National Rock Garden

Celebrating the Geological Heritage of Australia

Newsletter No. 13
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Harbour Bridge rock arrives at the NRG

Progress on design of Education Pavilion

PACE students assist with National Rock Garden rock selection process

The NRG at the Australian Earth Sciences Convention

Geoscience education in Canada

Rock of the month – plagioclase-pyrite gneiss

The National Rock Garden is proudly supported by the Geological Society of Australia and the Australian National University

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Harbour Bridge rock arrives at the NRG

Brad Pillans, Chair NRG Steering Committee

In May, another big rock specimen arrived at the NRG site - a 10 tonne block of Moruya granite, the rock that was quarried to construct the pylons of the Sydney Harbour Bridge. Strictly speaking, the rock is classified as a tonalite by geologists, which is a particular type of granite that is characterised by 20-60% quartz and a dominance of plagioclase feldspar; other minerals include dark-coloured mica and hornblende. So, to a geologist it is formally known as Moruya Tonalite, but most people (including me) know it as Moruya granite. Either name is acceptable, but note that in the formal name, Tonalite is spelt with an upper case "T" whereas in the informal name, granite is spelt with a lower case "g". Regardless of nomenclatural semantics, it is an igneous rock that slowly crystallised from magma deep (several kilometres) below the Earth's surface, nearly 400 million years ago towards the end of the Devonian Period of geological time. That the granite is now exposed at the surface is testament to erosion of several kilometres of overlying rock since it was formed.

I grew up in Moruya on the NSW south coast, so Moruya granite is, unsurprisingly, a favourite rock of mine. In fact I well remember a large sloping granite outcrop close to where I lived which provided endless fun as we slid down the smooth granite slope in the tray of an old wheelbarrow. Our new rock was delivered by semi-trailer, courtesy of Eurobodalla Shire Council, in Moruya. Coincidentally, the truck driver turned out to be one of my primary school friends from Moruya, whom I hadn't seen for more than 50 years! Our specimen was obtained from the original quarry, on the north bank of the Moruya River and kindly donated to the NRG by the NSW Government.

Moruya granite specimen being unloaded in Canberra. Photo courtesy Brad Pillans.

Moruya granite was used not only for the Harbour Bridge pylons, but also for the columns of the Sydney GPO and the Cenotaph in Martin Place, as well as the base of the Captain Cook statue in Hyde Park. The rectangular altar stone of the cenotaph weighs some 20 tonnes, about twice the weight of the rock that was recently delivered to the NRG. The Captain Cook statue stands on a block of granite of similarly grand size.

To mark the opening of the Harbour Bridge, in 1932, three commemorative postage stamps were issued - 2 pence (red colour), 3 pence (blue) and 5 shillings (green). The 5/- green stamp is highly prized by stamp collectors as it was printed in much smaller numbers than the lower value stamps, with nice used copies currently selling for around $300 and unused copies even more.

Commemorative stamp, issued in 1932, for the opening of the Sydney Harbour Bridge. Photo courtesy Brad Pillans.

We are planning to hold an appropriate inauguration ceremony for our newly acquired Moruya rock at the NRG at **2 pm on Sunday 9th October** – the first day of International Earth Science Week. Over the next few weeks, the block will be prepared to include a cut and polished face and a stainless steel plaque. All Friends of the NRG (as well as friends of Friends) are invited to attend the ceremony.

Southeast pylon of Sydney Harbour Bridge, faced with blocks of Moruya granite. Photo courtesy Mike Smith.

Captain Cook Statue with rock-solid base of Moruya granite, Hyde Park, Sydney. Photo courtesy Mike Smith.

Excellent progress on design of Education Pavilion at the National Rock Garden

Brad Pillans and Mike Smith, NRG Directors

In the last issue of the newsletter, we discussed the receipt of a grant of $30,000 from the Australian Geoscience Council (AGC) to fund the generation of a design concept for an Education Pavilion at the NRG site in Canberra. This article reports on the completion of the design work by a well-known firm of architects.

This grant, from AGC, enabled the NRG Steering Committee to commission well-known architects Tonkin Zulaikha Greer (TZG) to produce sketch designs and costings for the proposed Education Pavilion at the NRG site. TZG have previously worked closely with our landscape architects, Taylor Cullity Lethlean (who produced the NRG Masterplan) on other major projects in Canberra, including the National Arboretum and the National Botanic Gardens.

Earth science education is a primary focus of the National Rock Garden particularly for school children. In order to understand how to work effectively with large school groups, NRG steering committee members met with science educators in Canberra to hear diverse views on the requirements for this facility. Their feedback greatly assisted us in developing the pavilion design.

TZG's design and costing for the proposed NRG Education Pavilion and the adjoining Gallery, Amphitheatre and walls progressed well during the first quarter of this year. The NRG Directors met with TZG and NCA representatives on site and the directors were encouraged to contribute comments and suggestions on the design of the building and associated covered space. As part of this work, an updated site plan was generated which reflects the current thinking about the layout of the Rock Garden. This is shown in the image below.

The completed design concept is displayed in the two 3D visualisations on the next pages.

TZG provided a detailed cost breakdown for the work program entailing the cut and fill excavation for the pavilion, rock gallery and amphitheatre, the construction of the building itself, provision for entry walls and other structures, and all ancillary facilities, including toilets and a storeroom. This is the first reliable indication of the cost of the major elements of NRG site to achieve our aim of a functional educational facility for the public.

The total cost is estimated to be $4.1M for the works program covered by the TZG assignment, of which just over half ($2.3M) is for the pavilion itself. It is important to remember that this total does not include the cost of the delivery of NRG rock specimens and their preparation for display. Based on our experience in developing the Federation Rocks display, the cost for delivery and preparation of future rocks may be as much as $10,000 per rock. We hope that many of these rocks will be funded by Government, corporate or private donations.

The $4.1M figure both assists and challenges the NRG Steering Committee to find the financial support needed, and every aspect of planning for the NRG will need to be refined to enable effective marketing of the sponsorship opportunities, which could include naming rights for the Education Pavilion.

View from inside the Education Pavilion towards Black Mountain

View across the Rock Gallery towards the Education Pavilion

PACE students assist with National Rock Garden rock selection process

Mike Smith, NRG Director

Earlier this year, the Steering Committee of the National Rock Garden gained the collaboration of the Professional and Community Engagement (PACE) Program at Macquarie University to build up a set of descriptions of rocks which may be suitable for inclusion in the NRG site in the future. PACE is a program unique to Macquarie University that seeks to broaden the study experience by embedding real world learning activities into the degree.

The link-up was suggested by incoming NSW GSA Division President, Associate Professor Kelsie Dadd, to assist with the acquisition of the information needed to identify and select the most appropriate large and spectacular rocks for transportation to and for long term display at the NRG site in Canberra. The PACE Project involved two senior Earth Science students, Zechariah Yap and Eillen Cornejo, pictured below with Kelsie Dadd and the author.

L-R: Associate Professor Kelsie Dadd, Zechariah Yap, Eillen Cornejo and Mike Smith.
Photo courtesy Mike Smith.

The students began by making email contact with specific senior geoscientists who have previously agreed (through personal contact from Mike Smith or John Bain) to participate by providing a description of an agreed rock (or rocks). For practical reasons, we focused on the state of NSW for this initial program, and a list of potential rocks supplied by the NSW Rock Selection Sub-Committee formed the basis for contacting expert geologists. The geoscientists who provided detailed one or two rock descriptions include Paul Ashley, Jane Barron, David Branagan, Ian Collett, Kelsie Dadd, Morris Duggan, Peter Lewis, Barrie McKelvey, Joanna Parr, Ian Percival, Brad Pillans, Ian Pringle, Mike Smith, Barney Stevens and Tony Yeates. In addition, the two students compiled basic data for several other reports. Several other reports have been pledged, but are still pending availability of time for the writers.

The writing of the rock descriptions is facilitated by the use of a fairly straightforward pro forma table, the NRG Specimen Preliminary Fact Sheet. Key elements include formal and common name of rock, location (including map and GPS coordinates), and reasons for selection (in three separate categories – geological significance, cultural significance and economic significance). Essential components are photographs of the actual rock and scientific references relating to the rock. A time frame was suggested to the respondents, based on the need for the students to finish at the end of the Semester in June. In some boxes on the form, the words “not known” or “not available at this time” were noted as a logical response, and these can be added later as new information becomes available. Nevertheless, the responses have certainly advanced the documentation of preferred NRG rocks. The students followed up with the authors from time to time to make the fact sheets as complete as possible.

The benefits of this project for the two PACE students included gaining useful experience in various aspects of geological research, acquiring some skills in technical communication and developing expertise in the documentation of geoscientific data, while also building up a small network of senior contacts in the geological community.

The NRG Steering Committee herein thanks Zechariah and Eillen for their enthusiastic participation in the PACE project. We also thank Kelsie Dadd for her constructive supervision. Each student gave a presentation on the project in mid-June (unfortunately the writer was overseas) and both students received very good grades for their assignments. The PACE management have indicated that the university would be interested in a follow-up program in 2017, and this opportunity will be actively pursued. We are seeking support from additional senior geologists to help with descriptions of a further group of rocks from the other states of Australia.

Australian Earth Sciences Convention (AESC) in Adelaide, 26-30 June 2016

Brad Pillans, Chair NRG Steering Committee

Graziella Caprarelli at the NRG booth with microcline crystal at left front. Photo courtesy Brad Pillans.

The NRG was given a complimentary display booth at the AESC, held at the Adelaide Convention Centre from 26-30 June. The AESC is the major conference of the Geological Society of Australia (GSA), held every 2 years and attracting several hundred delegates. The NRG booth was in a prominent position just inside the main doors of the Exhibition Hall where morning/afternoon tea and lunch were served, and where posters were on display throughout the conference.

I was capably helped in running the booth by local GSA members, Graziella Caprarelli (University of South Australia) and Ben Kimpton (Adelaide University). Two impressive mineral specimens, for display, were kindly provided by Ben McHenry from the SA Museum – a 30 kg crystal of microcline feldspar ($KAlSi_3O_8$) from Harts Range, NT and a 5 kg 'Painted Lady' opal slab from Andamooka, SA.

Booth visitors were invited to make a gold coin donation and place their business cards into a prize draw for a lovely specimen of azurite ($Cu_3(CO_3)_2(OH)_2$), a bright blue copper mineral from the historic Burra Burra copper mine in South Australia, donated by the SA Museum. Copper was discovered at Burra, 160 km north of Adelaide in 1845 and within a few years was one of the world's largest copper mines. The prize was enthusiastically won by David Tilley from the NSW Geological Survey in Maitland.

The booth was visited by a good number of conference delegates with whom I had many enjoyable conversations about the NRG. Many people were familiar with the NRG, but quite a few had either not heard of us or had heard very little about us. In that respect, the booth was successful in raising the profile of the NRG among conference attendees.

I also gave a talk about the NRG, further informing conference attendees of NRG activities, both past and present, as well as some of our exciting plans for the future.

Geoscience education in Canada – the Rio Tinto Alcan planetarium in Montreal

Mike Smith, NRG Director

While visiting two of my grandchildren in Montreal for a month, I investigated various science education facilities. One afternoon, I took my 5 year-old grand-daughter to the Rio Tinto Alcan Planetarium near the Viau Metro station just north of the central business district. The city is well advanced in creating a scientific facility called the **Montréal Space for Life**, described as "the first space in the world dedicated to humankind and nature". Space for Life is the largest concentration of natural science museums in Canada, and includes the Botanical Garden, the Insectarium, the Biodome and the **Rio Tinto Alcan Planetarium**.

The planetarium opened in April 2013. Its web site, http://espacepourlavie.ca/en/rio-tinto-alcan-planetarium-1, (videos at https://www.youtube.com/watch?v=IupOxuRD8Os and at https://www.youtube.com/watch?v=bYAM7yfVKKI and https://youtu.be/j4h1qgTWoMM?t=72 are in French with selectable English sub-titles.

Approaching the Planetarium. Photo courtesy Mike Smith.

In contrast to the NRG which is primarily an outdoor educational facility, the planetarium is entirely indoors so it can operate over Quebec's very cold winters (and its hot summers).

There was a significant Earth Science component to many of the displays, as shown in the photographs below, using posters and displays of rock specimens. The linking of astronomy and earth science education to education in biology/botany is notable.

A portion of the adjacent poster states "*ONCE UPON A TIME IN PANGEA – Earth's crust is fractured in several places and it floats on magma, a very hot liquid. Yet, unless an earthquake strikes, you do not feel Earth's crust move. Before they separated from one another, all the continents were joined together in what is known as Pangea".*

Entry signage acknowledges corporate supporter. Photo courtesy Mike Smith.

Pangea jigsaw puzzle. Photo courtesy Mike Smith.

The adjacent poster explains *"This rock sample comes from the Nuvvuagittuq volcanic and sedimentary formation on the eastern shore of Hudson Bay in Quebec. It is one of the oldest geological formations ever discovered. This fragment of Earth's crust is estimated to be at least 3 billion 700 million years old"*

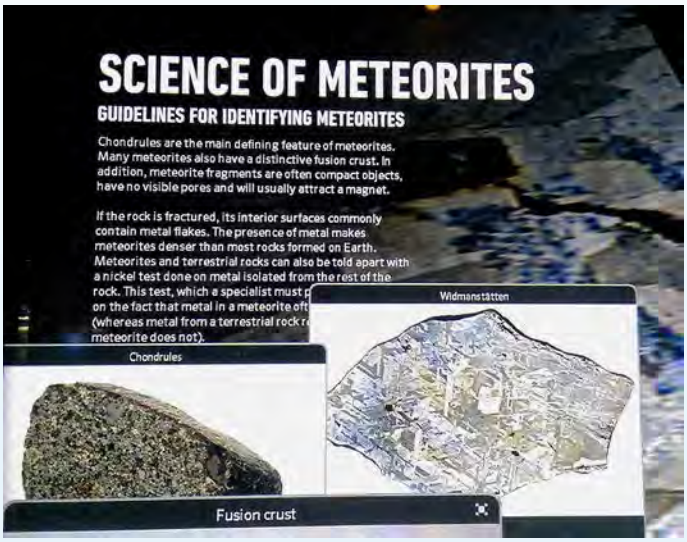
One of the oldest rocks on Earth, from Quebec. Photo courtesy Mike Smith.

Black smoker video. Photo courtesy Mike Smith.

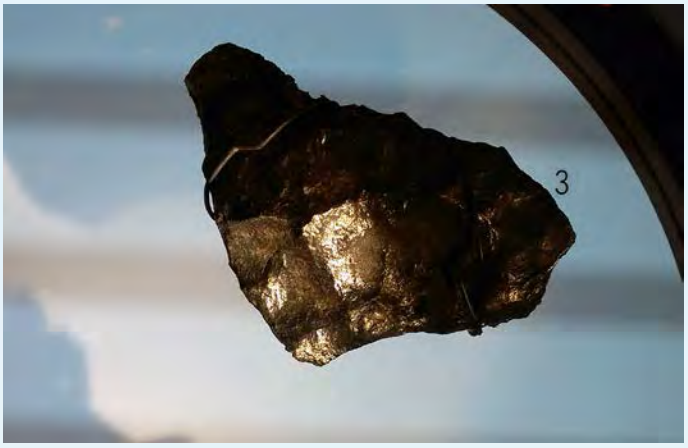
This display contains a good size stromatolite from Bolivia. Photo courtesy Mike Smith.

The adjacent text states "*Stromatolites are columns formed by the building of calcium carbonate deposited by bacterial colonies. These bacteria began developing about 3.5 billion years ago. The colonies they formed dominated our planet for nearly 3 billion years, and gradually altered the chemical composition of the atmosphere by producing oxygen".* [Recently published research, by an Australian-led research team has identified stromatolites in 3.7 billion year-old rocks in Greenland]

There were lots of meteorites on display (see below).



Part of poster explaining how to identify meteorites. Photo courtesy Mike Smith.



Example of a meteorite. Photo courtesy Mike Smith.

Three more meteorites. Photo courtesy Mike Smith.

Hologram scientist talks to visitors. Photo courtesy Mike Smith.

A highlight was a hologram scientist (right) providing a lively explanation (in French, then in English) of the origin and characteristics of meteorites. This hologram concept is a good idea for the NRG, if we can raise funds for the necessary projection system.

The planetarium project cost $48 million Canadian. The breakdown of this financial support is instructive for the National Rock Garden:

- City of Montréal: $25.7 million
- Federal Government (Canada Economic Development): $9 million
- Provincial Government of Quebec: $9.5 million
- Rio Tinto Alcan: $3.8 million

We see that corporate naming rights to the planetarium were acquired for a funding contribution of only 9% of the total cost. Three public agencies contributed the larger share of 91%. I observed that there was no signage inside the Planetarium exposition areas referring to the corporate sponsor, only on the exterior, the entry & the web site. The NRG directors are renewing efforts to engage with participants in the ACT Government and the Federal Government.

Finally, I need to say that there were a lot of interesting activities for a five-year old, from interactive screens, magnetic construction kits, steering through the stars, driving on a lunar surface, watching a rock being created and colouring in while talking excitedly to numerous older children. She liked the train travel as well. The planetarium also has a gift shop and a café.

Feedback and further information

We welcome feedback and suggestions on the development of the National Rock Garden. See the feedback boxes on the National Rock Garden website: www.nationalrockgarden.org.au

Tax deductible

The National Rock Garden is a registered Charity and all donations are tax deductible. Making a donation to the National Rock Garden is a great way to reduce your tax and feel good too! To make a donation, please visit the NRG website or phone (02) 9290 2194.

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The newsletter is circulated twice a year, ordinarily March and September. New "friends" are welcome and can be added to the email circulation list by contacting the editor.

Keep up with the latest NRG news, rock movements, rocks of the month and a whole lot more. Like us on Facebook:
https://www.facebook.com/pages/National-Rock-Garden

Rock of the month - plagioclase-pyrite gneiss

Ian Pringle*, *Consultant Geologist, Ian J Pringle & Associates

The rock of the month is a plagioclase-quartz-pyrite gneiss unit of the Himalaya Formation, Thackaringa Group, located about 25km SW of Broken Hill In western NSW. The age of the rock unit is 1,699 ± 10 million years (Statherian Period, Paleoproterozoic Era). The rock is very unusual in that it is made up almost entirely of quartz, pyrite, and sodium-rich plagioclase feldspar (albite). It forms stratabound lenses, often several kilometres long and several tens of metres thick within the Thackaringa Group located stratigraphically below the Broken Hill Group which hosts the massive Broken Hill orebody.

The pyrite within the rock contains cobalt (typically 0.4% - 0.6% Co) and because of the physical extent of the stratabound pyrite horizons, they represent very large, low-grade cobalt deposits. The rock is a paragneiss, meaning that it was formed by high-grade metamorphism of sedimentary rocks, and its origin has been debated by many geologists. The author considers that it originated as sulphide-enriched biogenic sediments in a shallow anoxic and saline basin (Pringle 2015). In any event, cobalt-pyrite horizons of this type and extent are unique to the Broken Hill area.

A large rock specimen could be collected on the east side of the ridge near a small saddle on Pine Hill (also called Pyrite Hill) on Thackaringa Station. This location is within Exploration Licence 6622 held by Broken Hill Prospecting Pty Ltd. The photograph in Figure 1 shows boulders dislodged during costeaning. Future work will require fresh costeans and a large specimen could be obtained to suit the requirements of the National Rock Garden.

Figure 1. Boulders of quartz-albite-pyrite gneiss at the Pyrite Hill Cobalt Prospect. Photo courtesy Wolf Leyh.

The deposits have combined mineral resources of 35.7 million tons of cobalt-pyrite ore with an average grade of 1.85 pounds per ton of cobalt (66 million pounds (30,000 tons) of contained cobalt). In addition, between 37 and 59 million tons of additional pyrite mineralization of similar cobalt grade is estimated to contain between 63 and 101 million pounds of cobalt (29,000–45,000 tons). The deposits are likely to extend further at depth and also along trend, and this will need to be verified by further exploration. The deposits have negligible contents of gold, silver, copper, rare earth elements or deleterious metals such as arsenic, mercury, antimony or lead.

Cobalt is a major component in many new rechargeable lithium-ion batteries (electric vehicles, mobile phones, notebooks and laptop computers) and some contain up to 60% cobalt content. Cobalt has been used for centuries as a pigment for bright blue colouring and more recently in super alloys and high pressure-temperature resistant metals in turbines, jet motors, military hardware, aircraft and space equipment. It is also the principle component of vitamin B12, essential for blood and brain function. The Democratic Republic of Congo accounted for about 60% of global 2015 cobalt production (92,000 tons) and most of this was byproduct from copper mining.

Broken Hill Prospecting has completed scoping studies for the co-production of sulphuric acid and cobalt and these have highlighted significant potential for a long term project with low capital start-up and staged development. Australia imports about half a million tons of sulphuric acid (and sulphur) each year, and several excellent opportunities for supply of sulphuric acid into domestic fertilizer and mineral processing industries have been identified. Co-generated electric thermal power and hematite could also add considerable value.

The project has potential to provide long-term cobalt and sulphuric acid supply. For example, a mine processing 7.5 million tons of cobalt-pyrite ore per year could produce about 1.5 million tons of pyrite concentrate (averaging 0.45% cobalt) containing 6,750 tons of cobalt metal. Processing of the concentrate could also produce several million tons of sulphuric acid each year.

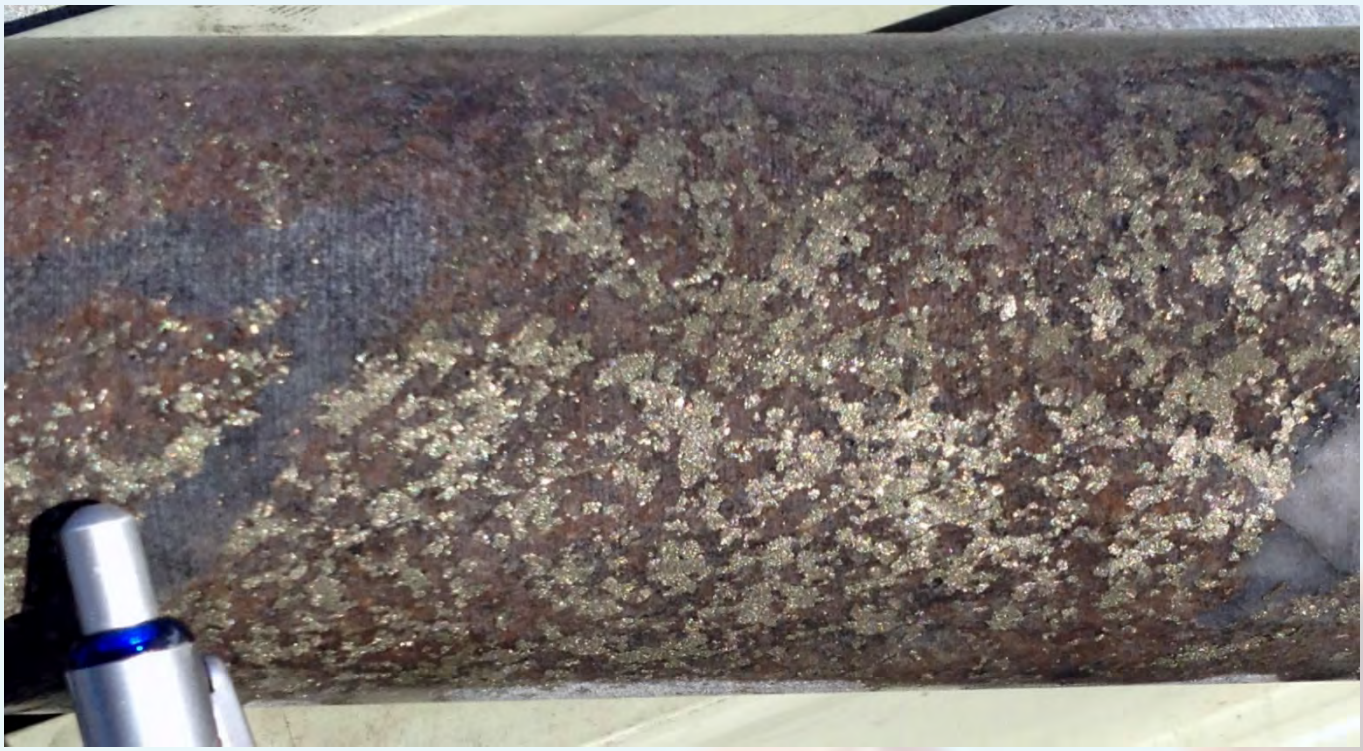

Figure 2. Pyrite-quartz-albite gneiss drill core intersection at the Railway Cobalt Prospect. Photo courtesy Ian Pringle.

Figure 3. Outcrop of the Himalaya Formation with interpreted sedimentary structures at Big Hill. Photo courtesy Ian Pringle.

References

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UPCOMING EVENT!

Don't forget to put the date for the inauguration ceremony for our newly acquired Moruya rock into your calendar!

When: 2 pm, Sunday 9 October 2016

Where: At the NRG

Newsletter compiled by Michelle Cooper. Edited by Brad Pillans and Mike Smith.