb reflecting the higher mica contents in 113839 are not significant. Mottled material (112840) is exposed in low outcrop slightly west of the creek samples. It has very high Fe (27.7%) and quite high As (1700 ppm) and Sb (77 ppm). The lag sample (112841) from the same general area as the mottled material, was divided into +2 mm and -75 μm fractions like the soils. The +2 mm fraction contains a significant proportion of angular magnetic fragments. Arsenic and Sb are again associated with the Fe in the coarse fraction and Au with the finer fraction. Molybdenum and Ba are high in both fractions and Cr and W are high in the finer fraction (Table 4).

5.4 Erosion Gully Profile

The six samples from the erosion gully at 20150E/9930N provide the opportunity to study variations in the upper part of a profile above unmineralized volcanics. The upper 0.2 m of the profile consists of fawn-coloured gritty soil occurring above a further 0.2 m of pale fawn soil with granules and pebbles (many of which are Fe-stained) and then grey-brown clay with Fe mottling occurs from 0.4 to 1.3 m at which depth indurated mottled saprolite occurs. Despite these variations, the mineralogy is uniform—assemblages of quartz, kaolinite, anatase and hematite although some maghemite occurs at 0.2-0.4 m and kaolinite is more abundant below that level.

The chemistry of the profile reflects the greater Fe content below 0.4 m but Au, As and Sb contents are low. Barium is significant in the saprolite (Table 5). The Au, As and Sb contents can probably be regarded as background values for these elements in the region.

5.5 PCRB01 and PCRB14

The top 2 m of drill material from PCRB01 and PCRB14 is grey to grey-brown soil with some pebbles with the interval 2-5 m consisting of fine off-white powder with some clay-rich aggregates. Such aggregates are more common in PCRB14. Mineralogically, the top 2 m of material from PCRB01 consists of quartz, plagioclase, orthoclase, kaolinite and muscovite whereas the interval 2 to 5 m does not contain the feldspars or mica but may have goethite and much more abundant kaolinite. The profile in PCRB14 is similar with feldspars in the top 2 m but hematite is also developed in that interval. Kaolinite is more abundant below than above 2 m and smectites are also developed below 1 m. Dolomite is strongly developed at 3-4 m with minor dolomite also present between 1 and 2 m. The presence of feldspars in the top 2 m of these profiles suggest that it is alluvium overlying weathered Silver Hills Volcanics. The chemistry of these profiles reveals the top 2 m of material to have greater Na, K, Ba, Cs and Rb (reflecting the feldspars) plus greater As, Cr but lesser Sb than the more kaolinitic material below (Table 6). In both profiles Fe increases with depth below the transported feldspar-bearing material, i.e. below 2 m. Gold abundances reach 100 ppb in the deepest portion of PCRB14 but even the uppermost sample of the weathered Silver Hills Volcanics (i.e. at 2-3 m) carries quite significant Au. Zn is probably present in dolomite in samples 113440 and 113442 in the PSRB14 profile (see discussion).

6. DISCUSSION

6.1 Weathering in the Silver Hills Volcanics

Assuming that the alunite, and hence the significant SO_3, in sample 112838 (Table 4) is derived from weathering pyrite, the samples from the creek profile at 20380E/9500N appear to reflect the effects of weathering of altered/mineralized Silver Hills Volcanics. In addition to the SO_3, As, Sb and perhaps W and Mo from the original Au-bearing pyrite assemblages are retained but Au itself is severely depleted. Assuming a typical Au content ~500 ppb in unweathered quartz-pyrite altered material, the reduction to <50 ppb in the creek bank samples imply an order of magnitude loss of Au due to weathering. Such severe leaching could reflect very acid weathering conditions (indicated by the presence of alunite). The separation of Au from its pathfinders is also a feature of the soils at Police Creek (see below). Of the pathfinder elements S, As, Sb, Mo and W, all except W would be expected to be partially mobile under acid weathering conditions. Although the nature of the original occurrence of W is not known (i.e. it could have been as scheelite, wolframite or other accessory minerals), its greater presence in the kaolinite-rich samples rather than the more ferruginous samples from the creek bank may suggest that it accumulates in the fine grained fraction, probably as a resistate mineral. If this is so W may provide evidence of whether the presence of potentially more mobile elements (Au, As, Sb, Mo, S) in a particular sample reflect an in situ situation or could reflect hydromorphic dispersion. (Further work to better document the occurrence of W is needed).

Silver Hills Volcanics also occur beneath alluvium in drill holes PCRB01 and PCRB14 at 9340N. There the presence of feldspars and lower kaolinitic contents relative to underlying samples readily identifies this Quaternary alluvial material as river sands. Apart from elevated lithophile elements reflecting the presence of feldspars, the Quaternary material has higher As and Cr but lower Sb than the weathered volcanics, i.e. As but not Sb may have migrated into the Quaternary material. However, significant amounts of both Au and its pathfinders may have been derived from quite some distance away and incorporated into the alluvium.

Within each 3 m interval of the Silver Hills Volcanics in the two drill holes the geochemistry is similar. As indicated above, As and Sb are low, less than 30 and 10 ppm respectively in both holes but Au contents vary. Au < 20 ppb in PCRB01 is typical of barren bedrock but Au = 70-100 ppb in PCRB14 suggests mineralization-related bedrock (R. Mustard, pers. comm., 1995). Thus PCRB01 represents a barren profile and PCRB14 a mineralized one. However the geochemistry in PCRB14 differs markedly from that in the mineralized creek profile where As and Sb contents are much higher and Au lower. Although non-coincidence of Au and As-Sb anomalies appear to be a feature of Police Creek samples, it is possible that the difference here may reflect different weathering conditions. Acid conditions (indicated by the presence of alunite) still remain in the creek profile but alkaline conditions occur in PCRB14 as indicated by the presence of dolomite and substantial smectite development. In this more alkaline environment Au may be retained cf. retention of Au with carbonates in the Yilgarn of W.A. (Lintern and Butt, 1993).

The 9340N line of drill holes collared in fluvial sands directly over Silver Hills Volcanics represents a topographic low. The work by Ross Mining N.L. has indicated that such topographic lows are often associated with elevated Zn (whereas topographic highs have depleted Zn contents). The occurrence of Zn with dolomite in PCRB14 is consistent with this observation, with the presence of dolomite suggesting pedogenic dolomite formation leading to the stabilization of Zn in an alkaline environment. Pedogenic dolomite at Police Creek is formed by the remobilization of carbonate from the underlying volcanics (R. Mustard, pers. comm. 1995), similar to its distribution in the Yilgarn, suggesting that such material is worthy of further study.

6.2 Soil Samples

Two anomalous zones occur along the 20050E line, a major one at 9450-9800N in transported material and a lesser one at 10050-10150N in residual soils. The 350 m long interval is defined by having As > 400 ppm, Sb > 10 ppm and often Mo 5 ppm in the Fe-rich coarse fraction of the soils <u>and</u> Au > 100 ppb, As ≥ 30 ppm and possibly $SO_3 > 0.20\%$ in the kaolinite-rich -75μm fraction of the soils. Australian Consolidated Minerals Limited previously defined a 250 m long anomaly along 20050E using a 100 ppb cut-off in the -80 mesh (-180 μm) fraction of the soils. Thus using the finer soil fraction for analysis results in the size of the anomaly being increased. In fact the +100 ppb contour defined by the -75 μm fraction appears to correlate with the +50 ppb contour defined by -80 mesh material along the 20050E line (Figure 4). If this association is maintained in an areal sense, using the finer material could double the size of the +100 ppb Au anomaly from 500x300 m to 550x550 m (Figure 4) in the soils at Police Creek.

The 100 m wide anomaly to the north is characterized by Au > 100 ppb, As ≥ 150 ppm, Sb ≥ 10 ppm within the coarse ferruginous-rich fraction of the soils. There is no anomaly within the fine fraction of these soils. The location of this anomaly in the coarse fraction of thin soils above lateritized bedrock and in an area where bedrock (exposed by a shallow costean) shows some veining suggests this anomaly may be directly related to the bedrock, i.e. the coarse fraction of the soil effectively represents weathered bedrock.

Triplicate 1g subsamples of sample 113415F (within the major Au anomaly) with a Au content of 1400 ppb (Table 3) gave assays of 1500, 1300 and 1200 ppb respectively. Such results suggest that the Au is evenly dispersed through the fine fraction, i.e. it is quite small. The good correspondence between the intervals with Au in the fine fraction and its pathfinders (As, Sb ± Mo) in the coarse fraction suggest that both Au and its pathfinders have been dispersed via the same fluid into the soil from the underlying rock. However in the soil environment As, Sb and Mo have been precipitated with Fe oxides and Au has precipitated as fine gold not associated with Fe oxides. Such Fe oxides could form from Fe derived from the weathering pyrite (i.e. same source of the other pathfinders) or the Fe could represent material already present in the soils which adsorbed the pathfinders.

In the smaller anomalous interval (10050-10150N) the association of Au with As and Sb in the coarse Fe-rich fraction could reflect a lack of opportunity for the Au to precipitate separately from the Fe oxides, i.e. the profile is less mature here and there has not been sufficient time for Au to form as discrete particles not specifically associated with the Fe oxides. Alternatively, because Au is known to be mechanically dispersed into the basal ~10-15 cm of transported units (R. Mustard, 1994, pers. comm.) the Au and its pathfinders at this location could represent Au-rich material originally present at the base of the Suttor Formation. Such material, transported mechanically and deposited during the initial stages of deposition of the Suttor Formation would unconformably overlie unrelated weathered Silver Hills Volcanics. However the presence of some boxworks (Appendix 2), implying direct derivation from sulfides, the presence of mineralized veins in the underlying/adjacent bedrock and the shallowness of soil there are consistent with derivation from the underlying rock during normal weathering/pedogenic processes. Thus mapping the regolith units and using appropriate sampling for the units is critical to successful geochemical exploration in such an area. (It would be expected that bedrock geochemistry would also reveal the northern anomaly). However when soil geochemistry alone is used and the nature of the soils is poorly defined, a procedure involving analysing both the -75 μm and +2 mm fractions of soils should be considered in order to detect both types of anomalies as found along the 20050E line at Police Creek.

The occurrence of anomalous Zn with slightly elevated Au in sample 113421A i.e. coarse material from 9900N (Table 2) could also reflect Au with pedogenic carbonate, by comparison with bedrock samples. Thus it is possible that a third type of Au association is present within the soils at Police Creek. This possibility adds to the justification for further study of the carbonates because of their potential as a sampling medium elsewhere in the Drummond Basin.

7. CONCLUSIONS AND IMPLICATIONS FOR EXPLORATION

Gold and its pathfinder elements S, As, Sb, Mo and W define anomalous areas in both soils and bedrock at Police Creek. Within the soils two types of anomalies occur (a) Au in the fine kaolinitic fraction of transported soils with As and Sb in the coarse ferruginous fraction of the same soil sample and both sample types defining the same area and (b) areas defined by the occurrence of Au plus As and Sb in the coarse ferruginous fraction of residual soils. The former occur in alluvium unconformably overlying mineralization within the Silver Hills Volcanics. This work suggests that by using the -75 μm fraction instead of the -80 mesh (-180 μm) fraction, the Au anomaly at 100 ppb is likely to be doubled in size. As > 400 ppm and Sb > 10 ppm occur in the coarse fraction of the Au-rich samples. The latter anomaly occurs in soils which directly overlie the volcanics and is seen only in the +2 mm fraction of the soil. Au > 100 ppb, As > 140 ppm, Sb ≥ 10 ppm in the coarse soil fraction but low levels of Au in the fine fraction define such zones. Thus, although the use of the fine fractions of soils alone defines the first type of anomaly, the second type is not identified by such a sampling procedure. A strategy using both the -75 μm fraction and the +2 mm material from soils is therefore recommended. Although S and Mo appear to be anomalous within various samples, As, Sb and Au appear to define the anomalies sufficiently well as to justify not using another method and adding to analytical costs

Study of the Silver Hills Volcanics profiles indicate that Au and its pathfinders report to different mineralogical fractions. The creek profile readily shows that As and Sb are associated with Fe oxides whereas S and W occur with the kaolinitic material. This profile also shows that although As, Sb, S, Mo and W are anomalous in an acidic environment (indicated by the presence of alunite), Au is quite low < 50 ppb. However in a more alkaline environment (indicated by the presence of dolomite in the profile) Au = 70-100 ppb but pathfinder element contents are low. Thus exploration using both Au and its pathfinders must be utilized to be certain of not missing anomalies.

8. RECOMMENDATIONS FOR FURTHER WORK

- More detailed regolith mapping over the deposit and fitting that mapping into a more regional context is needed. In particular further investigation of the origin of the regolith materials and regolith stratigraphy is required.

- Study of profiles through the alluvium into bedrock in the anomalous area should be made to better understand the behaviour of Au and its pathfinders in such material.

- Because W has the potential to discriminate between "in situ" and hydromorphically transported material, its mode of occurrence in primary and secondary material warrants further study.

- More information on the primary mineralization and the effects of weathering upon it are needed.

- Further investigation of the significance of carbonate in the soils should be undertaken.

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Table 1. Chemical compositions of soil fractions at Police Creek - Orientation Study (major components, wt%; minors, ppm ; except where otherwise indicated

Sample No.	113411				
Fraction	A	B	D	E	F
Size (μm)	+2000	-2000 +710	-500 +250	-250 +75	-75
SiO_2	76.3	89.4	88.6	85.8	73.7
Al_2O_3	8.17	5.16	5.71	6.18	9.09
Fe_2O_3	8.89	1.90	1.32	1.32	1.91
MnO	0.04	0.03	0.04	0.05	0.08
MgO	0.18	0.13	0.13	0.17	0.35
CaO	0.18	0.12	0.14	0.23	0.78
Na_2O	0.87	0.42	0.52	0.53	0.36
K_2O	1.59	1.16	1.07	1.08	1.26
TiO_2	0.27	0.18	0.23	0.32	0.63
P_2O_5	0.06	0.02	0.02	0.02	0.08
SO_3	0.03	0.04	0.04	0.05	0.10
As	100	19	10	10	17
Au(ppb)	7	5	6	5	32
Ba	490	400	400	350	410
Ce	45	25	28	33	90
Co	3	2	2	3	6
Cr	19	14	10	11	15
Cs	5	4	4	4	7
Cu	1	10	6	10	29
Ga	9	7	5	8	11
Nb	2	0	0	4	10
Pb	32	17	11	19	25
Rb	72	55	50	51	81
Sb	5	2	2	2	2
Sc	5	3	3	4	8
Sr	65	41	48	60	120
Th	14	8	8	8	14
U	2	<2	2	3	3
V	130	41	28	24	32
W	3	7	6	5	<2
Zn	23	14	12	16	35
Zr	140	97	99	230	720

Sample No.	113415				
Fraction	A	B	D	E	F
Size (μm)	+2000	-2000 +710	-500 +250	-250 +75	-75
SiO_2	72.2	80.7	84.7	87.0	81.3
Al_2O_3	7.28	7.06	6.61	5.36	7.21
Fe_2O_3	14.7	6.62	2.30	1.37	1.35
MnO	0.06	0.06	0.06	0.05	0.16
MgO	0.27	0.26	0.25	0.19	0.28
CaO	0.12	0.13	0.17	0.17	0.35
Na_2O	0.01	0.03	0.04	0.05	0.08
K_2O	1.48	1.45	1.34	1.10	1.22
TiO_2	0.33	0.33	0.35	0.40	0.77
P_2O_5	0.16	0.09	0.05	0.04	0.09
SO_3	0.12	0.11	0.10	0.09	0.21
As	910	390	130	68	82
Au(ppb)	45	89	130	150	1360
Ba	320	250	280	280	380
Ce	35	31	32	29	63
Co	3	4	4	3	7
Cr	19	22	18	11	16
Cs	4	5	5	4	5
Cu	9	8	13	14	13
Ga	13	9	9	6	7
Nb	0	4	0	0	7
Pb	17	19	17	13	23
Rb	96	93	92	79	86
Sb	37	21	11	7	6
Sc	8	7	6	5	9
Sr	56	58	57	55	83
Th	9	8	7	6	11
U	<2	2	<2	2	3
V	160	99	50	34	33
W	5	5	9	8	5
Zn	24	20	18	13	23
Zr	130	130	130	190	450

Sample No.	113417				
Fraction	A	B	D	E	F
Size (μm)	+2000	-2000 +710	-500 +250	-250 +75	-75
SiO_2	75.3	84.0	87.3	87.1	73.0
Al_2O_3	7.57	6.63	6.39	6.11	13.3
Fe_2O_3	11.1	4.65	1.96	1.73	2.97
MnO	0.08	0.06	0.07	0.10	0.08
MgO	0.35	0.33	0.36	0.37	0.91
CaO	0.18	0.27	0.20	0.17	0.35
Na_2O	0.05	0.04	0.05	0.06	0.14
K_2O	1.35	1.24	1.16	1.01	1.56
TiO_2	0.38	0.37	0.40	0.45	0.67
P_2O_5	0.09	0.05	0.04	0.03	0.06
SO_3	0.15	0.14	0.14	0.13	0.26
As	850	420	190	180	220
Au(ppb)	42	59	49	78	470
Ba	400	510	450	410	450
Ce	41	37	39	41	82
Co	4	3	4	8	9
Cr	14	14	15	9	16
Cs	4	3	4	4	12
Cu	5	4	8	0	7
Ga	12	10	7	7	15
Nb	0	0	0	5	5
Pb	20	22	14	18	19
Rb	91	89	80	79	170
Sb	44	25	14	12	11
Sc	8	7	7	7	14
Sr	86	83	88	87	160
Th	8	8	8	7	11
U	4	3	<2	<2	4
V	140	91	51	42	49
W	5	9	8	11	8
Zn	16	11	11	10	24
Zr	140	140	140	180	320

Table 1 cont'd

Sample No.	113426					113428				
Fraction	A	B	D	E	F	A	B	D	E	F
Size (μm)	+2000	-2000 +710	-500 +250	-250 +75	-75	+2000	-2000 +710	-500 +250	-250 +75	-75
SiO_2	79.2	93.7	87.5	84.9	81.2	82.5	94.5	81.3	89.3	86.7
Al_2O_3	5.75	2.61	4.64	5.83	7.79	8.22	2.39	9.28	4.71	5.60
Fe_2O_3	9.63	1.20	1.42	1.45	1.36	3.83	1.24	2.81	1.30	1.06
MnO	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.02	0.02
MgO	0.07	0.05	0.09	0.10	0.15	0.11	0.05	0.48	0.09	0.09
CaO	0.08	0.06	0.12	0.16	0.18	0.07	0.05	0.05	0.12	0.14
Na_2O	0.03	0.01	0.03	0.06	0.04	0.09	0.02	0.10	0.06	0.04
K_2O	0.41	0.27	0.47	0.46	0.40	2.02	0.40	2.49	0.76	0.62
TiO_2	0.25	0.11	0.34	0.45	0.54	0.11	0.06	0.41	0.22	0.51
P_2O_5	0.06	0.01	0.01	0.02	0.04	0.02	0.01	0.05	0.01	0.02
SO_3	0.16	0.05	0.09	0.09	0.13	0.05	0.02	0.22	0.03	0.04
As	140	11	13	12	9	15	4	5	4	3
Au(ppb)	160	11	16	19	36	<5 →	→	→	→	5
Ba	170	170	300	390	240	330	160	310	360	340
Ce	14	7	15	20	26	18	5	9	16	46
Co	<1 →	→	→	→	1	1	<1	1	1	1
Cr	16	11	10	12	10	15	11	13	11	9
Cs	3	2	4	5	6	2	1	3	4	4
Cu	0	0	2	5	7	0	0	0	0	2
Ga	9	5	5	8	10	12	3	14	6	6
Nb	1	0	1	3	6	2	0	2	2	13
Pb	26	12	24	19	30	27	15	10	22	26
Rb	23	<20	28	34	43	110	25	43	47	41
Sb	9	2	5	6	4	0.8	0.5	0.8	0.9	0.8
Sc	4	2	4	5	7	4	1	2	3	5
Sr	62	27	48	62	67	23	10	100	22	25
Th	11	5	8	11	13	12	5	8	10	21
U	<2	<2	<2	3	3	<2 →	→	→	→	3
V	210	25	37	35	28	75	27	45	24	18
W	5	9	8	8	2	8	10	12	7	2
Zn	8	5	11	10	12	13	4	6	9	13
Zr	110	54	110	300	350	79	37	140	200	490

Table 2. Chemical compositions of coarse (+2 mm) fractions of soils along 20050E Traverse, Police Creek (Major components, wt%; minors, ppm)

Sample No.	113411	113412	113413	113414	113415	113416	113417	113418	113419	113420	113421	113422	113423
Northing	9400	9450	9500	9550	9600	9650	9700	9750	9800	9850	9900	9950	10000
SiO_2	76.3				72.2		75.3						
Al_2O_3	8.17				7.28		7.57						
Fe_2O_3	8.42	7.96	8.66	11.5	14.0	12.7	10.4	9.81	10.6	7.06	2.76	5.56	4.20
MgO	0.18				0.27		0.35						
CaO	0.18				0.12		0.18						
Na_2O	0.89	0.04	0.04	0.03	0.03	0.04	0.06	0.06	0.08	0.05	0.05	0.05	0.04
K_2O	1.55	0.34	1.26	1.65	1.52	1.46	1.10	1.23	0.57	<0.20	<0.20	0.40	0.24
TiO_2	0.27				0.33		0.38						
SO_3	0.03				0.12		0.15						
As	100	420	420	690	910	940	850	410	430	190	27	73	58
Au(ppb)	7	6	14	<5	45	75	42	12	42	7	62	7	12
Ba	490	740	410	360	320	250	400	340	200	270	210	230	310
Ce	45	17	31	30	35	42	41	47	28	19	98	19	19
Co	3	3	3	4	3	6	4	6	2	2	3	1	2
Cr	19	21	31	28	19	25	14	20	24	24	26	27	25
Cs	5	2	4	4	4	6	4	5	4	3	3	2	3
Cu	1				9		5						
Ga	9				13		12						
Nb	2				0		0						
Pb	32				17		20						
Rb	72	30	91	95	96	110	91	74	41	<20	33	30	22
Sb	5	10	26	36	37	41	44	26	17	9	3	4	6
Sc	5	4	6	7	8	9	8	7	5	4	9	3	2
Sr	65				56		86						
Th	14	11	8	8	9	9	8	8	9	8	12	7	7
U	2	<2	<2	<2	<2	4	4	3	4	3	7	<2	<2
V	130				160		140						
W	3	5	7	3	5	8	5	8	10	13	11	19	20
Zn	23	<100 →	→	→	24	<100	16	<100 →	→	→	(140)	<100	<100
Zr	140				130		140						
				Mo 14	Mo 24	Mo 14			Mo6				

NOTE: Mo < 5 ppm, except where otherwise indicated

Table 2 cont'd

Sample No.	113424	113425	113426	113427	113428
Northing	10050	10100	10150	10200	10250
SiO_2			79.2		82.5
Al_2O_3			5.75		8.22
Fe_2O_3	7.26	12.2	9.05	2.04	3.72
MgO			0.07		0.11
CaO			0.08		0.07
Na_2O	0.04	0.06	0.04	0.06	0.09
K_2O	0.43	0.40	0.58	0.55	1.64
TiO_2			0.25		0.11
SO_3			0.16		0.05
As	190	260	140	10	15
Au(ppb)	130	35	160	<5	<5
Ba	290	430	170	330	330
Ce	26	58	14	13	18
Co	<1	<1	<1	<1	1
Cr	15	16	16	12	15
Cs	5	6	3	3	2
Cu			0		0
Ga			9		12
Nb			1		2
Pb			26		27
Rb	28	33	23	39	110
Sb	16	33	9	1	1
Sc	4	8	4	3	4
Sr			62		23
Th	9	10	11	11	12
U	<2	<2	<2	<2	<2
V			210		75
W	6	6	5	8	8
Zn	<100	<100	8	<100	13
Zr			110		79

Table 3. Chemical compositions of fine (-75 μm) fractions of soils along 20050 E Traverse, Police Creek (major components, wt%, minors, ppm)

Sample No.	113410	113411	113412	113413	113414	113415	113416	113417	113418	113419	113420	113421	113422
Northing	9350	9400	9450	9500	9550	9600	9650	9670	9750	9800	9850	9900	9950
SiO_2		73.7				81.3		73.0					
Al_2O_3		9.09				7.21		13.3					
Fe_2O_3	2.62	2.03	3.19	2.19	1.90	1.30	1.64	3.16	1.51	1.69	3.63	1.69	1.29
MgO		0.35				0.28		0.91					
CaO		0.78				0.35		0.35					
Na_2O	0.37	0.34	0.16	0.11	0.11	0.10	0.11	0.15	0.13	0.07	0.05	0.04	0.04
K_2O	1.36	1.18	0.98	1.24	1.25	1.42	0.96	1.84	1.00	0.51	0.39	0.31	0.52
TiO_2		0.63				0.77		0.67					
SO_3		0.10				0.21		0.26					
As	20	17	27	76	85	82	120	220	52	29	47	8	7
Au(ppb)	18	32	140	130	210	1400	1000	470	250	150	56	62	17
Ba	480	410	230	250	240	380	430	450	350	250	260	210	240
Ce	110	90	65	73	76	63	90	82	91	56	50	73	40
Co	8	6	11	10	10	7	15	9	9	2	3	2	2
Cr	17	15	38	24	17	16	18	16	15	16	24	16	15
Cs	7	7	10	7	7	5	7	12	6	6	10	6	5
Cu		29				13		7					
Ga		11				7		15					
Nb		10				7		5					
Pb		25				23		19					
Rb	91	81	100	110	120	86	100	170	77	46	43	45	38
Sb	3	2	5	6	6	6	7	11	5	5	5	3	2
Sc	10	8	11	11	12	9	14	14	11	9	10	10	7
Sr		120				83		160					
Th	16	14	13	12	12	11	13	11	13	15	17	15	15
U	3	3	2	2	3	3	7	4	4	5	4	6	4
V		32				33		49					
W	3	<2	6	21	6	5	8	8	8	7	5	4	8
Zn		35				23		24					
Zr		720				450		320					

NOTE All Mo < 5 ppm

Table 3 cont'd

Sample No.	113423	113424	113425	113426	113427	113428
Northing	10000	10050	10100	10150	10200	10250
SiO_2				81.2		86.7
Al_2O_3				7.79		5.60
Fe_2O_3	1.36	2.26	3.16	1.40	1.39	1.02
MgO				0.15		0.09
CaO				0.18		0.14
Na_2O	0.04	0.04	0.08	0.06	0.03	0.06
K_2O	0.37	<0.20	0.64	<0.20	0.46	0.47
TiO_2				0.54		0.51
SO_3				0.13		0.04
As	9	39	63	9	4	3
Au(ppb)	28	71	61	36	11	5
Ba	270	270	220	240	310	340
Ce	47	62	74	26	26	46
Co	3	2	2	1	2	1
Cr	13	14	15	10	10	9
Cs	6	10	11	6	5	4
Cu				7		2
Ga				10		6
Nb				6		13
Pb				30		26
Rb	37	36	62	43	51	41
Sb	4	11	14	4	1	1
Sc	8	8	14	7	6	5
Sr				67		25
Th	15	17	18	13	17	21
U	5	3	7	3	3	3
V				28		18
W	6	7	4	2	4	2
Zn				12		13
Zr				350		490

Table 4. Chemical composition of samples in Creek Profile (major components; wt%, minor ppm)

Sample No.	112838 Kaol	112839 Ferruginous	112840 Mottled	112841A Lag	112841F Fines
SiO_2	82.7	89.8			
Al_2O_3	8.48	4.14			
Fe_2O_3	1.05	2.63	27.7	19.0	4.29
MnO	0.01	0.02			
MgO	0.37	0.08			
CaO	0.04	0.10			
Na_2O	0.59	0.11	0.35	0.05	0.11
K_2O	1.11	2.13	1.77	1.20	1.28
TiO_2	0.39	0.12			
P_2O_5	0.05	0.01			
SO_3	0.59	0.03			
As	120	230	1700	1200	280
Au(ppb)	9	<5	12	<5	48
Ba	110	140	<100	900	570
Br	24	4	13	5	8
Ce	66	50	33	29	46
Co	<1	<1	11	3	6
Cl	6000	<20			
Cr	8	6	12	19	230
Cs	4	6	5	4	5
Cu	9	1			
Ga	9	5			
Mo	<5	<5	<5	24	19
Nb	0	3			
Pb	13	21			
Rb	65	150	150	80	89
Sb	11	10	77	55	14
Sc	9	8	13	8	9
Sr	170	17			
Th	6	8	16	10	10
U	<2	<2	4	<2	4
V	47	28			
W	12	6	6	<2	22
Zn	6	8	<100 →	→	→
Zr	130	75			

Table 5. Chemical composition of samples in Erosion Gully Profile (major components, wt%; minors, ppm)

Sample Depth (m)	113405 0-0.2	113406 0.2-0.4	113407 0.4-0.7	113408 0.7-1.00	113409 1.0-1.3	112842 ~1.3
Fe_2O_3	2.80	3.23	3.93	5.09	5.06	4.40
Na_2O	0.03	0.04	0.09	0.16	0.24	0.09
K_2O	<0.20	<0.20	0.46	<0.20	0.46	<0.20
As	56	79	63	71	69	61
Au(ppb)	10	15	15	11	7	13
Ba	270	320	270	190	220	530
Ce	31	26	40	40	37	53
Co	1	1	2	3	3	1
Cr	14	13	26	33	31	10
Cs	5	4	8	10	11	10
Rb	23	24	38	43	42	26
Sb	5	6	5	5	5	10
Sc	5	5	8	10	9	6
Th	10	10	14	14	14	12
U	4	3	3	3	3	2
W	5	4	8	8	10	7

NOTE Zn < 100 ppm

Table 6. Chemical Composition of Samples from PCRB01 and PCRB14 (major components, wt%; minors, ppm)

	PCRB01					PCRB14				
Sample	113429	113430	113431	113432	113433	113439	113440	113441	113442	113443
Depth (m)	0-1	1-2	2-3	3-4	4-5	0-1	1-2	2-3	3-4	4-5
Type	Alluvium		Clay rich			Alluvium		Clay rich		
Fe_2O_3	2.40	2.37	1.46	3.35	4.63	7.71	3.10	2.95	2.83	3.80
Na_2O	0.60	0.61	0.19	0.21	0.21	0.49	0.30	0.31	0.28	0.28
K_2O	1.57	1.24	<0.20	<0.20	0.43	1.19	0.49	<0.20	<0.20	<0.20
As	32	32	10	21	24	120	32	26	16	18
Au(ppb)	30	26	19	15	11	14	58	73	72	100
Ba	570	580	460	260	230	450	280	350	350	280
Ce	66	63	56	39	35	48	51	82	80	43
Co	7	6	7	9	13	4	8	9	14	10
Cr	21	15	14	10	10	25	26	19	18	14
Cs	7	7	3	3	3	7	8	5	5	5
Rb	90	80	<20	<20	<20	70	57	38	26	<20
Sb	3	3	7	7	8	5	4	5	5	6
Sc	6	6	7	7	7	7	8	9	8	8
Th	12	12	15	15	20	13	13	16	16	17
U	2	3	3	4	3	3	3	3	3	5
W	9	4	12	7	4	4	9	6	9	9
Zn	<100 →	→	→	→	→	→	100	<100	110	<100

Appendix 1

Descriptions of soils along 20050E Traverse, Police Creek

Sample No.	Northing	Description	Magnetic component	-75 µm material %
113410	9350	Pale grey sand with charcoal		21.8
113411	9400	Dark grey soil with pebble-sized lithic frags		19.1
113412	9450	Grey soil with pebble-sized lithic frags.	tr mag.	46.9
113413	9500	Brown soil with abundant granules.	Abundant mag.	25.9
113414	9550	Pale brown soil with granules, some pebbles	Some mag.	40.9
113415	9600	Pale brown soil with granules, some pebbles..	Signif. mag	43.6
113416	9650	Pale brown soil with granules and pebbles.	Signif. mag.	42.1
113417	9700	Coarse fawn soil with pebbles	Signif. mag.	48.0
113418	9750	Pale grey brown fine soil. trace pebbles	Some mag.	36.9
113419	9800	Pale brown fine soil with some granules	Some mag.	51.6
113420	9850	Brown soil with some pebbles and granules	tr mag.	47.4
113421	9900	Grey soil with granules	tr mag.	46.7
113422	9950	Pale grey brown soil with granules	tr. mag.	45.9
113423	10000	Fine grey soil with granules		44.4
113424	10050	Pale brown soil with granules		38.1
113425	10100	Fawn soil with some granules	tr mag.	49.8
113426	10150	Grey soil with some granules		47.0
113427	10200	Grey soil with abundant sandy granules		50.0
113428	10250	Pale grey-brown soil with granules	tr. mag.	51.0

Appendix 2

Descriptions of +2 mm fractions of soils along 20050E Traverse, Police Creek

Sample No.	Northing	% of whole sample	Description
113410	9350	0.2	Organics only
113411	9400	20.6	Lithic fragments, some Fe rich
113412	9450	25.6	Lithic fragments, some Fe rich
113413	9500	10.8	Brown Fe stained fragments
113414	9550	19.7	Brown Fe stained fragments
113415	9600	16.3	Brown Fe stained and angular qtz fragments
113416	9650	17.4	Brown Fe stained fragments
113417	9700	20.2	Brown Fe stained and angular qtz fragments
113418	9750	19.9	Brown Fe stained fragments
113419	9800	5.3	Fe and qtz (subrounded) fragments
113420	9850	4.0	Fe and qtz fragments (angular), abundant organics
113421	9900	2.5	Rounded Fe-stained fragments
113422	9950	2.7	Rounded qtz grains, organics
113423	10000	5.2	Subrounded qtz grains, organics
113424	10050	18.6	Subrounded-angular qtz grains with some Fe staining
113425	10100	14.2	White rounded kaolinitic frags. Kaol/Fe nodule with boxworks
113426	10150	7.1	Rounded qtz-rich and kaolinitic fragments, boxworks in fragments
113427	10200	10.2	Weathered s/s fragments
113428	10250	9.5	Angular qtz fragments, some Fe fragments