THE
MINERALOGICAL SOCIETY
OF
NEW SOUTH WALES INC

C/o School of Natural Science
B.C.R.I. Parramatta Campus University of Western Sydney
Locked Bag 1797 Penrith South DC N.S.W. 1797
Website: **www.minsocnsw.org.au**

NEWSLETTER

OCTOBER 2011

The October Meeting will be held on Friday the 7th of October at 7.30 p.m. in the LZG14 lecture theatre on the ground floor of Building LZ in the Science campus of the University of Western Sydney on the corner of Victoria Road and James Ruse Drive in North Parramatta.

The program will comprise a lecture to be given by Professor Ken McQueen on : -

'The Nature and Historical Development of the Albert Goldfield,

Milparinka – Tibooburra, western NSW'

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FORTHCOMING MEETINGS

Society Meetings will be held on the first Friday of each month through the rest of this year. Subject to circumstances some changes to the following schedule of program subjects and speakers may have to be made in due course.

November 4th : Lecture by Adam McKinnon on 'Establishing a New Mine at Mineral Hill'.

December 2nd : Christmas Social.

February 3rd 2012 : Lecture by Dieter Mylius and John Chapman on the 'Landforms and Minerals of Iceland'.

March 2nd 2012 : Lecture, (not finalised), on 'Metallogenic Mapping. Locating the Mineral Deposits of N.S.W.'

April 13th 2012 : (Good Friday is on the 6th of April in 2012. The Society Meeting therefore will be held on the second Friday). The program is not finalised but may include a lecture on 'Diamonds'.

May 4th 2012 : Members Mini-Auction.

June 1st 2012 : The Society Meeting is on the first Friday in June. Program to be advised.
(The Queen's Birthday public holiday is on Monday 11th June, - after the second weekend of the month.)

July 6th 2012 : Lecture by Arthur Roffey on 'A Lifetime with Minerals'

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FIELD TRIPS

The projected **Field Trip to the Garrawilla area** over the first week in October has had to be cancelled. Unfortunately not all of the property owners whose properties the trip party organizers would have wished to visit could be contacted and of those who were found permission was refused.

The **Upper Hunter Valley Excursion Field Trip** held over Saturday and Sunday the 3rd & 4th of September was very successful and attended by over thirty members. The day-time weather was fine and bright for the entire trip period although it still became quite cold overnight. The party assembled at the municipal picnic ground in Merriwa at midday on Saturday and after lunch there traveled some twenty-five kilometers along the Merriwa to Scone road to a section about two kilometers before the village of Bunnan. The sides of the road at that point had exposed a very soft rock with seams of calcite and the party spent an hour or two digging specimens out of the slope. The members then made their way into Scone to find overnight accommodation with most of them later going to the Scone R.S.L. Club for dinner.

On Sunday morning the party assembled in Scone at 7.30 a.m. to drive to Ardglen quarry which is about five kilometers past Murrurundi and about a half kilometer turn off the New England Highway. After a safety and induction briefing from John Chapman the party moved into the quarry to spend a very productive morning and much of the afternoon working mostly on one large slope of basalt rubble, slabs and boulders which turned out to be quite rich in vughs with a variety of minerals being found. Possibly the most plentiful mineral was natrolite, being found in quite large sheets and vughs of fine needle crystals but there was also plenty of calcite and specimens with natrolite also containing analcime. Collectively the entire party must have left the two collecting sites, more particularly Ardglen, with many tens of kilos of specimens.

The Field Trip was overall very productive of specimen material and provided a substantial opportunity for social interaction. Compliments are due to the organiser.

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THE SOCIETY COMMITTEE

PRESIDENT:	Dieter Mylius	Tel: (02) 9477 1060
VICE-PRESIDENT:	John Chapman	Tel (02) 9808 3481
	E-mail:	*chapmanjr@optusnet.com.au*
SECRETARY:	George Laking	Tel: (02) 9636 7145
	E-mail:	*bglaking@tech2u.com.au*
TREASURER:	Graham Ogle	Tel: (02) 9876 5224
COMMITTEE MEMBERS:	David Colchester	Tel: (02) 9449 3862
	Arthur Roffey	Tel: (02) 4572 5812
	John Smedley	Tel: (02) 9688 1284
	Gary Sutherland	Tel: (02) 9871 1379
	Penny Williamson	Tel: (02) 4221 4075

WELCOME

Welcome to new Society member Ray Hanson.

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SEPTEMBER MEETING

The September Meeting was opened by the President, Dieter Mylius. There were a few announcements, about the forthcoming field trips to **Bunnan, Ardglen** and the **Garrawilla area**. It was also announced that Ross Pogson, long-time Society member and Collections Manager for Mineralogy and Petrology at the Australian Museum had offered to provide a conducted tour through what he termed **'Aladdin's Cave, -** the mineralogy store rooms at the Museum, either later this year or the next.

After the few announcements the President handed the Meeting to the first speaker of the evening.

'An Occurrence of Campigliaite at Broken Hill'

Jim Sharpe

Some years ago Jim Sharpe happened to purchase a small mineral specimen at a show of what was said at the time to be ktenasite from Broken Hill. Just recently he had occasion to examine the specimen more closely under magnification and realised that there was another mineral present. Eventual X-Ray diffraction analysis established that the second mineral was campigliaite. This was quite interesting to the speaker as a copper specimen collector since as far as he was aware he had no other specimens of this mineral in his collection and the mineral is also fairly rare generally.

The type locality for campigliaite is the Temporino mine in Campiglia Marittima, Livorno Province, Tuscany, Italy, where it was discovered by Italian workers and approved as a new mineral in 1982. Since then it has been found in only a few other places and never in large quantities. Apart from the Temporino mine it has been reported from Piedmont in Italy and from mines in Utah. Jim Sharpe's discovery is the first instance recorded from Broken Hill. As would be expected of a copper mineral campigliaite is blue in colour and better specimens display light blue tufts of thin needles. The mineral is monoclinic and is a manganese copper sulphate, $Mn^{2+}Cu_4(SO_4)_2(OH)_6 \cdot 4H_2O$. It is similar in composition to other minerals found at Broken Hill such as ktenasite and serpierite and the speaker also displayed the formulae for these.

ktenasite, $(Cu^{2+},Zn)_5(SO_4)_2(OH)_6\ 6H_2O$
serpierite, $Ca(Cu^{2+},Zn)_4(SO_4)_2(OH)_6\ 3H_2O$

Jim Sharpe further discussed some of the chemical aspects of campigliaite speculating that given the abundance of manganese at Broken Hill it was likely that some campigliaite would have formed there and that more examples of the mineral would probably be found if collectors and mineralogists examined specimen material closely. The formation of campigliaite however has been dependent on the rare establishment of specific chemical conditions involving the oxidation of sulphide minerals in the presence of managanese and no large amounts of the mineral have apparently been formed anywhere.

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The second speaker of the evening was Society member John Tottenham who had traveled from Horsham in Victoria to deliver his lecture to the Society. He had changed the scheduled lecture title slightly to concentrate on aspects of the formation of gold nuggets and the movement of gold through deposits. His lecture was extensively illustrated by a montage of images of nuggets and gold crystals and crystal aggregates including references to his own gold prospecting finds as well as views of some of the major, spectacular and famous finds of Australian gold.

The following notes on his lecture have been provided by John Tottenham. A full version of the lecture with all the images, diagrams and illustrations will be added to the Society Web-site.

‘A Prospector’s Perspective on the Origin of Gold Nuggets’

John Tottenham

For practical purposes a gold nugget can be defined as a solid particle of gold capable of being detected by a metal detector specifically designed to find gold. Nuggets can range in weight from 0.1 grams up to 70-plus kg. Also some nuggets are either embedded in or contain quartz or ironstone. These are then called specimens and can reach gigantic proportions. The Holtermann Specimen, an image of which was displayed, weighed 103kg and contained 5,000 ounces of gold. It was said to be broken off from an even larger specimen.

GOLD NUGGET FORMATION THEORIES:

There are two main contested theories on nugget formation being : -

The currently favoured theory is that nuggets form at great depth in ore bodies and are eventually exposed by weathering and erosion over millions of years. This is Hypogene gold. A more conjectural theory is that some nuggets grow in near-surface elluvials - alluvials. This is Supergene gold.

As neither theory covers all examples it is likely that both theories with some modifications apply. If so, the following gives an overview of my and other’s observations

HYPOGENE GOLD

Contrary to what the old prospectors thought, gold does not flow as molten metal and solidify in rock cavities. Instead gold rich ore bodies are largely formed by sulphur-rich hot acid solutions. These solutions mostly precipitate the gold as a metal where chemical, pressure and temperature conditions suit. These hot acid solutions often carry substantial amounts of quartz and metal sulphides which also precipitate out when conditions allow. Typically gold formed in these circumstances is too small to be seen by the naked eye and is often included within metal sulphides such as pyrite.

Sometimes gold will be precipitated as nuggets when the gold bearing solutions pass slowly through narrow rock fractures for very long periods of time particularly, where there are suitable triggers for the gold to precipitate on. For example gold will precipitate on pyrite, other sulphides and carbon. Such gold is called Hypogene. The Ballarat indicator gold is a case in point.

Historical mining records indicate that whilst nuggets were rare at depth in most ore bodies, the surface outcrop of these ore bodies were often enriched in gold and often in the form of specimens and nuggets. Such gold is called Supergene.

SUPERGENE NUGGET FORMATION

Near surface gold rich metal sulphides exposed to oxygen rich water, produce sulphurous acid. This acid can very slowly dissolve fine gold. Subsequently this dissolved gold can be precipitated in coarser particles as Supergene gold, either in the ore body or adjacent to it. Continued supergene growth can produce nuggets and specimens with less trace elements, such as silver and copper, than the source gold. If the supergene growth continues and erosion is slow then eventually nuggets and specimens will be eroded from surface outcrops. However, if erosion is fast, such as in steep mountainous country then there is insufficient time for supergene nuggets to grow before the weathered ore body is eroded away.

A recent study of sawn slices taken from selected large West Australian nuggets has shown that these originated at depth in the ore bodies. The slices showed the gold had a coarse crystalline structure with trace metals indicating that the nuggets were not formed from near surface solutions. Hence these nuggets were Hypogene and not Supergene..

GOLD NUGGET SURFACE PATCHES

Nuggets still attached to source rocks and exposed to sediment movement are flattened, rounded and abraded. *(Often more on the exposed side than the other less exposed sides)*. Spongy gold is flattened into a more solid lumps and thin filigree edges are either rounded off or rolled over.

Once liberated, nuggets being seven times denser than typical sediments, are not readily moved by water and the passage of sediments. Sediments just move over the top of larger nuggets, further smoothing them. *(Again often more on one side than the other).* Silver and copper are leached from the exposed surfaces giving the nuggets a richer appearance.

The relative immovability of larger nuggets suggests that nugget patches should be very localised and concentrated near their source. However this is not always the case, for example glacial action and/or successive massive rain events can potentially move nuggets large distances. Specimens being less dense than solid nuggets can be transported much further, often km.

THOUGHTS ON THE MOBILITY OF NEAR SURFACE GOLD

Whilst gold was once thought to be insoluble to most natural occurring solvents at low temperatures with time and the right conditions gold does dissolve slowly. Once dissolved, gold has the potential to move away from its source and grow nuggets or specimens where soil acidity conditions are suitable. Such as :-

Near surface gold solubility:

Under acid saline ground conditions gold can be dissolved by chloride rich sulphur based acids.

Also gold can be dissolved in neutral ground conditions by soil based humic acids. These acids are similar to the cyanides used for conventional gold treatment. Sewage treatment sludges for example have humic acids and consequently have a relatively high gold content. The finer the gold, the more easily it is dissolved. It is thought that in Australia's past Tertiary times, the tropical conditions were favourable for nugget formation.

CAN A NUGGET'S SHAPE AND SURFACE TEXTURE GIVES CLUES TO IT'S ORIGIN?

Sometimes; for example.

Many nuggets appear as dull, well rounded and/or flattened pieces. Their shape and texture are derived from the movement of sediments over the gold. Consequently their original rough hackly and spongy portions after having been worked and smoothed, leave few clues to their origin. However, despite sediment abrasion and rounding, the shape of many surface (elluvial) nuggets is distinctly different from gold encased in nearby source rock (Reef Cap). Reef cap gold is often laminar and hackly from joint filling, where as adjacent elluvial nugget gold is often rounded and cauliflower shaped. This rounding suggests another growth mechanism.

MOBILITY OF GOLD IN SEDIMENTS

Reef cap gold invariably has a wide mix of sizes, whereas nugget patches often lack finer (but still detectable) gold and the size of the nuggets is relatively consistent. Dish sampling of nugget patches rarely shows fine gold. This suggests that near surface nuggets grow from re-dissolved fine gold. In some nugget patches overlying ore bodies, specimens are rare. This again suggests near surface nugget growth. Buried timber extracted from the Ballarat Deep Lead mines was often found to be part replaced by gold-rich pyrite. Electron microscopic examination of what appears to be well-rounded flat alluvial gold often shows unmistakable evidence of gold replacing bacterial microbes. It is inferred that the microbes precipitated the gold from solution.

Nugget beds have been found in permeable sediments located above the bottom of the alluvial wash in areas where there are no apparent ore bodies capable of yielding these nuggets. Rheola and Clermont come to mind here. If placed by alluvial processes nuggets being heavier are more likely to be found at the bottom of the alluvial wash.

WHAT DOES ALL OF THIS MEAN FOR PROSPECTORS ?

It is probable that some nuggets grow in near surface sediments. To find nuggets there needs to be a gold source to either allow nuggets to be eroded from a Reef cap or generate gold bearing solutions for later precipitation of gold nuggets remote from the original source. The gold source(s) may not be evident because the sources have either been eroded away without leaving surface traces or being of such low grade or disseminated, that they are not evident in surface traces.

The best chance of finding nuggets is to look in areas which either have had : -

Great depths of material eroded off the top of the ore body to concentrate both the Hypogene and Supergene gold in the adjacent detritus.

Been eroded very slowly to allow the development of Supergene gold in the Reef Cap.

Sulphidic ore bodies with their tops subject to deep weathering in previous tropical times sufficient to create a Supergene zone.

Indicator zones which allowed nuggets to form in the Hypogene zone.

SOME INDICATIONS OF AUSTRALIAN NUGGETY GROUND.

Flat or slightly sloping ground covered with extensive ore body debris, indicating great depth of weathering. The debris is typically quartz and iron stone, but in some areas quartz may be absent.

The presence of some well rounded gravel mixed with ore body debris, often indicates a long period of weathering necessary for nugget growth.

Surface laterites indicating previous tropical weathering and Supergene development in Tertiary times.

High levels of ground salinity from either wind-blown salt or Tertiary seas. WA salt lakes are known for their bright, sharp Supergene gold.

Iron rich rocks surface rocks and gravel, both indicating possible gold-rich sulphides at depth.

Small quartz and/or iron stone leaders as distinct from massive blows of quartz and/or iron stone. Larger gold is invariably found in the smaller leaders where the flow of gold-bearing solutions was slowed down sufficiently for the larger gold to grow.

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At the end of his lecture John Tottenham answered a number of questions including relating the interesting story about an American gold eagle (US$10) coin which had been dropped in the Klondike mining area sometime in the late 1800s and found in 1930. It was observed to have gold crystals growing on it supporting the speaker's contention that gold will move, albeit very slowly, as a solution through rock, and be precipitated on or into a suitable or receptive material or surface.

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FORTHCOMING EVENTS

GEMBOREE 2012

AUSTRALIA'S 48TH NATIONAL GEM AND MINERAL SHOW

Easter 2012 from the 6th to 9th of April 2012.

In the Bundaberg Showground, Burrum Street, Bundaberg, Queensland.
Hosted by the Bundaberg Gem & Mineral Society Inc on behalf of the
Queensland Gem Clubs Association and AFLACA.
Lapidary traders, tailgating stalls, entertainment, refreshments,
working demonstrations, displays, lectures, tours.

Everyone Welcome

Camping available on site. Booking enquiries to P.O.Box 5886 West Bundaberg 4670
or e-mail *bundygemboree@yahoo.com.au*