REVIEW OF THE CARLTON PROJECT
PINE CREEK AREA

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ARIMCO NL
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INTRODUCTION

This report to the Department of Mines & Energy summarises the work completed on the Carlton Project Area to 31 March 1990. The recommendations contained are designed to complete a resource study and ultimately a Mineable Reserve with a full economic valuation.

An initial examination of the Carlton database outlined the scope of work required to produce a resource estimate. Work was started by Arimco personnel in January 1990, with checks on survey control and resurvey of drill hole collars. The database required up-dating and improving. Down hole surveys of accessible drill holes were undertaken. Additional data from Pine Creek Goldfields was obtained in a data swap and was recompiled and will be added to the database after it has been converted to SURPAC compatible files. The enlarged database of Carlton will consist of some 24,504 metres of drilling, 22,223 assays and 423 drill holes.

Mr Taff Davies of Remote Sensing and Geological Services was retained to interpret the 3D geological model from the new drill hole information. Compilation of the data is now in progress and the final sections will be available in July.

Mr Daniel Guibal of Siromines was retained to complete a preliminary geostatistical review of Carlton the data base. Guibal examined the basic and spatial statistics. As expected, the grade continuity was not confirmed along strike but the mineralized envelope was well outlined along strike. Further infill drilling is required to confirm the statistical ranges. The ultimate aim is to produce a block model suitable for a mining reserve and a final mine plan.

In the course of the survey work, various problems were found with the lease boundaries, vacant wedges and overpegging with major conflicts. An Exploration Licence (EL 6958) over the area was applied for to stop "nuisance pegging" while the tenure problems are resolved. The most contentious problem concerns the area of conflict with Mr Tommy Harbrow (Lot 213) where he has built his residence.
LOCATION AND ACCESS

The Carlton Project Area is located on the north western edge of the Pine Creek township, which is situated some 220km south of Darwin on the Stuart Highway in the Northern Territory (see Figure 1).

Access to the site is excellent being adjacent to the realigned Stuart Highway, 1km north of Pine Creek. Pine Creek is a small township established on the historical gold fields in the 1870s and which now services the adjacent major operation at the Enterprise Mine. Pine Creek has one hotel and a number of stores, with an engineering shop and a commercial assay laboratory servicing the mines in the region.

The climate is monsoonal with an annual rainfall of about 1500mm, most of which falls in the wet season between November and April. The topography in the immediate Project Area is steep rocky ridges which are surrounded by undulating, sandy rises to the east and west. The vegetation is classed as tropical woodland but the growth is stunted on the rocky ridges while taller eucalypts grow in deeper soils along drainage systems.

The Carlton Project Area lies on two parallel ridges north west of Pine Creek. The larger ridge, known as Gandys Hill, has a trig point and dominates the area to the north west of the township. The second smaller ridge, some 300m east and adjacent to the Stuart Highway, is known as the International after the line of old workings. The topography in the Project area is quite steep which requires extensive dozing for drill pads and tracks for the placement and movement of truck mounted drill rigs on the sides of the ridges. The use of smaller track mounted rigs would be the preferred option when drilling in these difficult areas.

The Carlton Project consists of a number of mining tenements over the Gandys Hill and International areas and a block of leases to the west of the main area of interest. A complete listing of tenements is presented in the tenure section of this report.
SUMMARY OF HISTORY AND PREVIOUS WORK

Gold was first discovered in the Pine Creek area in the early 1870s and worked largely by the Chinese diggers under tributes with the European owners. Prior to 1894, no systematic records were kept but by 1915 over 124,960 tons of gold ore had been treated with an average grade of 32.14 g/t from batteries and 7.65 g/t from cyanide works. Production between 1915 and 1985 was small scale and sporadic. The mines in the Pine Creek area were the largest gold producers in the Pine Creek Geosyncline with reported production of nearly 3,000 kg of gold to 1985.

Underground development below the water table to 80m was carried out on Enterprise, Elsimor and Eleanor Mines all south and along strike from the Gandys Hill workings. The workings on Gandys Hill and International are all shallow; none appear to be deeper than 15m. Two adits, one 63m and the other 25m long were driven under the eastern side of Gandys Hill some 20m below the top of the hill. Little systematic exploration and no drilling had been completed in the project area prior to 1983. During 1982 Goldfields Exploration announced a mineable resource at the Enterprise, and production began during 1985.

Jon and Lyn Arnold, proprietors of Tasbax Pty Ltd, optioned the Gandys Hill property to Amoco Minerals in October 1983. Amoco carried out an extensive surface rock chip, dump sampling, mapping and 15 RC holes were drilled totally 1,163m. An induced polarization survey was completed to test the known association between the quartz sulphide bodies and gold mineralization. The drilling results were encouraging but not startling. Amoco, Head Office, directed the project be farmed-out, various parties were approached, including Homestake, ADL and Swan Resources. Lightning Ridge Mining NL entered into an agreement with Amoco and subsequently joint ventured 80% of its interest to Terrex Resources.

Terrex carried out further mapping and drilling which included both diamond and RC drilling. Mr Taff Davies was retained by Terrex as the Project Geologist at this time.

By September 1986, Tasbax had lost complete confidence in Terrex. Terrex/Lightning Ridge had failed to meet the required payments of $200,000 due under the terms of the Joint Venture agreement between Amoco and Tasbax. Cyprus (formerly Amoco) renegotiated the agreement with Tasbax and the Seruis/Terrex group were removed from the Joint Venture. Some exploration data from this period is no longer available due to this change of interests.

During March 1987, Frith, an adjacent lease owner entered into an option with Cyprus and Hudspeth & Co covering MLN 790 over the International. At this time Tasbax also added the house and buildings on site to the agreement. By July 1988, Cyprus had purchased from Tasbax the house and all the leases including MLN 39 in the Carlton Area.
Between 1987 and 1989, a number of RC drilling programmes were completed on Gandys Hill and International along with geological mapping. During late 1989, agreement for the transfer of exploration data with Pine Creek Goldfields was completed and this took place in November 1989. By this time some 8932.1m of drilling had been completed on Gandys Hill and 8581.9m on the International.

On 29 December 1989, Cyprus Gold Aust transferred their interests in Carlton to the joint venture partner, Arimco NL, for other considerations as part of an Australia-wide redistribution of assets and other interests on dissolution of the JV.

In January and February 1990, Arimco NL undertook an evaluation of the Carlton Project. The extra data from PCGF is being incorporated into the data bases. A 3D geological model is currently being compiled by Mr Taff Davies and only selected preliminary sections are available. Preliminary geostatistical studies have been undertaken by Mr Daniel Guibal of Siromines.
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* Burial site not to be disturbed
TENURE

In order to resolve the complex tenure problems, Arimco NL has made an application for an Exploration Licence 6958 on 9 February 1990, covering the area for a period of one year. The EL will freeze the area in our favour, protect our interests and remove the opportunity of nuisance pegging taking place in this highly sensitive area. The area has had a history of overpegging and problems with disputed ownerships. Bloomfield (1990) discusses the full details and options available to Arimco; these recommendations are included below report.

As part of the Arimco evaluation programme, the mining lease tenure in the Carlton Project Area was checked. The field identification of the survey of lease marks and comparisons with lease descriptions was completed by surveyors D Kentwell (Arimco) and C Bloomfield (Grid North). The tenure situation is so interlocked it is vital the correct relationships be resolved before the economic exploitation of the possible resource can be undertaken (see Figure 3).

A list of tenements held in the Carlton Project Area is listed in Table 1. Total area of tenements held is 31 ha under Mineral Lease and 540 ha under Mineral Claim with a further 1 ha under application. One EL, covering four blocks, covers the Carlton Project Area.

Recent survey work by Arimco has shown all the lease corners are at variance with those plotted on the currently existing Cyprus Geological maps, by some 5 to 10m but up to 30m. These lease surveys are also at variance with Mines Branch Survey plans (see Figure 4).

The principal problem areas are overpegging. The resultant conflicts with adjoining leases are summarised below:

1. MCN 763 (Arimco) and MLN 792 (Millwood) boundary was overpegged and has left a vacant wedge (see Figure 4). This wedge should be taken up by Arimco.

2. MCN 763 and Lot 213 (Harbrow) boundary have overpegged. NT Mines Branch Survey data suggests Lot 213 has overpegged MCN 763 by some 20m. Lot 213 was an old mining title which was transferred to freehold and incorrectly resurveyed by the NT Lands Branch. It would appear Mr Tommy Harbrow has now built a house in the area of conflict (see Figure 4). This problem will have to be resolved before development starts.

3. MCN 1230 (PCGF) has been shown to overpeg the western edge of MCN 763 (see Figure 4). Description to be amended.

4. The northern boundary of MLN 790 (Arimco) and MCN 1958 (PCGF) has been shown in field to be at variance with survey plans. Field identification of pegs is required to determine if the vacant strip is present (see Figure 3).
Figure 4

ARIMCO N.L.

MINING LEASES SOUTH END OF CARLTON

Scale 1:3437 Approx Do not scale

5. Minor problems between adjoining Arimco leases would be resolved if the leases were to be consolidated, re-described and surveyed.

6. The vacant ground south of MCN 763 and between MLN 13 (PCGF), this wedge should be taken up (see Figure 4).

The complex interlocked lease tenure with two other lease owners has been a major constraint in the effective evaluation of this prospect. The extra data of PCGF has only recently become available for evaluation by Arimco.
Namoona Group - Masson Formation
Mt Partridge Group - Wildman Siltstone and Mundogie Sandstone
South Alligator Group - Koolpin Formation, Gerowie Tuff, Mt Bonnie Formation
Finniss River Group - Burrell Creek Formation, Gerowie Tuff, Mt Bonnie Formation
Cullen Batholith - McMinns Bluff Granite
Tolmer Group - Depot Creek Sandstone, Stray Creek Sandstone
Daly River Group - Jindare Formation, Tindall Limestone, Junkin Formation
Petrel and Bathurst Island Formations
Major shear zone
Fault

Figure 5  REGIONAL GEOLOGY, PINE CREEK, NT.
GEOLOGY OF THE CARLTON AREA

(a) REGIONAL GEOLOGY

(i) Geology

The Carlton Project lies in the southern part of the Pine Creek Geosyncline, which is described by Needham, et al, 1980. The geosyncline contains Early Proterozoic metasedimentary rocks overlying gneissic and granitic Archaean basement. The basinal sequence up to 14km thick was folded at 1870-1800 Ma and metamorphosed mostly to greenschist facies in places to amphibolite facies (see Figure 5).

The sedimentary rocks of the geosyncline are mainly shale, siltstone, sandstone, conglomerate, carbonate rocks and iron formation. The pelitic rocks are commonly carbonaceous. Felsic to mafic volcanics and associated tuffaceous sediments are present. The sediments were intruded by transitional igneous rocks ranging from pre-tectonic dolerite sills and syn to post-tectonic granitoids, plutons and dolerite lopoliths and dykes. Largely undeformed cover of Middle Proterozoic Tolmer Group and Cambrian Daly River Group unconformably overlie the area forming dissected plateaux.

At Pine Creek the Burrell Creek Formation is a south-easting trending lobe conformable underlain by the Mount Bonnie Formation. The lobe is some 35km long and 5km wide in an embayment in the Cullen Batholith. The area has pervasive thermal metamorphic effects throughout. The lobe lies within a major structural feature termed the Noonamah-Katherine Lineament. In the Pine Creek Area, the lineament is represented by the Pine Creek Shear Zone. In the area around Pine Creek the lineament contains numerous aligned tight folds and shears and has been shown to host a concentration of gold occurrences.

(ii) Rock Nomenclature and Logging Procedure

With the exception of quartz veining, all rock types at Carlton are of sedimentary origin. Only three major species are recognised. These consist of coarse clastic, fine clastic to argillic and cherty rock types.

The coarse clastics range from fine to medium grain quartzwacke or greywacke. In hand specimen the coarse component appears to consist of glassy or milky angular to subrounded quartz. Feldspar is rarely visible and lithic fragments are identified on only a few occasions. The matrix consists mainly of fine granular or granoblastic quartz grains within which lie quantities of very fine grain biotite, chlorite and carbon. An increase in biotite tends to darken the matrix and is thought to indicate a primary rock with more detritial fragments.
Classification of RC drill cuttings was reliant on the identification of the contained clasts or metamorphic mineral assemblages. In drill core the coarser clastic units can be seen to be almost devoid of bedding features and to lack many of the metamorphic textures associated with the more alumina-rich argillic facies.

Sedimentary features rarely occur within the sandstones. Flatter structures lying at the interface of clastic and argillic sediments, graded and slump-bedding features are sometimes noted. Features indicative of a shallow-water environment are absent.

The relatively structureless appearance of the major quartzwacke assemblages noted within the drill core was also used a criterion for recognition of clastic assemblages during geological mapping. Structural data is rarely obtainable in major sandstone sequences at Carlton.

Because of their variable alumina content, argillites are often preferentially modified such that primary bedding features are still recognisable. In many instances carbon is present in sufficient quantities to discolour drill material. The carbonaceous facies themselves often have elevated levels of sulphide mineralization together with nodular and lamellar cherts. They frequently grade into or are interlaminated with non-carbonaceous argillic facies.

Argillaceous rocks may, by facies variation, pass into siltstones or, more rarely, directly into quartzwackes. Fine banding, probably related to a high biotitic component, is sometimes visible in these transitional zones. Such fine sedimentary laminae are referred to in the drill logs as 'HM' banding because of its physical resemblance to the heavy mineral banding sometimes encountered in shallow water clastics. This terminology has no genetic connotation.

Cherts occur as bands ranging in thickness from 4-5cms to less than 1cm. On occasions this silica coalesces to form small nodules. The laminae are believed to be laterally persistent and tend to be repeated over short intervals within the core. Chert is rarely recognisable in RC drill cuttings.

Quartz vein material estimates are imprecise because hydrothermally altered wall rock tends to be washed out during sample recovery and treatment. Exaggeration of relatively small quantities of quartz is anticipated in RC returns and this factor has been compensated for to some degree during logging.

The correlation of RC drill cuttings with diamond drill core is difficult. Mylonite zones tend to be ground up or sieved out of the drill returns and units logged as fine quartzwacke to siltstone in drill core may be identified as siltstone in RC drill samples because the sample is less representative. Overall however, the inter-hole correlation of geological data proved accurate enough to provide a stratigraphic framework for the project.
(iii) Metamorphism

Two metamorphic events have influenced Carlton geology. The earliest phase to occur is that of regional greenschist facies metamorphism. The second is believed to be granite-related and of the static-thermal type. Acid intrusive outcrop not far to the west of Carlton and the enormous amount of silica flooding which permeates all rock types in the area probably originates from this source. Rocks that outcrop less than a kilometre to the east of Carlton are largely unaffected by these events.

The sandstones at Carlton are converted to granoblastic quartz-rich assemblages, while the alumina rich argillites are now porphyroblastic quartz-chlorite-biotite-cordierite assemblages. Coarse cordierite porphyroblasts are usually compositionally zoned and lie within pale iron-deficient bands. Presumably the retrogressive phyllosilicates which replace the original Al₂SiO₅ polymorphs are iron-enriched at the expense of their surrounds.

Pink fine grain garnets commonly occur in the more graphitic stratigraphic members. These are frequently referred to in the drill logs as spessartine garnets since the colour and appearance is appropriate and these iron-manganese assemblages generally have a comparatively low-temperature origin in keeping with the metamorphic grade of the region.

(iv) Metasomatism and Quartz Paragenesis

Potash metasomatism influences substantial portions of the sequence. K-metasomatic alteration principally affects quartzwacke adjacent to quartz veining and to mineralised argillic units and is recognised because of its pink discoloration or bleached appearance. Coarse arsenopyrite blades, cruciform twins or discrete anhedral grains are associated with this type of alteration. The presence of metasomatic features within sandstone rather than within argillite is presumed to be the result of its comparatively higher degree of permeability.

Quartz emplacement is a multi-stage event which reflects the complex metamorphic and tectonic history of the region. At least three periods of quartz intrusion are identified in drill core.

The earliest of these appears to be the banded-stratiform graphitic or smoky quartz lying within the International Marker and elsewhere. These veins are often finely banded and sulphidic. Cross-cutting glassy and smoky quartz veins penetrate these.
Glassy to smoky quartz veins are the most common form of quartz mineralization and may be cut by white and opaque or milky coarsely vugly quartz believed to be of low-pressure or epithermal origin. Cavities within the veins may contain 'cockscomb' crystalline quartz growths and internally zoned quartz laminae. Epithermal quartz systems tend to form brittle fracture-fill stockwork of distinct morphology. Coarse subhedral pink potash feldspar aggregates have co-precipitated with these veins.

The epithermal veins appear to represent the last intrusive event to effect the geology at the Carlton prospect and as a result they have been disrupted only by brittle fracturing and late stage faulting. Their feldspar and sphalerite-galena mineralization suggests that they are granite derived. If so, the gold mineralization, which is interpreted as being unrelated to either quartz flooding or to epithermal quartz mineralization, must pre-date the granite-emplacement event.

Hairlike potash-rich salmon pink veining is sometimes present in the core. Calcium carbonate is rare and confined to fine late-stage brittle fractures. The main gold and sulphide assemblages do not appear to be particularly carbonated.

(v) Stratigraphy of the Carlton Area

Three major argillic and clastic stratigraphic subdivisions have been identified on the International Line and four such zones have been recognised within the Gandys Hill Line.

The lines are separated by an undrilled alluvium and scree covered slopes. However, the distance separating the two lines for which outcrop and drill data is not available is as little as 90 metres in the northern part of the prospect.

There is strong reason to believe that the clastics mapped as the Quartzwacke Unit on the International Line correlate with the Upper Quartzwacke Unit on the Gandys Hill Line. This is now known as the Middle Quartzwacke Unit. The lithologies observed both at surface and in drill material support this interpretation. The stratigraphy is therefore matched as follows:

<table>
<thead>
<tr>
<th>International Line</th>
<th>Gandys Hill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Argillite Unit</td>
<td>Middle Quartzwacke Unit</td>
</tr>
<tr>
<td>International Marker Unit</td>
<td>Middle Argillite Unit</td>
</tr>
<tr>
<td>Middle Quartzwacke Unit</td>
<td>Lower Quartzwacke Unit</td>
</tr>
<tr>
<td>Middle Argillite Unit</td>
<td>Lower Argillite Unit</td>
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</tbody>
</table>
(b) MINERALIZATION

The gold mineralization present on the International Line is predominantly quartz vein hosted (see Figure 6). This conclusion is drawn from the close association of gold and quartz and its much more erratic correlation with sulphide and specific rock types. Quartz vein material is returned from almost all gold-bearing RC intersections and drill core material displays the same type of gold-quartz association. Visible gold is observed to occur only in quartz veining. When sulphide is present in gold mineralized zones then quartz is usually present. In some instances the quartz and sulphide may have co-precipitated. This is probably the case within the International Marker - a zone which appears to have tapped off gold at certain levels of its stratigraphy throughout much of its extent.

The major structural components of the International Line appear to be of secondary importance in determining gold distribution and grade. The core of the International Anticline is no longer regarded as a prime target for exploration, since most of the gold mineralization present appears to lie on the south-western flank of this structure, and also within the Carlton Syncline itself. In some instances the mineralization crosses the core of the syncline and is located within the flanks of the Gandys Hill Anticline. As discussed above, the Carlton Syncline late stage brittle fault zone has no recognisable influence on the distribution of gold mineralization.

Stratigraphy plays some part in determining gold grade. The tendency of gold mineralization to track along the International Marker has been mentioned, and the concentration of the highest grades at the contact of argillite with sandstone is a commonly observed phenomenon. Quartz veins often display similar controls.

Early or intermediate stage smoky to glassy quartz appears to be associated with the gold mineralization. The milky quartz veins of epithermal type are not, as far as can be determined, gold bearing. This mineralization is probably associated with late stage granite intrusion. Gold in the Pine Creek goldfield however, occurs well beyond the thermal influence of the granite and is consequently inferred to have a regional metamorphic source.

Gold mineralization is closely related to quartz emplacement. This intrusion is controlled to a large degree by the structure of the Gandys Hill Anticline (see Figure 7). Quartz mineralization lies within the core of this structure as both massive quartz reef and as veins or stringers. The more massive quartz often possess a typical saddle-reef profile, the main quartz mineralization being confined to the core of the anticline and the quartz down-dip being most strongly developed on the eastern limb of the fold.
The reef cross-cuts stratigraphy but as a general rule is best
developed on or just above the Lower Quartzwacke and Upper
Argillite contact. It is well exposed near the termination of
the adit at 2957N and has been intersected over a width of 20
metres on section line 2750N. Between lines 2850N and 2900N its
plunge is reversed and it lies above the 200 mRL level. This
coincides with the anticline plunge reversal documented above.

The best grade gold mineralization lies mainly within, marginal
to, or directly above this reef. In contrast to the Inter-
national Line, the gold mineralization is mainly restricted to
argillite. Exceptions to this occur within the Lower Quartzwacke
below its upper contact, and within steeply dipping quartz
mineralised zones near the core of the anticline.

(c) THE INTERNATIONAL LINE

(i) Stratigraphy

The International Line contains three main stratigraphic units.
These reflect the occurrence of alternate pulses of high energy
clastic deposition interspersed with low energy precipitation of
argillic, silty and cherty sediments.

A number of subdivisions have been mapped within these units.
In some instances these indicate that short term stable
sedimentary regimes occurred throughout the region for which
drill information is available. The most persistent and readily
identified of these is referred to as the International Marker.
Other facies subdivisions are based on the presence or otherwise
of carbon and chert bands. The proposed layout of stratigraphy
for the International Line is as follows:

I. The Middle Argillite

This unit represents the lowest intersected stratigraphic member in the International Line. It is encountered in
core recovered on and to the north of line 3700N. One
lines 2850N and 3100N two sub-units are present comprising
a lower pale siliceous silty to argillaceous unit and an
upper dark grey graphitic unit. Elsewhere the lower member
has not been penetrated, and the graphitic unit may be
separated from the overlying clastics by a carbon-free
siliceous argillite.

Within the graphitic member on both lines 2850N and 3100N
two zones of lamellar and nodular chert are mapped. These
lie close to the upper and lower contacts of the sub unit.
Occasional fine pale stratiform bands, interpreted as thin
ash-fall zones are also recognised.

The graphitic member is estimated to be 12-15 metres thick,
but the thickness of the non-carbon bearing portion is more
variable, the upper silicic unit is absent from the
sequence in all intersections to the south of line 2900N.
II. The Middle Quartzwacke

This is for the most part a monotonous clastic sequence generally containing fine or fine to medium grain quartzwacke. It occasionally coarsens and may be graded and slumped. The thickness of the unit varies from 45 to 60 metres.

Argillaceous laminae break up the quartzwacke, indicating that it probably formed as a series of pulses interrupted by short periods of quiescence when muds and silts replaced sands as the dominant sediment. The distribution of the thicker argillic bands is shown on the 1:1,000 scale facies map. These correlate from section to section and it is presumed that the thicker members are continuous and interlinked clay lenses. The finer facies often vary laterally from carbonaceous to carbon-free.

Unit 2 contains the International Marker which lies from 20 to less than 10 metres below the upper contact of the quartzwacke. Above this zone the clastics tend to contain increased quantities of argillic material.

III. The International Marker

The International Marker (I.M.) is a distinct and readily mappable chronostratigraphic zone. It is predominantly argillic and graphitic. As such it is not notably different from other argillic members. However, near its lower contact it contains a finely laminated and sulphidic chert band. Its upper contact is often marked by the presence of laminated, smoky and sometimes contorted quartz veining. Thin nodular cherts may lie beneath the I.M. chert. In several instances the I.M. contains thin pale and possibly tuffaceous laminae.

The chert is often no more than a few centimetres thick, and yet may be correlated between all diamond drill intercepts to the south of line 2400N, i.e. over an area of 150 x 100 metres, and in core recovered from lines 2800N to 3000N. The I.M. varies in thickness from 2 to 7 metres, but where more substantial thicknesses are encountered the stratigraphy appears complexed by the merging of overlaying argillite as a result of the omission of intervening quartzwacke lenses.

IV. The Upper Argillite

The Unit 3 argillite is preserved in the core of the International Syncline. The thickness of the residue is usually in the order of 15 metres, but this may be structurally reduced where the amplitude of the fold increases.
One most lines the Unit may be subdivided into a lower pale silicic and an upper graphitic member. However between lines 2500N and 2650N the graphitic unit rests directly on Unit 2 quartzwacke. This upper member is frequently well laminated, locally sulphidic and chert banded or alternatively it may contain nodular cherts.

(ii) Structure

The structure of the International Line is relatively simple. It comprises a broad north-west trending anticline and a flanking relatively tightly folded syncline. The syncline structure lies to grid west of the anticline. The International Line gold mineralization is present within and transitional to both structures.

The core of the anticline is intersected by diamond drilling on line 3100N and mapped at surface near the Maid of Erin gold workings. It is offset to the north-east of the gold mineralised line and at outcrop the structure appears asymmetrical with the south-western limb being more steeply dipping than that lying to the north-east.

The syncline is an upright asymmetrical fold. The south-western limb is steeply dipping to sub-vertical while the north-eastern limb characteristically dips at 50° to 70° to the south west. The morphology of the fold is outlined by the contact between Unit 2 quartzwacke and Unit 3 argillite. These markers indicate that the fold amplitude is uniform throughout much of the International Line, but that the fold narrows just north of line 3000N. This is attributed to a shallowing of the synclinal keel to a level whereby the graphitic core is eroded.

The core of the syncline is faulted. This caused major brecciation, mylonitisation and slickensiding in the graphitic portion of Unit 3. Its influence is obvious in the central portion of the International Line but appears to diminish northwards. The substantial widths of fault gouge evident on lines 5500N in core obtained from drillholes IDD 14 and 17 are, for example, absent from drill core recovered from lines 3000N-3150N. Drilling carried out to the south of line 2550N was undertaken too far to grid west to intersect the fault.

The fault appears to bifurcate on line 2800N while elsewhere probable splays off this structure occur. The fault attitude is sub-vertical, however, its downthrow degree and direction are not known. The only other faulting to influence the International Line is a north trending feature which transects line 2550N and causes minor dextral displacement of the International Syncline.

The main fault is of the late-stage brittle fracture type. Its brecciates all quartz veining that lies within its sphere of influence and has not been affected by contact metamorphism or annealing processes.
Both surface geological and drill data prove that the most southerly mineralised zone as the Maid of Erin is both a structural and stratigraphic continuation of the International Line gold mineralization to the north-west.

(iv) Economic Geology

Plots of the relationship of stratigraphy and structure against gold distribution have been completed over the International Line. Major areas of gold mineralization have been blocked out on the drill sections and these data then extrapolated to the small scale level plans. A cut-off of 1 g/t was generally applied to these with the proviso that the intersected width of mineralization is sufficient to offset low gold grades.

The 'ore' blocks indicated on the International Line drill sections offer a best-fit estimation of gold distribution based on the correlation of quartz-gold mineralised zones, or, less commonly, on the influence of stratigraphy on gold distribution.

The level plans of gold mineralization and its relationship to stratigraphy show that the gold lies mainly within the Unit 2 quartzwacke, but the substantial blocks of mineralization have been intersected within both Units 1 and 3. There is clear justification for laterally extending the drilling into flanking stratigraphy.

The planar view of gold mineralization of the R.L. plans show that correlation of blocks of mineralization between sections is sometimes poor. Presumably in some areas the host quartz stockwork and vein systems pinch and swell markedly. There is some indication that the gold bearing zones possess an en-echelon arrangement with the mineralization being offset to the north and east. This equates with the pattern of gold workings mapped on the International Line.

On some lines of drilling substantial gold intercepts cannot be correlated with drilling results from adjacent drill holes. In general the mineralization tends to be truncated with depth, or down-dip. The reasons for this are thought not to be related to complex structure are more likely due to rapid variations in the distribution of gold mineralization. The prepared structures which now contain gold are probably sharply lenticular in profile and possibly act as conduits for lateral migration of ore-bearing material rather than for vertical emplacement of the mineralization.

(d) THE GANDYS HILL LINE

(i) Stratigraphy

The Gandys Hill Line gold mineralization lies within the major south-plunging anticlinal fold of the Gandys Hill Anticline. This structure is believed to be an extension of the Enterprise Mine anticline which lies 1.2 kilometres to the south-east.
Four major stratigraphic units have been recognised within the Gandys Hill Anticline. These consist of alternating argillic and clastic units as follows:

I. **The Lower Argillite**

The Lower Argillite has been intersected within the core of the Gandys Hill Anticline in drilling carried out on and to the north of line 3000N. The unit is tightly deformed and its true thickness is not known. Diamond drill core on line 3150N shows that the argillite is mainly carbonaceous and contains abundant chert laminae and nodular bands.

II. **The Lower Quartzwacke**

This is an undifferentiated fine to medium grain clastic member that is similar in many regards to the quartzwacke sequences encountered within the International Line. It is massive and fails to develop the argillic banding that occurs in, for example, the upper portions of the International Line Unit 2 quartzwacke. It varies in thickness from 30 to 40 metres.

III. **The Middle Argillite**

This member varies from 40 to 50 metres in thickness. It is characteristically chert banded and graphitic, but non-graphitic facies are also encountered in most drill sections. The lower portion of the unit may be broken by one or more thin, and sometimes impersistent, quartzwacke bands.

In outcrop the Middle Argillite contains a relatively thin (2-4 metres wide) pale grey marker zone. The colour is created by the development of a white powdery coating. Internally the unit often appears weakly ferruginous and finely silty. Its diagnostic characteristics are probably amplified by weathering processes as the Marker cannot be recognised in drill material.

IV. **The Middle Quartzwacke**

The upper quartzwacke constitutes the youngest portion of the Gandys Hill Line stratigraphy intersected in drilling. It is a complex and often rapidly alternating sequence of clastics and silty to argillic rock types generally dominated by quartzwacke. The sandstone becomes more massive upwards and ranges in grade from fine to medium or rather coarse.
(ii) **Structure**

The Gandys Hill Anticline is a disharmonic upright symmetrical fold in which the argillic components of the succession have operated as zones of decollement thereby creating incompetent or flow patterns of folding. Thus in the northern segment of the mineralised zone the Lower Argillite is severely compressed relative to the overlying more competent sandstones. Its structural style is tightly isoclinal, but the overlying stratigraphy is less severely deformed.

The position of the Lower Quartzwacke and Middle Argillite contact is closely defined by drilling on several lines. The quartzwacke is generally deformed into a relatively broad or open and often asymmetrical structure. This contact at the crest of the fold is much more severely deformed than on the limbs. This is believed to be a drag response to the more disrupted overlying argillite lubricant. The argillite itself is considered to be flexured or drag-folded and possibly faulted by processes of bedding plane slip. Several structures related to differential movements of argillite on the flanks of the fold have been identified and incorporated in the drill sections.

At surface the Gandys Hill Marker can be traced to the crest of the anticline and mapped as a unit which diverges along the limbs of the fold in the central and northern portion of the prospect. A very similar band is also present within the Upper Argillite on the north-eastern flank of the fold. This converges on the Marker and can be outcrop-mapped to a point within ten metres of it. It is interpreted as a synclinal, tightly drag folded repetition of the Marker.

The International Anticline is a south plunging structure. Linear fabric and rodded chert bands pitch in the order of 10° to 15° to the south. However, in detail the fold plunge is demonstrably variable. For example between lines 2850N and 2900N the fold plunges at 6° to the north. Between lines 2500N and 2750N the fold plunges 10° to the south, this representing a relative lowering of 42 metres in the location of any point on the fold crest over a distance of 250 metres. Overall the fold appears to plunge at 11° to the south. The measured drop in elevation of the Lower Quartzwacke-Middle Argillite contact at the fold crest between lines 2500 and 3150 north is therefore 115 metres.

High angle normal faulting has been mapped near the crest of the anticline from drill results obtained on lines 2950N and 3000N.

(iii) **Economic Geology**

The establishment of gold mineralization blocks in Gandys Hill was undertaken on the same basis as those for the International Line. As such they are guides to the distribution of gold and should be modified to conform to more precise economic parameters
than those on which they are based. Only relatively high grade areas of mineralization have been outlined as selection of a lower cut-off level might obfuscate correlation of these main zones of gold mineralization. The distribution of the ore blocks are detailed on both the drill section plans and on the 1:1,000 level plans.

At both the 200 mRL and 225 mRL the richer zones of gold mineralization can be seen to converge southward and plunge below surface. This pattern of mineralization is concomitant with the structure of the Gandys Hill Anticline Projection of the main core of gold mineralization into areas where no drilling has been previously undertaken can be carried out with a fair degree of confidence.

As the Gandys Hill Line gold mineralization is relatively closely defined by both structures and stratigraphy it is reasonable to presume that the main core of the mineralization has been progressively denuded by erosion northwards. Only the residual mineralization lying on the flanks of the anticline are present on the northern drill lines.

Similarly, to the south the main zone of gold mineralization deepens. Thus on 2000N, which lies very near to the southern boundary of MCNs 763 and 297, the apex of the main gold bearing body intersected on line 2500N would lie at a depth of approximately 100 metres. The Gandys Hill Anticline is assumed to be the structural extension of the gold mineralised body of the Enterprise Mine. This being so then the gold being mined must either:

a. Lie at a higher stratigraphic level than that in the Enterprise Anticline, or
b. Be an upfaulted continuation of the Enterprise Anticline gold mineralization, or
c. Be projected to its present level by plunge reversal of the fold.

Pit mapping indicates that the anticline at the Enterprise Mine has a gentle southward plunge, which steepens outside the southern limit of the pit.
Figure 8  HISTOGRAMS OF CARLTON PROJECT Composite Assays
GEOSTATISTICAL REVIEW

Mr Daniel Guibal of Siromines was retained to complete a preliminary review the geostatistics of the Gandys Hill and International Line on the Carlton Project.

Some major constraints on the databases were known, the main one being mixed assay populations. The databases were clean except for two drill holes in Gandys Hill which were removed. Only a simple preliminary geological model was available.

The lack of paired diamond and RC holes is an important factor for the proper evaluation of the geostatistics of this Project. The completion of paired drill holes in the next drilling programme is urgently required to investigate the sample bias between diamond and RC drilling. The final 3D geological model will be the controlling factor of this full geostatistical review. The location of the paired drill holes has to be carefully planned so as not to bias the distribution of the data and full selection of the geological environments are made.

The assay populations from both Gandys Hill and the International were composited into 2.9m lengths and a Gaussian transformation made. The composited populations of Gandys Hill and International have been shown to be a lognormal population (see Figure 8). The q-q plots for Gandys show that a 3-parameter lognormal model (see Figure 9) could be fitted to the transformed population except for the very low grades and perhaps some very high grades. The population distribution of the International is not so clear cut, and the fit of a 3-parameter lognormal model is not as good. It is possible that a second statistical population is present in the International.

The complete series of variograms are presented in Appendix I. The indicator variograms in the Gandys Hill ore body envelope of +0.3 g/t are well structured down hole with a low nugget effect and have an isotropic behaviour. A short range of 20-25m can be found and a range of 100m N-S. There is no doubt that the 0.3 g/t cutoff corresponds to a continuous variable. Each limb was examined separately and were very similar in the two cross directions with perhaps the eastern limb having a better continuity N-S. The raw data shows good structure down dip and across strike but has high nugget effects, no N-S structure is present. The transformed values variograms on Gandys Hill are much better structured but have higher nugget effects. The N-S direction is not as well developed but has a range of 70m to 100m and again the eastern limb has a better N-S structure.

The indicator variograms in the International's ore body envelope of +0.3 g/t are structured with a relatively high nugget effect. Ranges of 30-40m down dip and across dip is clear but the N-S range of 200m exists. The raw data is not well structured with high nugget effects and short ranges. The transformed values behave better with ranges of 20m to 30m down dip but no structure along strike. This lack of continuity along strike makes resource calculations uncertain at this stage.
Figure 9  Q - Q PLOT OF CARLTON PROJECT  Composite Assays
This is a direct indication that more drilling on closer spaced sections is required on the International.

In summary, the variography of the raw grades and Gaussian transformed grades within the mineralized envelope (+0.3 g/t) at Gandys Hill are well structured down dip and across strike have variable ranges along strike. The International Line is less well structured and requires more drilling to test the geological and grade continuity as the prospect has only been drilled on 50m sections. Further drilling on Gandys Hill is required to test the continuity of the grade along strike with careful attention paid to establishing the preferred direction and orientation of the possible ore shoots and veins.

The variance ($\sigma^2$) of both deposits is greater than 2.2 in the global basis. The variance is not extreme but is very high especially as the higher grade selections are made. The coefficient of variance is consistent ranging between 1.3 to 1.6 for the population cuts above +0.3 and +0.4 while the more selective body selections of +0.3 and +0.4 range between 1.7 and 2.1 for both prospects (see Table 2).

Further drilling is required on Gandys Hill and the International to test the grade continuity and the geological interpretations. The problem of sample bias between diamond and RC drilling has to be resolved urgently. It would appear that the 25m drill section spacing is reasonable on Gandys Hill and the International Prospect has to be completed to the same standard. Further close spaced drilling is required on both Gandys Hill and International to define the N-S continuity of the grade. The mineralization in the core of the fold axes would be expected to have different spatial statistics to those in the limbs of the folds. The 3D geological model will supply the basis for this statistical drilling. The geological model has to be completed before a final statistical review can be completed.
<table>
<thead>
<tr>
<th>Selection</th>
<th>No of Data</th>
<th>Median</th>
<th>Mean $\mu$</th>
<th>Maximum</th>
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<tr>
<td><strong>GANDY'S HILL</strong></td>
<td></td>
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(after Guibal, 1990)
EXPLORATION PROGRAMME

The 3D geological interpretation of the Carlton Project Area will be completed by Mr Taff Davies. This interpretation will then be used as the basis for planning the next stage of the exploration.

The initial drilling programmed will be designed to get extra data to improve our geostatistical base and detailed geological interpretation. It is thought that this programme will be mainly diamond drilling. A shallow hammer drilling will be used to augment the deeper diamond drilling and previous RC drilling.

The current conflict in the Mining Tenure will be examined in detail and an attempt will be made to resolve the contentious aspects of the tenure. EL 6958 has been applied for over the area, this has frozen the area and removed the opportunity of nuisance pegging in this sensitive area.

A considerable amount of detailed drilling is still required to bring this Project to the development stage. It is currently proposed to stage this work and assess the results as each programme is completed. The aim being to bring the Project to the development stage as quickly and economically as is practical.

[Signature]

PETER DREVERMAN
Senior Geologist
ARIMCO NL
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