QUEENSLAND GEOLOGICAL RECORD 2007/02

A summary of field inspection of mineral deposits of the Hodgkinson Province

JSF Lam & PD Garrad

Queensland **the Smart State**

Queensland Government
Department of **Mines and Energy**

ADDRESS FOR CORRESPONDENCE:

Geological Survey of Queensland
Department of Mines and Energy
Block A, 80 Meiers Road, Indooroopilly, QLD 4068
Telephone: (07) 3362 9364; International +61 7 3362 9364
Facsimile: (07) 3362 9343; International +61 7 3362 9343
Internet: www.dme.qld.gov.au

ISSN 1039-5547
ISBN 978-1-7417-2627-5
Graphics by: JSF Lam
Issued:December, 2007

REFERENCE: LAM, J.S. & GARRAD, P.D., 2007: A summary of field inspection of mineral deposits of the Hodgkinson Province. *Queensland Geological Record* **2007/02**.

CONTENTS

SUMMARY

The Hodgkinson Province hosts several operating mines producing significant tonnages of base metals and tin in Queensland. Other advanced mining project developments are for base metals, tungsten and gold. Exploration for nickel and diatomaceous earth has met with some success. Minor limestone is being mined from a small quarry.

The Collingwood lode tin deposit situated 30km south of Cooktown is a type of siliceous-sheeted greisen lode associated with pegmatite. It is the largest underground tin mine in Australia producing ore grade at 1.3% cassiterite with grains up to 2–3mm size. Reserve estimates as of 30 June 2006 total 953 900t at 1.19% Sn.

The Kangaroo Creek deposit is currently the only surface operating alluvial tin mine in Queensland. Alluvial tin is obtained from 0.5m thick cement beds of rounded quartz pebbles, containing very fine-grained cassiterite underneath sandy alluvium up to 2m thick. Inferred resource should extend the one man operation for the next ten years.

The Watershed Grid is a world class deposit of scheelite (calcium tungstate), situated 150km north-west of Cairns. The project is at the pre-feasibility stage; with a program of in-fill drilling, bulk sampling and metallurgical development in progress. The Watershed deposit has an Inferred Resource of 21.79Mt at 0.26% WO_3 for a contained WO_3 content of 56 300t.

The regional north-north-west trending Retina shear hosts a number of shear-related antimony and gold deposits associated with mylonite zone in metasediments. These deposits are being explored by Republic Gold Ltd. Exploration has outlined resources of 2 847 000t at 1.7g/t Au containing 156 000ozs of gold within the Sleeping Giant deposit. The Northcote deposit contains 9 420 000t at 1.7g/t Au containing 573 000ozs of gold.

Solomons Mine Pty Ltd has produced small tonnages of copper sulphate (pentahydrate) crystals from copper ore by the open cut method at the Tartana West deposit.

Kagara Zinc Ltd has several advanced exploration targets and opencut and underground mines in the Hodgkinson Province. The King Vol and Monte Video prospects situated on the western margin of the Hodgkinson Province occur within sediments of the Chillagoe Formation. Oxidised zinc and lead mineralisation is associated with surface ferruginous gossan karst collapsed breccia overlying massive sulphides skarn deposit. Diamond hole drilling at King Vol showed that the mineralised oxide zones were derived from primary sulphide mineralisation.

Mining is conducted at the Mungana deposit which has been classified as a low sulphidation porphyry Cu-Au skarn deposit developed within carbonate and

aluminosilicate host rocks, which contains a resource of 1.96Mt at 14.4% Zn, 2.8% Cu, 2.2% Pb, 187g/t Ag and 1.14g/t Au.

The Balcooma deposit consists of four separate stratigraphic horizons containing copper-rich massive base metals sulphide mineralisation with three recorded types of mineralisation as magnetite, pyrite-chalcopyrite and sphalerite-galena-pyrite. Balcooma will be mined as an underground operation and a decline is currently being developed.

Exploration has advanced the progress of the Bell Creek lateritised nickel enrichment (>1% Ni) deposit, and the Glen Eagle and Conjuboy diatomite deposits.

Field inspection of several minor gold and rutile occurrences has not identified suitable hand size specimens for mineral alteration study or age dating. Diatomite samples were collected from selected occurrences.

BACKGROUND

First pass mineral occurrence mapping of the Hodgkinson Province by the Geological Survey of Queensland commenced in 1985 and was completed by 1996 (see Bibliography). The results of the early fieldwork were plotted on air-photos and 1:100000 scale topographic base maps. The site location accuracy of mines and mineral occurrences was linked to the location accuracy of plotting of occurrences (ie ~100m), but this was greatly improved with the use of Global Position System (GPS) in the later years of the mapping.

Outputs from the mineral occurrence mapping include a range of publications and maps, and a comprehensive computer database which summarises all known mineral occurrences in the region. A generalised report on major mineral occurrences and regional geology of the Hodgkinson Province was compiled by Garrad & Bultitude (1999).

The mineral occurrence database is frequently used online by exploration geologists at the interactive resource and tenure maps site (http://www.nrw.qld.gov.au/science/geoscience/tenure_maps.html) as an initial information source to plan exploration and target generation. The database provides historical production figures, the range of commodities at a site, the inferred mineral deposit model and mine working information as well as an overview of all known mineralisation in the region.

In the late 1990s and early 2000s, company exploration in Queensland was underpinned by the Native Title issues resulting in a significant downturn of mineral exploration activities in Queensland. The Native Title issues had been resolved to some extent in 2003 and company explorations again became more robust. The improvement of commodity prices in 2005 facilitated greater interest in exploring for base metals, tin, tungsten, uranium and gold. Some of the

previously marginally subeconomic deposits were re-evaluated and have been developed for commercial mining.

Over the years, update of major mine production and resources for the whole of Queensland was carried out to provide additional information for the Queensland Year Book as well as to the publication of Queensland Minerals (Editions 1 to 4). Compilation of this information gives a snapshot of the current health of the Queensland mining economy and brings an awareness of the high potential for successful mineral exploration and mining in Queensland to a global exploration industry.

AIMS

In addition to the mine production figures, field studies are required as part of the geological data gathering process to update the Department mineral occurrence database.

The aims of the fieldwork in the Hodgkinson Province were:

- To inspect current major working mines and to facilitate significant mining project developments, as well as promoting new pre-competitive geoscience data releases from the Geological Survey of Queensland to exploration geologists working in the field.
- To assess the likelihoods of delineating alteration zones marginal to selected mineral deposits and to collect mineral samples that may be suitable for age dating.
- To collect diatomite samples for laboratory analysis and comparison from the region as part of a program to compare the variation in quality of the diatomite throughout the State and the commercial uses for individual deposits.

FIELDWORK

Operating mines and advanced prospects inspected were at Collingwood, Watershed Grid, Tregoora, King Vol, Monte Video, Tartana, Northcote, Kangaroo Creek, Bell Creek, Conjuboy, Balcooma, Surveyor, Mungana and Christmas Creek (Figure 1).

Collingwood (operating underground mine working lode tin hosted by greisen associated with pegmatite)

This deposit was discovered by Shell/Billiton in the 1980s. The underground mine is currently being operated (Plate 1) and a number of levels are being developed. Kim Miller of Bluestone Nominees Pty Ltd provided a guided tour of the underground workings. Most of the ore comes from the NNW trending Amos

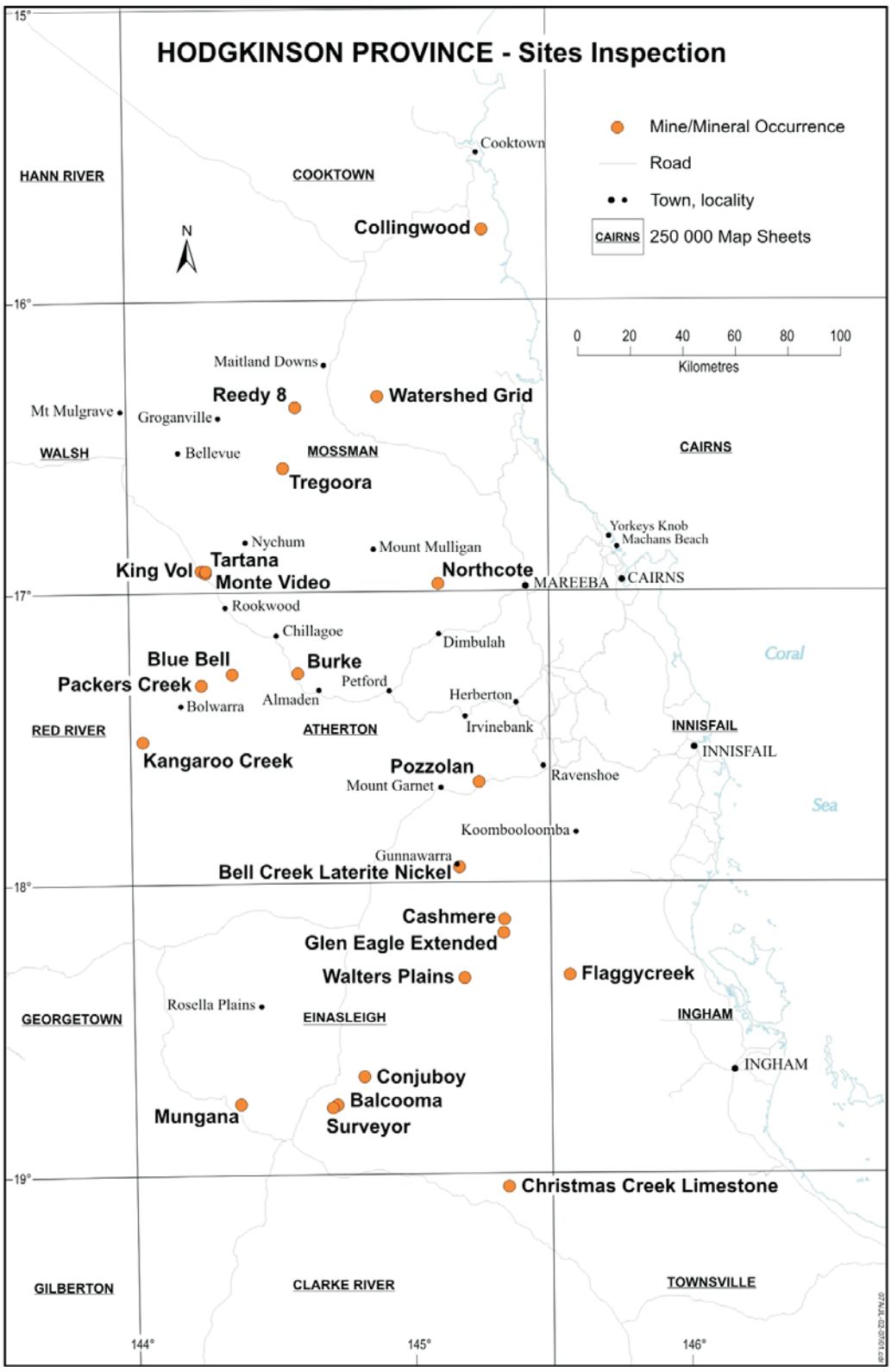

Figure 1: Inspection sites

Plate 1: Collingwood adit portal

lode along strike length exceeding 1.5km and up to 3m wide. There are four smaller subparallel lodes that will be mined in the future. The average ore grade is 1.3% cassiterite with grains up to 2–3mm size occurring in greisen hanging wall (Plate 2). Overall, the ore body dips steeply to the east and the weekly operation cost of mining is about $25 000.00 for the 35 staff. The treatment plant (Plate 3) is only operating on half capacity and further production requires more ore reserves to be established.

Exploration in 2006 suggests the lode is open to the north and a program of drilling is expected to improve the mine resource when completed. Plates 1–3 are photographs of adit portal, the ore in underground workings and the treatment plant in the mine.

Watershed Grid (advanced project of calc-silicate scheelite vein and disseminated grains deposit in metasediments)

The Watershed Grid (MGA 94 Zone 55, 0273715E, 8192369N) deposit was originally discovered by Utah Minerals in the 1980s. Vital Metals Ltd have the current tenure over the area. Staff members Nigel Storey and Andrew Harwood were on the prospect site and welcomed any geological information on this deposit, as they were new to the area. Their interpretation was that the scheelite mineralisation is hosted by the Devonian Hodgkinson Formation and is closely associated with the sandstone and conglomerate beds but absent in the black shales. The scheelite veins are difficult to recognise in outcrop under daylight conditions. Ultra-violet light was used to take advantage of scheelite giving a blue hue under the short wave UV radiation. Outcrop and core of the prospect are shown in Plates 4 and 5. The current known ore grade is about 0.3% tungstate ore

Plate 2: Collingwood underground tourmaline rich cassiterite greisen zone

Plate 3: Collingwood treatment plant

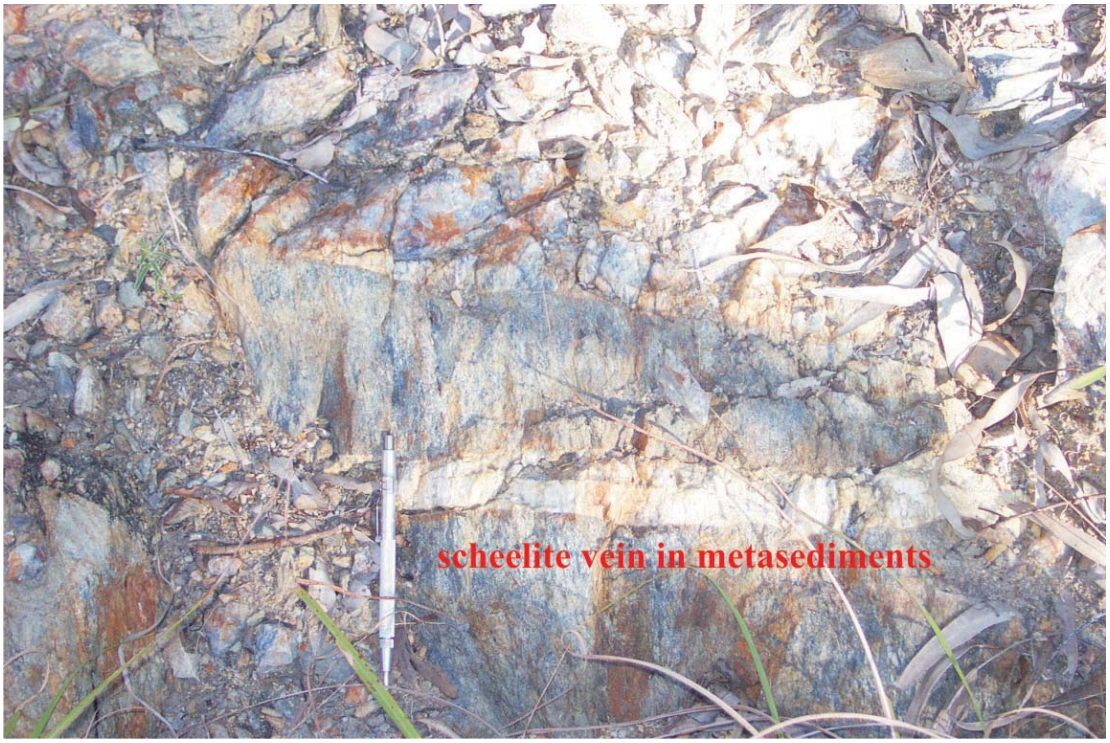

Plate 4: Watershed Grid vein-hosted scheelite

Plate 5: Watershed Grid core (scheelite is outlined in red)

and the coarse-grained scheelite ore will be sorted by optical illumination techniques.

Tregoora (part of Retina shear-related antimony and gold deposit associated with mylonite zone in metasediments)

Trevor Jackson of Republic Gold is a geologist with extensive experience of antimony-gold exploration in Victoria and he indicated that the Queensland shear-related style mineralisation is vastly different to that in Victoria. The Retina shear zone trends NNW and can be traced over 1.5km. His interpretation of the Retina shear zone is that antimony mineralisation with peripheral gold mineralisation is present within a mylonite zone up to 10m in width and that the mineralisation style is intrusive-related within a quartz porphyry dyke system. Mr. Jackson had located a small outcrop of feldspar porphyry dyke in the northern end of the Retina shear.

Drill cores geochemistry show that gold mineralisation is associated with sandstone and not with black shale (Plate 6), and anomalous gold assay values are strongly correlated with high arsenic assay values. The core sections are generally sulphide poor.

Plate 6: Tregoora core, anomalous gold assay values mainly associated with the competent sandstone and not with the carbonaceous shale

Previous mining included 3 open pits (Tregoora — MGA 94, Zone 55, 0238149E, 8163668N; Sleeping Giant and Retina) each more than 100m in length and 50m in width (Plates 7, 8, 9, 10 and 11). Republic Gold Ltd intends to explore the ground between the pits and further north along the Retina shear.

The *Northcote deposit* (MGA 94 Zone 55 0303700E, 8118700N) is located to the east of the Hodgkinson Gold Field. The deposit hosts a similar style of

Plate 7: Sleeping Giant open cut, view looking towards north and showing remains of eastern quarry wall from previous mining

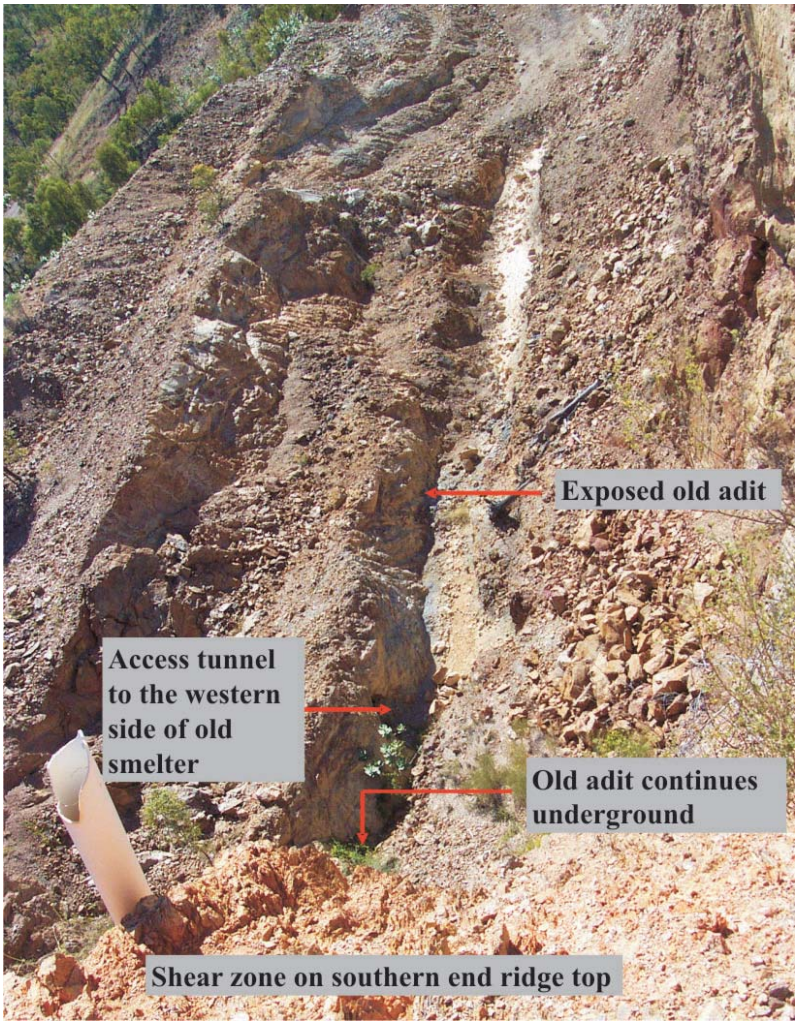

Plate 8: Retina open cut, photo looking north taken at the southern end of the Retina shear zone on ridge top

Plate 9: Retina access adit, eastern entrance of access tunnel leading to smelter on the western side

Plate 10: Retina mine, close up photo of mylonite zone showing local kinking of bands within the mylonite zone

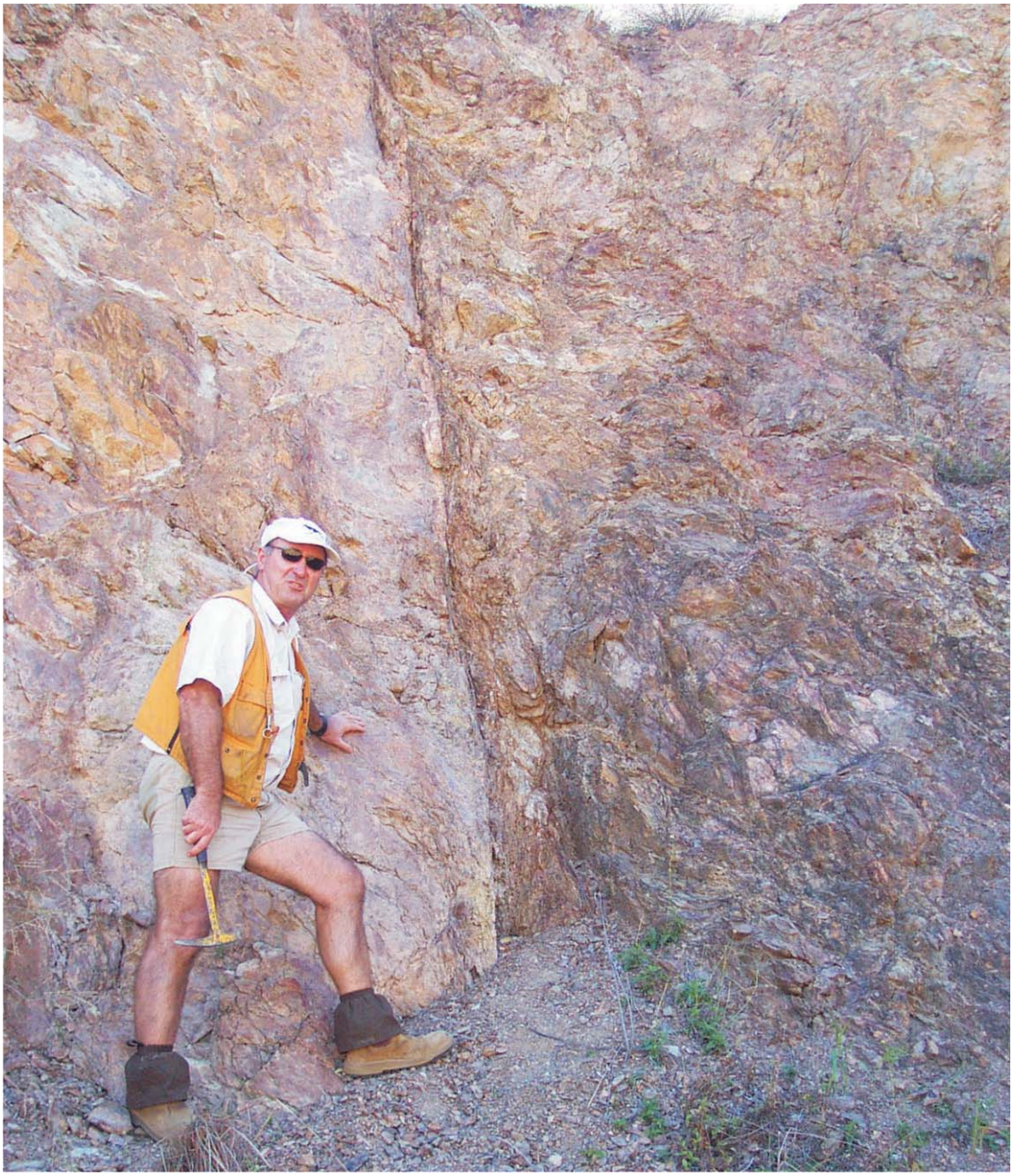

Plate 11: Open cut exposure of shear and reef, Trevor Jackson and the Retina shear zone to the east (looking north)

antimony-gold mineralisation as Tregoora (Plates 12, 13). The oxide portions of the deposit were previously mined from several small open cuts (Plate 14). Sporadic old workings and gossan outcrops can be traced along trend to the Tunnel workings in the north (Plate 15).

Whilst in the area we alerted Trevor Jackson to the location of the Great Australian and Just in Time workings. Mine dumps at these workings contain large crystals of arsenopyrite in massive white quartz. Past mining appears to have followed parallel NNW-trending shear zones. These zones contain prominent massive white quartz lodes adjacent and parallel to the shear. Other old workings were also sunk along WNW shear zone occurring to the southern part of the NNW-trending workings. Trevor was delighted with the inspection as shear

Plate 12: Folded chert north of Retina

Plate 13: Northcote drill core

Plate 14: Northcote, Emily open pit, exposure of north-north-west-trending shear zone at distance

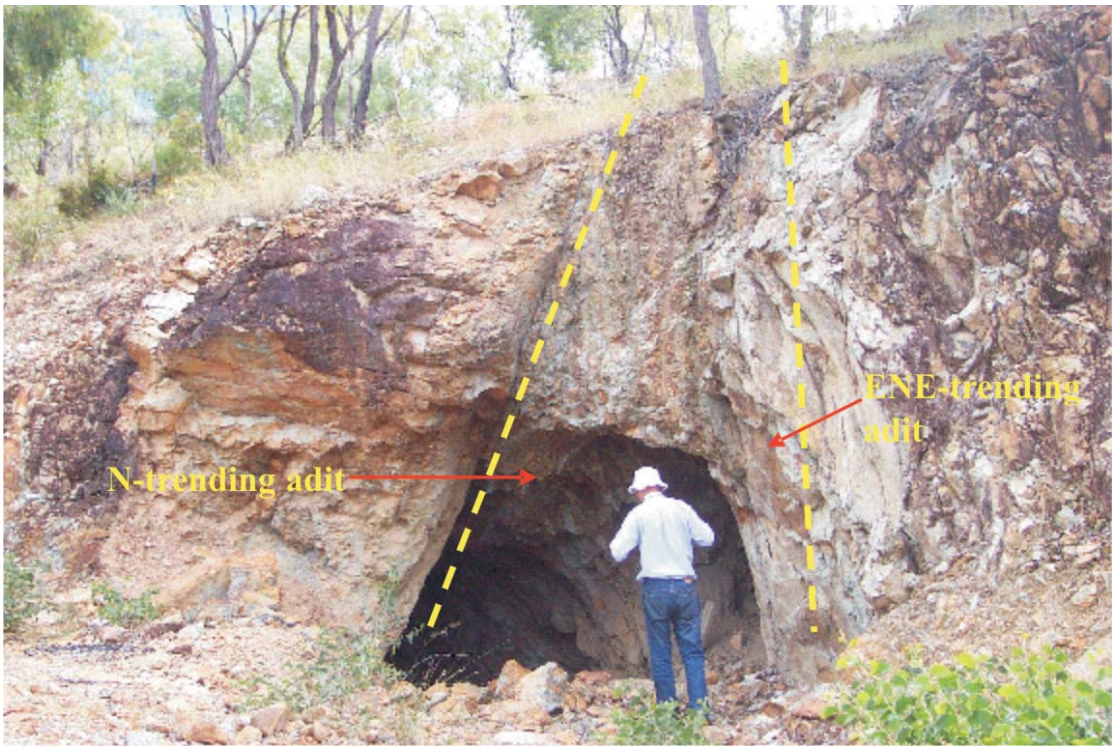

Plate 15: Tunnel Prospect, entrance to the intersection of two adits and indicating the orientation of major shears

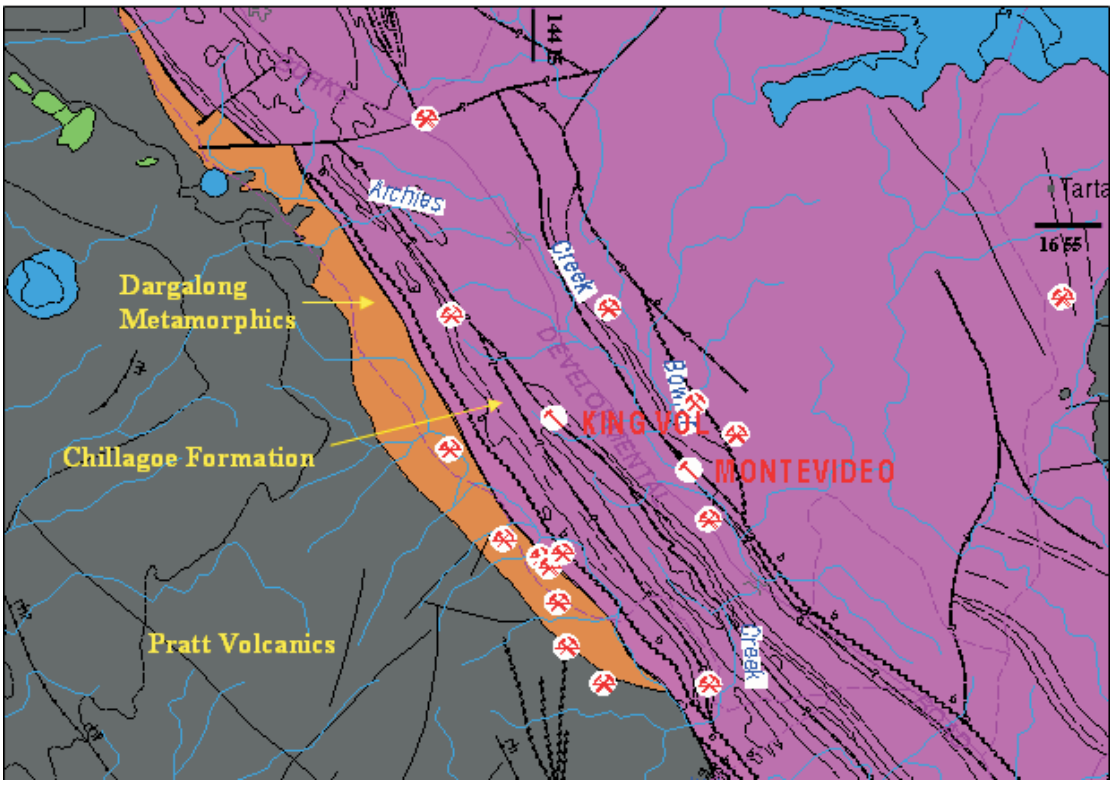

Figure 2: General locations of King Vol and Montevideo and regional geology of the area

zones at the Great Australian and Just in Time have the potential host target tonnage and increase the ore resource as satellite feeds to a central plant.

Montevideo and King Vol (oxdised zinc and lead mineralisation associated with surface ferruginous gossan karst collapsed breccia overlying massive sulphides skarn deposit)

Kagara Zinc secured 100% ownership of EPM 7672 and other tenements from Perilya Mines NL in July 2000.

The King Vol prospect (MGA 94, Zone 55, 0207047E, 8125432N) (Figure 2, Plate 16) is located on the western margin of the Hodgkinson Province within sediments of the Chillagoe Formation. Diamond drilling was carried out in three stages (Plate 17). An initial exploratory programme that comprised two drill holes, commenced in December 1989 and was completed in early 1990. The work successfully located primary mineralization and indicated that gossanous zones extend to depths of at least 70m (Plate 18). Subsequent drilling showed that oxidation might continue in reactive mineralized zones down to 150m depth. Diamond drilling showed that the mineralized oxide zones were derived from primary sulphide mineralization.

The Montevideo (MGA 94, Zone 55, 0208514E, 8124869N) (Figure 2) deposit occurs on the eastern side of a large limestone unit that overlies a sandstone unit to the east. The sandstone appears to be intruded by a localised granite body. Past mining was in an oxidised ore in a small breccia zone represented at the surface by a strongly ferruginous, gossanous outcrop. Step out drilling intersected high

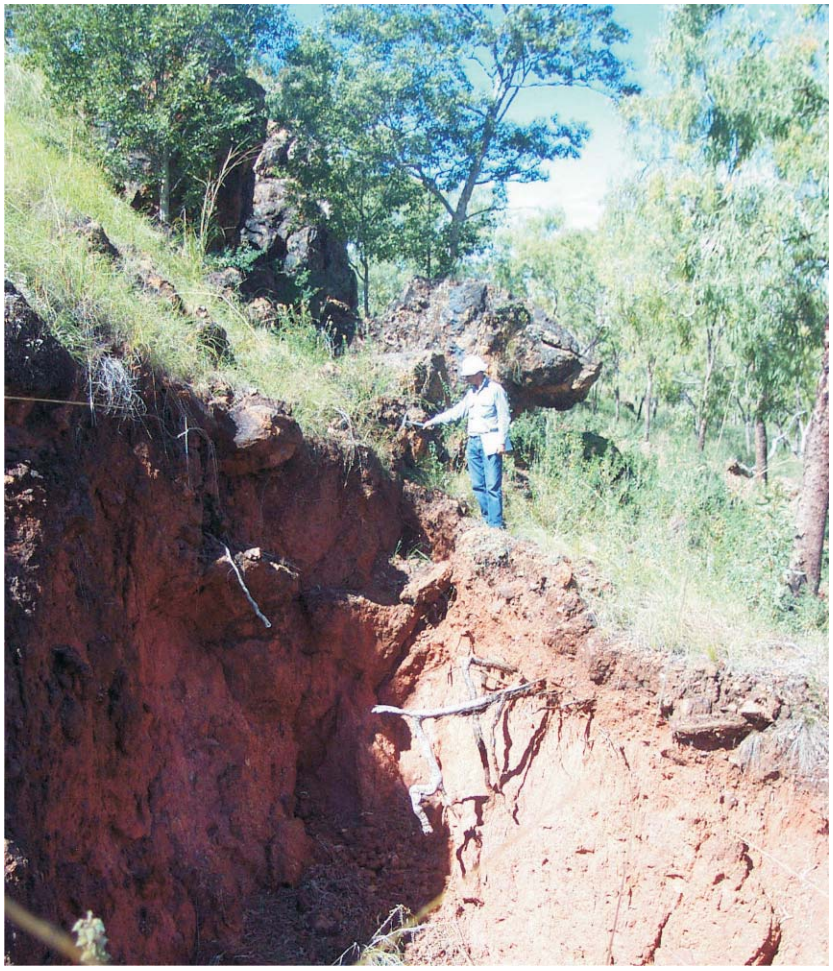

Plate 16: King Vol old working (photo taken on 26/6/2006)

grade zinc low copper mineralisation in some sections of drill core. Anomalous zinc in soil geochemistry has been obtained over the limestone unit and drilling intersected 38m of magnetite in limestone and high-grade zinc values in chert. A sample of granite was sent for zircon age dating by ANU, and Kagara Zinc is willing to share the information with the Geological Survey of Queensland.

Tartana West (Oxidised copper mineralisation hosted by meta-arenite)

This mine (MGA 94, Zone 55, 0207615E, 8126669N) is operated by Solomons Mine Pty Ltd extracting copper ore by the open cut method. The ore is heap leached and the pregnant copper sulphate solution is piped to a retaining pond. Copper sulphate (pentahydrate) crystals are recovered by a centrifuge process and bagged on site (Plates 19, 20). The final product is loosely packed equigranular copper sulphate crystals. The whole operation is managed by 6 people.

Martin Meyer, the mine-operating manager, is keen to locate further resources to extend the mine life. He is interested in determining the appropriate ore deposit model for this ore body, as an understanding of the deposit type would guide his exploration methods. A specimen identified as decomposed granite by an American geologist was shown to be from an outcrop of weathered arenite. A brief inspection of ore (Plate 21) and host rock specimens at the mine site led to the conclusion that the Tartana deposit is similar to the OK copper mine (35km to

Plate 17: King Vol drilling, step out drilling about 500m west of King Vol working

Plate 18: King Vol core, significant intersection of zinc mineralisation

Plate 19: Tartana centrifuge copper sulphate (photo taken on 26/6/2006)

Plate 20: Tartana plant bagging copper sulphide (photo taken on 26/6/2006)

Plate 21: Tartana West oxide ore, copper carbonate, black oxide and chalcopyrite

the north), which is documented as a Besshi/Kieslager VMS style deposit. It is considered likely that mineralisation at Tartana is similar in origin. It was recommended that Solomons Mine Pty Ltd contact JCU for a student to undertake a detailed study of the mineralisation being exposed by the current mining to confirm this hypothesis.

The geological setting of the quarry face shows an upright stringer zone of copper carbonates parallel to bedding in meta-arenite. Little to no copper mineral was found in the thinly bedded black shales (Plate 22).

Kangaroo Creek (MGA 94, Zone 55, 0185486E, 8060316N)

The Kangaroo Creek deposit is currently the only operating alluvial tin mine in Queensland. The flood plain on the southern bank of Kangaroo Creek was worked by surface scrapping up to 2m deep. The face of this exposure shows thin weakly cemented beds of rounded quartz pebbles containing very fine-grained cassiterite. Average width of the beds is about 0.5m with locally beds up to 1m in thickness contain high grades of cassiterite (Plate 23). There are sufficient alluvial ground resources for the next ten years of mining at the current rate of output.

Mr R Watson, one of the owners of this mine, was on site working the old ground on the southern bank of Kangaroo Creek. The yield of heavy concentrate was 2/3kg per cubic metre of wash treated. About 50% of the concentrate is cassiterite and the other 50% is mainly ironstone, ilmenite and monazite. The cassiterite was separated from the heavy minerals by a wet secondary process (Plate 24). Most of the recovered grains are generally less than 1mm and samples were checked by field test utilising zinc block and hydrochloric acid (Plate 25). After the subsidence of the chemical reaction, the cassiterite grains generally were coated with a thin crust of zinc metal. This method is not infallible as some of the ruby-coloured cassiterite is passive to the test.

Plate 22: Tartana open cut exposed oxide ore, exposure of vertical copper carbonate and oxide stringers zone parallel to the cleavage of the host metasediments at the Tartana West mine

Plate 23: Kangaroo Creek reworked/primary wash(?)

Plate 24: Kangaroo Creek plant, R Watson and his alluvial cassiterite treatment plant 27/6/2006

Plate 25: Kangaroo Creek zinc block, field test of cassiterite grains by zinc and hydrochloric acid

Bell Creek laterite nickel deposit (MGA 94, Zone 55, 0305049E, 8013485N)

Serpentinite

The Halls Reward Metamorphics is the major rock unit in the Bell Creek area where it has been intruded by small ultramafic bodies. The metamorphic rocks are quartz-biotite and quartz-muscovite schists and the composition of the ultramafic bodies ranges from dominantly serpentine to dominantly amphibolite. Deep chemical weathering during the Cainozoic caused the formation of a laterite profile and where this has been developed over the ultramafic units it contains enhanced assays for nickel.

Nickel enrichment (>1% Ni) is present both within the ferruginous duricrust and the underlying weathered serpentinite. The duricrust has a varible thickness (up to ~5m) and is best developed over the plateau in the southern part of ML 7021. Magnesite is commonly present in the lower levels of the duricrust. The duricrust is underlain either by hard, barren silicified serpentinite or locally by deeply weathered serpentinite; the latter probably developed along fracture zones.

The prospect area is gridded by numerous drill pads and access roads. No mining activity was observed at the site.

Christmas Creek limestone deposit (MGA 94, Zone 55, 0324096E, 7892072N)

Mr Wilkins has acquired this limestone quarry recently and is screening the dump material. Planning on restarting quarrying and drilling of benches is in progress (Plate 26). Caves in the adjoining national park have received minor damage.

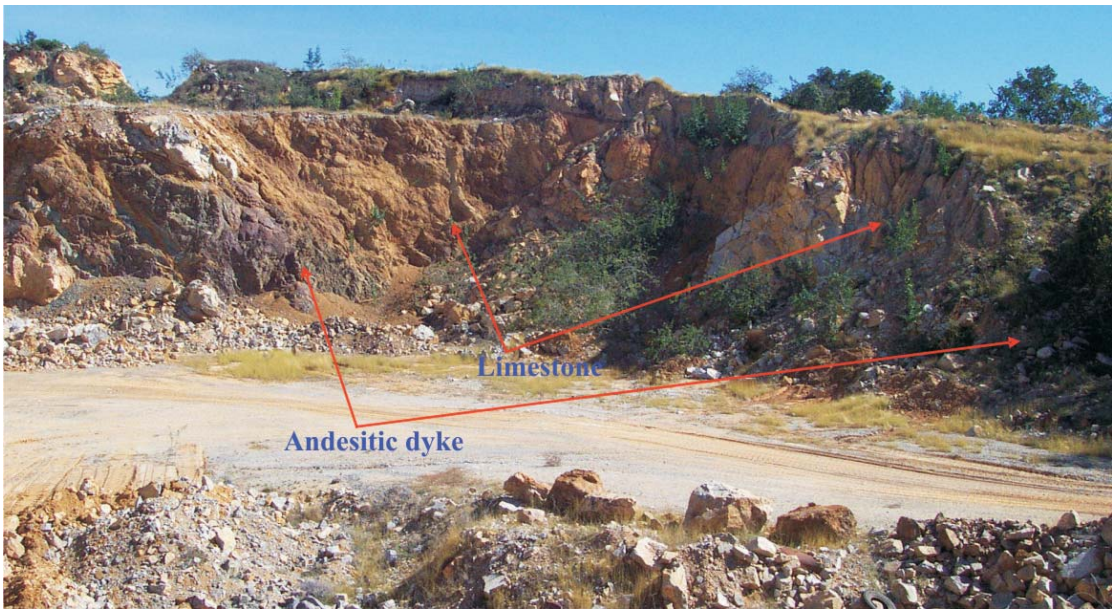

Plate 26: Christmas Creek limestone quarry, andesitic dyke intruding coral-bearing limestone

Surveyor underground mine (MGA 94, Zone 55, 0257236E, 7921926N)

In 1975, the Surveyor-1 gossan was the initial discovery in the Balcooma massive sulphide province. The deposit consists of synformal sulphide lens in the keel of a south-plunging fold hosted by tuffs of the Balcooma Metavolcanics. A footwall stringer and disseminated zone occurs beneath the lens. Alteration is predominantly sericitic and confined to the tuffaceous footwall. The Surveyor East mineralisation occurs as a small shallow deposit 150m east of Surveyor-1.

Balcooma and Balcooma North opencuts (MGA 94, Zone 55, 0258920E, 7922870N)

Carpentaria Exploration Company Pty Ltd identified the Balcooma gossans in 1978 and in 1979 the first drill hole intersected massive sulphides.

The Balcooma deposit consists of four separate stratigraphic horizons containing copper-rich massive base metals sulphide mineralisation with three recorded types of mineralisation as magnetite, pyrite-chalcopyrite and sphalerite-galena-pyrite.

Open pit mining is exposing the sulphide ore bodies after removal and processing of the oxide ore. Significant waste rock removal is being undertaken to stabilised pit walls and access deeper ore bodies.

Mungana underground mine (MGA 94, Zone 55, 0222214E, 8106769N)

This resource 2.6km north-west of the Red Dome pit was delineated by Niugini Mining Ltd. It includes a near surface resource amenable to open pit extraction overlying the Mungana Deep resource which can be reached by underground mining.

The project is considered only marginally economic by Niugini Mining Ltd who noted that complex metallurgy detracts from the marketability of the gold/copper and lead/zinc concentrate that would be produced.

The Mungana deposit can be categorised as a low sulphidation porphyry Cu-Au skarn deposit developed within carbonate and aluminosilicate host rocks. The mineralising system is highly telescoped and multiphase in origin with separate hydrothermal events spanning ~35My. The final overprinting hydrothermal phase can be categorised as a structurally controlled high sulphidation system (M. Barr, personal communication, 2006)

The portal of the Mungana decline has just commenced and will spiral down to access the identified deeper resources (Plates 27, 28 and 29).

The following prospects and mineral occurrences were inspected and assessed for suitable samples for alteration mapping/identification and/or for age dating.

Plate 27: Mungana portal (photo taken 27/6/2006)

Plate 28: Mungana portal frame and machinery (photo taken 27/6/2006)

Plate 29: Mungana haul truck (photo taken 27/6/2006)

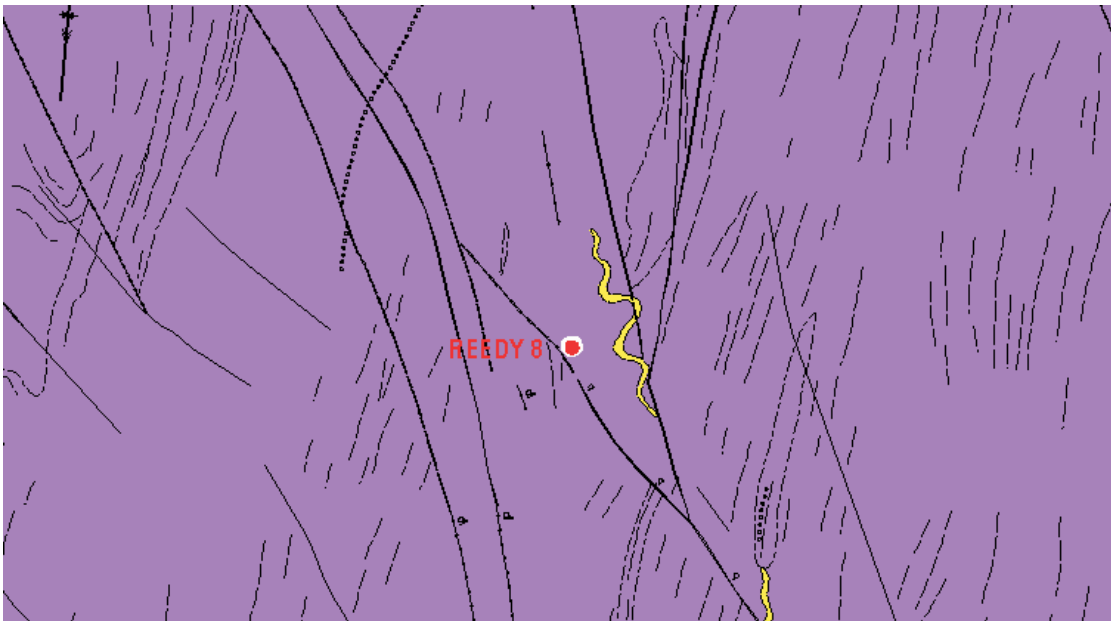

Figure 3: Major local structure elements of the Reedy 8 Prospect

Reedy 8 Prospect (MGA 94 Zone 55, 242495E, 8188030N)

Mineralisation is associated with a north-trending shear zone crosscutting metasediments of the Hodgkinson Formation (Figure 3). Surface mapping by company geologists indicated that individual quartz veins are continuous over 10–50m, but that there are several *en echelon* veins along most of the mineralised zone. Massive stibnite and cervantite form 'bands' up to 100mm wide in quartz veins in greywacke, fine-grained sandstone and phyllite (Plates 30, 31).

Gold mineralisation is present in the thicker (up to 0.5m) quartz reefs and also occurs in the host rocks, associated with stockwork quartz veining and

Plate 30: Reedy 8 Prospect, massive quartz lode up to 0.5m wide dipping to the west. Sampled quartz material in trench wall at MGA 94 Zone 55 0242872E, 8187377N.

Plate 31: Reedy 8, host rock samples collected on both side of exposed narrow quartz lode in another trench wall

disseminated pyrite. Goulevitch (1991) reported that samples assayed up to 11.45g/t Au.

Stuart Find (MGA 94 Zone 55, 280914E, 8149370N)

Workings extend over 180m near the crest of a ridge (Figure 4). Past mining comprises a decline on hanging wall of quartz vein to depth of >10m and a small open cut (10m x 3m) and shallow trenches over 30m strike length. Quartz in dumps is stained with jarosite and carries abundant sulphide mineral. Lode structure can be traced over 250m along and immediately adjacent to the crest of ridge consisting of arenite/greywacke overlain by conglomerate. The quartz lode is associated with a fault zone striking 145–160° and dipping 55–60° west-south-west. The quartz veins are white, massive and crudely laminated up to 1.3m thick (Plate 32) and contain coarse-grained aggregates of pyrite. Fine-grained pyrite is disseminated in weakly sheared wall rocks and within the fault zone.

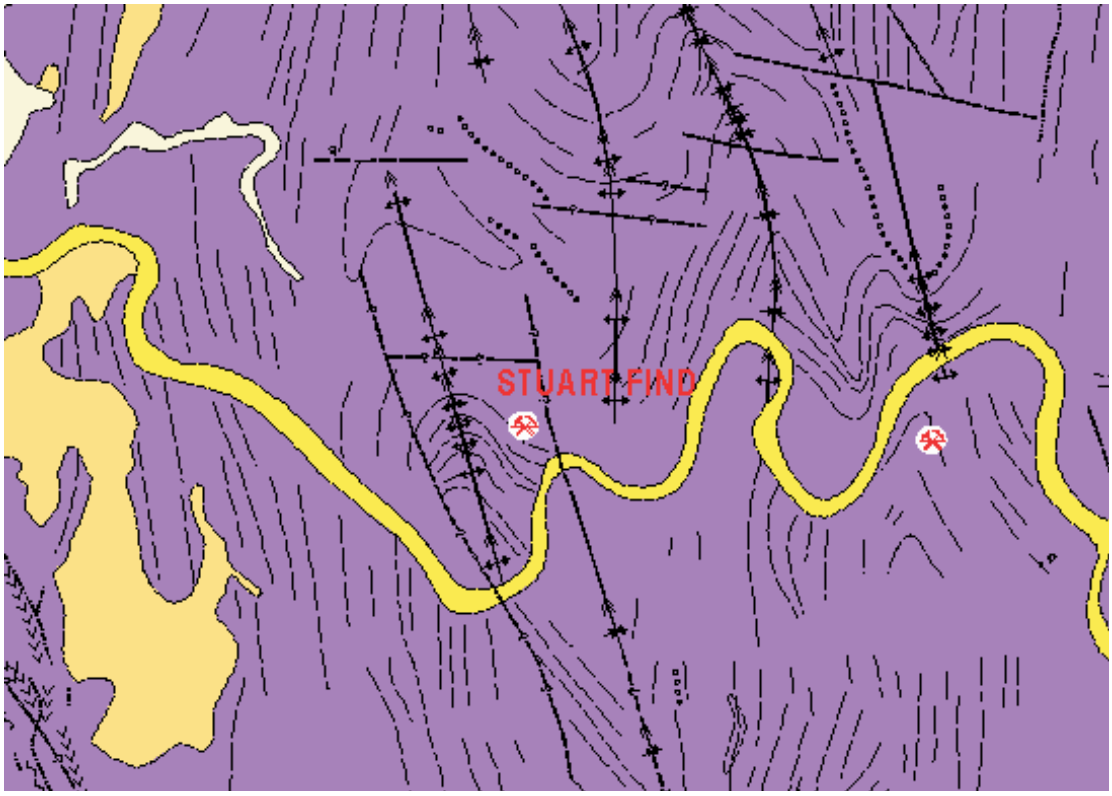

Figure 4: Major local structure elements of the Stuart Find mine

Burke (MGA 94, Zone 55, 243313E, 8085919N)

Company exploration reported that garnet skarns with minor silicification replace magnetite skarns. These skarns were initially located from follow up of stream sediment gold anomalies. Re-sampling the anomalies located others with assay values up to 0.42g/t Au. Rock samples assayed up to 0.93g/t Au, 0.55% Sn with elevated Cu, Pb, Zn, As and W.

The Departmental MERLIN graphic shows two Burke sites, one is a prospect and the other a mineral occurrence (Figure 5). Field inspection failed to locate skarn

Plate 32: Stuart Find, main working where barren massive white quartz dump discarded by previous miners.

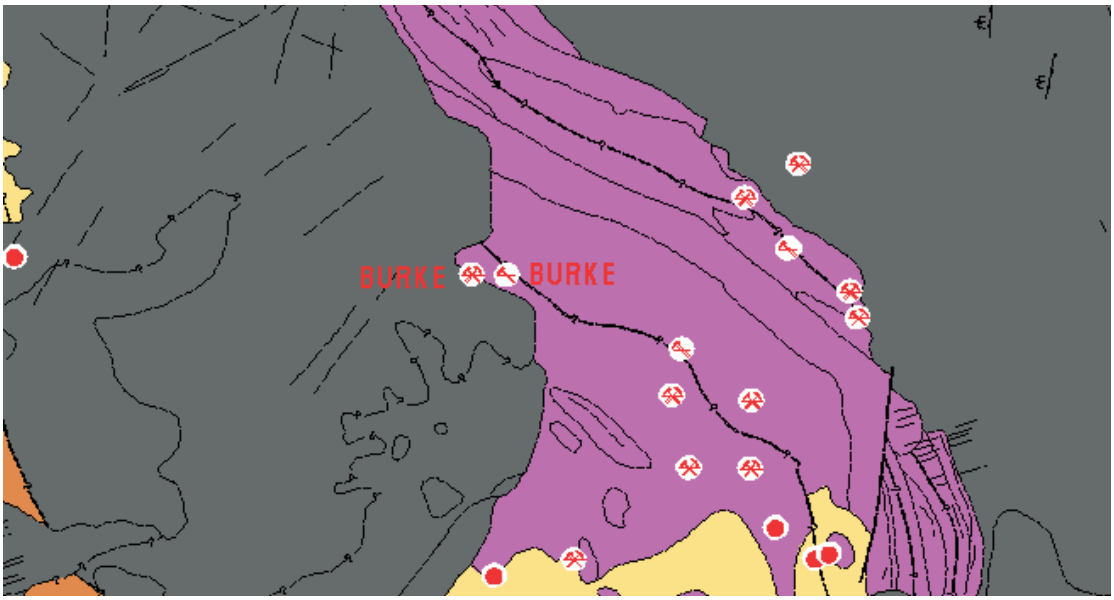

Figure 5: Major local structure elements and rock formation of the Burke prospect

outcrops at either the mineral occurrence site or the prospect site both of which occur to the west of the Burke Development Road. However, magnetite/hematite pebble float was found 50m east of the road, near a small creek bank. Further south of the creek float of hematite pebbles was also found.

Mount Rutile (MGA 94, Zone 55, 243313E, 8085919N)

Rutile occurs in a foliated, granoblastic, 1–3mm white to pale cream aplite or aplitic granite, which strikes 300°–320°, and dips steeply to the south-west (Figure 6). The gneissic leucogranite contains muscovite-sericite and/or a bleached biotite. Locally, the gneissic leucogranite is coarse-grained with quartz or quartz-felspathic stringers subparallel to foliation. Red-brown grains or grain aggregates of rutile are disseminated through the gneissic leucogranite,

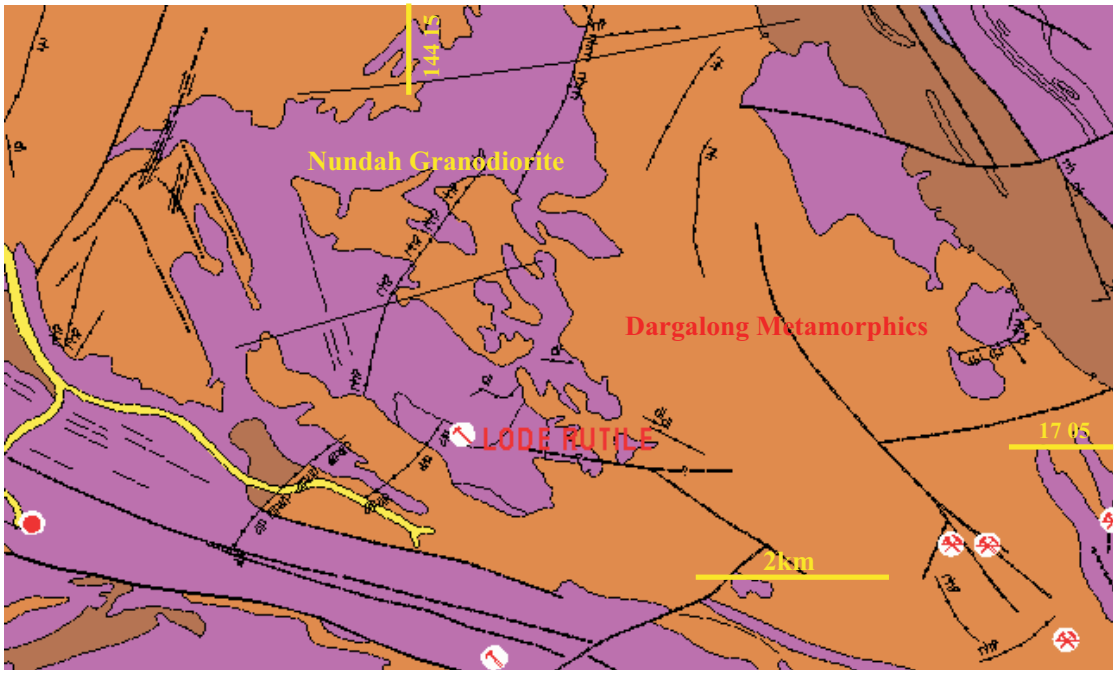

Figure 6: Major local structure elements and rock formation of the Lode Rutile deposit

concentrated along margins of interlayered gneissic leucogranite bands, or as relatively massive lumps or segregations (Plates 33, 34).

Parts of the north-west-trending lode zone are cut by massive quartz veins, and some north or north-east-trending pegmatite veins or dykes to 0.4m wide post-date rutile crystallisation.

Country rock adjacent to the rutile-bearing zone consists of quartz-mica-feldspar gneiss and schist with lenses and veins of graphic-textured foliated aplite and

Plate 33: Mount Rutile ore in gneissic leucogranite

Plate 34: Mount Rutile ore in leucogranite

pegmatite, and boudins, pods and veins of massive white quartz with feldspar patches.

Packers Creek (MGA 94, Zone 55, 0218713E, 8086471N)

The *Packers Creek prospect* (Figure 7) consists of a series of gossanous breccia outcrops and a separate, subparallel copper mineralised shear. Old working consists of a small prospecting pit sunk on a small south-east-trending shear zone up to 2m wide in dark coloured fine-grained mafic rock (Plate 35). A company geologist described the breccia as being composed of intensely bleached, clay-sericite altered, limonite-haematite stained, clasts of mica schist and minor chloritised gabbro. Chalcedonic to cryptocrystalline comb quartz veining, quartz micro veinlets and siliceous matrix infill zones to the gossan breccia were also observed.

Previous miner did not test outcrop of massive white quartz to the east of the track.

Blue Bell (MGA 94, Zone 55, 0207014E, 8082169N)

Old workings are present on the north side of Big Black Gin Creek (Figure 8). A shaft trending 340° was sunk on a 1m shear zone in gabbro(?). Mullock at this site consisted of copper-stained blue and green carbonates and minor black copper oxide. Mineralisation appears to be oxidised quartz-sulphide lodes associated with dolerite/amphibolite dykes.

The following diatomite deposits were inspected and sampled.

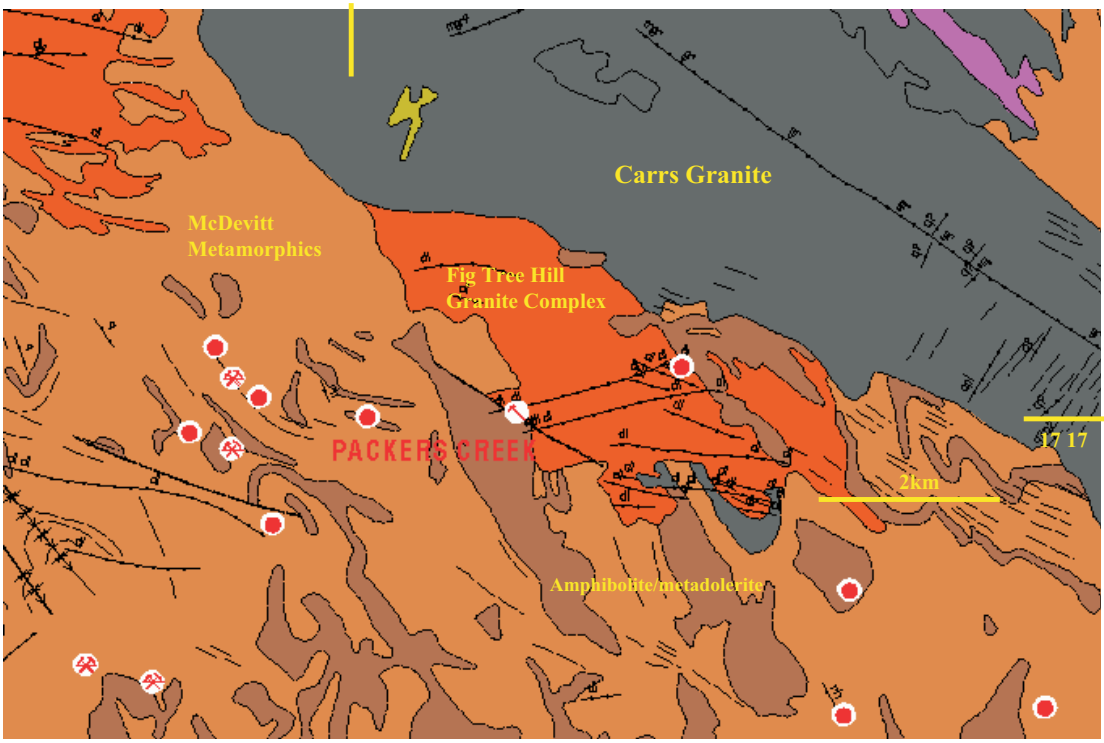

Figure 7: Major local structure elements and rock formation of the Packers Creek deposit

Plate 35: Packers Creek pit

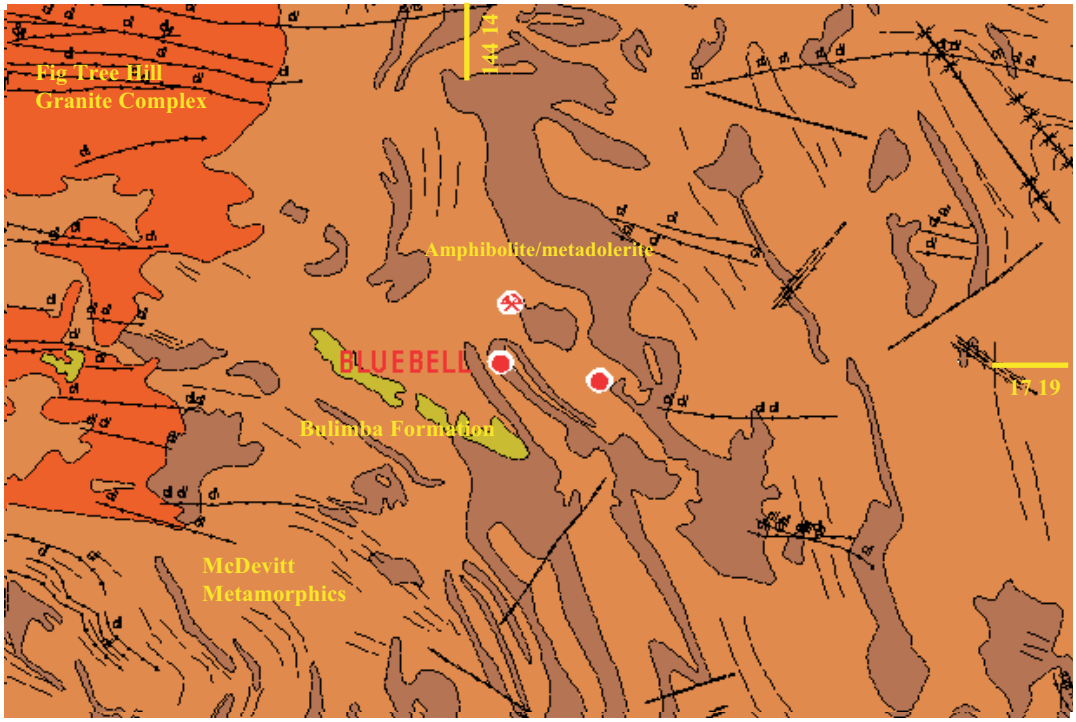

Figure 8: Major local structure elements and rock formation of the Bell Creek deposit

Innot Hot Springs (MGA 94, Zone 55, 0312415E, 8046077N)

The Pozzolan diatomite deposit (Figure 9) crops out over an area of ~300m in diameter and 1m in thickness. The diatomite bed rests on granite and is overlain by black soil and basalt. A small shallow quarry 100m by 100m has been excavated on the flat lying diatomite bed (Plate 36). There are two distinct bands of diatomite; a 1m thick finely laminated whitish grey diatomite overlying a 0.3m thick greyish white diatomite (Plate 37). At site MGA 94, Zone 55, 0312597E, 8046032N, an exposure of greyish white diatomite has the appearance of a dried mud crack with a pitted surface (Plate 38).

Krosch (1976) reported the diatom assemblage at this site is different from all other Queensland occurrences. The genera consists largely of the rod-like *Epithema*, both the broad and narrow rectangular *Diatomella*, the filiform *Synedra*, and the naviculoid *Navicula* and *Cymbella*. Sponge spicules are common.

Cashmere (MGA94, Zone 55, 0322315E, 7993777N)

At the sample site, diatomite exposed on the south-west bank of a small creek is under a blanket cover of 0.5m thick black soils (Plates 40, 41). Vesicular basalt crops out prominently on hilltop.

Krosch (1976) described this diatomite occurrence as 100m long by 18m wide and 3m thick, overlain by basalt. The diatomite is chalk-white, consisting of cylindrical *Melosira Sp* (White & Crespin, 1959).

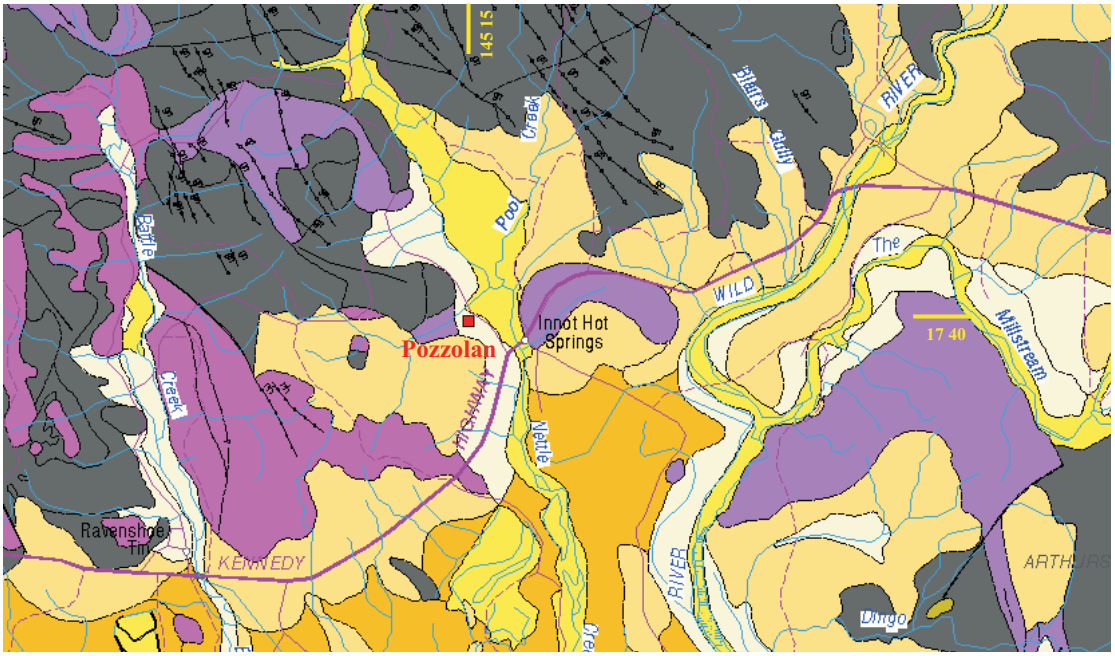

Figure 9: General location of Pozzolan diatomite deposit

Plate 36: Pozzolan diatomite quarry, shallow surface scrapping of diatomite

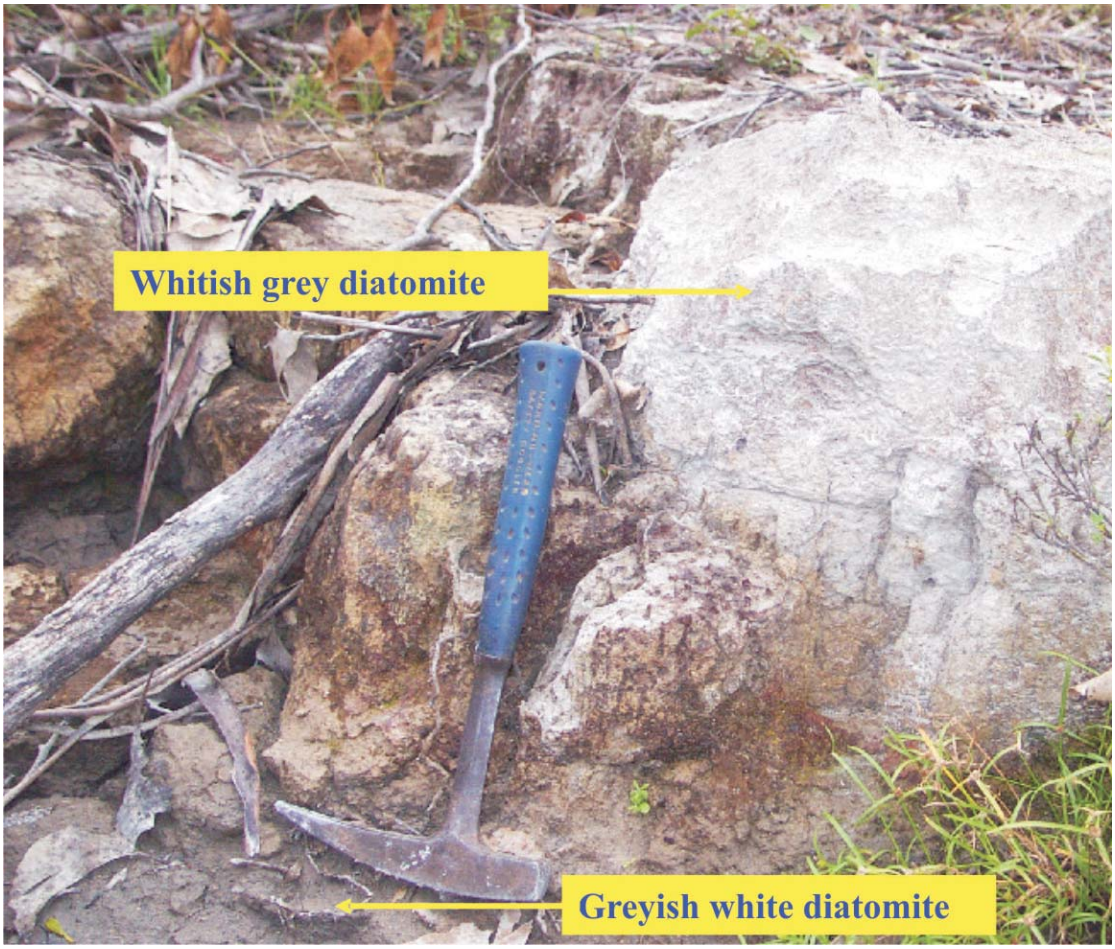

Plate 37: Pozzolan diatomite deposit: 1 to 1.5m thick bed of white diatomite lying on a bed of 0.3m thick mud cracked grey diatomite adjacent to unconsolidated sandy sediment on top of decomposed granite.

Plate 38: Pozzolan diatomite deposit, pitted mud crack diatomite

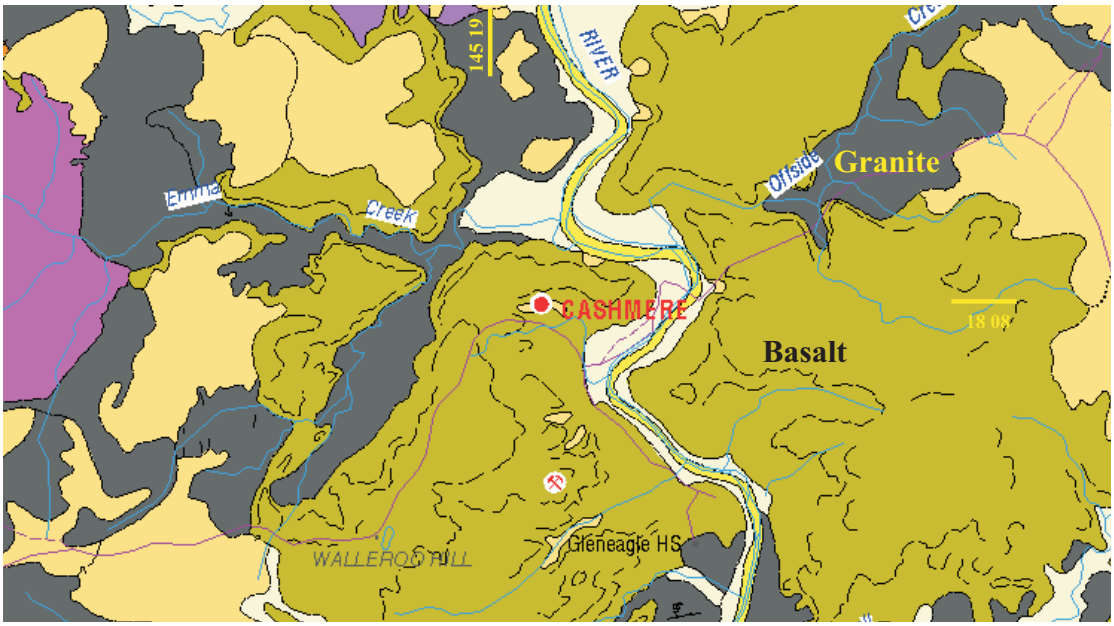

Figure 10: General location of Cashmere diatomite deposit

Plate 39: Typical road access on flooded lava plains

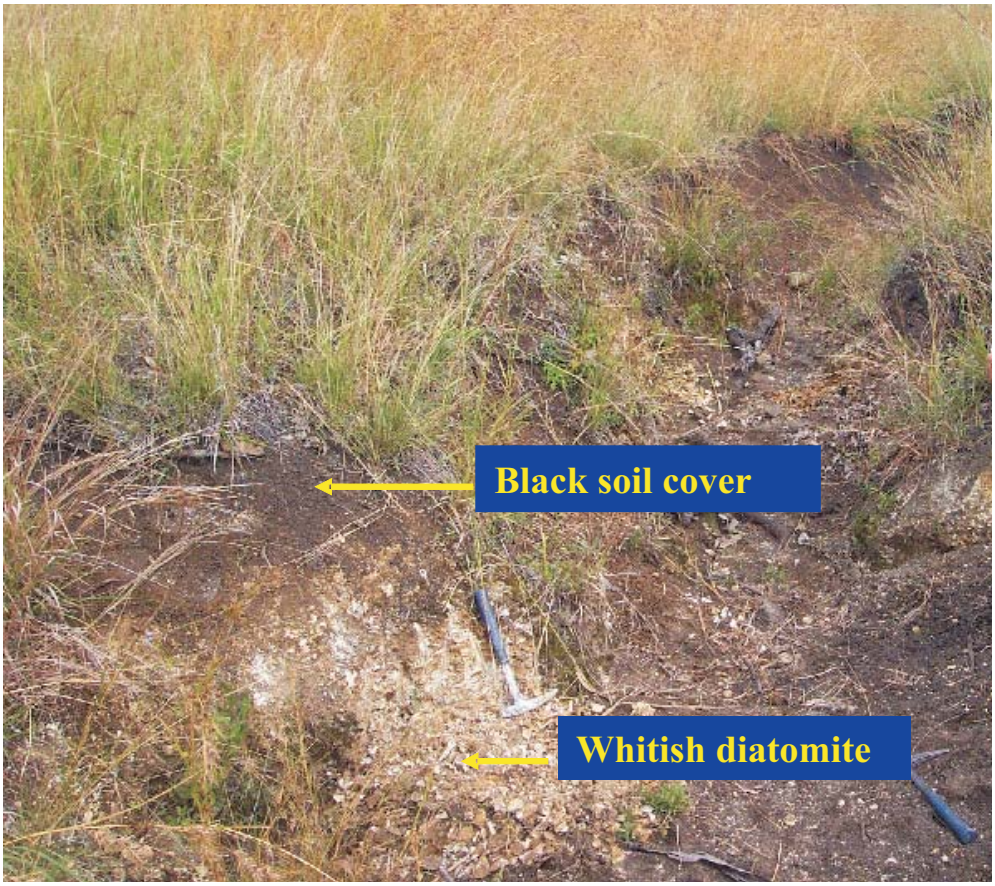

Plate 40: Cashmere diatomite occurrence, diatomite exposure on shallow bank of a small creek

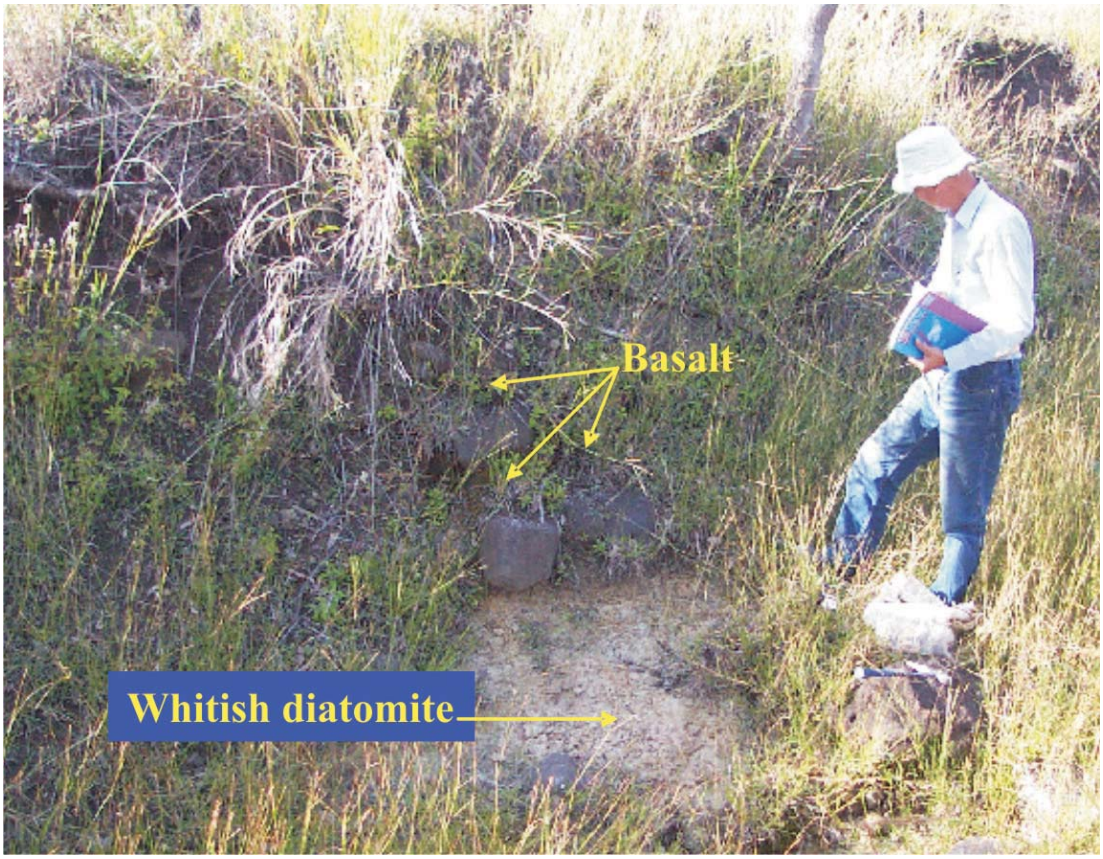

Plate 41: Cashmere diatomite occurrence, another diatomite exposure on shallow bank of a narrow creek

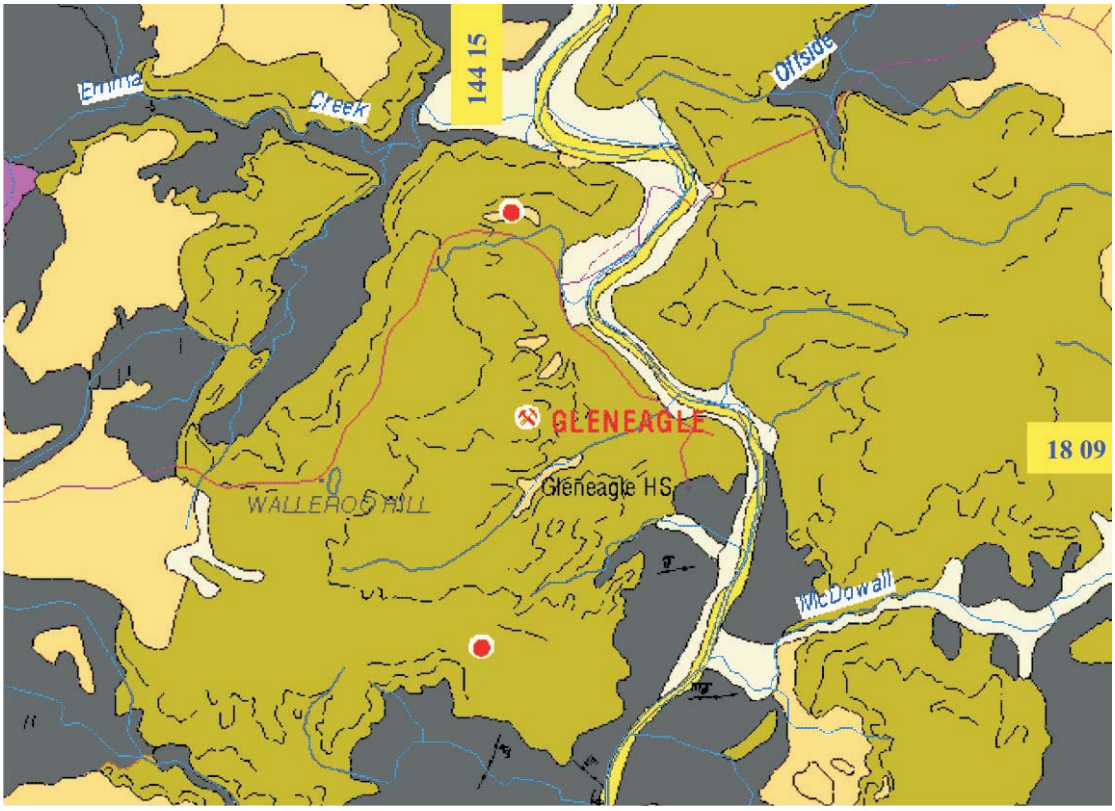

Figure 11: General location of Glen Eagle diatomite deposit

Glen Eagle (MGA 94, Zone 55, 0322515E, 7991363N)

A bed of diatomite up to 3m thick overlain by black soil/basalt is exposed on the creek bank (Plate 42). It is chalky white, and dips to the south-west. Krosch (1976) reported *Melosira sp*. as the predominant diatom. Company exploration outlines a resource potential in excess of 200Mt of amorphous diatomaceous earth of a base grade of 70% SiO_2.

Walters Plains (MGA94, Zone 55, 0307115E, 7971377N)

Krosch (1976) reported that outcrops in a small tributary of Leichardt Creek consist of well-striated, impure diatomite with intercalations of coarse-grained, clayey sandstone (Plate 43). The diatoms identified are *Cymbella, Epithema, Navicula* and broken fragments of *Synedra*.

Conjuboy (MGA 94, Zone 55, 0269547E, 7935100N)

The deposit is exposed in Wyandotte Creek near its junction with Fig Tree Spring (Figure 12). Krosch (1976) reported that the diatomite is made up predominantly of *Melosira* with broken frustules of *Synedra, Pinnularia* and *Navicula*.

Plate 42: Glen Eagle diatomite deposit, one of the creek bank exposures of diatomite

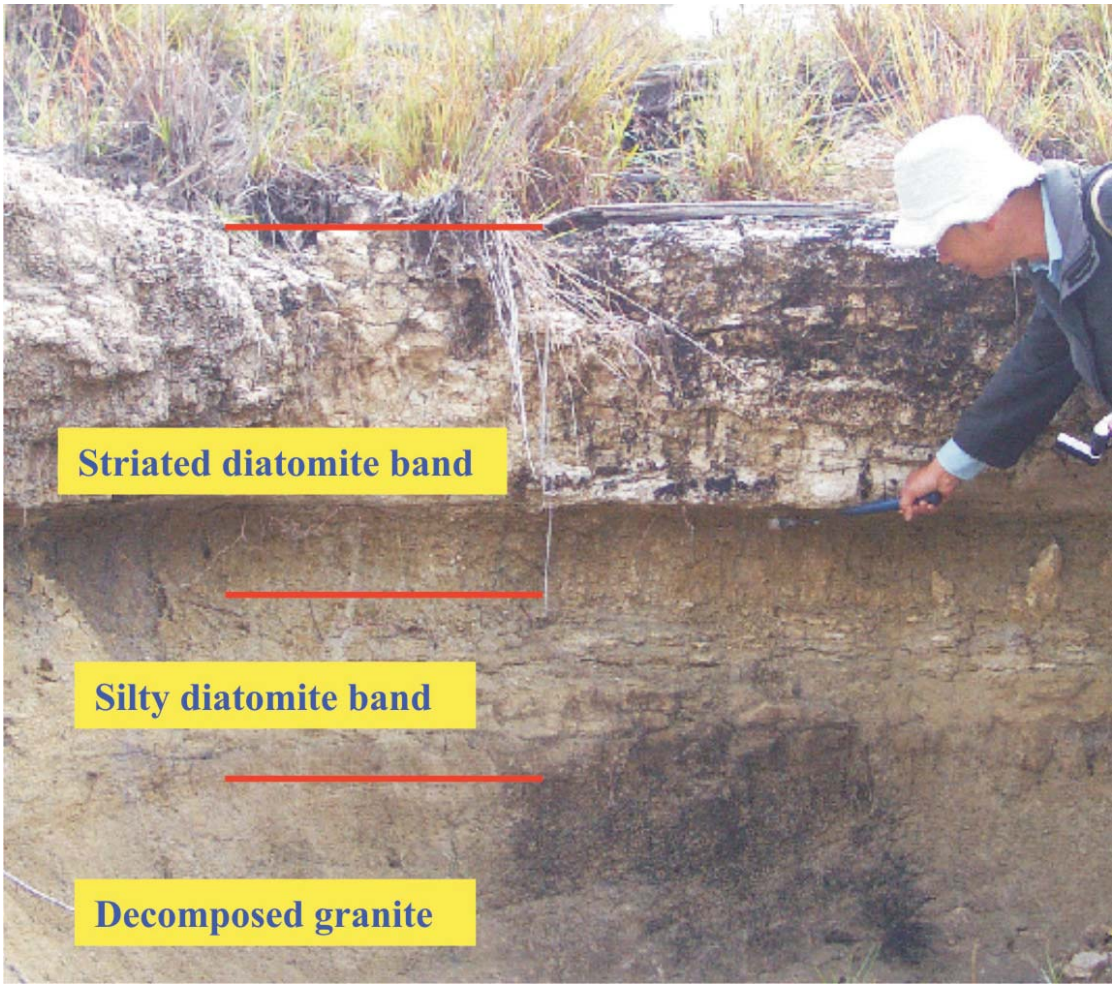

Plate 43: Walters Plains diatomite deposit: creek bank exposure shows 0.6m thick white diatomite overlying 0.3m thick silty diatomite overlying decomposed granite.

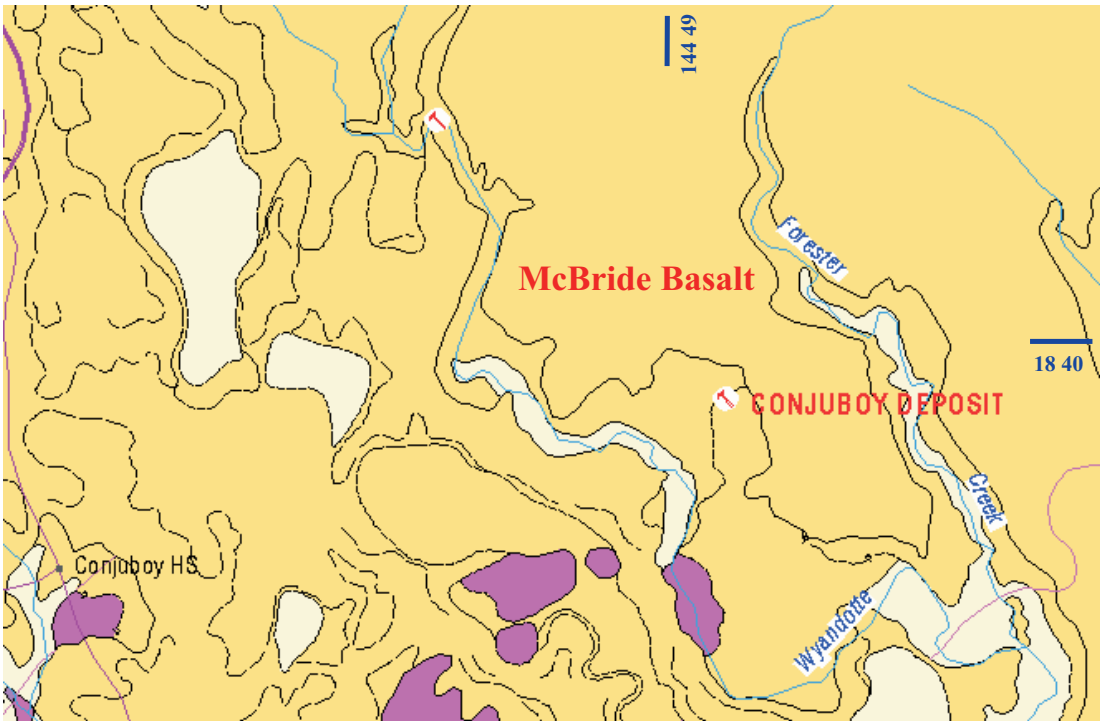

Figure 12: General location of Conjuboy diatomite deposit

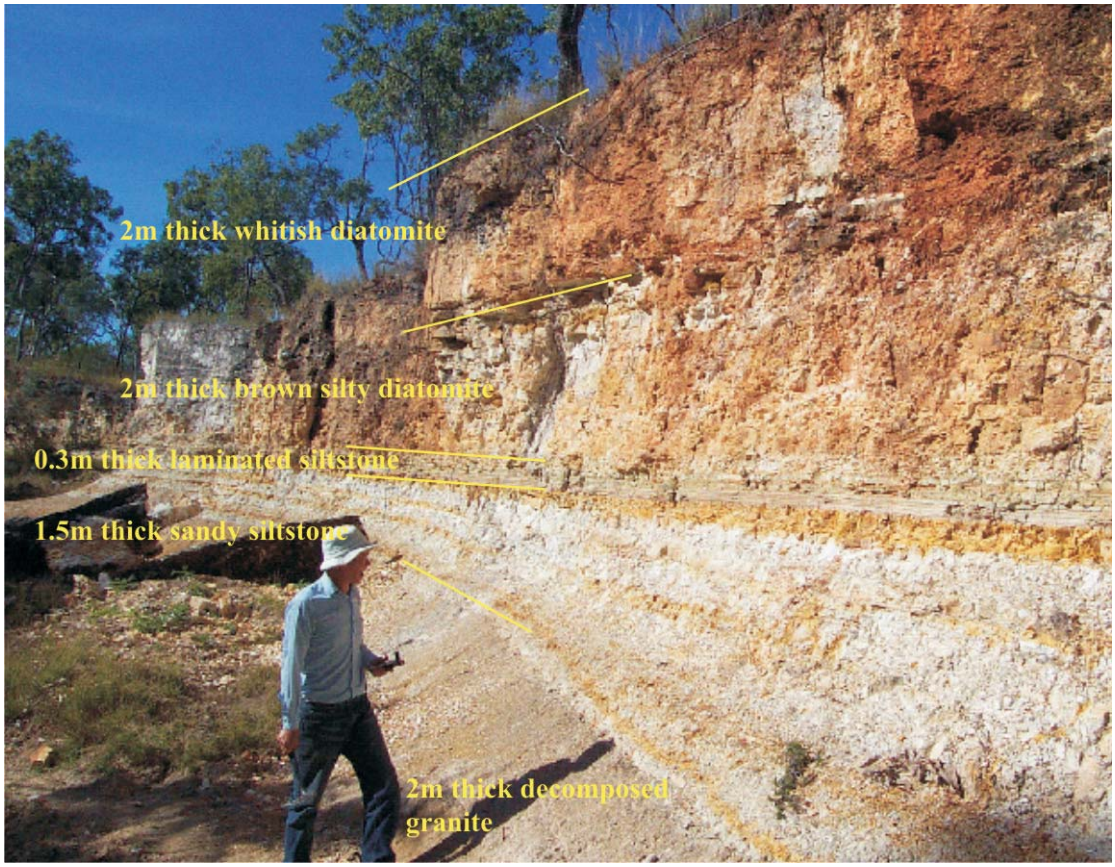

Plate 44: Conjuboy diatomite deposit, creek bank exposure of massive diatomite beds overlying siltstone and decomposed granite.

Plate 45: Flaggy Creek diatomite deposit, creek bed exposure shows 1m tall rock bar of white diatomite overlying duricrust and decomposed granite.

Metals Exploration Ltd (AP 2630M & 2808M, 1980) mapped the area and reported that the diatomite seam has a thickness of 20–30m interbedded and underlain by claystone in a fresh water lake on the surface of basalt. The diatomaceous earth is poorly cemented, and contains clay lenses and sandy to coarser conglomeratic bands. Where exposed in creek cuttings the diatomite seam is 10–15m thick with a cover of 0–5m of sandy clay, diatomite rubble, basalt rubble and soil (Plate 44). Past drilling has shown that the diatomite-bearing horizon comprises two main zones of material, a "low grade" diatomite which is pale orange in colour or grey-white with increasing clay content, and a "high-grade" diatomite which tends to be white to slightly-tinted.

The Australian Diatomaceous Earth Joint Venture is investigating this deposit for mining and laboratory analysis indicated the diatomite ore could be treated and its application as a filtration medium improved. The resource figure to 2006 is 3.55Mt.

Flaggy Creek/Princess Hill (MGA 94, Zone 55, 346815E, 7972477N)

Diatomite appears to be overlying duricrust with upward fining of grain size (Plate 45). Krosch (1976) reported this deposit contains broken frustules of *Melosira sp*.

CONCLUSIONS

Past mining at King Vol and Montevideo was on the oxide ore. Mining stopped at the sulphide zone. These deposits are good examples of tell tale signs of potential skarn deposit at depth when the geological setting is taken into consideration to

target style of mineralisation in the area. The old timers either did not wish to work on refractory ores or had no effective means to prospect buried sulphide deposits.

Mineral occurrence mapping (MINOCC) provides a base and framework for exploration geologists and researchers to generate target areas for further exploration. Most of the small surface mineral occurrences have been overlooked or under-explored. Back to the basics taking the geology and structure into the equation will assist in identification of potential areas for burial deposits.

It is highly recommended that GSQ should provide further research studies on potential areas by reviewing all past relevant exploration results, plotting drill hole data and identifying areas for further exploration from the first pass of MINOCC mapping.

Visiting major working mines provides first hand practical experience. It is highly recommended that all field geologists should have the opportunity to do so on a yearly basis as hands-on training to improve their economic geology knowledge and widen their perception of mineral deposits related to regional geological settings. Fieldwork will also provide the opportunity to promote the Geological Survey of Queensland's latest releases of geological information and to encourage the field geologists using it.

Field study of alteration as distinct from weathering associated with surface outcrop mineralisation and mineral occurrence is difficult for base metals and gold hosted by metasediments in the Hodgkinson Province.

Surface outcrop sampling will confuse the issue of alteration as it can not be certain the alteration minerals are the result of mineralising fluids or due to oxidation and surface outcrop weathering.

Collecting mineral samples for age dating requires expert training.

Queensland is known to have a number of diatomite deposits extending from Innot Hot Springs in the north to Numinbah Valley in the south. Very little study on the environment of deposition of the diatomite has been conducted, and few species were identified. This field work provided the opportunity to collect diatomite samples from Innot Hot Springs, Glen Eagle homestead area and Conjuboy homestead area.

Dave Purdy has collected diatomite samples from the Mount Coolon area.

Other diatomite deposits that were sampled include Black Duck Creek, Maidenwell and in the Gold Coast hinterland.

BIBLIOGRAPHY

BRUVEL, F.J., BULTITUDE, R.J., CULPEPER, L.G. GARRAD, P.D. LAM, J.S.F. & MORWOOD, D.A., 1991: Mineral occurrences — Ravenshoe 1:100 000 Sheet Area, Queensland. *Queensland Resource Industries Record*, **1991/05**.

CLARKE, G.W. MORWOOD, D.A., & DASH, P.H., 1994: Review of the Ollera Creek Mineral Field, North Queensland. *Queensland Geological Record*, **1994/08**.

CULPEPER, L.G., LAM, J.S., MORWOOD, D.A., & BURROWS, P.E., 1990: Mineral occurrence data sheets – Bellevue 1:100 000 Sheet area. *Queensland Resource Industries Record*, **1990/04**.

DASH, P. H. & CRANFIELD, L.C., 1993: Mineral occurrences Rumula 1:100 000 Sheet Area, North Queensland. *Queensland Geological Record*, **1993/17**.

DENARO, T.J., CULPEPER, L.G.. MORWOOD, D.A, BURROWS, P.E., 1994: Mineral occurrences: Helenvale 1:100 000 Sheet Area, Cape York Peninsula, Queensland. *Queensland Geological Record*, **1994/13**.

DASH, P.H., BARKER, R.M., MORWOOD, D.A., CULPEPER, L.G. & LAM, J.S., 1991: Mineral Occurrences — Atherton 1:100 000 Sheet Area. *Queensland Resource Industries Record*, **1991/14**

DASH, P., GARRAD, P. & MITCHELL, G., 1988: Mineral occurrence data sheets Chillagoe 1:100 000 map Sheet area, Metallogenic Studies program. *Queensland Department of Mines Record*, **1988/17**.

DASH, P.H. & MORWOOD, D.A., 1994: Mineral occurrences, Cairns 1:100 000 Sheet Area, North Queensland. *Queensland Geological Record*, **1994/06**.

CULPEPER, L.G., LAM, J.S., MORWOOD, D.A. & BURROWS, P.E., 1990: Mineral occurrence data sheets — Bellevue 1:100 000 Sheet area. *Queensland Resource Industries Record*, **1990/04**.

GARRAD, P.D.,1993: Mineral occurrences Mount Mulligan 1:100 000 Sheet Area, North Queensland. *Queensland Geological Record*, **1993/11**.

GARRAD, P.D. & BULTITUDE, R.J., 1999: *Geology, mining history and mineralisation of the Hodgkinson and Kennedy Provinces, Cairns region, north Queensland*. Queensland minerals and energy review series, Queensland Department of Mines and Energy.

GOULEVITCH, J., 1991: EPM 5902 (Tornado), EPM 5964 (Hurricane) Final Report. Held by the Queensland Department of Mines and Energy as CR22703.

KROSCH, N.J., 1976: Summary report - diatomite. Queensland Department of Mines, internal report.

LAM, J.S.F., 1993: Summary of the mineral occurrences of the Mossman 1:100 000 Sheet Area (7965), North Queensland. *Queensland Geological Record*, **1993/13**.

LAM, J.S.F. & GENN, D.L.P., 1993: Mineral occurrences South Palmer River 1:100 000 North Queensland. *Queensland Geological Record*, **1993/26**.

LAM, J.S.F., DENARO, T.J., BURROWS, P.E. & GARRAD, P.D.,1991: Summary of the mineral occurrences of the Maytown 1:100 000 Sheet Area (7765), North Queensland. *Queensland Resource Industries Record*, **1991/10**.

LAM, J.S.F., GARRAD, P.D. & MITCHELL, G., 1988: Mineral occurrence data sheets, Bullock Creek 1:100 000 sheet area. *Queensland Department of Mines Record*, **1988/12**.

MORWOOD, D.A. & DASH, P.H., 1996: Mineral occurrences of the Ingham 1:250 000 Sheet Area, North Queensland. *Queensland Geological Record*, **1996/05**.

SAWERS, J.D., HAYWARD, M.A., COOPER, W., DASH, P.H., GARRAD, P.D., ISHAQ, S. & LAM, J.S.F., 1987: Metallogenic Studies Program, Mungana 1:100 000 Sheet, Mineral occurrence data sheets. Geological Survey of Queensland Record, 1987/29.

WHITE, D.A. & CRESPIN, I., 1959: Some diatomite deposits, north Queensland.*Queensland Government Mining Journal*, **60**, 191–193.