**Types of Gold Deposits.**

Gold can be described according to its natural size and nature of occurrence. Based on these, gold occurs in six main forms:

1. Large pieces of free gold >2mm in size that are known as nuggets.
2. Pieces of gold and gangue (quartz, ironstone etc.) known as specimens.
3. Coarse to fine grains of free gold 2mm to 150 microns that are visible to the naked eye.
4. Microcrystalline gold 150 to 0.8 microns in size only visible with a microscope.
5. Submicrocrystalline particles of gold that occur in the crystal lattice of certain sulphide ores.
6. In compounds with tellurium.

All types show various degrees of crystallinity from rounded grains (eg. alluvial) with no crystal faces through subhedral grains with some crystal faces (hydrothermal) to crystalline grains with well developed crystal faces (hydrothermal and supergene gold). In most situations, gold is found in rounded forms, however, where open space crystallisation has occurred, such as in supergene environments, crystalline gold is common.

Nuggets are well known to metal detector operators. While many nuggets are almost pure gold, impurities of iron and quartz are common. Nuggets that have been chemically deposited or altered in the weathering profile are often intergrown with ironstone.

Large grains and veinlets of gold intergrown with quartz are derived from quartz reefs and lodes and are referred to as specimens. These are also well known to metal detector operators.

Free grains of gold that are visible to the naked eye are either intergrown with gangue in primary deposits or as loose grains within secondary deposits. Machinery is required to separate gold grains from unwanted gangue. Fortunately, the high specific gravity of gold enables it to be effectively segregated and concentrated using low cost gravity methods, such as jigs, sluices, shaking tables etc.

Microcrystalline gold is common within primary deposits. Grains of gold are disseminated and intergrown within a quartz gangue or locked within sulphide minerals. Coarse grains can be liberated by crushing and grinding followed by concentration using gravity concentrators. If the ore consists of very fine grains extraction with sodium cyanide or amalgam is necessary.

Gold contained within sulphide minerals is present as small grains and particles within the crystal lattice of the mineral. Many primary deposits consist of disseminated grains of pyrite, chalcopryte, arsenopyrite and/or pyrrhotite containing significant amounts of gold and intergrown with gangue minerals. Sulphide minerals cannot be concentrated by gravity methods due to their low specific gravity. Froth flotation is common, followed by
treatment with sodium cyanide to remove the gold. Such mining methods are expensive and can only be used on large deposits, however low grades can be worked.

Gold also occurs in compounds of gold and/or silver with tellurium. The tellurides, calaverite and sylvanite are mined for their gold content. They are quite rare, however, have been mined in Kalgoorlie.

5.0 GOLD ENVIRONMENTS

Gold occurs in alluvial, eluvial, supgene, quartz vein and stockwork, shear related and hydrothermal replacement deposits. In the general sense, alluvial refers to eluvial, colluvial, fluvial and lacustrine deposits but is restricted to the traditional meaning of stream and lake deposited gold here. Alluvial, eluvial and supgene deposits are secondary deposits formed by reworking of primary deposits. Quartz vein and stockwork, shear related and hydrothermal replacement deposits are primary deposits formed by the direct precipitation of gold from hydrothermal solutions originating in the earth's interior. Alluvial and eluvial deposits are collectively known as placer deposits. Large, continuous quartz veins are known as quartz reefs and all other large primary deposits are usually referred to as lodes. Alluvial deposits are formed by the mechanical accumulation of grains, derived from pre-existing rocks, in streams and lakes. Eluvial gold is deposited on the surface by the downward movement of material, via gravity processes, from the source which is situated above. Supgene deposits result from "in situ" weathering of mineralised bedrock which leaves behind a residue of weathered bedrock, primary and secondary ore in the weathered profile. Quartz veins are formed from hydrothermal solutions which intrude the country rock along fractures and faults. Lodes consist of a closely spaced network of quartz veins and veinlets. Shear related deposits form during shearing of the host rock along planes of stress. The associated hydrothermal solutions form gold bearing alteration haloes around the shear zones. Hydrothermal replacement deposits are formed when hot aqueous solutions react with and replace the host rock.

Figure 4

Alluvial Deposits

Alluvial deposits consist of hydrodynamically accumulated gold by streams and lakes. They occur on the surface, just below the surface or deeply buried. Ancient stream channels that are deeply buried are called deep leads.

Gold and heavy minerals, such as magnetite, ilmenite, zircons etc. have high specific gravities; therefore, they will be transported within the base of flowing currents where they will be trapped by irregularities in the channel base or changes in current velocity. In present day channels, the heavy mineral fraction, including gold, will accumulate in pools and in cavities, fractures, depressions, behind ridges and boulders present in runs between pools. Gold will also occur in buried channel alluvium below the present river bed. Basal channel deposits will contain the most gold. These rest upon the bedrock. Other channel base deposits can occur between the surface and bedrock where they are marked by beds
of coarse sediments, pebbles and conglomerates. Gold and heavy minerals will be much finer grained than the light fraction. This is due to their density and size relationships, expressed as their hydraulic ratio. Consequently, fine gold and small gold nuggets will be found with coarse sediments, pebbles and conglomerates.

Another area of heavy mineral accumulation is the point bar. A point bar is formed on the inside of a bend in a meandering stream. Current flow is strongest on the outside of the bend, decreasing inwards. As a result, heavy minerals will drop out of suspension on the inside of the bend, or point bar, where current flow is least. As the stream migrates laterally, increasingly finer grained material is deposited until the channel is finally covered by fine grained alluvium. Stream channels that migrate laterally form widespread alluvial deposits that may contain gold in the abandoned channel base or point bar.

Figure 5

Eluvial Deposits

Eluvial gold is deposited by gravity processes on the surfaces of hills, rises and flat lying areas. Rainfall assists by carrying the surface material, or float, downslope. Eluvial deposits consist of the unconsolidated rock fragments and soil lying on the surface. It is derived from quartz reefs and other mineralised deposits (supergene, quartz reef and lode) located above. Deposits of transported material containing gold also form on the surface of hillsides where it is concentrated at changes in gradient, such as, the base of a hill. Technically, this hill wash is referred to as a colluvial deposit but is included with eluvial deposits here.

Figure 6

Supergene Deposits

Supergene deposits include both secondary and primary gold that occur in the weathering profile from "in situ" weathering of an orebody. It consists of chemically altered primary grains and nuggets, secondary grains and unaltered primary gold which may overly auriferous bedrock. Supergene gold, as it is popularly known, is the chemically precipitated gold grains and nuggets deposited within surface ironstone's, including laterite, of the weathering profile. Aqueous solutions travelling through the weathering profile transport and concentrate the gold element at or above the water table. Chemically reworked and physically transported primary grains and nuggets are present in the surface and near surface laterite and soil. Secondary gold, formed by chemical precipitation, is dispersed within the surface laterite and deeper saprolite of the weathering profile. Below the water table, unaltered primary gold, within the orebody may be present. Rich deposits, such as the "Rabbit Warren" gold find, near Leonora, have been found by the metal detecting prospector in WA.

Quartz Reefs and Stockworks
Auriferous quartz veins and stockworks containing free gold are keenly sought after by prospectors. Quartz veins originate from hydrothermal solutions being injected along fractures and faults in the country rock. The source of these hydrothermal solutions varies. They may be sourced from rising magmas that crystallise to form igneous rocks. The solutions left over are injected into fractures and faults overlying the igneous bodies. They may also originate from a deeper magma source or metamorphism of the surrounding country rock.

Figure 8

Fractures and faults cut the country rock at various angles and in various patterns. Consequently, the infilling quartz veins cut the country rock according to the pattern of fractures. A concentrated network of gold bearing quartz veins forms quartz stockwork deposits. Widely spaced networks of quartz veins are known as vein sets. Saddle reefs form when quartz veins are concentrated in the apex of an anticline.

Quartz veins are classified as hypothermal (high temperature), mesothermal (medium temperature) or epithermal (low temperature) veins. Hypothermal veins are deposited at great depths (>3600m). Epithermal veins are deposited near the surface. Gold is not only present within the quartz vein itself but also in the altered zone of wall rock associated with quartz veins. Gold occurs as free grains in quartz veins and submicroscopic particles within sulphide minerals. The auriferous sulphide minerals are concentrated in the altered zone of wall rock adjacent to quartz veins and within the quartz veins themselves.

In the Yilgarn Block, most auriferous quartz veins are contained within mafic rock types (particularly meta-basalts, meta-dolerites, amphibolites) within volcanic dominated greenstone belts. Ultramafics and felsic volcanics also contain gold deposits (in fact, all rock types are represented). Auriferous quartz veins are mainly controlled by shear zones and faults, particularly where faults cut competent (brittle) beds, such as dolerite, contained within less competent country rock. Vein type mineralisation occurs at Kalgoorlie, Leonora, Wiluna, Cue, Mt. Magnet, Sandstone, Marble Bar etc..

Figure 9

Other

Shear related, Banded Iron Formation hosted and hydrothermal replacement deposits also occur (listed in decreasing abundance). Shear related gold mineralisation consists of alteration haloes (a form of replacement) around zones of intense deformation (shear zones), formed from the reaction of hydrothermal solutions with the wall rock. Gold is present as submicroscopic particles within sulphide minerals that occupy the alteration haloes. Quartz veining can also be present.

B.I.F. (Banded Iron Formation) hosted deposits are an example of host rock control, being restricted to a B.I.F. unit. They contain either replacement style or auriferous quartz vein mineralisation. In replacement style B.I.F. deposits, hydrothermal solutions transport
the gold element along faults, forming auriferous deposits by replacing magnetite and carbonates within B.I.F.. At Hill 50, near Mt. Magnet, gold is concentrated along northeasterly trending faults cutting the Banded Iron Formation. Gold is present as submicroscopic particles within sulphide minerals plus/minus free grains. The sulphide minerals replace carbonates and magnetite within B.I.F.. Auriferous quartz veins, within B.I.F., occur in the same fashion as those described under Quartz Reefs and Stockworks. These deposits are entirely restricted to a host B.I.F. unit.

With hydrothermal replacement deposits, hydrothermal solutions react with and replace the host rock, forming massive or disseminated gold deposits. In the massive style these typically preferentially replace a specific bed. This style is called stratabound as it is restricted to a single bed, or stratum. These can occur in combination with the deposit styles described above.

Figure 10

6.0 PROSPECTING METHODS

In the early days, prospectors adapted their equipment to environmental conditions so that dryblowers were used in dry areas and hydraulic concentrators in wet areas. Today, metal detectors have superseded the dryblower as the major prospecting tool. The gold pan and sample mill also have their uses.

Metal Detecting

The abundance of iron oxides on the surface of W.A.’s goldfields caused many problems for the first metal detectors. This led to the introduction of ground cancelling machines in 1975. They proved effective and became popular, although there are still areas where ground cancelling machines cannot operate.

The metal detecting prospector is concerned with alluvial, eluvial, and supergene gold. In the Yilgarn and Pilbara Blocks, these occur in linear greenstone belts. Areas that have been dryblown by the early prospectors mark surface gold producing districts. Many nuggets have been found on and adjacent to these dryblowing patches. Together with the geology, they should be regarded as initial guides to metal detecting areas.

Alluvial gold can be found in the small seasonal streams that cut these areas. Basal channel deposits concentrate heavy minerals and are the most prospective deposits. Laterally migrating streams that change course regularly will contain gold in the abandoned channel base and point bar. These deposits will occur in the present day stream channel and immediately adjacent ground.

Eluvial gold can be found on low hills, rises and flat lying areas adjacent to the above locations. These are often covered with quartz and ironstone rubble. Eluvial deposits are concentrated at a change in gradient, such as the base of a hill.
Supergene deposits are found on low hills or flat lying areas that have developed laterite profiles over bedrock. The occurrence of supergene gold is difficult to predict since it is controlled by a complex combination of processes. It is generally present above weathered orebodies where it is concentrated and deposited by certain solutions travelling through the weathered zone. Secondary gold occurs in the surface laterite and deeper saprolite of the weathered zone (laterite profile) and consists of dispersed crystalline grains. Chemically altered and physically transported primary grains and nuggets, derived from the original orebody, occur in the surface and near surface with the secondary deposits. These are the main targets for metal detector operators. Weathered bedrock is also often covered by thick sequences of transported overburden (sand sheets, alluvium and colluvium). This material should be avoided as it has been diluted and mixed. The prospector should also beware of laterite profiles developed over alluvium and colluvium instead of bedrock.

In most situations, alluvial, eluvial and supergene deposits will only form over bedrock or residual laterite profiles. Exceptions to this occur when alluvial and eluvial systems are fed from these areas or where deeply buried ancient river channels exist.