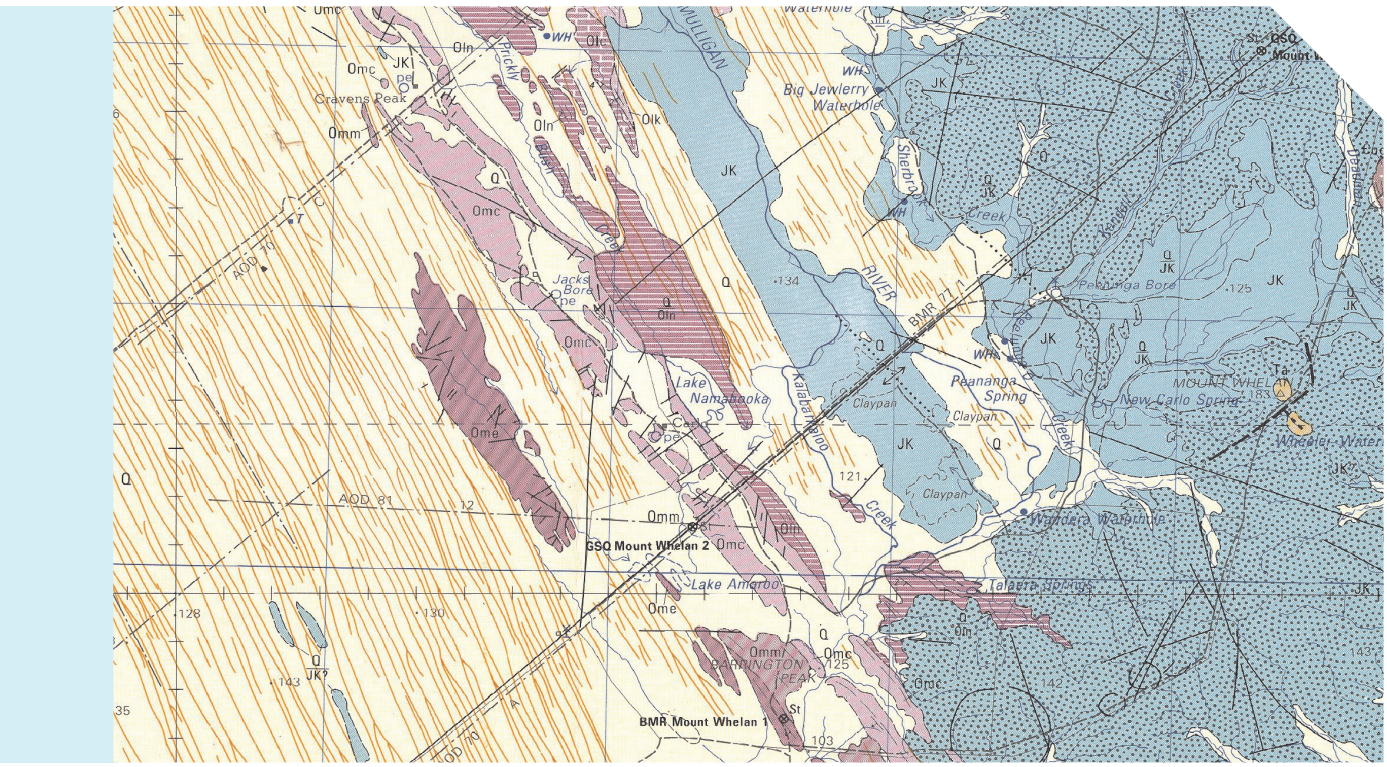
Queensland Geological Record 2009/02

A summary of company exploration results for minerals and petroleum in the Mount Whelan 1:250 000 (SF54-13) Sheet area, central west Queensland

JS Lam & M McKillop



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Queensland Government

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CONTENTS

SUMMARY

This report summarises company exploration in the Mount Whelan 1:250 000 (SF54-13) Sheet area for mineral commodities and petroleum other than water and coal. Exploration for minerals was conducted under Exploration Permits for Minerals (EPM) and for petroleum under Authorities to Prospect for Petroleum (ATP).

Mineral exploration was conducted over the southern part of the Georgina Basin and the central part of the Eromanga Basin. Exploration focused on the potential for an alluvial diamond deposit and diamonds from a primary source along the south-eastern margin of the North Australian Craton. This exploration was based on the presence of continuous and deep (>200km) fast seismic velocity data that indicates a thick lithospheric mantle root beneath the southern Georgina Basin. The Silurian–Devonian Craven Peak beds on the Toomba Range were explored for primary diamond deposits due to the presence of detrital chromites that reflected a lamproite origin. Concurrently, Ordovician age rocks of the Toko Group were explored using a kimberlitic model following up scattered occurrences of detrital chromite and picro-ilmenite grains from around Beattie Creek and Toko Range. No discrete diamond primary source has been discovered.

Older rocks commonly associated with a Cambrian age basement high in the Georgina Basin are buried beneath a >300m thick sedimentary cover of Mesozoic rocks. The western margin of the Toomba Fault Zone was explored for Carlin-style precious metal replacement deposits apparently associated with buried rock structures showing magnetic and gravity trends. Company exploration for minerals intersected gneiss and granitoid basement rocks of Proterozoic age in drill holes up to 464m in depth. The drilling indicated an apparent uniform succession of Middle Cambrian rocks dipping gently to the west into the Toko Syncline. Traces of pyrite, sphalerite, galena and fluorite were encountered in dolomitic sections of the Thorntonia Limestone, which is also enriched in bitumen.

The Ninmaroo and Kelly Creek Formations, and Thorntonia Limestone in the Toko Syncline and Ethabuka and Mirrica structures within the Georgina Basin, have potential for economic hydrocarbon accumulations. Cambrian organically-rich source rocks are postulated in the deeper parts of the Toko Syncline. These structures have been under-explored, with very few wells and limited seismic coverage. The Toko Syncline also has potential for oil and gas deposits and is within close proximity to the infrastructure of the Ballera – Mount Isa gas pipeline.

Keywords: Mount Whelan 1:250 000 Sheet (SF54-13), Abudda Lakes 6551, Mount Whelan 6651, Herbert Downs 6751, Mirricabore 6550, Barrington Peak 6650, Mount Tarley 6750, Exploration Permits for Minerals (EPM), Authorities to Prospect for Petroleum (ATP), diamond, lead, manganese, phosphate, zinc, hydrocarbons, Arunta Province, Tennant Creek Province, Mount Isa Inlier, Adavale Basin, Cooper Basin, Eromanga Basin, Galilee Basin, Georgina Basin, Great Australian Basin, mineral exploration, petroleum exploration, airborne radiometric, magnetic and gravity data, Alice Springs Orogeny, Toko Syncline,

Toomba Fault Zone, Sun Hill Fault Zone, Warrabin Trough, Injune Creek Group, Rolling Downs Group, Toko Group, Beetle Creek Formation, Carlo Formation, Coolibah Formation, Kelly Creek Formation, Marion Formation, Mithaka Formation, Ninmaroo Formation, Nora Formation, Wallumbilla Formation, Wilgunya Formation, Toolebuc Formation, Austral Downs Limestone, Georgina Limestone, Thorntonia Limestone, Hooray Sandstone, Hutton Sandstone, Longsight Sandstone, Steamboat Sandstone, Sylvester Sandstone, Allaru Mudstone, Sun Hill Arkose, Cravens Peak beds, Mount Coley Sinter.

INTRODUCTION

This review summarises the results of mineral exploration carried out under Exploration Permits for Minerals (EPM) and hydrocarbon exploration carried out under Exploration Permits for Petroleum (ATP) in the Mount Whelan 1:250 000 (SF54-13) Sheet area. In this area company exploration from 1950 to 2007 was carried out over 24 mineral exploration permits and 19 petroleum exploration permits. The exploration review covers non-confidential company exploration reports from 1956 to 2007. These reports have been submitted as a requirement of holding Exploration Permits for Minerals and Authorities to Prospect for Petroleum, and can be viewed at the Department of Employment, Economic Development and Innovation (DEEDI), Mines and Energy Information Centre located at 41 George Street, Brisbane (a list of company reports is included in Appendix 1, Table 2) or in the department's online digital company report system (QDEX) (www.dme.qld.gov.au).

Summaries for each of the historical EPMs and ATPs by different ten year time periods (e.g. 1980–1989) can be accessed at the same web site under the 'Interactive Resource and Tenure Maps'.

The company exploration report summary table (Appendix 1, Table 1) provides a quick reference on the exploration techniques employed by companies to carry out their search for mineral or petroleum deposits within an area.

Company mineral exploration results are summarised under commodities, and subdivided into geographic locations. Petroleum exploration results are listed in numerical order of the permits.

Locations of historical, current and application for mineral exploration permits and petroleum exploration permits as at the end of December 2008 are presented in Appendix 1 as Figures 11 to 32. In late 2008, there were 17 current EPMs and 25 EPM applications, one current ATP and eight ATP applications within the Sheet area.

LOCALITY

The Mount Whelan 1:250 000 Sheet (SF54-13) area lies between latitudes 23°00'S and 24°00'S and longitudes 138°00'E and 139°30'E in central-western Queensland. The map is subdivided into six 1:100 000 Sheet areas — ABUDDA

LAKES 6551, MOUNT WHELAN 6651, HERBERT DOWNS 6751, MIRRICA BORE 6550, BARRINGTON PEAK 6650, and MOUNT TARLEY 6750) (Figures 1 and 2).

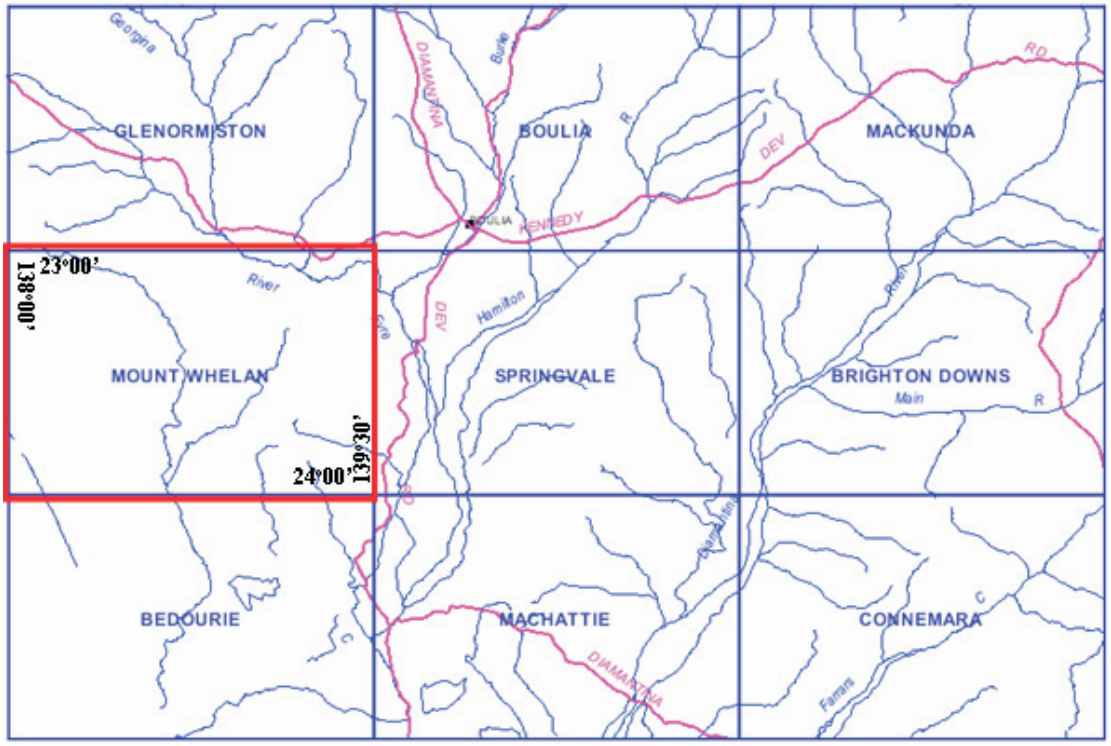

Figure 1: Locality of Mount Whelan 1:250 000 (SF54-13) Sheet area

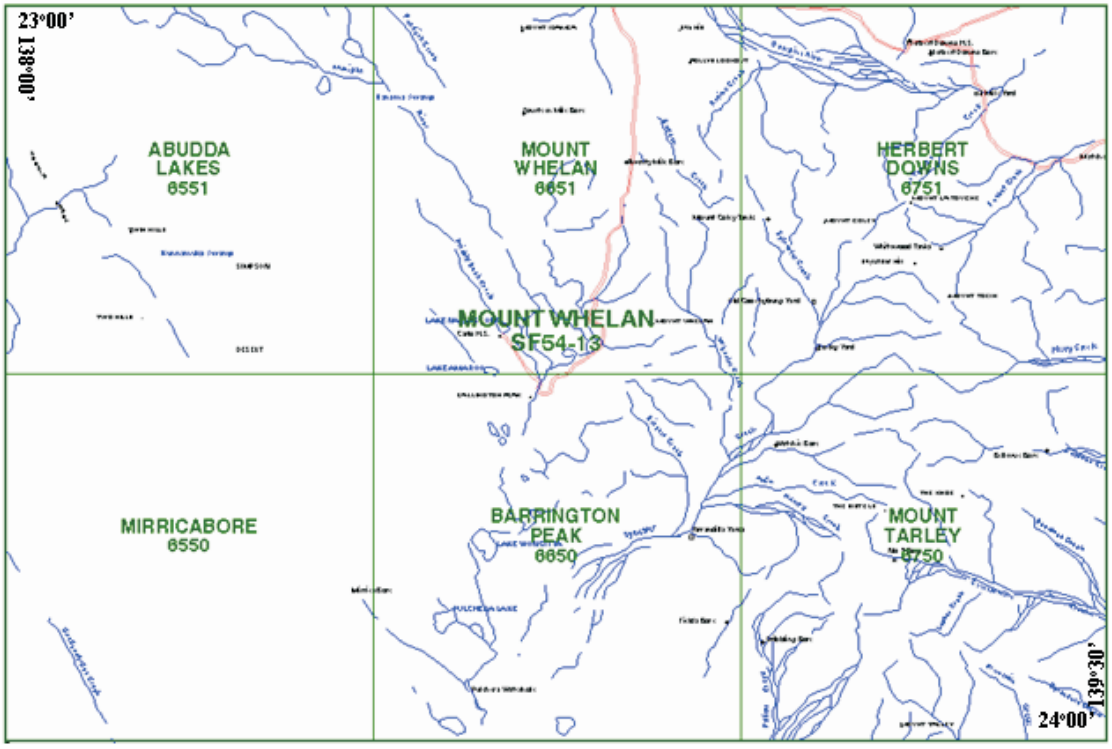

Figure 2: Index of 1:100 000 Sheet area to the Mount Whelan 1:250 000 (SF54-13) Sheet area

REGIONAL AND ECONOMIC GEOLOGY

The Mount Whelan 1:250 000 Sheet area encompasses the southern part of the Georgina Basin, and the central north of the Eromanga Basin (Figures 3 and 4).

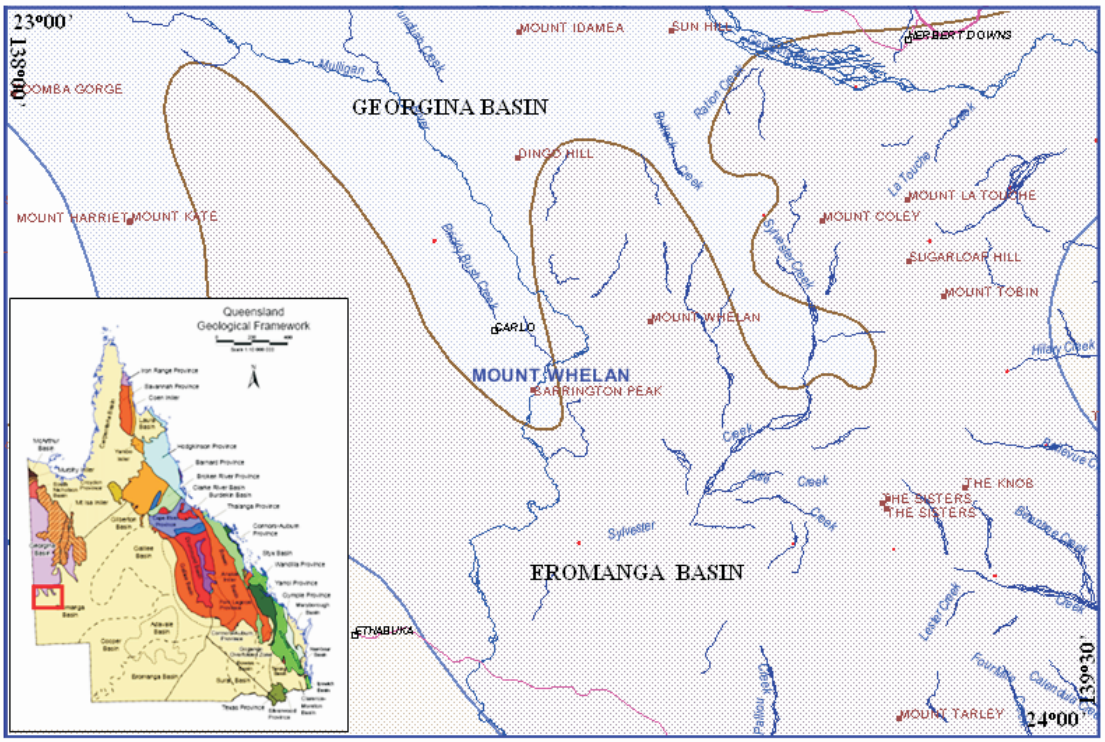

Figure 3: Tectonic Element of the Mount Whelan 1:250 000 Sheet (Department of Mines and Energy) and location of the map sheet within Queensland

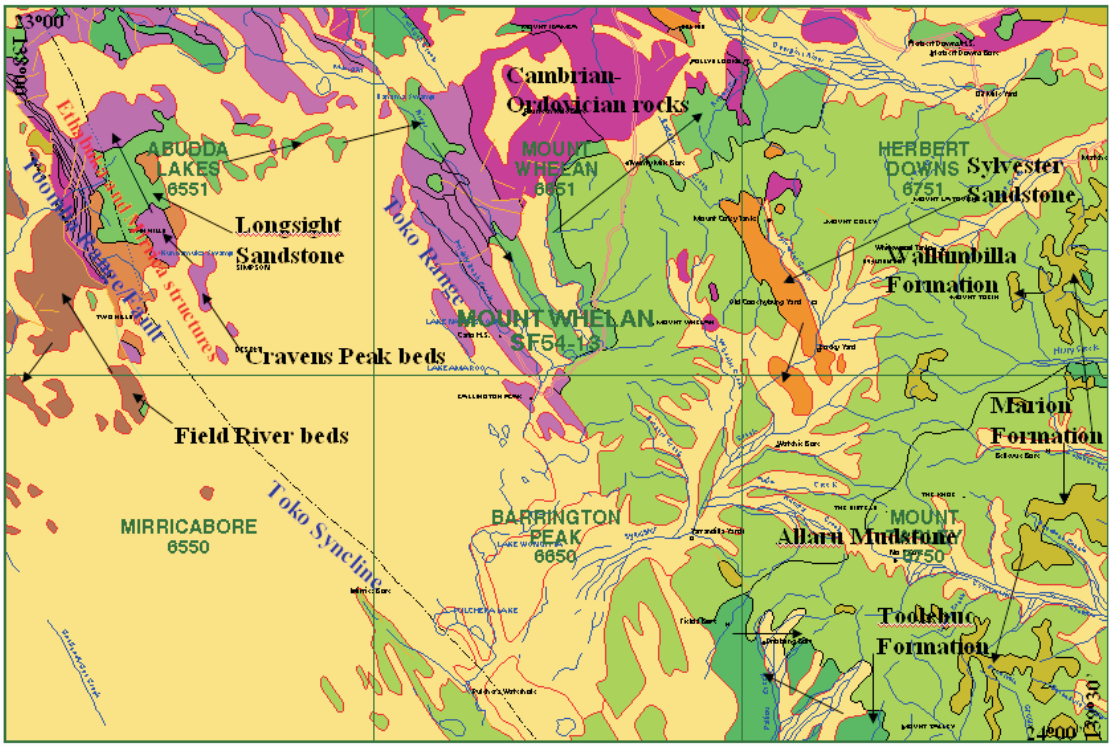

Figure 4: Regional geology of the Mount Whelan 1:250 000 Sheet (First Edition 1966, Bureau of Mineral Resources, Geology and Geophysics)

The Georgina Basin contains Early Cambrian to Middle Ordovician marine sediments and Devonian freshwater sediments that extend from western Queensland to the Northern Territory. It overlies Precambrian basement rocks of the Mount Isa Inlier to the east and the Tennant Creek and Arunta Provinces to the west. Early Cambrian rocks in the southern Georgina Basin consist of a mixed sequence of carbonate and siliciclastic rocks. Middle Cambrian sedimentation occurs throughout the basin whereas Late Cambrian rocks are only preserved in the southern parts of the basin. By the Early Ordovician, deposition was restricted to the Toko Syncline area where it continued until the Middle Ordovician. Early to Middle Devonian rocks were deposited in the Toko Syncline area which was then thrust towards the east, and folded by the Alice Springs Orogeny. The southern Georgina Basin is overlain by Cretaceous platform sediments of the Eromanga Basin.

The Georgina Basin is prospective for Mississippi Valley-style and Century-style lead–zinc mineralisation throughout its succession from Neoproterozoic siliciclastic rocks to Lower Ordovician carbonate and mixed carbonate-siliciclastic rocks of the Ninmaroo Formation. Phosphate deposits in Middle Cambrian Beetle Creek Formation are mined at Duchess, and low-grade phosphate deposits occur in the Nora and Mithaka Formations of the Toko Group. Low-grade manganese deposits occur in the Steamboat Sandstone and at the unconformity between dolomite of the Ninmaroo Formation and Longsight Sandstone in the Smoky Creek area (Reynolds, 1964).

The southern Georgina Basin is also prospective for oil and gas. Company exploration has discovered widespread hydrocarbons from the Nora Formation, Ninmaroo Formation, and the Thortonia and Georgina Limestones. The Toko Syncline is a significant depocentre that contains extensive, organically rich, oil and gas-mature source rocks throughout the Cambrian succession.

Three petroleum exploration wells were drilled to test the hydrocarbon potential of Cambrian–Ordovician marine sediments within the Toko Syncline. All recorded minor dry gas shows. Netting Fence-1 (1964) was located at the northern end of the Toko Syncline and intersected Ordovician sediments (to 726m), and Cambrian limestone (to 2000m) on a granite basement. AOD Ethabuka-1 (1973, 1960m total depth) and Mirrica-1 (1980, 3318m) evaluated a large faulted anticlinal structure delineated by reflection seismic. AOD Ethabuka-1 penetrated a thick cover sequence of 640m of Cretaceous sediments of the Eromanga Basin underlain by Devonian siliclastic rocks (to1024m) and Ordovician carbonates (to the EOH). Mirrica-1 (1980) drilled a similar sequence as AOD Ethabuka-1. It drilled through the Ordovician (to 2034m), into Cambrian carbonates (to 3263m) and terminated in granite basement.

The Mesozoic Eromanga Basin, a subdivision of the larger Great Australian Basin, consists of Triassic fluvial and lacustrine sediments overlain by Jurassic fluvial and Cretaceous continental and marine clastic sediments. These are covered by a thin veneer of Cainozoic continental sediments. Company exploration reported widespread small and isolated gypsum occurrences in the younger sediments.

Abundant organically-rich source beds have been identified in Triassic and Permian sediments of the underlying basins and Early Jurassic and Permian–Triassic sequences have reached oil impregnation stage. Cretaceous and Middle to Late Jurassic sequences of the Eromanga Basin are immature to marginally mature. Commercial oil and gas fields have been found in the overlying Eromanga Basin adjacent to the Cooper Basin. Good to excellent reservoir quality sandstones are found in the Jurassic to Early Cretaceous section.

PROTEROZOIC TO PERMIAN

Georgina Basin

Within the Mount Whelan Sheet area, the southern Georgina Basin is underlain by the Proterozoic granite and gneiss of the Arunta Province and arkose, sandstone, siltstone, shale, dolomite of the Field River beds along the Toomba Fault. The Early to Middle Cambrian Sun Hill Arkose and Sylvester Sandstone of the Georgina Basin crop out as a north-north-west trending belt west of Sylvester Creek, forming low rounded hills of flat-lying arkose, siltstone, dolomitic arkosic grit and dolomite. The Sylvester Sandstone consists of massive, fine- to medium-grained silicified sandstone. Isolated outcrops of very fine-grained, dark-grey dolomitic limestone of the Late Cambrian Georgina Limestone occur in the Wheeler Waterhole area and north of Mount Coley Tank. The darker carbonate rocks are impregnated with bitumen.

The Late Cambrian Georgina Limestone is unconformably overlain by and faulted against the Cambrian–Ordovician Ninmaroo Formation along the Sun Hill Fault Zone. The Early Cambrian Sun Hill Arkose is upthrust against the Ninmaroo Formation at the eastern end of the fault system. The subdued relief of low mounds of Ninmaroo Formation outcrop consists of flat-lying beds of fine- to coarse-grained dolomite, sandy dolomite, limestone, sandy limestone and minor shale.

The Ordovician sequence comprises limestone overlain by flat-lying sandstones along Toko Range. The Early Ordovician Kelly Creek Formation consists of sandstone, siltstone, dolostone conformably overlies the Ninmaroo Formation. The Coolibah Formation overlies the Kelly Creek Formation, which dominantly consists of fine-grained limestone. The Toko Group rocks form the scarp, plateau and hill morphology of the Toko Range. The Group comprising the Nora Formation, Carlo Formation, Mithaka Formation and Ethabuka Sandstone is unconformably overlain by the Devonian Cravens Peak beds.

For more details on the geology of the Georgina Basin, readers are referred to a report by Draper, 2007 (see bibliography).

The main structural elements of the Sheet area are the Toomba Fault Zone and Toko Syncline. The Toomba Fault Zone is a high angle reverse fault dipping south-west. The Toko Syncline is southerly plunging and asymmetric with steep dips along its western limb (abutting the Toomba Fault) and shallow dips along its eastern edge.

MESOZOIC

Eromanga Basin

The Eromanga Basin is a Late Triassic to Cretaceous sedimentary basin that forms the major part of the Great Artesian Basin. The basin is characterised by terrestrial sequences in the Late Triassic to Jurassic, followed by shallow marine in the early Cretaceous to paralic to fluvial and lacustrine in the late Cretaceous. The succession is up to 2500m thick in south-west Queensland. The major geological units outcropping in the Eromanga Basin include the Jurassic Hutton Sandstone and Injune Creek Group, the Jurassic to Cretaceous Hooray Sandstone and the Cretaceous Rolling Downs Group. At least 50% of the Eromanga Basin overlies older basins that include the Cooper Basin (completely), most of the Galilee Basin, Adavale Basin and Warrabin Trough and the southern part of the Georgina Basin.

Within the Mount Whelan Sheet area the basal unit of the Eromanga Basin is the Jurassic to Cretaceous Longsight Sandstone which crops out intermittently as lateritised flat plateaus across the northern section of Toko Range and Toomba Range. The lower part of the Longsight Sandstone consists of silty sandstone with plant fossils and worm burrows, and the upper part of glauconitic sandstone with marine fossils (Senior & others, 1978).

The Longsight Sandstone is conformably overlain by the Wallumbilla Formation, Toolebuc Formation and Allaru Mudstone. These units were formerly mapped as Wilgunya Formation, a marine transgression in the Early Cretaceous which produced the impermeable claystone. These overlying units occur as ironstone-covered outcrops in mesa slopes and as hilly country over a large area in the eastern half of the Sheet area (Reynolds, 1964).

CAINOZOIC

A thin veneer of Cainozoic continental sediments is present within the Mount Whelan Sheet area. A marine incursion in the Miocene is responsible for the upper limestone unit. A period of silicification and duricrust formation post-dated the deposition of the Tertiary limestones, so that the upper exposed surface of the limestone is predominantly chalcedonic.

Sedimentation post-dates laterisation including undifferentiated cemented alluvium, sand and soil of the Marion Formation (silicified sandstone and sandy siltstone), Mount Coley Sinter (chalcedony, sinter and sandstone) and the Austral Downs Limestone (limestone and chalcedony). These units occur as hill caps and along river courses and as small remnant deposits along present day drainages (Reynolds, 1964).

Southward tilt in the Late Tertiary produced the present day drainage and erosion (Casey, 1968). Widespread sand and soil with gravel horizons is being deposited as alluvium to form the Burke River Channel system.

REGIONAL GRAVITY AND MAGNETIC

As part of the Smart Exploration Program, an initiative of the Geological Survey of Queensland, airborne radiometric, magnetic and gravity surveys have been completed since 2006 and have captured new continental-standard regional data over north-west Queensland. These geophysical data have been released progressively by the Geological Survey of Queensland, and Geoscience Australia has also included the gravity data in the National Gravity Data Base. These data can be accessed and downloaded at www.geoscience.gov.au/gadds. The magnetic and radiometric data can also be acquired on DVD for 'cost of provision' from the Queensland Department of Employment, Economic Development and Innovation at sales@dme.qld.gov.au. The tiff gravity, magnetic and radiometric images for the Mount Whelan 1:250 000 Sheet area are presented as Figures 5 to 10. Preliminary interpretation of these images indicates that modifications need to be made to the existing geology map (edition 1965) and the interpreted solid geology.

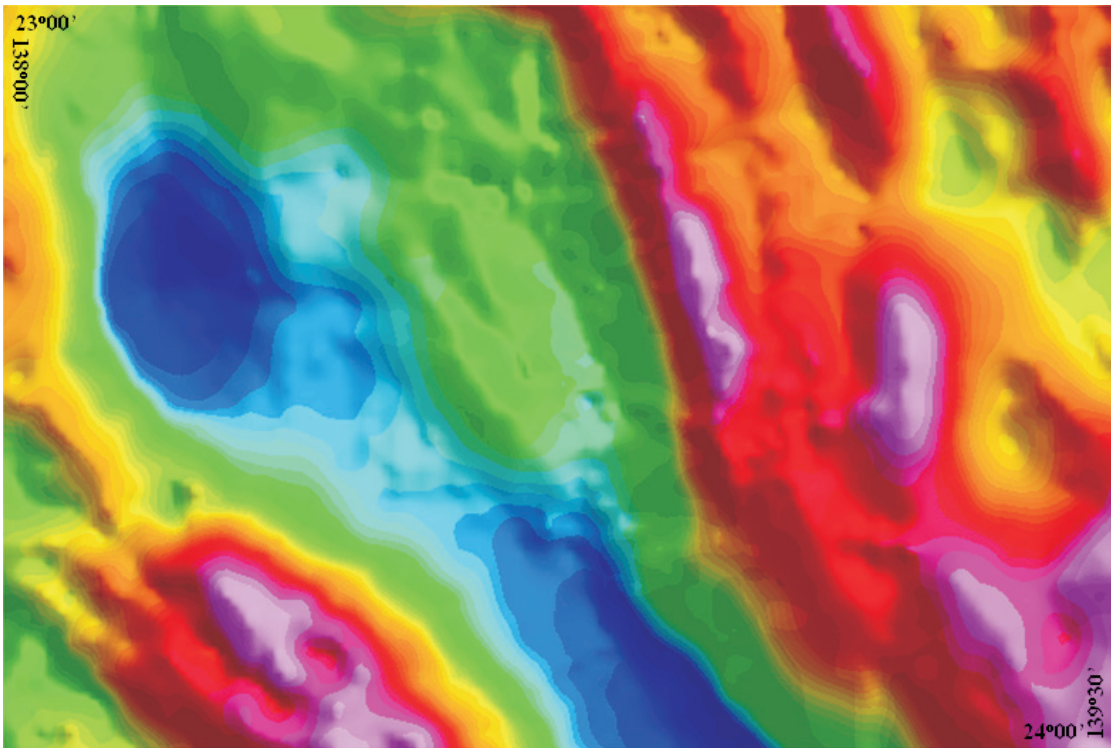

Figure 5: Bouguer Gravity tiff image at 4km x 4km station spacing (magenta-red high, green moderate, blue low gravity features)

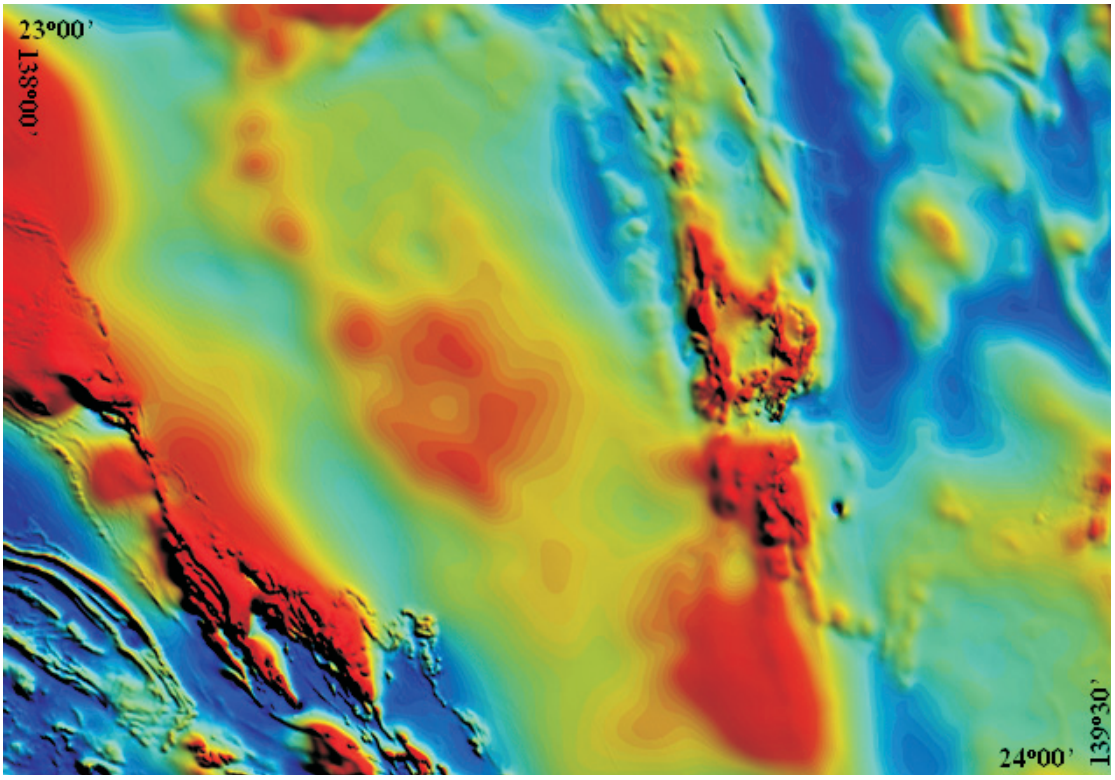

Figure 6: Magnetic pseudocolour total magnetic geotiff image — red high, blue low

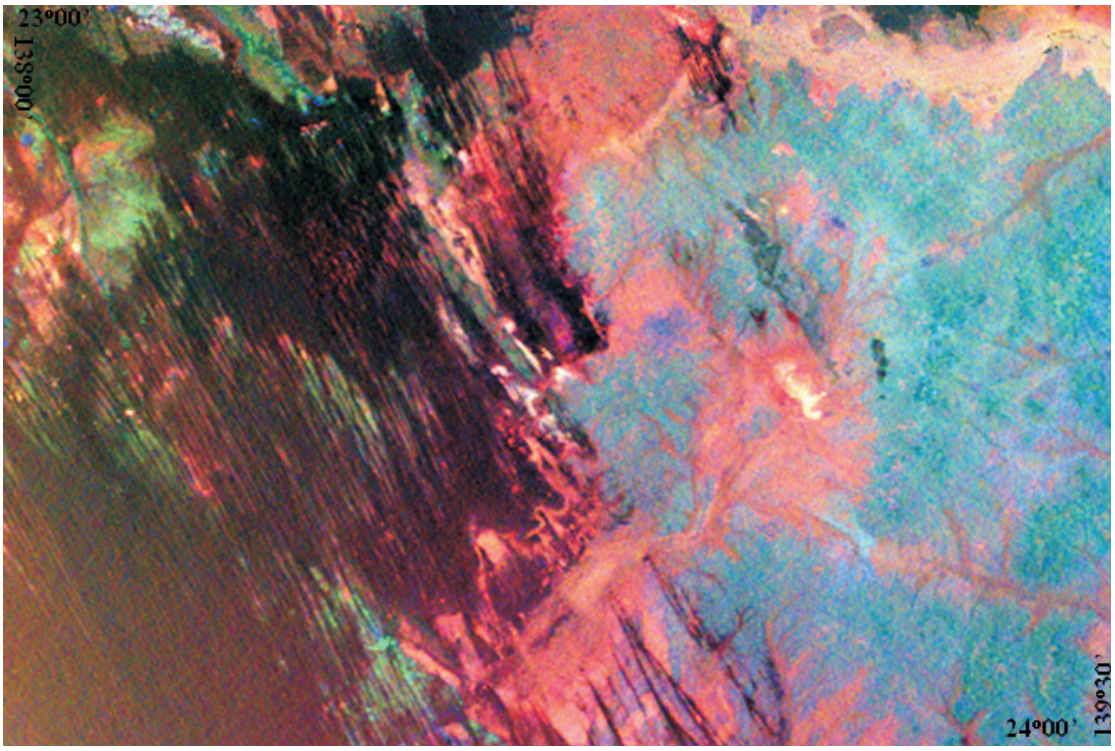

Figure 7: Radiometric Ternary K–Th–U (red-blue-green) composite colour image

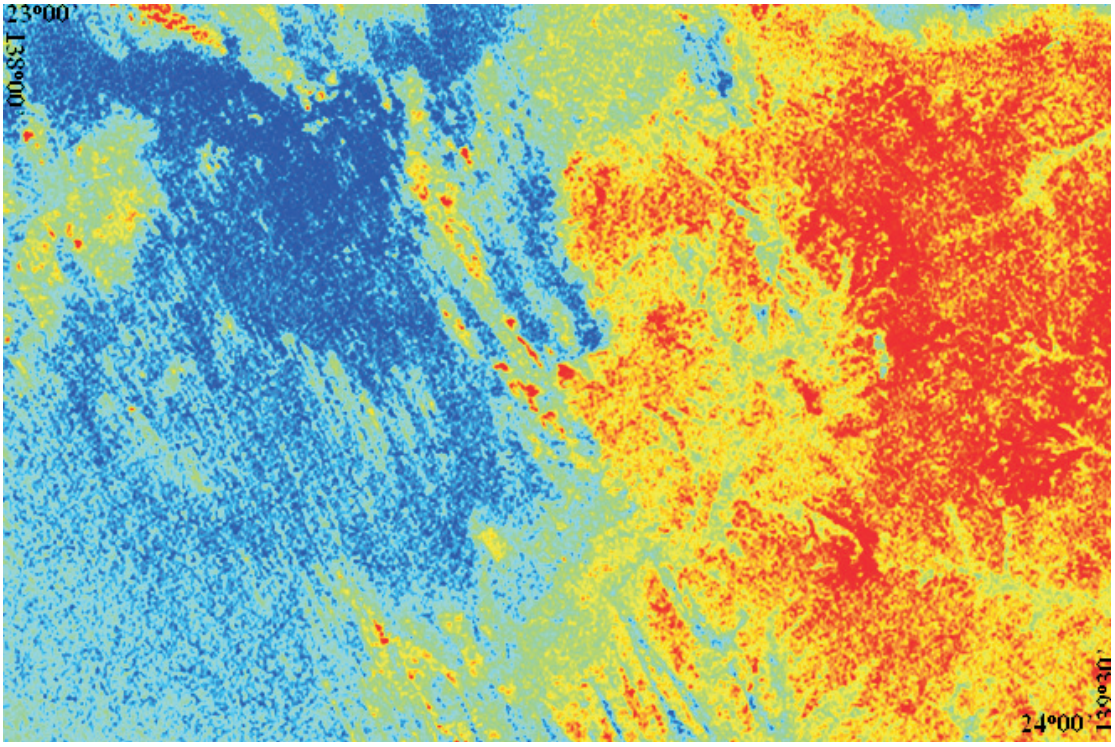

Figure 8: Pseudocolour geotiff radiometric image showing the uranium (U) channel

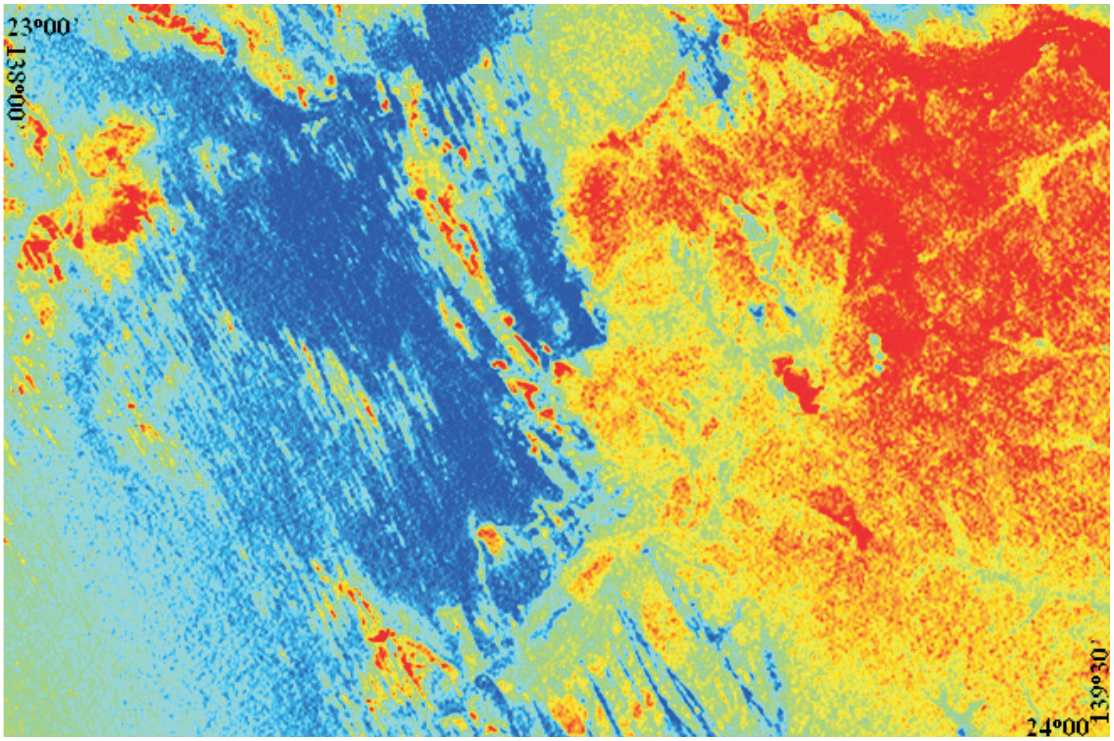

Figure 9: Pseudocolour geotiff radiometric image showing the thorium (Th) channel

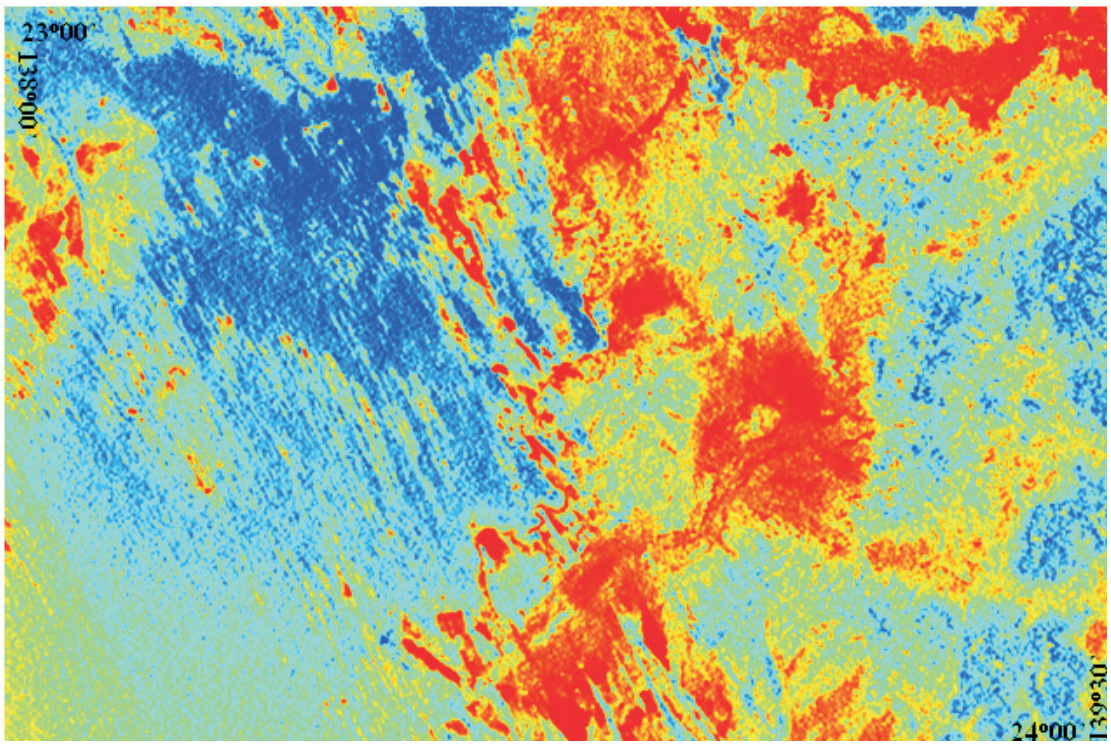

Figure 10: Pseudocolour geotiff radiometric image showing the potassium (K) channel

COMPANY EXPLORATION RESULTS

PART A (MINERAL COMMODITIES)
J S Lam

Diamond

Toomba Range (EPM 2349, 2350)

Dampier Mining Company Ltd (EPM 2349, 2350; 1980) conducted a program of shallow bore holes drilling within the tenement area of EPM 2349. A total of 12 bore holes were drilled to test six interpreted aeromagnetic anomalies, in particular a linear aeromagnetic anomaly probably related to possible kimberlite intrusions adjacent to the inferred Toomba Fault. Some of the holes intersected grey shale, arkose and siltstone below the surface sand to 30m. Geochemical analysis of drill cuttings showed no indication of kimberlitic rock or diamond indicator minerals.

Toko Range (EPM 4206, 4207)

Even though no kimberlitic/lamproitic rocks or diamond occurrences were reported from the area, detrital grains of chromite and picro-ilmenite of possible kimberlitic derivation were discovered by CRA Exploration Pty Ltd during regional reconnaissance sampling in 1985. CRA Exploration Pty Ltd (EPMs 4205 and 4206, 1986) conducted further stream gravel sampling and confirmed

chromite and picro-ilmenite of possible kimberlitic derivation in 13 samples scattered through two broad catchment anomalies at Beattie Creek and Toko Range. Indicator minerals in the Beattie Creek anomaly were probably derived from a fluviatile boulder conglomerate of the Poodyea Formation which was again probably derived from reworking of the Devonian Cravens Peak beds (Radke & others, 1983) which crop out in the core of the Toko Syncline. Recent U–Pb dating studies of detrital minerals by Elkedra Diamonds NL indicate the Poodyea Formation is Late Devonian – Carboniferous in age. By contrast picro-ilmenite from the Toko Range anomaly is apparently unrelated to the conglomerate as the associated indicator minerals support a primary kimberlitic source. No diamonds have been recovered from these two catchment areas.

Base Metals

Mount Whelan (EPM 3494, 3495, 13735)

Western Mining Corporation Ltd (EPMs 3494 and 3495, 1983) explored the Wheeler Creek area, 46km south-west of Herbert Downs homestead, targeting carbonate-hosted lead–zinc mineralisation in Cambrian limestone of the Georgina Basin. The basal Thorntonia Limestone was considered the most favourable stratigraphic unit in the south-eastern limb of the Toko Syncline having greatest potential for this style of mineralisation. However, the local surface area has undergone deep Tertiary weathering with the development of thick silcrete profiles. The company considered both soil and stream sediment sampling didn't reflect mineralisation from the underlying strata. Consequently they resorted to rock chip sampling which generally returned background assay values for base metals. However, selective sampling of thin quartz veins carrying minor galena (assaying 0.37% Pb) was exposed in a small prospector's pit (Unnamed 305739, approximate grid reference MGA 94, Zone 54, 305071E, 7392295N) in a section of the Sun Hill Arkose 5.3km north-east of Watchie Bore.

Twelve holes were drilled (up to 464m in depth) to reach basement rocks. Traces of pyrite, sphalerite, galena and fluorite were intersected in dolomitic sections of Thorntonia Limestone. Bitumen is abundant in this unit. The drilling indicated an almost uniform succession of Middle Cambrian units dipping gently to the west into the core of the Toko Syncline, and containing (?)Lower Cambrian Sun Hill Arkose lensing in from the east. The highest base metal values were in drill hole SYLD-2. Up to 1170ppm Zn and 310ppm Pb were in 0.5m core splits from the Thorntonia Limestone, which here consists of abundant sparry calcite with minor pyrite and traces of sphalerite and galena. The company concluded the depth to basement rock exceeded 300m and thus abandoned exploration at the time.

Anglo American Exploration (Australia) Pty Ltd (EPM 13735, 2003) reviewed previous company exploration reports and downgraded the prospectivity of the Mount Whelan area.

Toomba Range area (EPM 3797, 4359, 7897, 8672, 8723, 8753)

In 1984, BHP Minerals Pty Ltd/Jones Mining (EPM 3797) evaluated the Toomba Range area west of Mount Alfred for Roxby Downs-type targets. The area

appeared to have potential of hosting a Roxby Downs/Olympic Dam-style base metal deposit based on the coincidence of gravity and magnetic highs within a region of graben-controlled Adelaidean sedimentation adjacent to a basement high. However, an assessment of coincident gravity aeromagnetic highs by ground geophysical traverses downgraded the prospectivity of the area. No drilling was undertaken.

West of Mount Harriet, Electrolytic Zinc Co of Australasia Ltd (EPM 4359, 1987) explored along the Toomba Fault Zone for Carlin-type precious metal replacement deposits. These occur in brecciated calcareous shales, sandstones and limestones of the Ninmaroo, Kelly Creek and Carlo Sandstone Formations of the Georgina Basin. These units are associated with a hydrothermal event and were over thrust by the basement Proterozoic rocks of the Black Stump and Sun Hill Arkoses and Tardida Tillite. Exploration involved soil sampling even though wind blown sand up to 1–2m depth and the effects of calcrete, silcrete (grey billy), and lateritisation have occurred on land surface. An east–west oriented soil line was sampled across the trace of the fault. Samples were analysed for Cu, Pb, Zn, Ag, Fe, Mn, Ca, Mo, As, Sb, Se, Te, Bi and Hg. This sampling program failed to return any anomalous base metals assay results.

In 1991, CRA Exploration Pty Ltd (EPM 7897) searched for gold and base metals along the Toomba Fault Zone by collecting 50 stream sediment samples and nine rock chip samples. Poor drainage development and widespread aeolian sand were also noted as major problems in analysing the geochemistry of the stream sediment samples. All samples returned gold assays >0.05ppm Au. A weak base metal anomaly of 32ppm Cu, 160ppm Pb and 210ppm Zn was obtained from sample number 3171108. In all, nine rock chip samples were collected from a prominent line of weakly iron-stained and silicified sediments containing abundant fine micro-quartz veining along the trace of the Toomba Fault Zone. These samples returned only weakly anomalous base metal values (maximum 140ppm Pb and 660ppm Zn) without any supporting gold values (maximum 0.03ppm Au). The assay values were not considered as anomalous.

South-west of Mount Alfred, Hunter Resources Ltd (EPMs 8672, 8723, 8753, 1992) completed computer modelling of aeromagnetic, radiometric, and gravity data and concluded that the technique of exploration to discover a perceived similar Olympic Dam style mineralisation in the area was high risk and precluded further investigations.

Mirrica Bore area (EPMs 9340, 9343, 10675, 13746)

In 1995, BHP Minerals Pty Ltd (EPMs 9340, 9343, 10675) explored for precious and base metals mineralisation associated with buried structures showing magnetic complexity and gravity trends, which lies along a continent-scale lineament (represented locally as the Toomba Fault Zone/Toko Syncline). The company targeted a line of intense magnetic features along the western side of the Toomba Fault Zone with a coincident prominent gravity ridge. Computer modelling of magnetic data suggested the stratigraphy is steeply dipping, buried at a depth of 50–75m, and has moderate magnetic susceptibilities. BHP Minerals Pty Ltd drilled 19 air core holes (1419m) in the Mirrica Bore area. Proterozoic

basement rock comprising gneiss and granitoids was intersected in 13 of these holes at an average depth of 51m. The highest rock chip assay values were 138ppm Cu, 199ppm Zn, 204ppm Ni, 635ppm Cr, 38ppm W and 3130ppm Ba. Age dating of outcrop and samples from drill holes gave ages of ~1790Ma for gneiss/metamorphic rocks and 1745Ma for granitoids which is consistent with ages for rocks from the Arunta Province.

Glengarry Resources Ltd in 2006 (EPM 13746) explored for iron oxide related copper/gold deposits such as Olympic Dam and Ernest Henry, sediment hosted Cu-Pb-Zn-Ag deposits such as Mount Isa, Broken Hill and Cannington and gold deposits in concealed Proterozoic granite breccia. Literature research, data acquisition and compilation, airborne magnetics interpretation, soil, lag, rock chip and water bore sampling and air core drilling were conducted. The geochemical sampling defined a number of soil/lag anomalies which were followed up by 21 air core holes. No significant base metals or gold assay results were obtained from drill cuttings.

Mineral exploration conclusions

The Mount Whelan 1:250 000 Sheet area has been explored for Carlin-style, Roxby Downs/Olympic Dam-style and Mississippi Valley-style base metals deposits throughout the Proterozoic gneiss and granitoid, and the Silurian to Devonian sediments. Exploration was conducted over the southern extent of the Georgina Basin and the central part of the Eromanga Basin. Most of the older rocks associated with basement high in the Georgina Basin are under Mesozoic sediments cover and have not been explored extensively for mineral deposits. The western margin of the Toomba Fault Zone was explored for iron-oxide related copper/gold deposits associated with concealed Proterozoic granite breccia. Company mineral exploration drilling indicated uniform succession of Middle Cambrian rock units dipping gently west into the Toko Syncline.

Diamond exploration was focused on the potential of alluvial deposit and primary source deposit along the south-eastern margin of the North Australian Craton. The Silurian–Devonian Cravens Peak beds on Toomba Range were explored for primary diamond deposits because detrital, lamproite-origin chromites were found in the area. Likewise, the Ordovician rocks of the Toko Group were explored as detrital grains of chromite and picro-ilmenite of possible kimberlitic derivation were also discovered scattered around Beattie Creek and Toko Range. Although no discrete diamond has been found, further exploration is being carried out in 2009 to assess the area potential for both primary and alluvial diamond deposits.

PART B (PETROLEUM)

M. McKillop

Exploration overview

Field mapping was conducted by the Geological Survey of Queensland (GSQ) and the Bureau of Mineral Resources (BMR) — now Geoscience Australia (GA) during the late 1950s and early 1960s. In 1963–64, the BMR conducted the

Georgina Basin aeromagnetic survey and south-eastern Georgina Basin seismic survey. The results of these surveys were used to define the western edge of the Toko Syncline.

During the period from 1964 to 1991, there were seven wells drilled in the Toko Syncline. Four wells drilled within the Mount Whelan Sheet area included stratigraphic wells (GSQ Mount Whelan-1 and GSQ Mount Whelan-2), drilled by the Geological Survey of Queensland and exploration wells AOD Ethabuka-1 and AOD Mirrica-1. All wells intersected hydrocarbons. No further drilling has been undertaken following the abandoning of AOD Mirrica-1 in August 1980.

Alliance Oil Development (AOD) explored the Toko Syncline from the late 1960s to the early 1980s. AOD conducted two seismic surveys as well as field mapping, gravity, magnetic, soil gas, and air photo surveys. Geochemical and maturation investigations were conducted in order to determine source rock potential, maturity and reservoir characteristics. Phoenix Oil and Gas tenure during the mid to late 1980s resulted in undertaking Landsat, thematic mapping, and a soil gas survey. Dyad Australia Incorporated (Dyad) explored much of the area from the 1990s until 2004. Dyad completed an additional seismic survey that highlighted favourable targets but was unable to attract an investment partner to conduct drilling tests.

The most significant hydrocarbon shows from the Georgina Basin have been from the Toko Syncline where AOD Ethabuka-1 flowed dry gas from the Coolibah Formation at 7000m^3/d. Bitumen was also observed infilling fractures in the Nora Formation. AOD Ethabuka-1 was abandoned before reaching the reservoir target of the Ninmaroo Formation. AOD Mirrica-1 which is ~14km to the north-west of AOD Ethabuka-1 produced only minor gas from Cambrian rocks.

Petroleum Exploration

ATP 43

ATP 43 (Figure 19) straddled the southern portion of the Mount Whelan sheet and was operated in the late 1950s by Santos Ltd. The work included aerial geological reconnaissance, field surveys and some seismic operations largely around the Innamincka Dome area within the Barrolka (SG54-11) and Durham Downs (SG54-15) 1:250 000 Sheet areas and an adjoining tenement in South Australia. No significant work was conducted in the Mount Whelan sheet area.

ATP 54

ATP 54 (Figure 20) was granted in September 1958 to the Papuan Apinaipi Petroleum Company (PAP) and covered an area of 111 360km^2. The Mount Whelan sheet was situated in the bottom south-western corner of this ATP. Other 1:250 000 sheet areas which were partially contained in ATP 54 were Glenormiston (SF54-9) and Urandangi (SF54-5) to the north, Boulia (SF54-10) to the north-east and Springvale (SF54-14) to the east. This ATP was relinquished in January 1967.

Much of the work conducted was outside the Mount Whelan (SF54-13) 1:250 000 Sheet area. A gravity survey over the Netting Fence Anticline was primarily within the Glenormiston area however a small portion of this broached the northern Mount Whelan area. Spot correlation seismic work was conducted in 1960–61 over the Netting Fence anticline area. The field examinations were primarily looking at potential structural trap prospects as interpreted from government maps of the area. One well drilled in close proximity to the Mount Whelan sheet is PAP Netting Fence-1 on the Glenormiston 1:250 000 Sheet. This well intersected hydrocarbons, mainly bitumen, impregnating siltstone and carbonate rock of the Nora, Ninmaroo, Georgina and "Netting Fence" Formations.

ATP 66

ATP 66 (Figure 21) commenced on January 1 1959 carried over from ATP 43 and was operated by Santos Ltd. In March 1959 a joint venture agreement was signed between Delhi Australian Petroleum Ltd and French Petroleum Company (Australia) Pty Ltd. ATP 66 covered the 1:250 000 sheets Bedourie (SG54-1), Machattie (SG54-2) and Connemara (SG54-3) and partially covered nine others. The primary focus of the exploration effort was to investigate the petroleum potential of Mesozoic and Permian strata. Although extensive work was conducted during the life of this ATP, no significant work was conducted in the Mount Whelan sheet area.

ATP 160

ATP 160 (Figure 22) covered 9 450km^2 and was granted in June 1969 to Alliance Oil Development Australia NL. In 1970 the company conducted the Toko Range seismic survey which outlined the axis of the Toko Syncline and fault blocks containing closures. AOD Ethabuka-1 (GDA 94, Zone 54, 237638E and 7378190N) was drilled to 1960.5m (total depth) in 1973 to test a large faulted anticlinal structure delineated from the seismic survey. The well flowed dry gas from the Coolibah Formation at 7000m^3/day and bitumen was observed infilling fractures in the Nora Formation. Due to drilling problems, the well was abandoned before reaching its reservoir target in the Ninmaroo Formation.

Numerous studies were conducted during 1977 and 1978, investigating the source rock and reservoir character of the Georgina Basin. The work included:

- An assessment of the hydrocarbon potential in the Toko Syncline area which showed that Cambrian to Mid-Ordovician strata offered promising targets and the deeper parts of this syncline were protected from water flushing. Suitable carbonate sandstone reservoirs were likely to be linked to major faulted anticlines on the western flank of the Toko Syncline.

- Three core samples from drill hole AOD Ethabuka-1 were analysed for their total organic content. Hydrocarbons were detected within the section representing the Ethabuka structure, however no source rocks were identified. It was concluded that rich source rocks could be the Cambrian rocks at greater depth.

- An investigation into maturation, total organic carbon and generation potential in 1978 concluded that dry gas is most likely to occur in the Toko Syncline and the degree of metamorphism does not preclude significant production volumes being produced. It also suggested the chances of adequate porosity in quartz sandstones is very low, and as a result carbonate reservoirs with vuggy porosity would be suitable host rocks for hydrocarbon. It was also hypothesised that ~600m of sediment had been removed by erosion in the Toko Syncline.

- Twelve core samples were selected from GSQ Mount Whelan-2. Only one of the samples contained >0.3% total organic carbon.

- A petrographic study was conducted on samples from GSQ Mount Whelan-2 in order to better understand the potential of the carbonate reservoirs. Although a series of detailed descriptions are made, no summation of the results was provided.

After a farm out agreement in 1979 with five other companies (later joined by three more), AOD Mirrica-1 (GDA 94, Zone 54, 223967E, 7381477N) was drilled into the Toko Syncline in 1980 and only produced minor gas from the Cambrian rocks. The poor results suggested that the principle phase of hydrocarbon development preceded movement on the Toomba Fault and that prospective hydrocarbons are more likely in fracture systems related to movement which post-dated the Toomba Fault or included in stratigraphic traps.

A re-evaluation of the geology and hydrocarbon potential of ATP 160 based on the results of AOD Mirrica-1, PAP Netting Fence-1, GSQ Mount Whelan-1 (GDA 94, Zone 54, 282982E, 7420728N) and GSQ Mount Whelan-2 (GDA 94, Zone 54, 262993E and 7401770N Zone 54) was completed in February 1981. This study suggests that Palaeozoic reef build ups occur between PAP Netting Fence-1 and AOD Miricca-1. The Abudda Lakes seismic survey comprising 355 line kilometres was conducted in 1981 to identify the location of low-relief reefs, structural and stratigraphic traps, proposed by previous surveys. No prospects were outlined that might warrant drill testing as all the leads identified were small and considered high risk.

In 1982, a lithofacies study was conducted to better define the subsurface stratigraphic units and improve understanding of lithological trends within the units of interest. The conclusions of this study are as follows:

- The Kelly Creek Formation possesses reservoir potential in the form of structurally controlled stratigraphic traps. Exploration targets proximal to the zone of most rapid thickening in the Kelly Creek Formation should have priority over other targets in the study area.

- The Ninmaroo Formation was of secondary importance; however, carbonate build-ups developed along the zone of the structural hinge could provide exploration targets.

- The Coolibah Formation may be important as a regional seal for the Kelly Creek Formation, although this unit may also have some reservoir potential.

Following the Abudda Lakes Seismic Survey efforts were made to obtain farm-in partners without success. The operators decided to relinquish the permit in May 1983, due to the level of perceived risk and associated high operational costs.

ATP 166

ATP 166 (Figure 22) was granted in November 1969 to Amplo Exploration Ltd, Boral Ltd, Esso Exploration and Production Australia and Pioneer Concrete Services. In November 1988, Viking Exploration Incorporated resumed control and in December 1993 this tenure was operated by Rincon Production Company Incorporated till relinquishment in September 1996. The primary focus of their work was in the Galilee Basin. No significant work was conducted in the Mount Whelan sheet area.

ATP 198

ATP 198 (Figure 23) was granted to Cooper Basin Oil Corporation in June 1972. The tenement was relinquished in May 1976. Only a small portion in the south of the Mount Whelan heet was contained in this permit. Other map sheets which contained areas within this ATP were Springvale (SF54-14), Brighton Downs (SF54-15), Maneroo (SF54-16), Jundah SG54-4), Longreach (SF55-13), Blackall (SG55-1) and Jericho (SF55-14). The primary focus of exploration was in the Cooper and Eromanga Basins. No significant work was conducted in the Mount Whelan sheet area.

ATP 211

ATP 211 (Figure 24) was granted in September 1974 and partially covered twelve 1:250 000 sheets. The tenement was relinquished in November 1975 by the Black Giant Oil Company. Only a small portion in the south-western corner of this ATP was contained within the Mount Whelan sheet. Geological assessments were made over the entire ATP and the northern Mount Whelan 1:250 000 Sheet was assessed as having potential for sizable target structures within the Cambrian and Ordovician strata of the Georgina Basin. Despite this assessment no wells were drilled and no seismic surveys were conducted in the Mount Whelan sheet area.

ATP 224

ATP 224 (Figure 25) covered Springvale (SG54-14) and partially seven other 1:250 000 sheet areas including the Mount Whelan Sheet. This tenure was granted in February 1976 to the Black Giant Oil Company and relinquished in October 1979. Investigations based on surface observations within this ATP were primarily focused around the Mount Datson anticline in the Herbert Downs (6751) and Mount Tarley (6750) 1:100 000 Sheet areas. A source rock evaluation was also conducted from well cuttings in PPC Black Mountain-1 in the Boulia (SG54-10) Sheet. No other significant work was conducted within the Mount Whelan Sheet.

ATP 283

ATP 283 (Figure 26) was granted to Oil and Minerals Quest N.L. in August 1980 and relinquished in November 1983. The majority of this permit covered the Springvale (SF54-14), Boulia (SF54-10) and Duchess (SF54-6) 1:250 000 Sheet areas with a small enclave in the Maneroo (SF54-16) sheet. A literature review was conducted on the Georgina Basin however no significant work was conducted in the Mount Whelan sheet area.

ATP 300

ATP 300 (Figure 26) was granted in August 1981 and relinquished in May 1983. The tenement area covered the south-western portion of the Mount Whelan (SF54-13) sheet. No report was submitted to the Department.

ATP 307

ATP 307 (Figure 26) partially covered four 1:250,000 sheet areas and was granted to Queensland Petroleum Pty Limited in May 1981 and relinquished in February 1984. The total area was 258 980km^2, of which the southern portion covered the north-eastern portion of the Mount Whelan (SF54-13) sheet. The company undertook literature reviews, air photograph and satellite imagery interpretation. Field investigations were focused on anticlinal structures identified through air photograph interpretation. No wells were drilled or seismic surveys undertaken under ATP 307. Although the majority of the work was conducted outside the Mount Whelan (SF54-13) sheet, the Glenormiston anticline was interpreted to be projecting into the north-western portion of this sheet.

ATP 346

Phoenix Oil and Gas (POG) was granted ATP 346 (Figure 27) in October 1984 and relinquished the permit in August 1988. ATP 346 covered the Abudda Lakes (6551), Mirricabore (6550), Barrington Peak (6650) and a portion of the Mount Whelan (6651) 1:100 000 Sheets and part of the Glenormiston (SG54-9) 1:250 000 Sheet. POG conducted Landsat imagery interpretation, thematic mapping and a soil gas survey. The results of the soil gas alkane survey suggested the area has potential for gas resources, however, the lack of significant anomalous sample clusters suggests that further work would have to be carried out before any final conclusions could be made. No follow up ground exploration was conducted under ATP 346.

ATP 354

ATP 354 (Figure 27) was granted in September 1985 to Median Oil N.L. who held the largest share in this ATP. The majority of this Authority to Prospect was in the Springvale (SF54-14), Boulia (SF54-10) and Duchess (SF54-6) 1:250 000 Sheets and included the Mount Tarney (6750) 1:100 000 Sheet within the Mount Whelan Sheet. In December 1985, a study was commissioned to conduct a space photograph interpretation of the structural geology within this ATP. As a result two areas of interest within the Mount Whelan sheet were identified.

In 1987, a series of subsurface geologic maps were produced using the Landsat, water and petroleum well data, and structural data derived from published geological maps. These maps which include the Mount Tarley 1:100 000 Sheet area consist of a Palaeozoic unconformity depth map, a top Longsight Sandstone structure map and a Longsight Sandstone Isopach map. No other significant work was conducted in the Mount Whelan sheet. The ATP was relinquished in August 1988.

ATP 398

ATP 398 (Figure 28) was granted to Hailey Energy Corporation Australia in January 1989 and relinquished in December 1993. The ATP covered in part the Birdsville (SG54-5), Betoota (SG54-6), Bedourie (SG54-1), Machattie (SG54-2), Mount Whelan (SF54-13) and Glenormiston (SF54-9) 1:250 000 Sheet areas. Work within the Mount Whelan (SF54-13) Sheet area included a review of available literature covering the potential hydrocarbon traps within the Toko Syncline area. Proposed exploration work included a seismic survey integrating petrophysical and stratigraphic data to identify porosity trends and stratigraphic traps. Although Hailey Energy Corporation considered this area to be prospective for hydrocarbons, no significant work was conducted in the Mount Whelan Sheet area.

ATP 460

ATP 460 (Figure 28) was granted to Dyad Australia Incorporated (Dyad) in November 1990 and relinquished in November 1993. This ATP covered the central portion of the Mount Whelan (SF54-13) sheet including the Toko Syncline. Dyad reprocessed available seismic data and undertook a data review. As a result, several structural prospects were identified within the Toko Syncline, but no further work was done. ATP 460 was conditionally surrendered in favour of ATP 554 in the same vicinity.

ATP 554

ATP 554 (Figure 29) was granted to Dyad Australia Incorporated in November 1993 and relinquished in July 2004. This ATP was carried over from ATP 460 and also covered the central portion of the Mount Whelan Sheet area covering the Toko Syncline. In conjunction with work conducted in ATP 460, structural targets were identified along the western portion of the Toko Syncline, where the Ethabuka structure was drilled (AOD Ethabuka-1) in 1974. Duke Energy International joined Dyad Australia Incorporated and completed the Ethabuka Seismic Survey comprising approximately 100 line kilometres in June 1999. This survey was undertaken to confirm the Ethabuka Structure. Duke Energy however withdrew from the project before another well was drilled due to the remoteness of the location and perceived financial risk factors.

Despite the attractiveness of the Ethabuka structure and the willingness of Dyad Australia Incorporated to fund a significant portion of the cost for drilling another well, the company was unable to attract external investment to continue the project.

ATP 566

ATP 566 (Figure 29) was granted in May 1994 and surrendered in January 2007 by Maneroo Oil Company Ltd. The majority of this ATP focused on exploring the north-western Windorah Trough within the Eromanga Basin outside the Mount Whelan (SF54-13) sheet, however a small enclave was contained within the eastern Mount Whelan sheet area. No significant work within the Mount Whelan area was conducted.

ATP 582

ATP 582 (Figure 29) was granted in June 1994 to Cooper-Eromanga Oil Incorporated and the title is current, awaiting finalisation of Native Title negotiations. Only a small portion of the ATP is within the Abudda Lakes (6551) and Mirricabore (6550) 1:100 000 Sheet areas. A relinquishment of 3050 sub-blocks in July 1997 reduced the area covered in the Mirricabore (6550) 1:100 000 sheet.

ATP 615

ATP 615 (Figure 30) was granted to Oil Seeps Incorporated in October 1995 and was relinquished in September 1999. This ATP covered 52 223km^2 in area and the south-western portion of this ATP extended onto Herbert Downs (6751) and Mount Tarley (6750) 1:100 000 Sheet areas. The Boulia (SF54-10) and Springvale (SG54-14) 1:250 000 Sheet areas were totally covered with four adjoining sheets being partially contained within this ATP. The company's main interest was the Burke River graben, situated on the Boulia (SF54-10) and Springvale (SF54-14) 1:250 000 Sheets. A review of available remote sensing data concluded that the prospectivity for hydrocarbons in the Mount Whelan (SF54-13) Sheet area were low and no significant work was conducted.

Hydrocarbon exploration conclusions

Company exploration provided information on the geometry and extent of the Toko Syncline and its fault blocks containing the Ethabuka and the Mirrica structures. Within the Mount Whelan (SF54-13) 1:250 000 Sheet area, a total of 4 wells were drilled to test the Toko Syncline and all of the wells intersected hydrocarbons. The last well to be drilled was completed in August 1980.

The Toko Syncline is considered by oil companies as having good potential for hydrocarbon discoveries but the remote location and lack of infrastructure has discouraged exploration of the major structures along the syncline. The Ethabuka and Mirrica structures were drilled; however, the target formation was not reached in AOD Ethabuka-1.

The majority of the exploration work was carried out by Alliance Oil Development NL (AOD). AOD demonstrated that good potential exists for economic gas deposits in the Toko Syncline. Phoenix Oil and Gas conducted a soil gas alkane survey which also indicated the Toko Syncline potential for gas, however the results were not conclusive. Dyad followed up with an additional

seismic survey that reaffirmed that attractive structures are present which should be tested for hydrocarbon accumulations. However, farm-in partners for both AOD and Dyad perceived that high exploration costs equated to unacceptably high investment risk. With the proximity of the Ballera to Mount Isa Pipeline and the increasing demand for gas as an energy source, the Toko Syncline may be considered more attractive for gas exploration in the future.

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APPENDIX 1: Tenure and work completed

Table 1: EPM and ATP company exploration report summary

Tenure	Locality	Tenure Holder	Exploration Technique	Commodity	Report No
EPM 2349, EPM 2350	SW OF GLENORMISTON	DAMPIER MINING CO LTD	RADIOACTIVITY SURVEYS, MAGNETIC SURVEYS, MINERAL EXPLORATION, AERIAL GEOPHYSICAL SURVEYS	DIAMOND	8969, 9314, 10005, 10006, 10016
EPM 3494, EPM 3495	SW OF BOULIA	WESTERN MINING CORP LTD	GEOPHYSICAL SURVEYS, MINERAL EXPLORATION, PERCUSSION DRILLING, MISSISSIPPI VALLEY TYPE DEPOSITS, DIAMOND DRILLING, ASSAY VALUE, GEOLOGICAL LOGS, AERIAL MAGNETIC SURVEYS, GROUND MAGNETIC SURVEYS	SILVER, LEAD, ZINC	13286, 13287, 14237, 14238, 14869, 15344, 15719
EPM 3797	SW OF BOULIA	SURVEYOR RESOURCES PTY LTD	MINERAL EXPLORATION, RECONNAISSANCE, MAGNETIC SURVEYS, GRAVITY SURVEYS, GEOPHYSICAL SURVEYS	GOLD, COPPER, URANIUM	14658
EPM 4206, EPM 4207	W OF BOULIA	CRA EXPLORATION PTY LTD	STREAM SEDIMENT SAMPLING, MINERAL EXPLORATION, GEOCHEMICAL EXPLORATION, ASSAY VALUE	GOLD, DIAMOND	16636, 16637, 16638, 16639, 16640, 17154, 17155
EPM 4358	W OF BOULIA	ELECTROLYTIC ZINC CO. OF AUSTRALASIA LTD	MINERAL EXPLORATION, ASSAY VALUE, SOIL SAMPLING, GEOLOGY, GEOCHEMICAL EXPLORATION	SILVER, GOLD, COPPER, LEAD, ZINC	16080
EPM 4359	W OF MOUNT ISA	ELECTROLYTIC ZINC CO. OF AUSTRALASIA LTD	GEOCHEMICAL EXPLORATION, MINERAL EXPLORATION, ASSAY VALUE, SOIL SAMPLING, GEOLOGY	SILVER, GOLD, COPPER, LEAD, ZINC	16278
EPM 7897	S OF URANDANGI	CRA EXPLORATION PTY LTD	ROCK CHIP SAMPLING, STREAM SEDIMENT SAMPLING, LABORATORY TESTS, LITERATURE REVIEW, RECONNAISSANCE, ASSAY VALUE	GOLD, COPPER, LEAD, ZINC	23290

Table 1 (continued)

Tenure	Locality	Tenure Holder	Exploration Technique	Commodity	Report No
EPM 8672, EPM 8723, EPM 8753	SW OF GLENORMISTON	HUNTER RESOURCES LTD	MINERAL EXPLORATION, GEOPHYSICAL SURVEYS, GRAVITY SURVEYS, REINTERPRETATION, AERIAL MAGNETIC SURVEYS, LITERATURE REVIEW, AERIAL RADIOACTIVITY SURVEYS	GOLD, COPPER, LEAD, ZINC	24088
EPM 10675, EPM 9338, EPM 9340, EPM 9343	WSW OF BOULIA	BHP MINERALS PTY LTD	REINTERPRETATION, MINERAL EXPLORATION, GROUND MAGNETIC SURVEYS, GEOCHEMICAL INTERPRETATION, GEOCHEMICAL EXPLORATION, DRILL CUTTINGS ANALYSIS, AERIAL MAGNETIC SURVEYS, GEOPHYSICAL INTERPRETATION, LITERATURE REVIEW, GEOPHYSICAL SURVEYS, BASE MAPS, ISOTOPE GEOCHEMISTRY, PETROLOGY, AERIAL RADIOACTIVITY SURVEYS, GROUND WATER SAMPLING	SILVER, GOLD, COPPER, LEAD, ZINC	25911, 26768, 27578
EPM 12670, EPM 12671, EPM 12672, EPM 12673, EPM 12674, EPM 12675, EPM 12676, EPM 12677, EPM 12678, EPM 12679, EPM 12680, EPM 12681, EPM 12682, EPM 12683, EPM 12684, EPM 12685, EPM 12799, EPM 12800, EPM 12801, EPM 12802, EPM 12851, EPM 12852, EPM 12853, EPM 12854	WESTERN QLD	GLENGARRY RESOURCES NL	MINERAL EXPLORATION, IMAGE INTERPRETATION, STRUCTURAL GEOLOGY, REGIONAL GEOLOGY, LINEAMENTS, LITERATURE REVIEWS	SILVER, GOLD, COPPER, LEAD, PALLADIUM, PLATINUM, VANADIUM OXIDE, ZINC	32548

Table 1 (continued)

Tenure	Locality	Tenure Holder	Exploration Technique	Commodity	Report No
EPM 13735	SW OF BOULIA	ANGLO AMERICAN EXPLORATION (AUSTRALIA) PTY LTD	MINERAL EXPLORATION, LITERATURE REVIEW	SILVER, COPPER, LEAD, ZINC	36229
EPM 13746	SSW OF MOUNT ISA	GLENGARRY RESOURCES LTD	GEOPHYSICAL INTERPRETATION, PETROLOGY, RC DRILLING, AERIAL MAGNETIC MAPS, MINERAL EXPLORATION, SOIL SAMPLING, ROCK CHIP SAMPLING, WATER SAMPLING, ASSAYING, ASSAY VALUE, SATELLITE IMAGERY, LITERATURE REVIEW	GOLD	36872, 36873, 38837
ATP 43	PARTLY COVERED EIGHT 250,000 SHEETS AND SMALL AREA OF MOUNT WHELAN SHEET.	SANTOS	NO SIGNIFICANT WORK CONDUCTED IN MOUNT WHELAN SHEET.	PETROLEUM	N/A
ATP 54	PARTLY COVERED FOUR 250,000 SHEETS AND 90% MOUNT WHELAN 250,000 SHEET	PAPUAN APINAIPI PETROLEUM COMPANY	GRAVITY SURVEY, SPOT CORRELATION SEISMIC, FIELD INVESTIGATIONS	PETROLEUM	2080, 1794, 1749, 1596, 1261, 1029, 861, 753, 739, 659, 581, 526
ATP 66	COVERED THREE 250,000 SHEETS AND IN PART NINE OTHER 250,000 SHEETS	SANTOS LTD.	NO SIGNIFICANT WORK CONDUCTED IN MOUNT WHELAN SHEET	PETROLEUM	N/A
ATP 160	PARTLY COVERED WESTERN HALF OF MOUNT WHELAN AND PART OF GLENORMISTON 250,000 SHEETS	ALLIANCE OIL DEVELOPMENT AUSTRALIA N.L.	DRILLING, SEISMIC SURVEYS, LITHOGRAPHIC STUDY, PETROLOGICAL ANALYSIS, ORGANIC CARBON ANALYSIS, PHOTOGEOLOGICAL STUDY	PETROLEUM	12220, 11074, 10426, 9068, 8980, 8295, 7677, 7358, 6766, 6657, 6558, 6460, 6262, 5119, 5019, 4383, 3245, 3161
ATP 166	COVEREDEIGHT 250,000 SHEETS AND EASTERN PART OF MOUNT WHELAN SHEET.	VIKING EXPLORATION INCORPORATED.	NO SIGNIFICANT WORK CONDUCTED IN MOUNT WHELAN SHEET	PETROLEUM	N/A
ATP 198	PARTLY COVEREDSEVEN 250,000 SHEETS AND SMALL AREA OF MOUNT WHELAN SHEET	COOPER BASIN OIL CORPORATION	NO SIGNIFICANT WORK CONDUCTED IN MOUNT WHELAN SHEET	PETROLEUM	N/A
ATP 211	PARTLY COVERED TWELVE 250,000 SHEETS AND SMALL AREA OF MOUNT WHELAN SHEET	BLACK GIANT OIL COMPANY	LITERATURE REVIEWS, FIELD INVESTIGATIONS	PETROLEUM	4954, 5563

Table 1 (continued)

Tenure	Locality	Tenure Holder	Exploration Technique	Commodity	Report No
ATP 224	PARTLY COVERED SEVEN 250,000 SHEETS AND LARGE AREA OF MOUNT WHELAN SHEET	BLACK GIANT OIL COMPANY	NO SIGNIFICANT WORK CONDUCTED IN MOUNT WHELAN SHEET.	PETROLEUM	N/A
ATP 283	PARTLY COVERS FOUR 250,000 SHEETS AND SPRINGVALE SHEET	OIL AND MINERALS QUEST N.L.	LITERATURE REVIEW, NO SIGNIFICANT WORK CONDUCTED IN MOUNT WHELAN SHEET.	PETROLEUM	10413
ATP 307	PARTLY COVERED THREE 250,000 SHEETS AND LARGE AREA OF MOUNT WHELAN SHEET	QUEENSLAND PETROLEUM PTY LIMITED	FIELD INVESTIGATIONS, AIR PHOTOGRAPHIC INTERPRETATION, SATELLITE IMAGE INTERPREATION.	PETROLEUM	12988, 12578, 10521, 10520
ATP 346	PARTLY COVERED GLENORMISTON AND SW PART OF MOUNT WHELAN 250,000N SHEETS	PHOENIX OIL AND GAS	LANDSAT IMAGERY INTERPRETATION, THERMATIC MAPPING, SOIL GAS SURVEY.	PETROLEUM	17383, 17222, 14666, 14031, 14030
ATP 354	BOULIA AND SPRINGVALE AND IN PART DUCHESS AND MOUNT WHELAN	MEDIAN OIL N.L	LANDSAT INTERPRETATION, STRUCTURAL MAPPING	PETROLEUM	15158, 16207
ATP 398	PARTLY COVERED FOUR 250,000 SHEETS AND WESTERN AREA OF MOUNT WHELAN SHEET	HAILEY ENERGY CORPORATION OF AUSTRALIA	LITERATURE AND EXISTING DATA REVIEWS. NO SIGNIFICANT WORK CONDUCTED.	PETROLEUM	25346, 23356, 22821, 22789, 21183
ATP 460	CENTRAL AREA OF MOUNT WHELAN 250,000 SHEET	DYAD PETROLEUM COMPANY	SEISMIC REPROCESSING	PETROLEUM	24979, 24430, 23996, 23995
ATP 554	CENTRAL AREA OF MOUNT WHELAN 250,000 SHEET	DYAD PETROLEUM COMPANY	SEISMIC REPROCESSING, SEISMIC SURVEY, GEOPHYSICAL INTERPRETATION, STRATIGRAPHIC CORRELATION.	PETROLEUM	37780, 31626, 28956, 26955
ATP 566	PARTLY COVERED MANEROO AND MOUNT WHELAN 250,000 SHEETS	MANEROO OIL COMPANY LIMITED	NO SIGNIFICANT WORK CONDUCTED IN MOUNT WHELAN SHEET.	PETROLEUM	N/A
ATP 582	PARTLY COVEREDFOUR 250,000 SHEETS AND WESTERN AREA OF MOUNT WHELAN SHEET	COOPER-EROMANGA OIL INCORPORATED	AWAITING NATIVE TITLE CLEARANCE.	PETROLEUM	49910
ATP 615	PARTLY COVEREDFIVE 250,000 SHEETS AND EASTERN AREA OF MOUNT WHELAN SHEET.	OIL SEEPS INCORPORATED	NO SIGNIFICANT WORK CONDUCTED.	PETROLEUM	N/A

Table 2: ATP and EPM company exploration report listing

Report No	Report title
526	REPORT ON GRAVITY SURVEY IN A TO P 54P BY L J STARKY (MINAD) NOV 1960
581	6 MONTHLY REPORT FOR PERIOD ENDED 28/2/1961 D M TRAVES 2/5/1961
659	6 MONTHLY REPORT FOR PERIOD 1/3-31/8/1961 D M TRAVES 29/9/1961
739	SEISMOGRAPH SURVEY BOULIA AREA FINAL REPORT CROSS SECTIONS 1962
753	6 MONTHLY REPORT TO 28/2/1962 D M TRAVES 16/3/1962
861	6 MONTHLY REPORT 1/3-31/8/1962 D M TRAVES 26/9/1962
1029	SIX MONTHLY REPORT FOR 1.9.1962-28.2.1963, BEANTREE 1, CANARY 1, BLACK MOUNTAIN 1, ELIZABETH SPRINGS 1.
1261	A-P 54P, SEISMIC SURVEY SUMMARY REPORT
1596	WELL COMPLETION REPORT, PAP NETTING FENCE NO. 1 WELL.
1749	A-P 54P, QLD, FIVE YEARLY REPORT, 1.09.58-31.08.63.
1794	REPORT ON RELINQUISHMENT AREA A-P 54P, QLD.
2080	A-P 54P, QLD, FINAL REPORT Q/54P/323.
3161	PHOTOGEOLOGICAL STUDY OF TOKO RANGE AREA, A-P 160P, QLD.
3245	COMPLETION REPORT, TOKO RANGE SEISMIC 1970
4383	APPLICATION FOR SUBSIDY, ALLIANCE ETHABUKA NO. 1 WELL, A-P 160P, QLD.
4954	GEOLOGICAL REPORT, BLACK GIANT OIL COMPANY, A-P 211P, QLD. AUST.
5019	FARMOUT PROPOSAL, ETHABUKA AND MIRRICA STRUCTURES.
5119	A-P 160P, AOD ETHABUKA 1, WELL COMPLETION REPORT
5563	CLONCURRY 1:100,000 SHEET AREA. RELINQUISHMENT REPORT, 1.2.76. (A) TEXT; (B) MAPS.
6262	W OF BOULIA HYDROCARBON POTENTIAL OF THE SOUTH EASTERN GEORGINA BASIN BY MAURICE L P CADART, OCTOBER 1977
6460	W OF BOULIA PROGRESS REPORT, TOKO SUB-BASIN SOURCEROCK STUDY BY M WILTSHIRE, 17/5/1978
6558	W OF BOULIA TOTAL ORGANIC CARBON ANALYSIS OF GSQ MT WHELAN 2 SAMPLE RESEARCH (SINGAPORE) P/L, 10/7/1978 (SOURCEROCK ANALYSIS)
6657	REVIEW, A-P 160P, QLD, SEISMIC SURVEYS 1963-1977, TOKO SYNCLINE, SE GEORGINA BASIN.
6766	W OF BOULIA MINERALOGICAL REPORT - PETROGRAPHIC DESCRIPTION OF LIMES GSQ MOUNT WHELAN 2, BY PONTIFEX & ASSOC (CO'S REPORT NO 2414)
7358	DRILLING GLENORMISTON 1:250,000 SHEET AREA (SOURCEROCK ANALYSIS) RE ANALYSIS OF ROCK EXTRACTS FROM PAP NETTING FENCE 1 WELL AND FPC THE BROTHERS 1 WELL, GEORGINA BASIN SEPTEMBER 1979 (CO'S NO RKER 790004) (SEE ALSO C/R 1596)
7677	MOUNT WHELAN 1:250,000 SHEET AREA (SF5413) REPORT ON DRILLING PROPOSAL, AOD MIRRICA NO 1, GEORGINA BASIN
8295	AOD MIRRICA NO. 1, WELL COMPLETION REPORT.
8969	A-P 2349M, 2350M, TOOMBA RANGE, REPORT FOR THE SIX MONTHS ENDED 28/2/81
8980	NOTES AND COMMENTS ON THE ORGANIC PETROLOGY OF KEROGEN EXTRACTS AND CUTTINGS SAMPLES, AOD ETHABUKA 1.
9068	DISCUSSION OF PROSPECTS AND PROPOSED EXPLORATION PROGRAM 1981-1985.
9314	A-P 2349M & 2350M, TOOMBA RANGE, REPORT FOR THE SIX MONTHS ENDED 28/8/81
10005	REPORT FOR THE SIX MONTHS ENDED 28.2.82.
10006	A-P 2349M, TOOMBA RANGE, QLD, FINAL REPORT.

Table 2 (continued)

Report No	Report title
10016	A-P 2350M TOOMBA RANGE, QLD, FINAL REPORT.
10413	A-P 283M, EROMANGA BASIN, HALF YEARLY REPORT FOR PERIOD ENDED 31.7.1981, (406/2).
10426	ABUDDA LAKES, SEISMIC SURVEY 1981, FINAL REPORT.
10520	A-P 307P, PRELIMINARY PETROLEUM PROSPECTS OF THE GEORGINA BASIN, (QPL 2).
10521	A-P 307P, GEORGINA BASIN, QLD, GEOLOGY AND PETROLEUM POTENTIAL, (QPL 11).
11074	LITHOFACIES STUDY, A-P 160P, GEORGINA BASIN, QLD, NINMAROO, COOLIBAH & KELLY CREEK FORMATIONS.
12220	RELINQUISHMENT OF A-P 160P, GEORGINA BASIN, QLD.
12578	UNJILIGUNA ANTICLINE, URANDANGI PHOTOGEOLOGY, A-P 307P.
12988	FINAL REPORT ON A-P 307P, GEORGINA BASIN, QLD.
13286	A TO P 3494M, 3495M, MT WHELAN-SYLVESTER CREEK, NW QLD, FIRST SIX MONTHLY REPORT TO 17.11.83.
13287	A TO P 3494M, 3495M, MT WHELAN-SYLVESTER CREEK, NW QLD, SECOND SIX MONTHLY REPORT TO 17.05.84.
14030	NOTES TO ACCOMPANY THE LANDSAT INTERPRETATION OF A-P 346P, SOUTH WESTERN GEORGINA BASIN, QLD.
14031	NOTES TO ACCOMPANY THE NOAA - AVHRR INTERPRETATION OF A-P 346P, SOUTH WESTERN GEORGINA BASIN, QLD.
14237	A TO P 3494M, 3495M, MT WHELAN, SYLVESTER CREEK, NW QLD, THIRD SIX MONTHLY REPORT TO 16.11.84.
14238	A TO P 3494M, 3495M, MT WHELAN, SYLVESTER CREEK, NW QLD, FOURTH SIX MONTHLY REPORT TO 16.05.85.
14658	EXPLORATION LICENCES 4320 AND 4321 HOY RIVER, NORTHERN TERRITORY AND A-P 3797M MT WHELAN, QLD, FINAL REPORT.
14666	THE HYDROCARBON POTENTIAL OF A-P 346P SE GEORGINA BASIN, QLD,
14869	A TO P 3494M & 3495M, MOUNT WHELAN-SYLVESTER CREEK, NW QLD, REPORT ON AREAS RELINQUISHED 16.05.85.
15158	NOTES TO ACCOMPANY THE LANDSAT INTERPRETATION OF THE STRUCTURAL GEOLOGY OF A-P 354P, WESTERN QLD, (ACCOMPANIES SIX MONTHLY REPORT TO 1.03.86).
15344	A TO P 3493M & 3459M, MOUNT WHELAN-SYLVESTER CREEK, N.W. QLD, FIFTH SIX MONTHLY REPORT TO 16.11.85.
15719	A-P 3494M & 3495M, MOUNT WHELAN, SYLVESTER CREEK, NW QLD, DEL COMBINED SIXTH SIX MONTHLY REPORT TO 16.05.86 AND FINAL REPORT.
16080	A-P 4358M, SUN HILL, MOUNT ISA MINING DISTRICT, QLD, FIRST & FINAL REPORT FOR PERIOD ENDED 10.03.86.
16207	STRUCTURAL AND ISOPACH MAPPING IN A-P 354P, QLD
16278	FIRST & FINAL REPORT FOR A-P 4359M, TOOMBA RANGE, W. OF MOUNT ISA.
16636	A-P 4206M, BEATTIE CREEK, REPORT FOR FIRST SIX MONTHS OF TENURE 7/2/86 TO 6/8/86
16637	BEATTIE CREEK A-P 4206M, REPORT FOR SECOND SIX MONTHS OF TENURE 07.08.86-06.02.87..
16638	BEATTIE CREEK A-P 4206M & GIDYA A-P 4207M, REPORT FOR AREAS RELINQUISHED DURING THE PERIOD OF TENURE 07.02.86-06.02.87.

Table 2 (continued)

Report No	Report title
16639	GIDYA A-P 4207M, W. QLD, REPORT FOR FIRST SIX MONTHS OF TENURE 07.02.86-06.08.86.
16640	A-P 4207M, GIDYA, REPORT FOR SECOND SIX MONTHS OF TENURE 07.08.86- 06.02.87.
17154	BEATTIE CREEK, AP 4206M, REPORT FOR THIRD SIX MONTHS OF TENURE 7.02.87-6.08.87.
17155	GIDYA, A-P 4207M, REPORT FOR THIRD SIX MONTHS OF TENURE 7.02.87- 6.08.87.
17222	SOIL GAS ALKANE SURVEY, A-P 346P, GEORGINA BASIN, QLD.
17383	REPORT ON RELINQUISHED PORTION OF A-P 346P, GEORGINA BASIN.
21183	A-P 398P, GEOLOGICAL REPORT
22789	ATP 398, GEOLOGICAL SUMMARY ON FARMOUT AREA
22821	A-P 398P, RELINQUISHMENT REPORT FOR THE REDUCTION IN AREA DUE 1/1/91
23290	EPM 7897, SIMPSON, EXPLORATION REPORT FOR THE PERIOD 17/4/91 TO 16/12/91 AND FINAL REPORT
23356	A-P 398P, RELINQUISHMENT REPORT FOR THE REDUCTION IN AREA DUE 1/1/92 AND THE VOLUNTARY REDUCTION IN AREA TAKEN 14/1/92
23995	A-P 460P, GEOPHYSICAL REPORT
23996	A-P 460P, SIMPSON DESERT PROSPECT AND GEOPHYSICAL REPORT
24088	EPM 8672 (MOUNT ALFRED), 8723 (TOOMBA RANGE), 8753 (MOUNT GERALD), FINAL REPORT
24430	A-P 460P, RELINQUISHMENT REPORT EFFECTIVE 1/11/92
24979	A-P 460P, FINAL STATUS REPORT INCLUDING THE PULCHERA PROSPECT
25346	A-P 398P, FINAL REPORT
25911	EPM 9338 (TOOMBA), 9340 (MIRRICA), 9343 (MOUNT WHELAN), MOUNT WHELAN PROJECT, ANNUAL REPORT FOR THE PERIOD ENDED 5/5/94
26768	EPM 9338 (TOOMBA), 9340 (MIRRICA), 9343 (MOUNT WHELAN), ANNUAL REPORT FOR THE PERIOD ENDED 5/5/95
26955	A-P 538P, 554P, GEOLOGICAL AND GEOPHYSICAL REPORTS, GEORGINA BASIN
27578	EPM 9338 (TOOMBA), 9340 (MIRRICA), 9343 (MOUNT WHELAN), 10675 (PULCHERA), FINAL REPORT FOR THE PERIOD ENDED 31/12/95
28956	A-P 538P, 554P, GEOPHYSICAL REPORT
31626	A-P 554P, ETHABUKA, FINAL SEISMIC SURVEY REPORT
32548	EPM 12670, 12671, 12672, 12673, 12674, 12675, 12676, 12677, 12678, 12679, 12680, 12681, 12682, 12683, 12684, 12685, 12799, 12800, 12801, 12802, 12851, 12852, 12853, 12854, DIAMANTINA PROJECT, INFORMATION MEMORANDUM
36229	EPM 13735, MOUNT WHELAN, FIRST AND FINAL REPORT FOR PERIOD 10/3/03 TO 18/12/03
36872	EPM 13746, MIRRICA BORE, DIAMANTINA PROJECT, ANNUAL REPORT FOR THE PERIOD ENDING 19/3/04
36873	EPM 13746, MIRRICA BORE, DIAMANTINA PROJECT, PARTIAL RELINQUISHMENT REPORT FOR 51 SUBLOCKS SURRENDERED 15/3/04
37780	A-P 554P, FINAL REPORT
38837	EPM 13746, MIRRICA BORE, ANNUAL/FINAL REPORT TO 19/3/05
49910	A-P 582P, PARTIAL RELINQUISHMENT REPORT FOR PERIOD ENDING 18/7/07

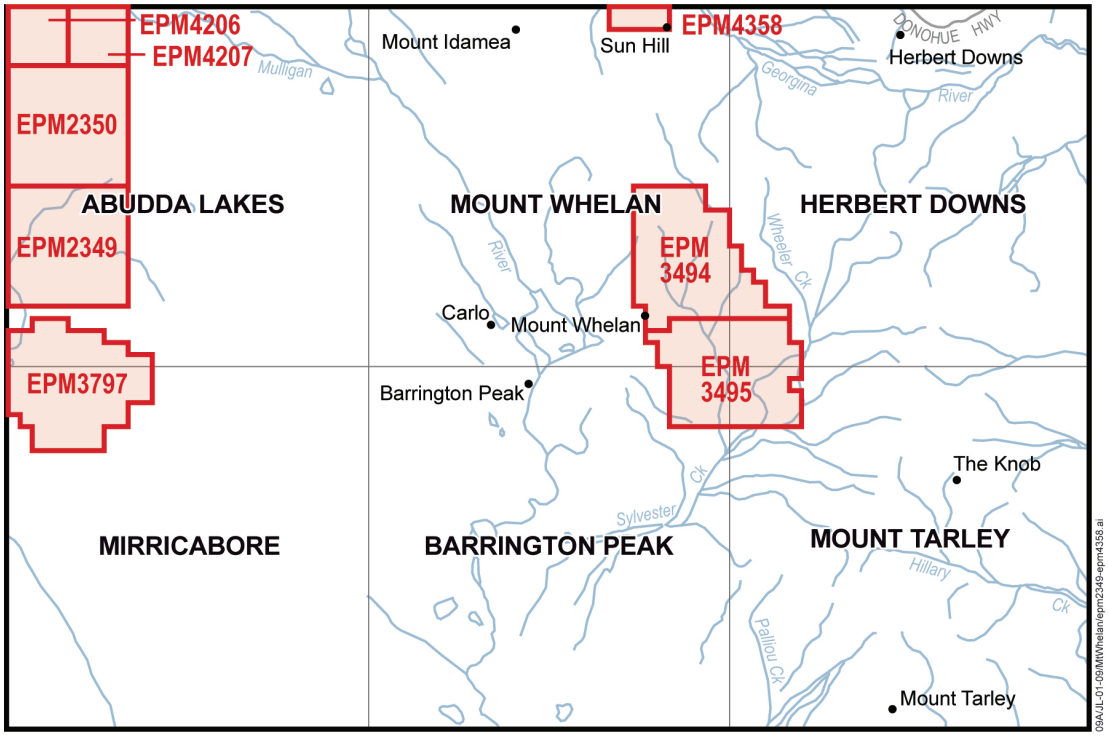

Figure 11: EPM2349 - EPM4358

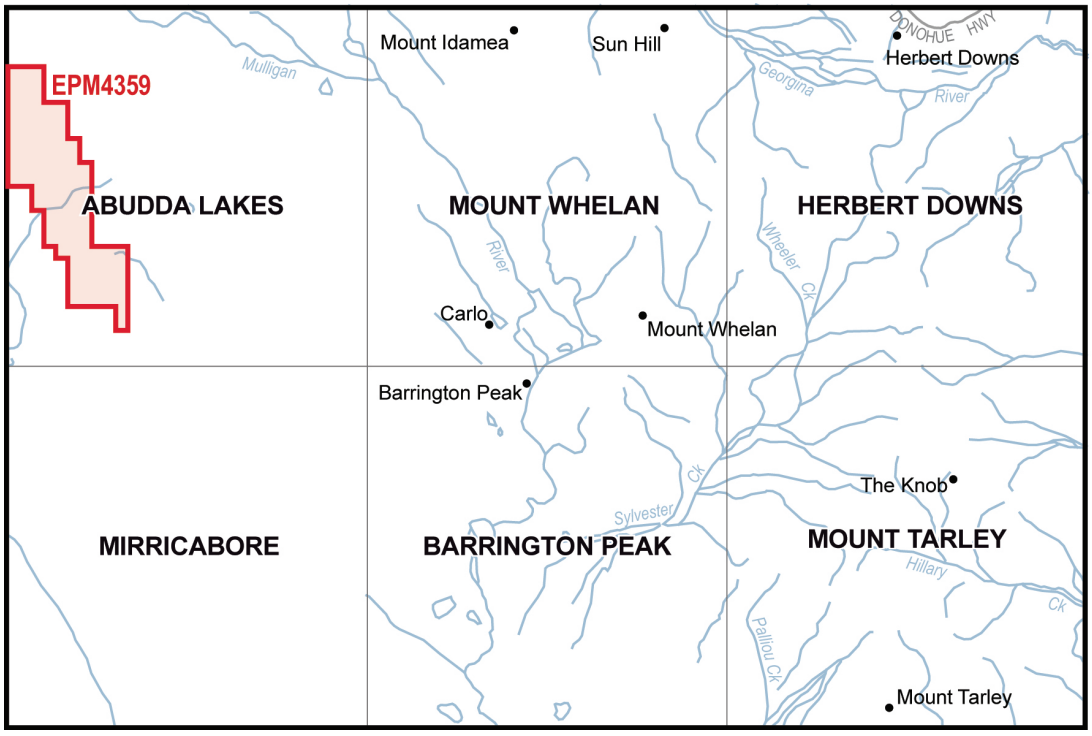

Figure 12: EPM4359

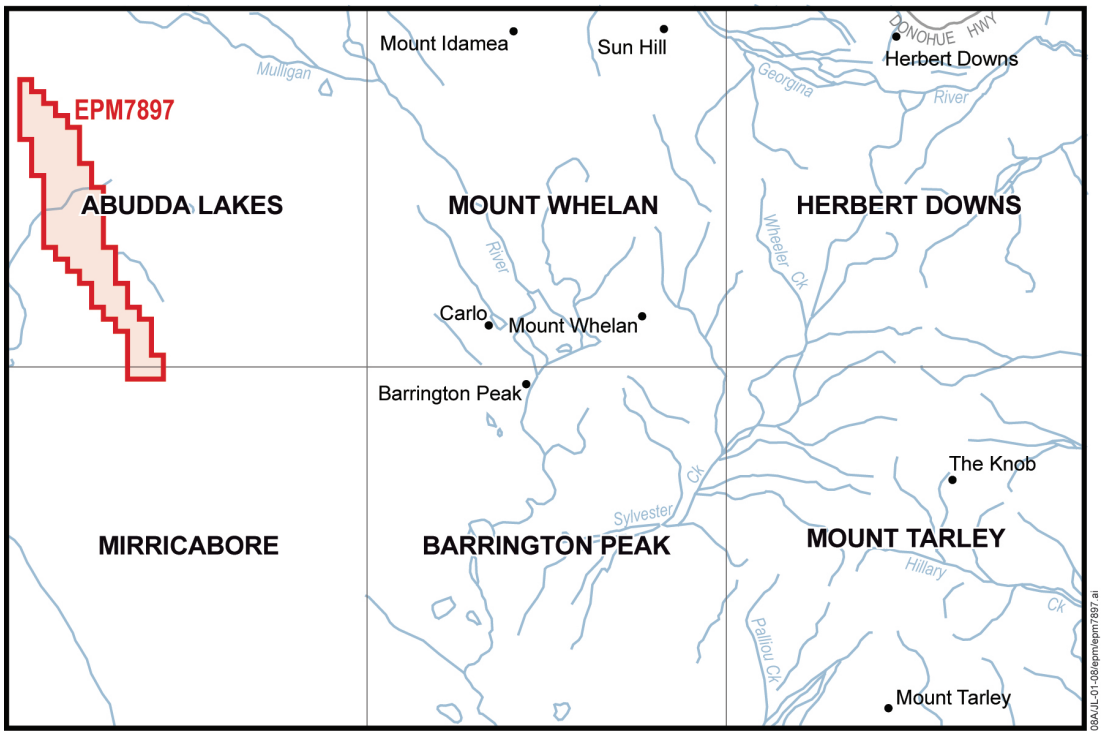

Figure 13: EPM7897

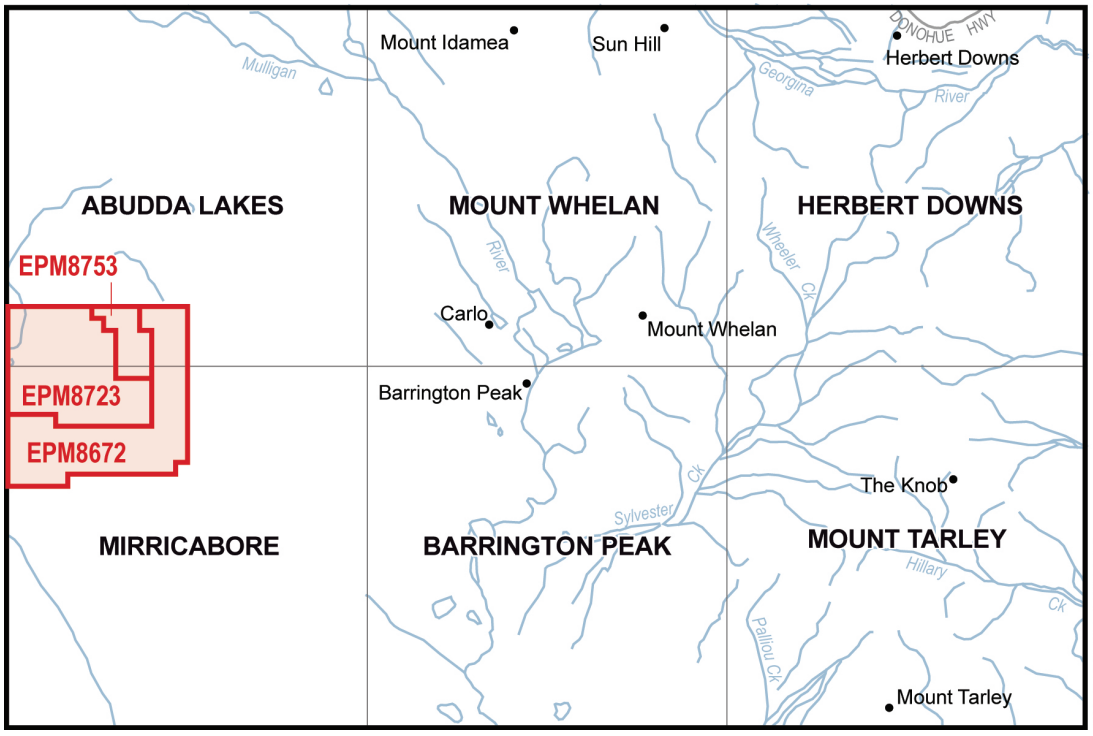

Figure 14: EPM8672 – EPM8753

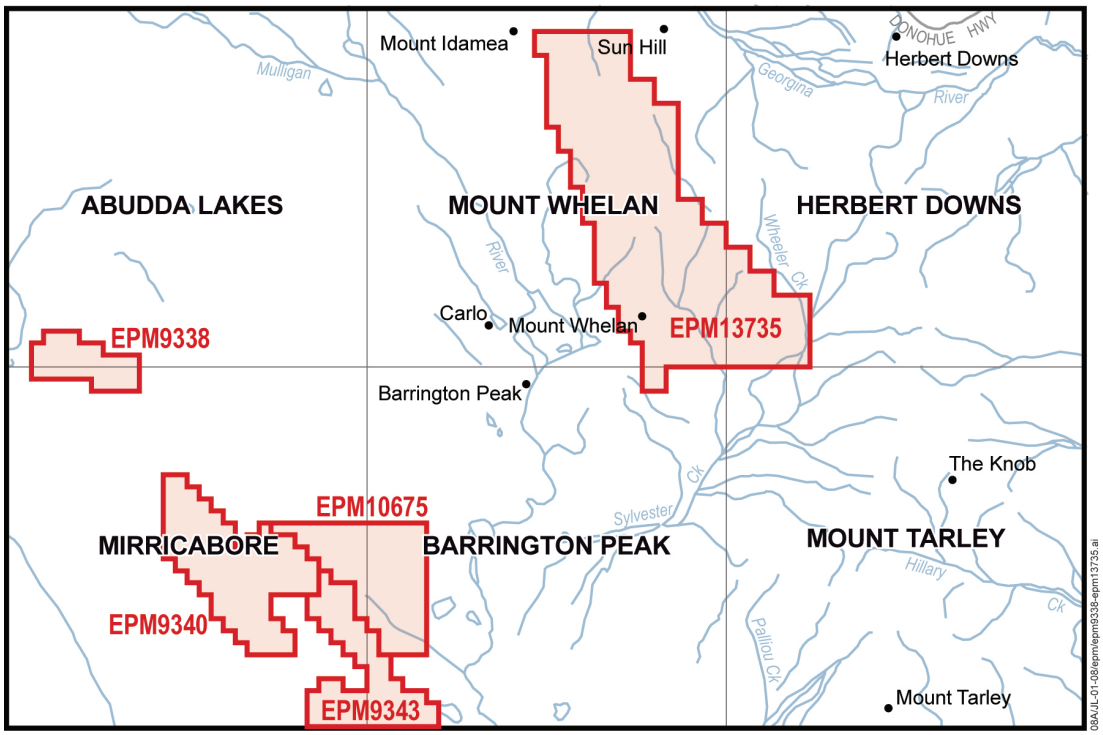

Figure 15: EPM9338 – EPM13735

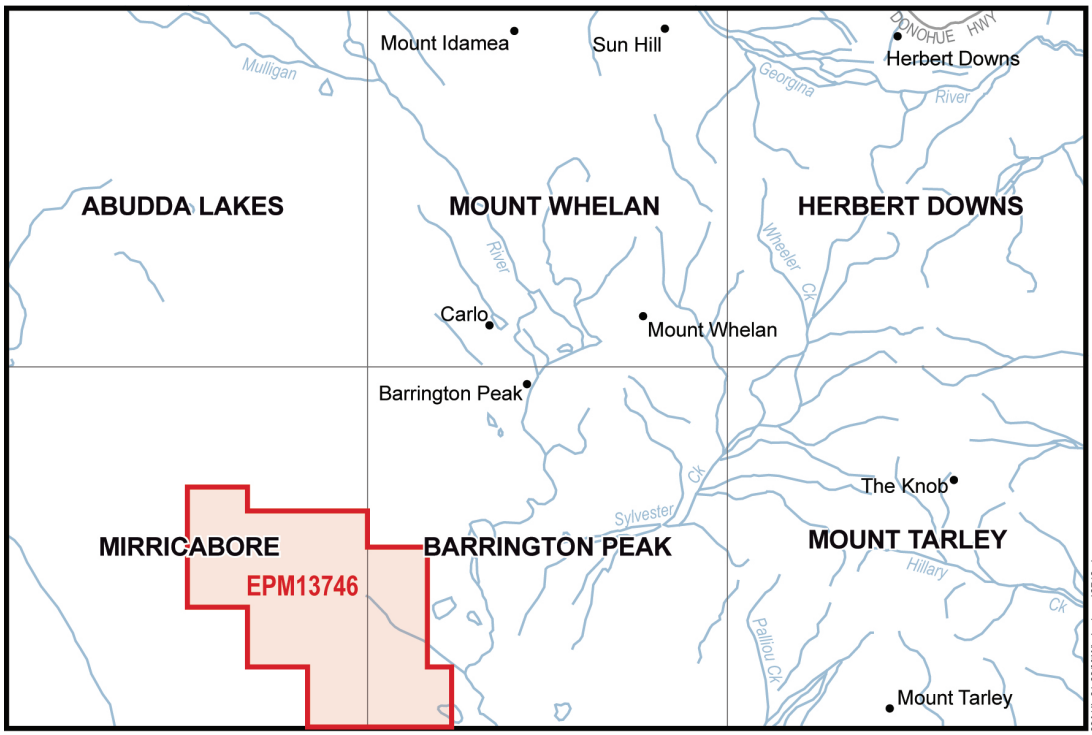

Figure 16: EPM13746

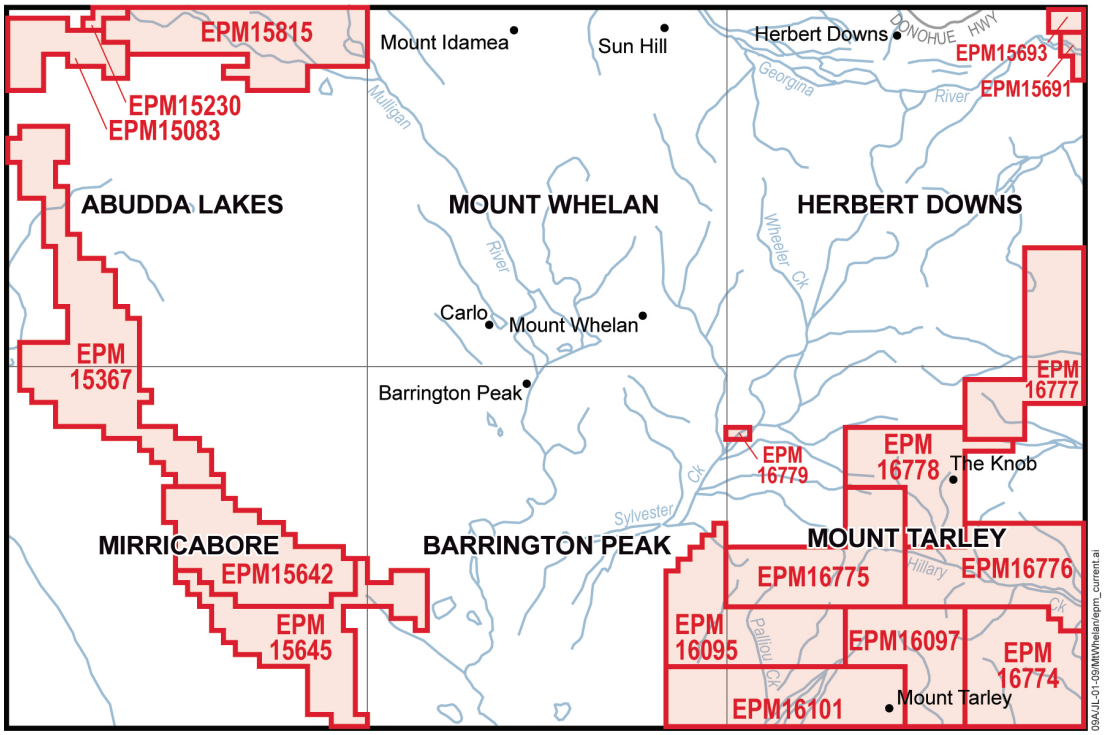

Figure 17: Current EPM15083 – EPM16779

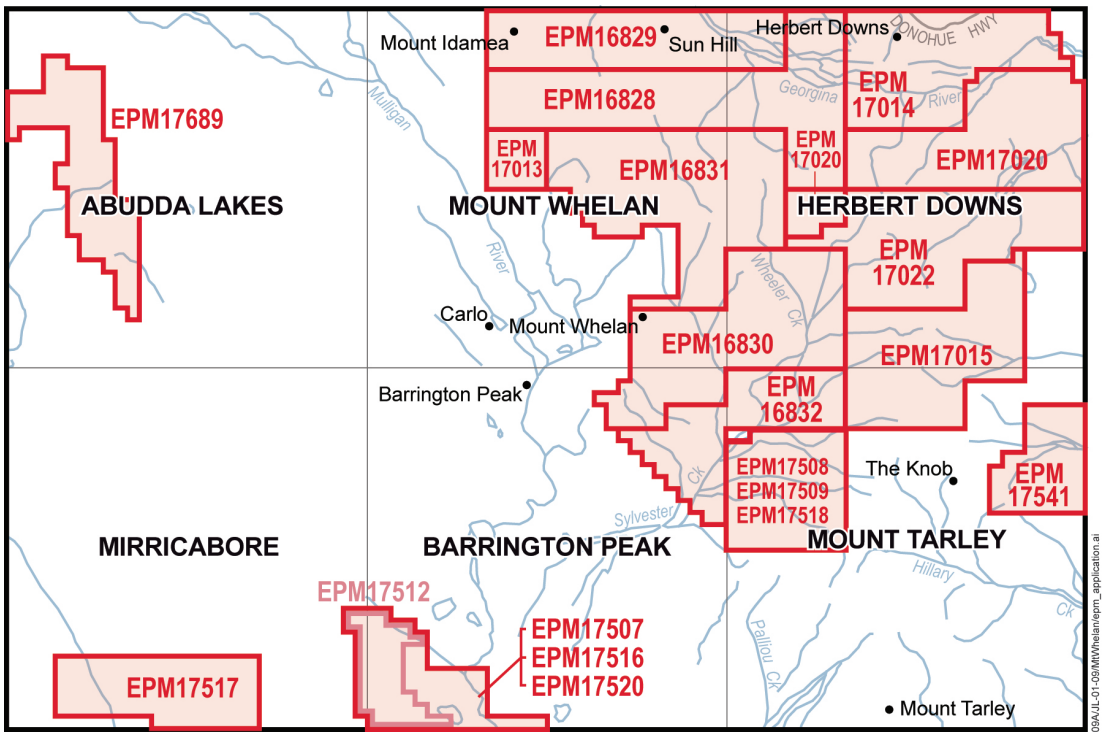

Figure 18: Application EPM16828 – EPM17689

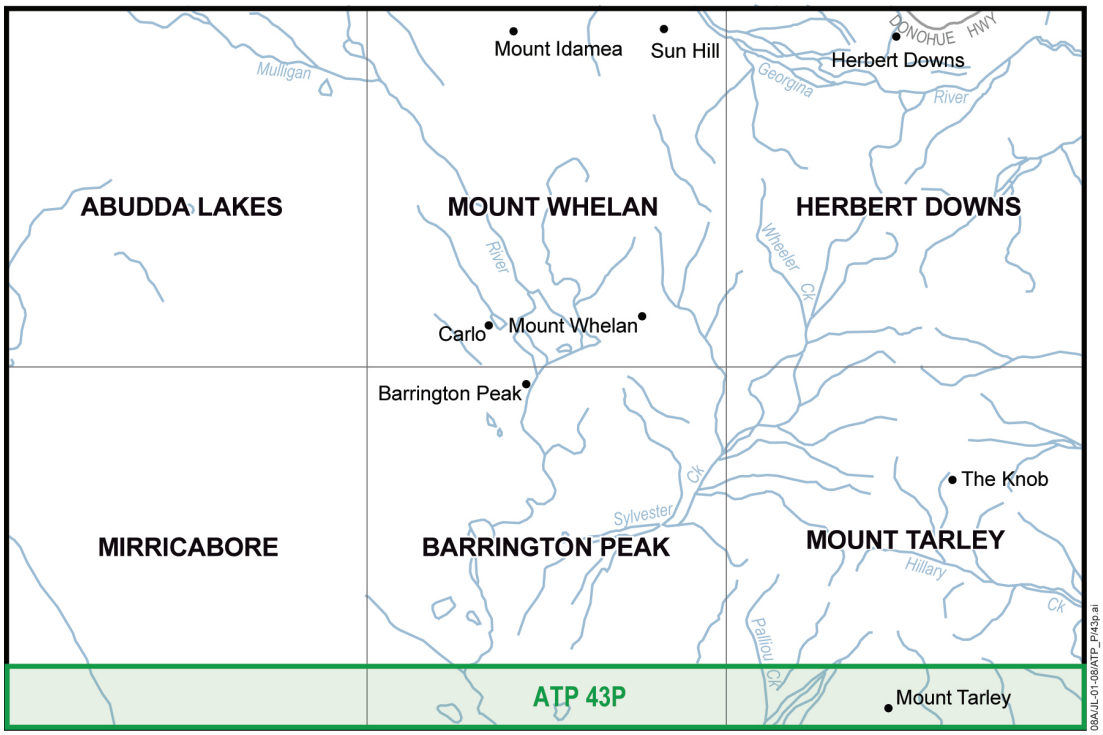

Figure 19: ATP 43P

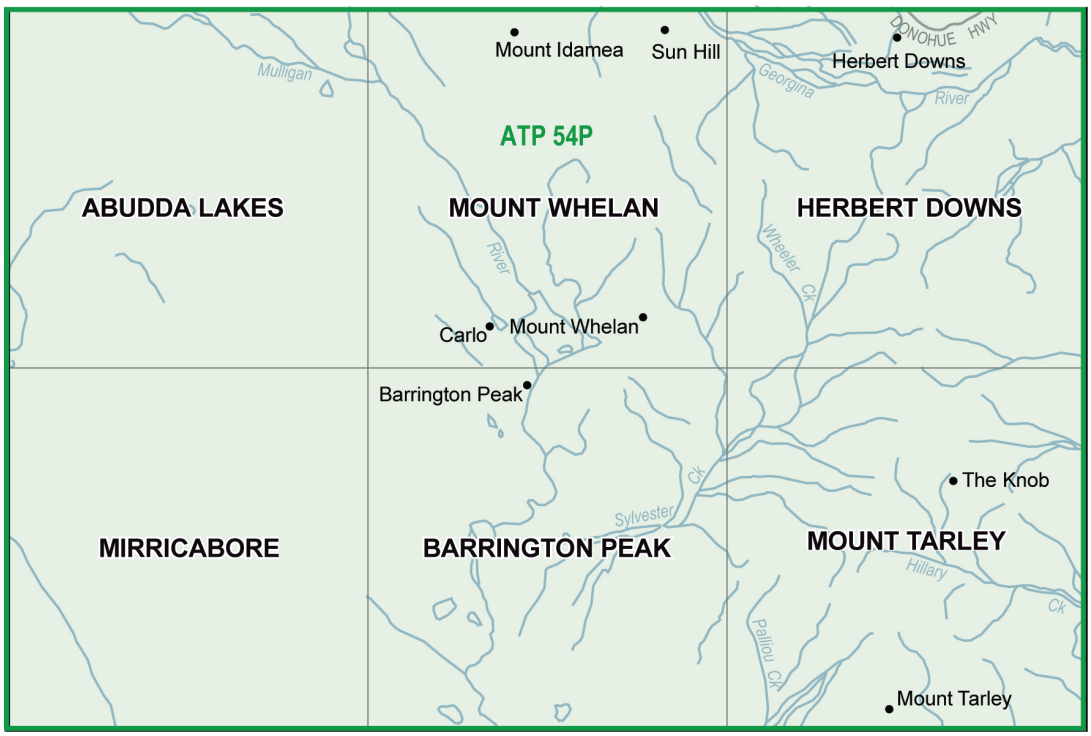

Figure 20: ATP 54P

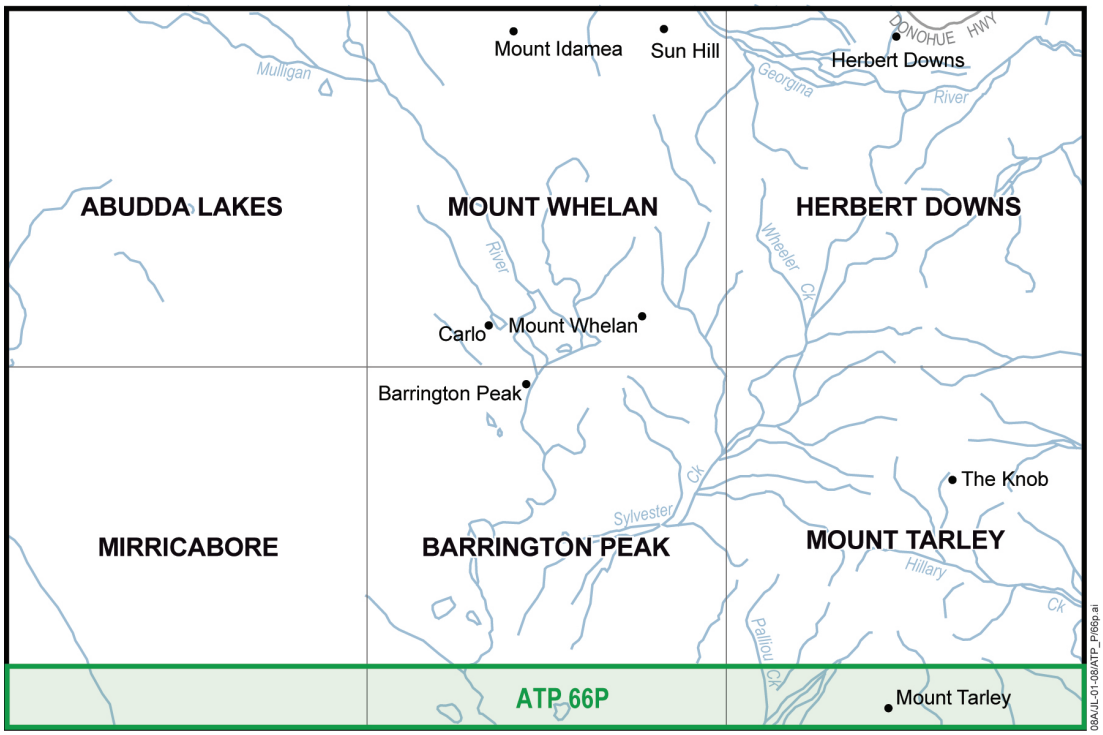

Figure 21: ATP 66P

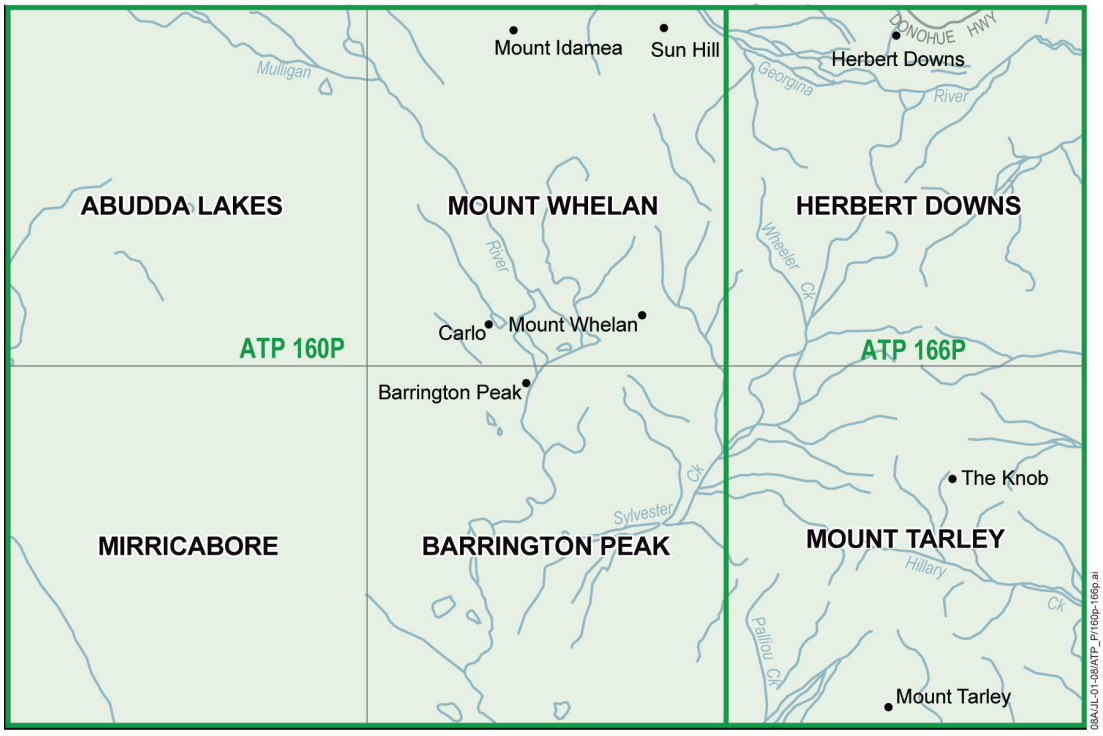

Figure 22: ATP 160P – ATP 166P

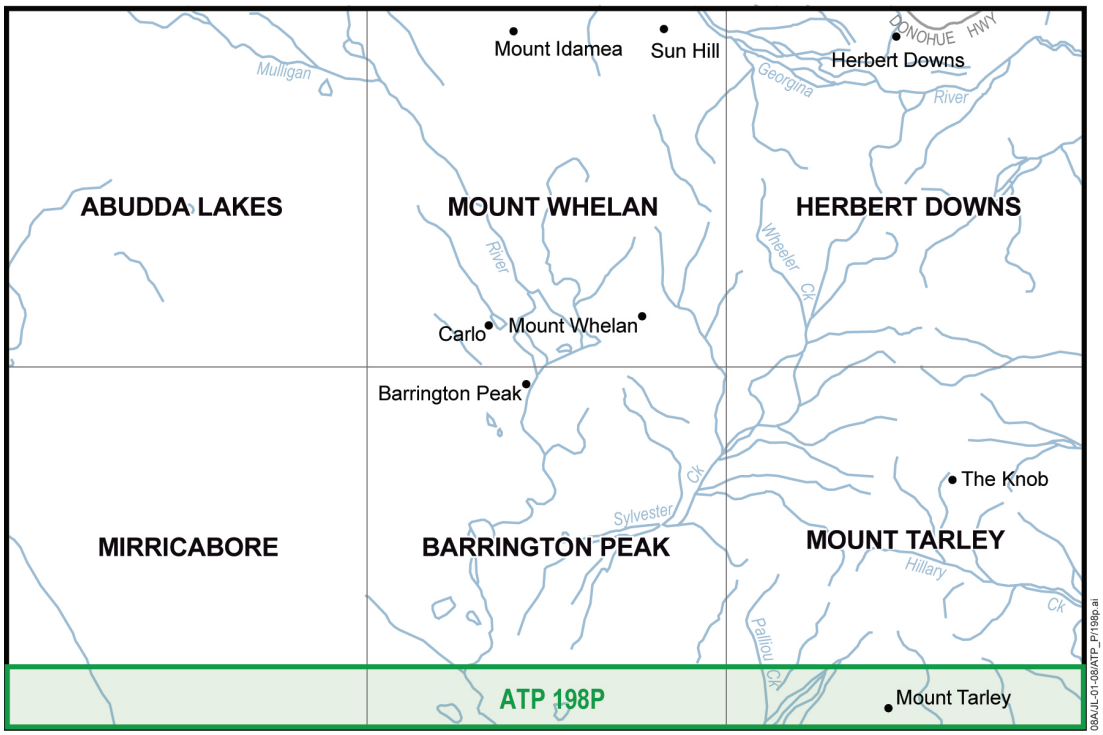

Figure 23: ATP 198P

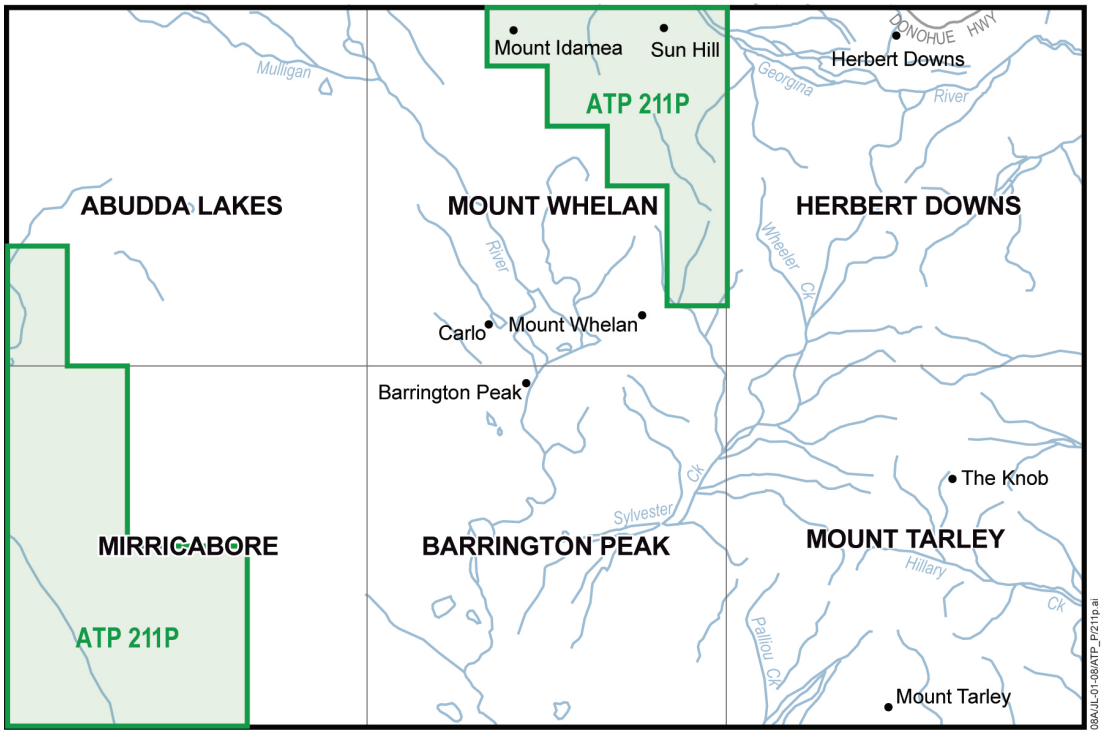

Figure 24: ATP 211P

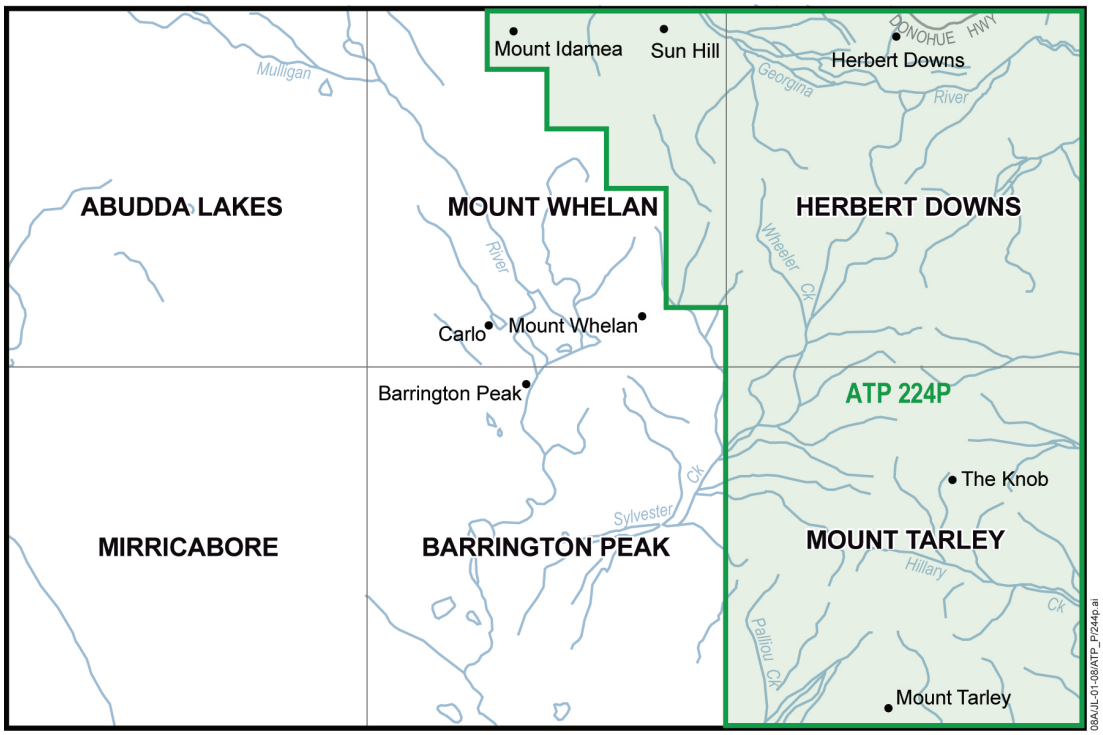

Figure 25: ATP 224P

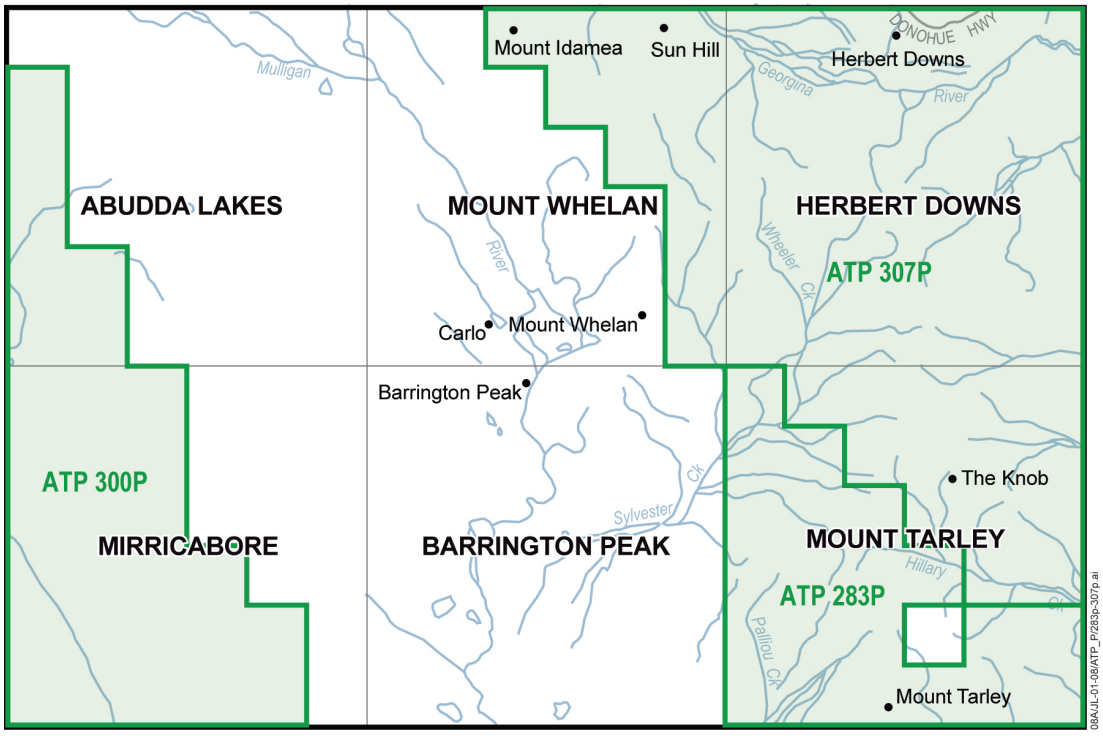

Figure 26: ATP 283P – ATP 307P

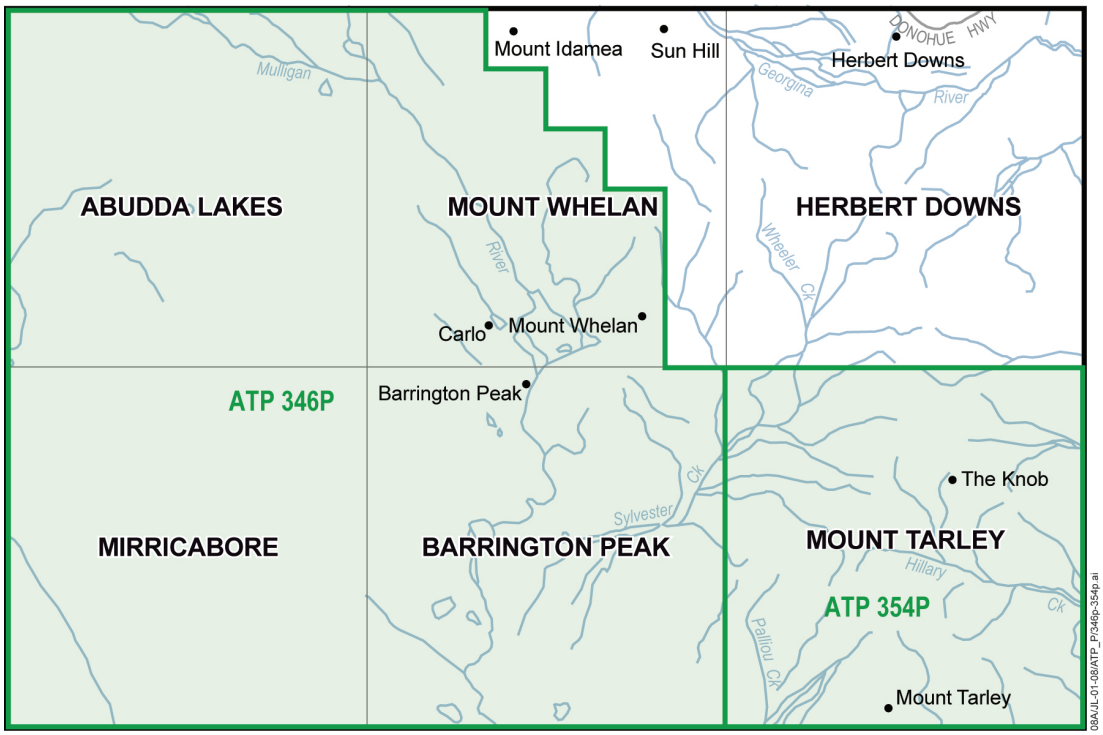

Figure 27: ATP 346P – ATP 354P

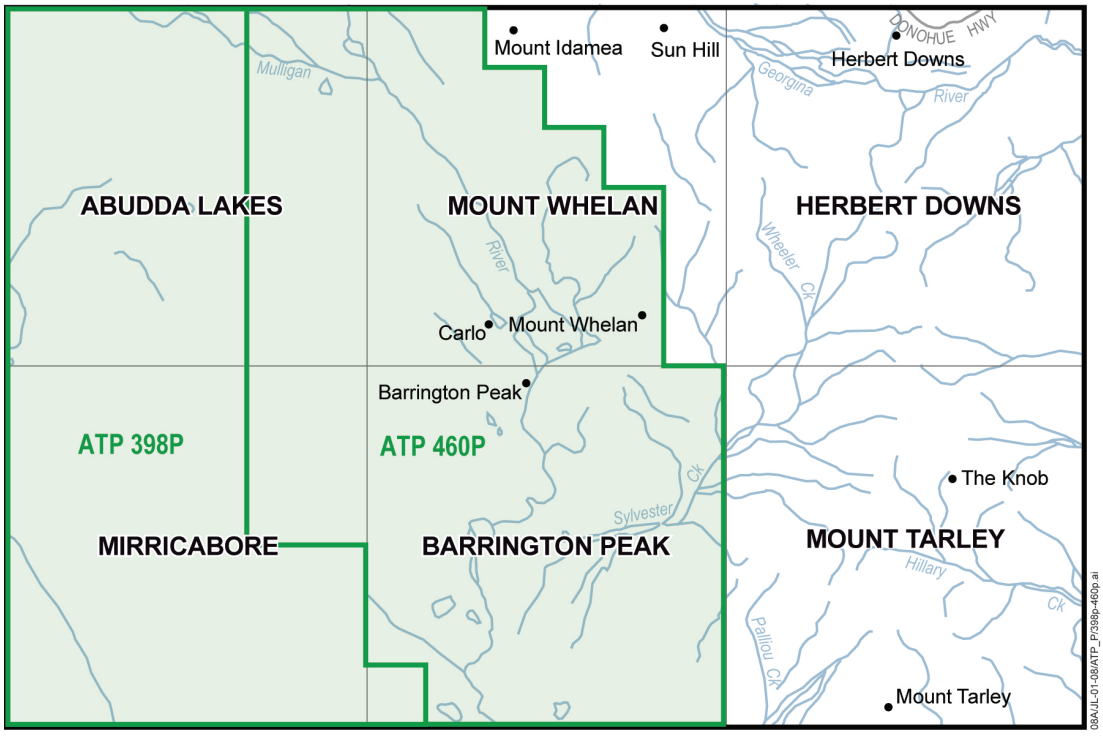

Figure 28: ATP 398P – ATP 460P

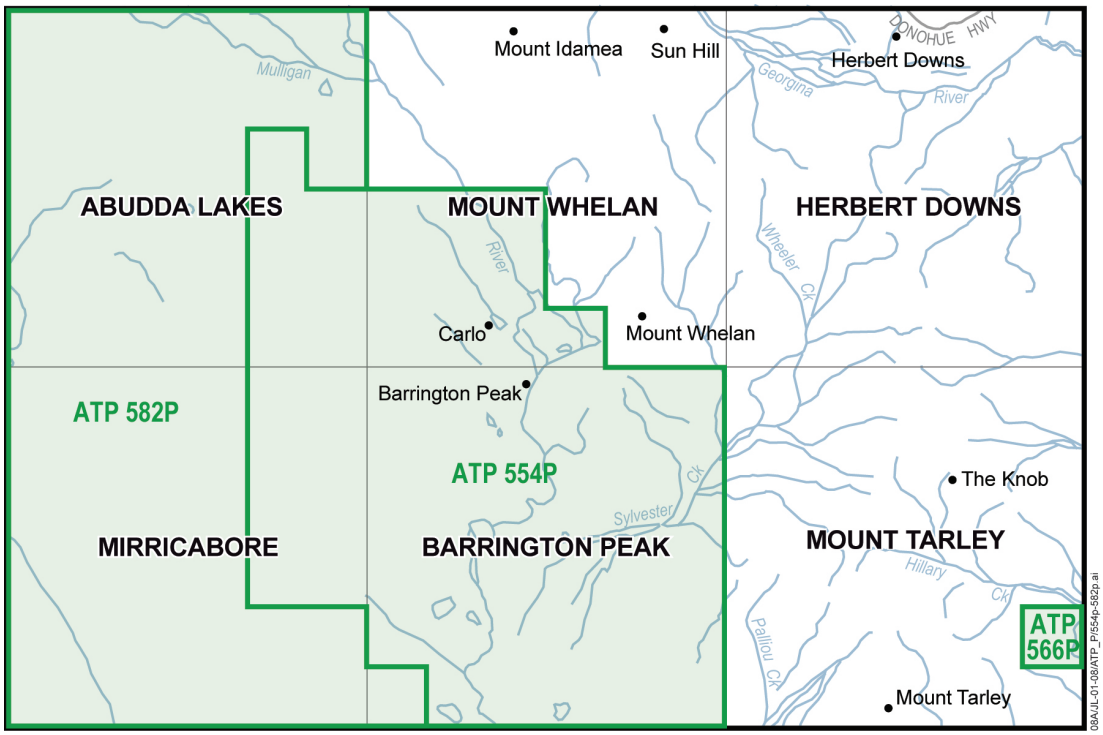

Figure 29: ATP 554P – ATP 582P

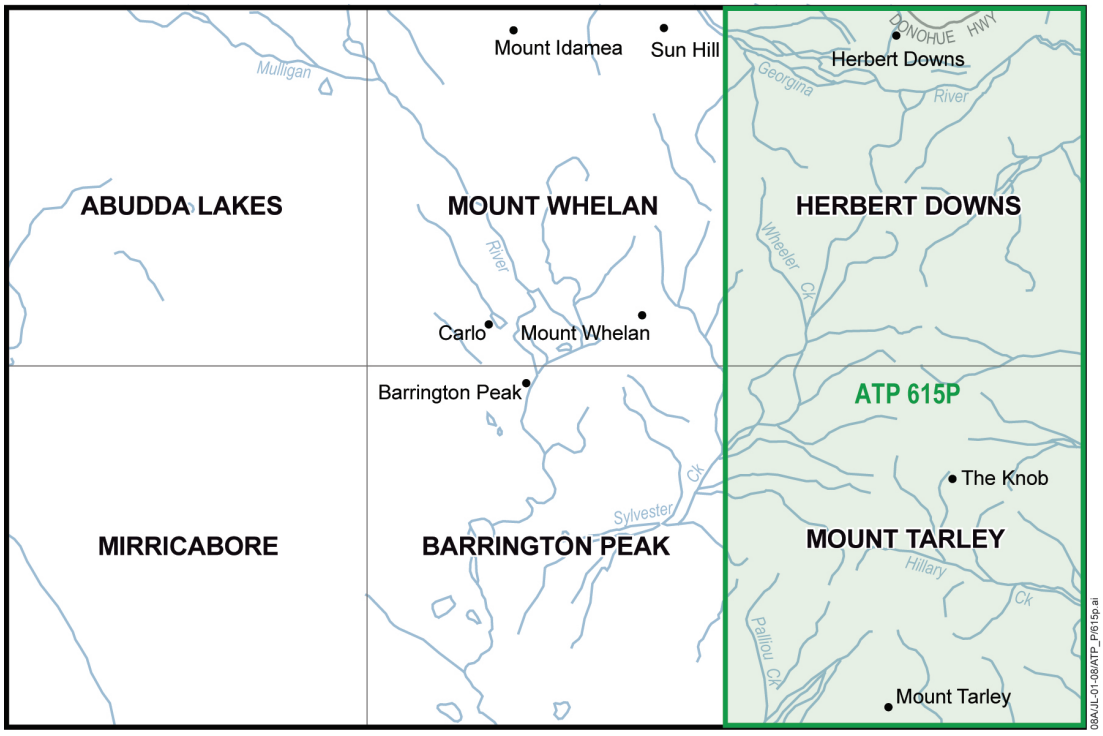

Figure 30: ATP 615P

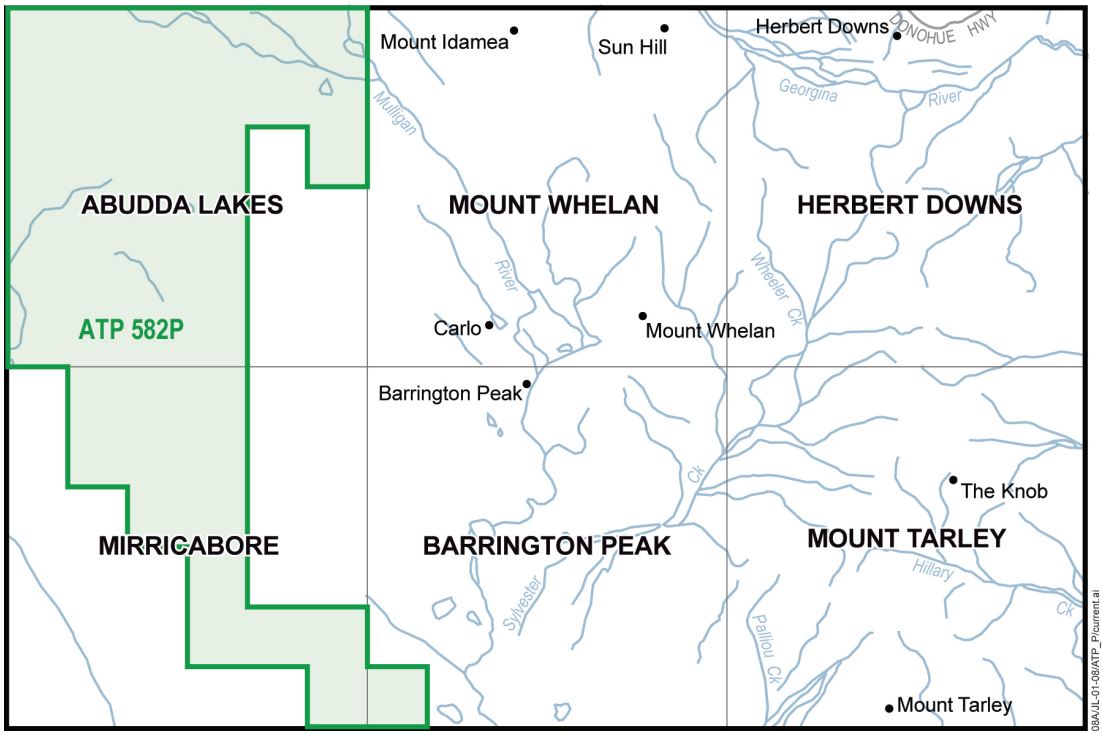

Figure 31: Current ATP 582P

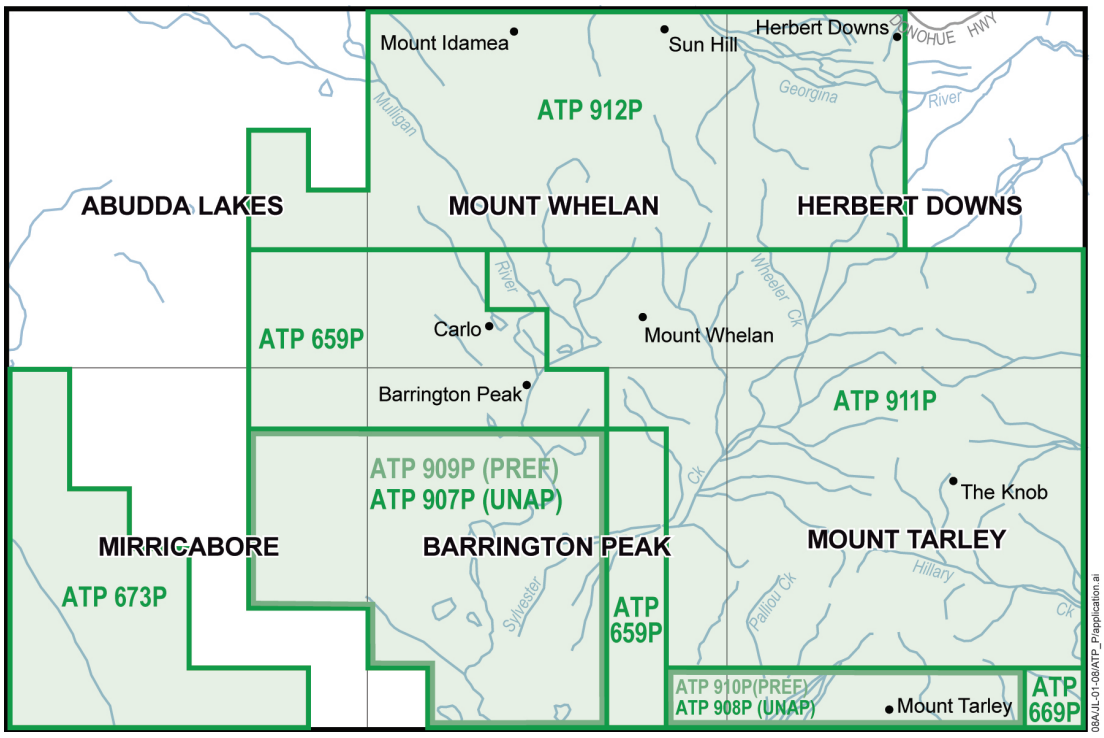

Figure 32: Application ATP 659 – ATP 912