CAPE TOWN
GEM & MINERAL CLUB
FOR THE STUDY OF ROCKS, MINERALS & CRYSTALS

WEBSITE NEWSLETTER

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NOVEMBER 2024

Approaching the Andes – see page 10

DIARY

November	*2*	*10:00–14:00*	*Open to the Public Day – Rocks, gems, jewellery, mineral specimens to look at, chat about, swap, sell or buy.*
December	*7*	*10:00–14:00*	*Open to the Public Day – Rocks, gems, jewellery, mineral specimens to look at, chat about, swap, sell or buy.*

The mim Museum

By Peter Rosewarne

Introduction

Some time ago I started seeing references to wonderful mineral specimens coming from a source called the mim Museum. After some rudimentary searching I found that this was a privately-owned museum located in the city of Beirut, Lebanon. I also found that the correct 'spelling' is lower case for mim as the Arabic word for the letter "M" is mim and the white Arabic letter in the middle of the blue logo cube is the word for *mim* (**Figure 1**). But let's rather hear the founder, Dr Salim Eddé, a Lebanese businessman, explain in his own words:

"*I then asked myself what name I should give the museum. Rather than a French or English name, I was looking for an Arabic name since the museum is in Lebanon. I also wanted an original name, and I wanted to void the usual names like the Museum of Mineralogy of Beirut. I contacted a publicity agency in Beirut and they proposed MIM, the 24^th^ letter of the Arabic alphabet. The Arabic MIM is also the equivalent of the letter M of the Latin alphabet, and in Arabic it is the first letter of the words for "museum", "minerals" and "mines" (and it also works in English and in French). In addition, MIM is easy to pronounce in all languages. I immediately adopted the idea*."

Figure 1: mim Museum Logo

The collection is one of the best privately-owned mineral collections in the World. It now contains many of the best known and iconic mineral specimens, such as the "Miguel Romero" "Aztec Sun" *legrandite*, the "Gene Meieran" *euclase* and the "Stuart Wilensky" *spessartite*, (see **Figure 7**) arguably the World's best matrix *garnet* specimen. He apparently sited his museum in Beirut for the love of his country but it is unfortunate that, after being known as the "Paris of the Middle East," it is now in an area of increasingly intense conflict. I remember contacting the museum after the huge explosion in the harbour on 4 August 2020 (unrelated to the surrounding conflict) asking if everything was OK and fortunately the museum was unscathed, unlike much of the city and thousands of people. So, sit back and marvel at some of the World's 'best-of' mineral specimens ever found, with the emphasis being on aesthetics rather than technical descriptions of the minerals. A detailed account of the founding of the museum in Dr Eddé's own words can be found at the end of this article.
NB: The museum also hosts a substantial collection of fossils, particularly from Lebanon, but this aspect is not covered herein, this being a mineralogical newsletter.

The Museum
The mim Museum is located on the campus of the Saint-Joseph University in downtown Beirut. The collection has been built-up since 1997 and the mim Museum opened on October 12, 2013 and, as of 2023, there were more than 2 000 specimens on display. The opening was covered in an article in The Mineralogical Record in 2013 and a follow-up article in 2014. It has also featured in a 2023 Rocks & Minerals article. This article relies heavily on these publications as I have never visited the museum but hope to one day. I contacted the museum's Assistant Curator, Carole Atallah, for permission to write this article and also to ask for the images of the museum and the minerals contained herein, which were kindly provided. She also proof-read the Draft.
The museum is intended to be an interesting and informative place to visit, especially to younger visitors, rather than a stuffy, boring experience as many of us might remember in more famous museums in our childhood. The exhibits are arranged in groups of academic, industrial and economic themes and to emphasise the key mineral collecting tenets of aesthetics, science and history. It relies on modern and aesthetical exhibiting features and uses the latest communication tools for a greater interactivity with visitors. Visual animations on touch screens introduce the visitor to mineralogy, chemical classification and radioactivity. Satellite images lead the viewer to the mineral's areas of origin. The exterior building housing the museum is shown in **Figure 2**.

Figure 2: Exterior of the mim Museum Building, Beirut, Lebanon

The museum is divided into a series of themed spaces and the information that follows is based on the museum's descriptions.

The Atrium
Designed as a covered central court giving access to the different exhibition galleries, the Atrium was thought as a meeting space, where cultural gatherings can take place such as conferences, book signings, product launching and other events.

Crystallography is intimately connected to the perfect order in which the atoms of a solid body are arranged to yield crystals with beautiful geometric shapes. It is the same pattern that, when repeated indefinitely in three directions, makes a crystal and, along the way, what is termed a "*periodic tiling*". The only regular patterns that can cover a plane surface without leaving any holes are the equilateral triangle (angles of 60°), the square (90° angles) and the hexagon (120° angles). The same is true when it comes to the periodic tiling of a three-dimensional space, and that is one of the main reasons why 60, 90 and 120-degree angles are so frequent in crystals. The wall separating the Atrium from the Treasure Room is an implied reference to this order that is present in crystals. It is named the *Penrose Wall* in honour of the twentieth-century English mathematician and physicist Roger Penrose (**Figure 3**). He demonstrated that it was possible to tile a plane surface with two different patterns without leaving any holes, but that the result was quasi-periodic, i.e. no longer periodic. This means that while there is no apparent order or pattern that repeats itself over a short distance, a kind of order and repetition can be detected over long distances (do you understand that?).

While the wall tiling is in two dimensions, the architect produced an illusion of three dimensions by using tiles in brushed brass and oriented them differently to give this three-dimensional aspect.

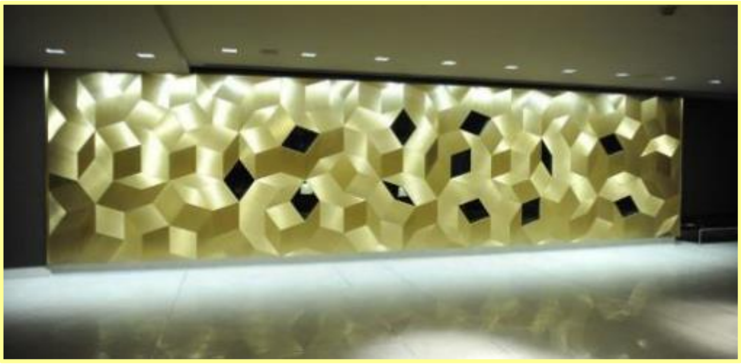

Figure 3: The Penrose Wall

The Nine Classes

In a mine-like atmosphere, with very shallow lighting, nine showcases feature one mineral of each class, not necessarily representative of the class. An interactive Periodic Table of Elements, showing also the crystal systems and the mineral types found in the museum exhibition familiarizes the visitor with the world of crystals.

Minerals by Class

Minerals are presented here in a systematic way and showcases are dedicated to each class of minerals.

Treasure

Here one can see precious metals, such as silver and gold, as well as gems such as rubies, topazes and emeralds. All specimens, with the exception of the silver and gold, have been specially selected for their transparency, colour and well-expressed geometric shapes. This room is not organized according to a traditional order but is rather a free-form exhibit that highlights the aesthetic aspects of the most beautiful samples, exceptional specimens and precious substances in their natural state. Special lighting systems have been designed for certain display cases in order to highlight the colour variations seen in such pieces as tanzanite, the transparency and colour of semiprecious stones such as peridot and tourmaline, or the details of some spectacular pieces such as fibrous gold and silver.

Figure 4: The Nine Classes

Figure 5: Example of Minerals by Classes

Figure 6: The Treasure Room

The Minerals

General

Some of these images have featured in previous Minchat articles and these are reduced in size into **Figure 7** and we'll thereafter concentrate on some 'new' wonders from the collection. All images are courtesy of the mim museum, with photography by James Elliot and Augustin de Valence. Looking through the new *Ikons* book previously reviewed in the Minchat, I counted 60 specimens having been sourced from the mim Museum collection. This out of a total of 448 in the book, which underlines the standard of the minerals in the collection and their standing in the top echelons of the mineral collecting world.

Figure 7: Aquamarine & Schorl, Elbaite, Rhodonite, Legrandite, Spessartite

Figure 8: Selection of Beryl Crystals

The next sub-sections cover the major mineral specimen producing continents, Africa, Asia, South America, Europe and North America.

Africa

First up in terms of individual mineral specimens is a large cabinet size *dioptase* from the Tsumeb Mine, Namibia, in **Figure 9**. The largest crystal is 3 cm, large for Tsumeb and this is probably one of the best dioptase specimens from this august locality.

Figure 9: Dioptase on Calcite, Tsumeb Mine, Namibia. 20 x 13 x 12.5 cm

The Kalahari Manganese Field (KMF) in the Northern Cape Province of South Africa has produced many fine collector specimens over the years and the *sturmanite* crystal group in **Figure 10** is one of them. Sturmanite is a rare *hydrated calcium-iron sulfate*.

Figure 10: Sturmanite, N'Chwaning II Mine, South Africa. 14 x 9 x 6.5 cm

Staying with the KMF, **Figure 11** is an extraordinary grouping of *shigaite* crystals with some minor *rhodochrosite* from the N'Chwaning II Mine; extraordinary because it is 4 cm tall, a veritable monster for this rare *aluminium/manganese hydroxide* with some sulfate and *sodium* mineral.

11a

11b

Figure 11a: Shigaite, N'Chwaning II Mine, South Africa 4 cm (courtesy of Rocks & Minerals) **11b** the mim Museum

Tanzanite is the blue variety of zoisite and is only found in the Merelani Hills area of Tanzania. Some crystals are naturally blue but many yellow, grey and colourless ones are heat-treated to get the blue colour. A monster crystal is shown in **Figure 12**.

Figure 12: Tanzanite, Merelani Hills, Tanzania, 14.5 cm tall

Asia

The pegmatites of Afghanistan produce some of the World's best crystals of the *pyroxene*, *spodumene*, variety *kunzite*, with large size, gemminess and deep lilac colour, as shown in **Figure 13**. This colour is due to the presence of *lithium*.

Figure 13: Spodumene var. Kunzite, Mawi, Afghanistan. 25 cm tall>

The yellow variety of spodumene is called *triphane* and a beautiful example is shown in **Figure 14**.

<**Figure 14: Spodumene, var. Triphane, Dara-i-Pech, Afghanistan**. 21 cm tall

China warrants an article on its own but because there probably will be one in the future in the "Famous Regions" series, only two examples are included here. **Figure 15** is *helvite* on *quartz* from Kèshíkèténg Qí, Chìfēng Prefecture, Nèiméng (inner Mongolia), a *manganese-beryllium silicate-sulfide*, with crystals to 4 cm.

Figure 16 shows a 10 cm pyramoidal *scheelite* crystal from Pingwuxian, Mianyang Prefecture, Sichuan Province, China. Scheelite is a *calcium tungstate*.

Figure 15: Helvite on Quartz, China 20 x 12 x 14 cm

Figure 16: Scheelite, China

South America

One of the most famous South American minerals is probably *emerald*, particularly from the Muzo and Chivor mines in Colombia. These are the stones against which other emeralds are measured for quality. Beautiful gemmy hexagonal crystals on *calcite* can be found in top collections as in **Figure 17**. These emerald deposits are somewhat unique in that they are hosted in black shales and carbonates.

Figure 17: Emerald on Calcite, Colombia. 7 x 5 x 5.5 cm

The *phosphophyllite* twins specimen in **Figure 18** makes up for what it lacks in size by being one of the best examples of this ‘holy grail’ of connoisseur mineral collectors. It is a hydrated *zinc phosphate* and good crystals are very rare. Not my cup of tea and just as well as specimens like this probably cost a million US$ or so…

<Figure 18: Phosphophyllite Twins. Mina Unificada, Bolivia. 6 cm (courtesy of The Mineralogical Record).

The huge *euclase* crystal in **Figure 19** is famous in the mineral collecting world, despite its missing part. It is 15.7 cm tall and is from the Mina Gachalá, Guavió-Guatequé, Estado Cundinamarca, Colombia. Euclase is a *beryllium, aluminium* hydroxide silicate. I believe that there is a custom-made artificial replacement for the missing segment.

Figure 19: Euclase Crystal, Colombia>

The 16 cm cluster of *bournonite* crystals in **Figure 20 below**, showing its typical cogwheel crystal habit, is from the Mina Viboras, Machacamarca, Provincia Cornelio Saavedra, Potosí, Bolivia. These specimens rival the "best-of" specimens from the Herodsfoot Mine in the UK. Bournonite is a *lead-copper-antimony sulfosalt.* It is a mineral of *hydrothermal* vein deposits.

Figure 20: Bournonite Crystal Cluster, Bolivia

Europe

The Alps of France and Switzerland are the source of some of the World's best pink octahedral *fluorite* and the example in **Figure 21** from the Planggenstock, Göscheneralp, Uri Canton, Switzerland is right up there with them. The fluorite crystal is 18.4 cm tall.

Figure 21: Octahedral Fluorite, Switzerland

I'm including *diaspore* from Turkey here although I think the mine location is in Asia rather than Europe and as a trivia question aside, Istanbul is the only city in the World half in Europe and half in Asia. In **Figure 22** we have a huge translucent V-shaped twin, pale green or pink depending on the lighting. The terminations are perfect, which is rare for diaspores from this mine that often have fibrous terminations, and virtually unheard of for crystals of this size. The gem variety of diaspore from this locality goes under the trade name of *zultanite*.

Figure 22: Diaspore Twin, İlbir Dağı, Milâs İlçesi, Muğla İli, Turkey
11.5 x 8 x 11.5 cm

North America

Figure 23 is of a classic *rhodocrosite* specimen from the Good Luck Pocket at the Sweet Home Mine in Colorado, USA. The largest crystal is 5 cm.

Figure 23: Rhodocrosite Crystals, Sweet Home Mine, USA 14 x 11.5 x 8 cm

Figure 24a shows a group of large native *copper* crystals from the famous Keweenaw County area of Michigan State, USA. The largest crystal is 5.4 cm. **Figure 24b** is a painting of the same specimen by Ksenia Levterova.

24a  **24b** 

Figure 24a: Native Copper, Keweenaw, Michigan, USA 7 x 6 x 8 cm **Figure 24b** (©Ksenia Levterova)

Moving further north into Canada, finally, we have a very large plate of green *vesuvianite* crystals to 3 cm from the famous Jeffrey Mine, in **Figure 25**. This large open pit exploited asbestos deposits but is long closed and the productive specimen-producing levels (*hessonite, pectolite, diopside*, vesuvianite) are now flooded.

Figure 25: Vesuvianite Crystals, Jeffrey Mine, Canada 20.5 x 13 x 8 cm

Concluding Remarks

It has only been possible to feature a handful of the wonderful mineral specimens housed in the mim Museum in this article, but they are enough to illustrate that this is one of the pre-eminent mineral collections in the World, especially one assembled by one person rather than an institution. In my opinion, the images featured in this article are the best I've ever been able to assemble into one Minchat article.

Last but not least, many thanks to Carole Atallah for supplying all the wonderful images contained herein and for proof-reading the draft, and of course to Dr Salim Eddé, firstly for assembling such a magnificent mineral collection and secondly, for sharing it with the general public in this unique museum.

Here's hoping that you both stay safe in these uncertain times and that the mim Museum continues to thrive and provide a source of wonder and education to its privileged visitors.

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Wilson, W.E. (2014), *The Opening of the MIM Museum in Beirut, Lebanon*. The Mineralogical Record January-February 2014, Vol. 45, No.1. p61-83.

See also: https://www.youtube.com/watch?v=OcBfjQJ73_8 **Mineral Talks LIVE - Episode 13 - Salim Eddé - Founder; mim Museum, Beirut, Lebanon**

The Andes on a Plate – Literally!

By **Peter Rosewarne**

Introduction

In early September 2024 I was privileged to present a scientific paper at Water Congress 2024 held in Santiago, the capital of Chile. This reprised a visit I did to Santiago in 1994. I found it a very pleasant city, safe, with no minibus taxis and no beggars, apart from people doing acrobatics at traffic lights, which makes a change from just holding out their hand or cup. The flight route from Sao Paulo, Brazil, to Santiago takes you right across the Andes Mountains for about the last half hour of the four-hour flight and it is a spectacular sight. In 2024 I flew over the Andes and was driven into them up to 3 500 m but in 1994 I flew over them and was driven into them, up to 5 500 m, getting breathtaking views and breathtaking altitude as well above about 4 000 m!

There is a draft beer called 'chopp' in Chile, pronounced shop, and on my previous trip I had so many I could have opened a shopping centre. The latest trip was more sedate but they do produce good wines so pour yourself a glass, sit back and learn about the Andes; the mountains, how they were and still are being formed and some of the minerals found there (unless otherwise stated, these are from or ex The Rosey Collection). I was expecting a relatively cheap trip as the Chilean peso is 0.019 to the SA Rand but no – the hotels and restaurants charge in US$...

The Mountains

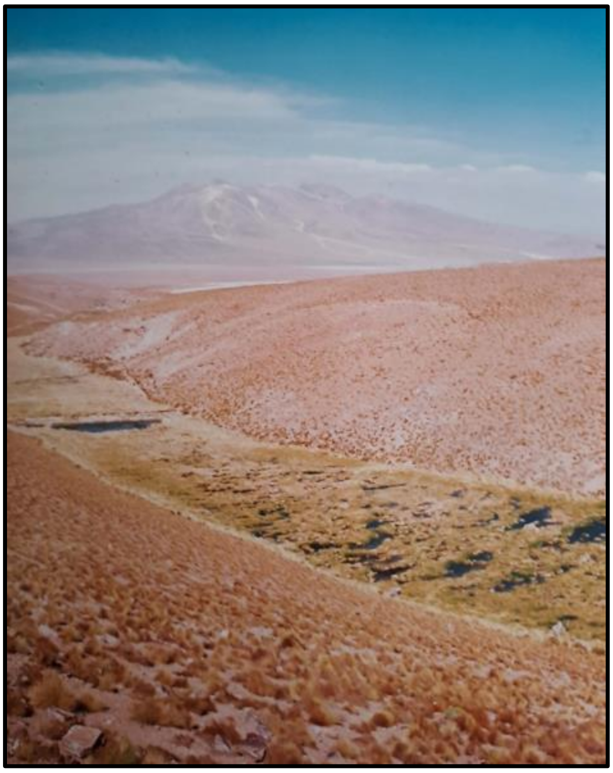
It is the longest continental mountain range in the World at 8 900 km and the article title is a pun on the fact that the Andes form the western margin of the South American Plate (SAP) above the subduction zone of the Nazca Oceanic Plate. They extend from Venezuela in the north to Tierra del Fuego in Chile at the southernmost tip of South America (**Figure 1**). They form part of the theory of *plate tectonics* first expounded in the early 1970s as a way to explain, *inter alia*, continental drift, glacial sediments in e.g. South Africa and coal deposits in e.g. Antarctica.

Figure 1: South America and the Andes (Maps of the World)

In winter they show a spectacular white winter wonderland, as shown in **Figures 2** and **3**. In summer they present a predominantly drab brown landscape from both the air and on the ground (**Figure 4**[1]), with isolated elongated patches of green along *quebradas* (narrow drainage channels, and patches of white representing salt lakes or *salares* (**Figure 5**) on the altiplano plateau (the second highest after the Tibetan Plateau) and patches of snow. The salares are mined for *salt* and *lithium* (see Minchat #152 of September 2022 article, Lithium), while sulfur is mined on the peaks of some of the volcanoes in Bolivia (**Figures 6a** and **6b**).

Figure 2: Approaching the Andes

Figure 3: The Andes>



<Figure 4: A Quebrada

Figure 5: Salare de Michincha

[1] Figures 4-6 were taken in 1994 on normal Kodak film prints and now re-photographed, hence the poor quality

6a  6b 

Figure 6a: Line of Bolivian Volcanoes Figure 6b: Sulfur Crystals

The biggest mining product from Chile is *copper*, usually extracted from *porphyry* copper deposits by means of gigantic open pits. Colluassi Copper Mine is shown in **Figure 7**. I did the initial groundwater investigation for this mine in 1994 hence my earlier visit to Santiago and the Andes.

Figure 7: Colluassi Open Pit Copper Mine (Internet image)

The western edge of the Andes lies in a "rain shadow" which gives rise to one of the driest regions on Earth, the Atacama Desert. This area used to be home to a thriving *nitrate* mining industry where the ultra-dry climate led to the preservation of the highly soluble ore minerals, including collector's minerals such as *atacamite*. By contrast, the eastern slopes give rise to some of the World's mightiest river systems, such as the Amazon.
A rock, *andesite*, and a mineral, *andesine feldspar,* a variety of *plagioclase*, are named after the Andes. The former is a *calc-alkaline lava*, characteristic of the Andes region, comprising of andesine with coloured *silicates* such as *hornblende* and *pyroxene*. *Strata cone* volcanoes such as Aconcagua (**Figure 8**), the highest mountain in the southern hemisphere at 6 961 m, poke up through vast areas of *rhyolite* and *dacite* lavas, *pyroclastic ignimbrites* and sediments. There are over 50 other volcanoes more than 6 000 m high.

Figure 8: Aconcagua (the mountain with the cloud halo)

Their Formation

The Andes owe their existence to the SAP moving westwards and over-riding the Nazca Plate (NP) in a *subduction zone*, with the latter moving eastwards and downwards. These movements were initiated by the break-up of the Gondwana super-continent about 50 Ma. The SAP is being pushed westwards by seafloor spreading from the mid-Atlantic Ridge, where new oceanic crust is being formed by the eruption of basaltic lava.

The basaltic NP, along with a veneer of sediments, then undergoes dewatering as the temperature rises with depth. This water interacts with hot mantle material (*eclogite/peridotite*?), lowering its melting point and causing partial melting. This gives rise to *magma*, which rises into the overlying crust, some solidifying as *granitic/dioritic* batholiths and some erupting explosively as typical calc-alkali lavas of andesitic composition. A schematic cross-section is shown in **Figure 9**.

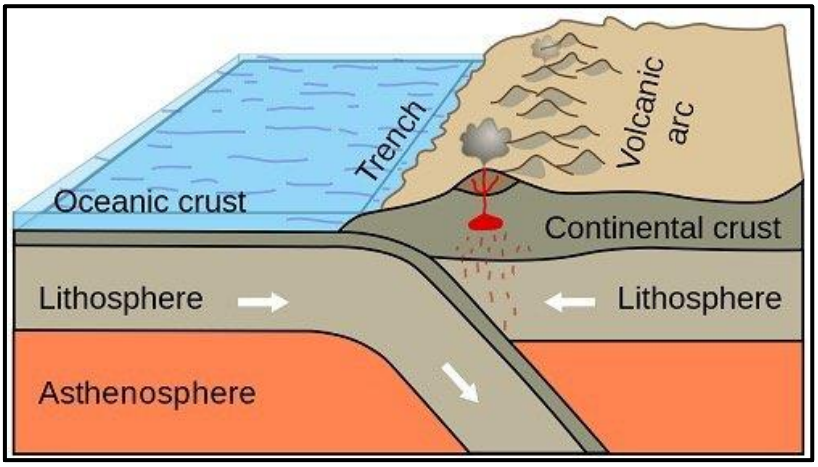


Figure 9: Schematic Cross-section of the Andes Plate Boundaries

A geological map of the central Andes area is shown in **Figure 10 below**. My 2024 route into the Andes basically followed a northeast direction from Santiago to the Argentine border. I think Aconcagua is the furthest north red triangle on **Figure 10**. From west to east there is a Coastal Cordillera, a Coastal Depression, the Principal Cordillera (the Andes proper), a Frontal Cordillera and then a Foreland. There is intense thrust faulting in the eastern Principal Cordillera and apart from plentiful volcanic rocks there are also interbedded sedimentary sequences of Triassic to Eocene age (**Figure 11**), with some intrusives. The area was also glaciated, as indicated by the U-shaped valleys with ridges or *arêtes* as shown in **Figure 12** which are typical of such landscapes.

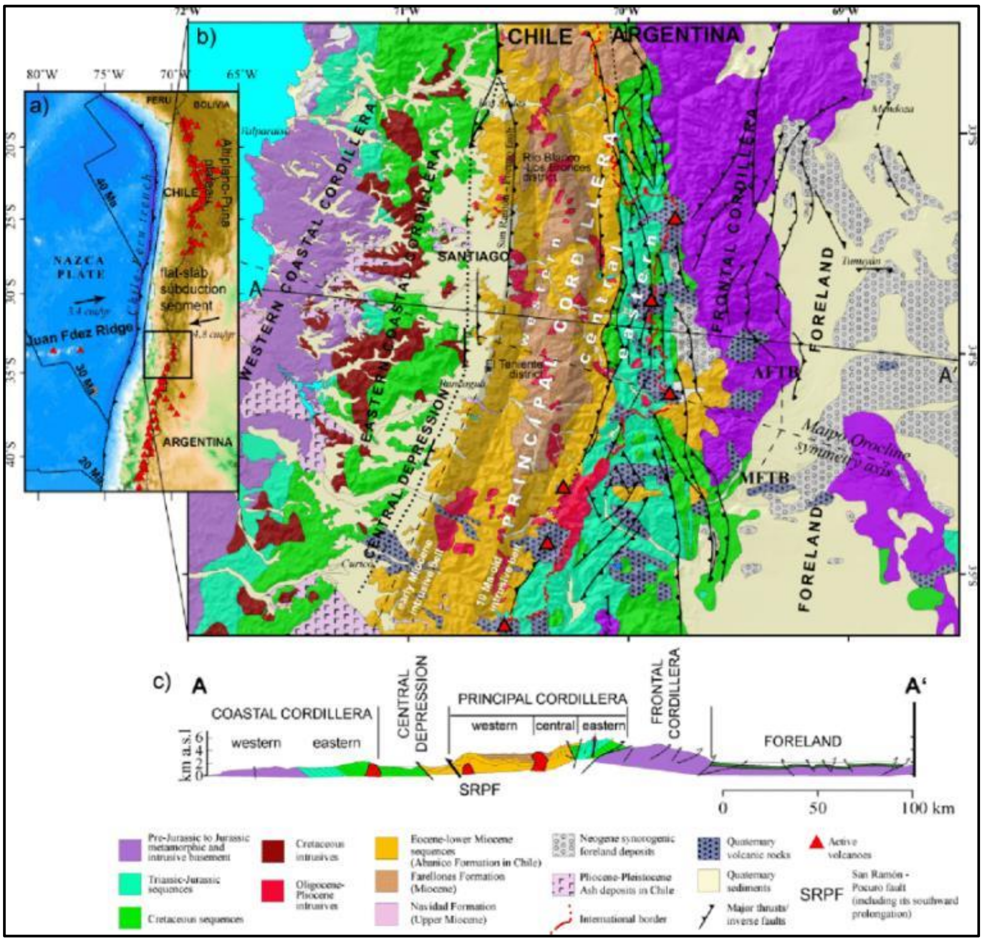


Figure 10: Geology of the Central Andes (ResearchGate, Marcelo Farios)


Figure 11: Interbedded Sedimentary Rocks **Figure 12: U-Shaped Valleys and Arêtes**

Because of the lack of rivers flowing to the Pacific Ocean from the western side of the Andes, the subducted plate only has a thin covering of sediments, causing increased friction with the SAP resulting in increased compression and uplift of the latter. The Andes are a classic *orogenic* belt.

The Minerals

I was hoping to see and buy some local mineral specimens on my 2024 trip but due to time constraints, and prioritizing some birding, I only ended up buying some *lapis lazuli* carvings, from the aptly named Blue Stones.

Colombia

The most famous Andean mineral is probably *emerald*, particularly from the Muzo and Chivor mines in Colombia. These are the stones against which other emeralds are measured for quality. Beautiful gemmy hexagonal crystals on *calcite* can be found in top collections (**Figure 13**). These emerald deposits are somewhat unique in that they are hosted in black shales and carbonates. They also host the World's best *euclase* crystals, with one monster 15 cm crystal being the best of the best (**Figure 14**)


Figure 13 left: Emerald Crystal on Calcite, Muzo, Colombia (courtesy of Wilensky Fine Minerals)
Figure 14: Euclase Crystal (courtesy of the mim Museum)

Bolivia

The Potosi area lies in the so-called Tin-Belt of Bolivia. It is host to very large reserves of *tin* and *silver* and also to best-of examples of the rare *phosphate* minerals *ludlamite* (**Figure 15a**) and *vivianite* (**Figure 16a**), plus nice octahedral *magnetite* crystals (**Figure 17**). As with many collector mineral specimens, provenance is important, and ludlamite and vivianite specimens from Bolivia command much higher prices than those from Brazil (see **Figures 15b** and **16b**; not strictly relevant because Brazil doesn't include the Andes). Recent finds of *bournonite* from Potosi are also some of the best-of, as the example in **Figure 18** illustrates, rivalling the old timers from the Herodsfoot Mine, UK and more recent ones from China. A cluster of *cassiterite* crystals is shown in **Figure 19**. Thinking about it, Bolivia would be a good country to continue the "Famous Regions" series of articles but I've shot myself in the foot by featuring many of its iconic minerals here.

Figure 15a: Ludlamite, Potosi, Bolivia

Figure 15b: Ludlamite, Brazil

Figure 16a: Vivianite Crystals, Potosi, Bolivia

Figure 16b: Vivianite Crystals, Brazil

Figure 17: Plate of Magnetite Octahedra, Potosi, Bolivia

Figure 18 left: Bournonite, Potosi, Bolivia (Courtesy of Weinrich Minerals) **Figure 19: Cassiterite Crystals, Potosi, Bolivia**

Peru

Peru hosts multiple collector minerals such as *axinite, pyrite* and *rhodochrosite*. A good example of axinite-Mn (a *calcium-aluminium boro-silicate*) is shown in **Figure 20**, with long bladed crystals and a few dark green *epidote* crystals. These Mn axinites always have a slightly violet tinge to my eye. A nice cluster of octahedral *pyrite* crystals is shown in **Figure 21**, from the Huanzala Mine.

Figure 20: Axinite-Mn, Canta

Figure 21: Pyrite Octahedra Cluster, Huanzala Mine

A surprise for me is a gigantic cluster of *scheelite* crystals from the Turmalina Mine, at 12 x 13 cm, as shown in **Figure 22**, also immortalised in a Peruvian stamp. They look a bit like the Chinese scheelites?

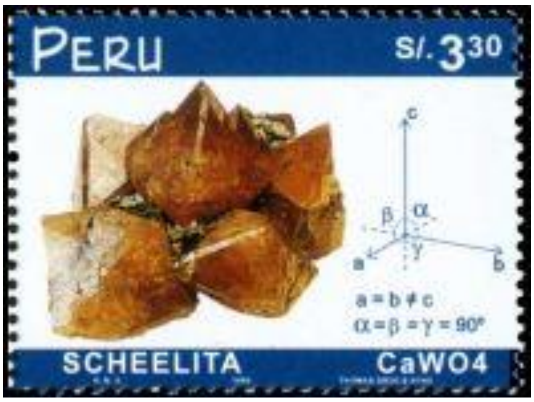


Figure 22 Scheelite Crystal Cluster and Stamp, Turmalina Mine, Peru

Chile

Chile produces lots of *copper*, but not as collector specimens, plus *atacamite* (**Figure 23**) and *proustite* a silver *sulfosalt* with some *arsenic* thrown in (**Figure 24**) for collectors and lapis lazuli (**Figure 25**), mainly as carvings and in jewellery.

From left: Figure 23: Atacamite from La Farole Mine (courtesy of Dakota Matrix)
Figure 24: Proustite from Charnocillo (courtesy of Wikipedia) **Figure 25: Lapis Lazuli Condor Carving**

Concluding Remarks

Well, the 2024 trip was one hell of a trip in more ways than one; I got to see Andean Condors, Aconcagua, had the most enjoyable day trip I've ever had, into the Andes, got to visit Valparaiso on the Pacific coast, did some wine tasting, saw and photographed 30 new species of birds and my presentation to Water Congress 2024 went very well. The long and winding road to Inca Lagoon, my 2024 high point in the Andes at an elevation of 3 500 m, is also one of the most spectacular roads I've ever been on (**Figure 26**). HOWEVER, I am not getting on a plane again for a very long time; the flights were all good (even SAA) and on time but the QUEUES – at check-in, customs, security, to board and then when you arrive at your destination you've got to do it all again in reverse. And the waiting, and the US$. From now on it is staycations or Namibia for me. *Adios Amigos*.

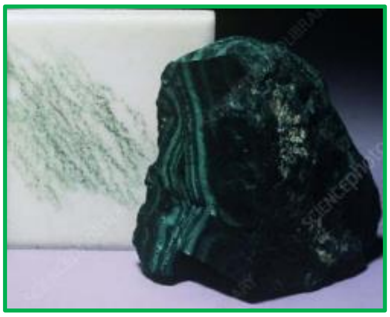
Figure 26

A "Green" Streak!

By Peter Rosewarne

Introduction

And so we come to the last of the 'mainstream 'colour-theme articles with green. Lots of common minerals are green, often due to the presence of *copper* or *chrome*, including *malachite, fluorite, garnet, dioptase, smithsonite, epidote* and *tourmaline*. Plus, some uncommon ones such as *ludlamite, emerald, olivine, cupro-adamite, vivianite* and *olivenite*. Some of them also have a green streak. 😊 Green localities include Green Monster Mountain, Alaska, for epidote and minerals with green names such as *greenockite* and *verdelite*. Images are from or ex The Rosey Collection.



Minerals

First up is a botryoidal specimen of the *zinc arsenate-hydroxide,* adamite, this one from the prolific producer of collector-grade minerals, the Ojuela Mine in Mexico. It usually forms in the oxidized zone above zinc ore bodies and is coloured yellow by *iron* and green by traces of copper. **Figure 1** is a sort of yellowy-green colour suggesting that both chromophores are present.

Figure 1: Adamite, Ojuela Mine, Mexico

In **Figure 2a below** we have a lovely specimen of green fluorite from the Rogerley Mine in the UK. This is a specimen-mining operation run since 2017 by UK mining Ventures, involving Crystal Classics owners Ian and Diana Bruce. The deep green specimens exhibit a lovely deep blue/purple daylight fluorescence as shown in **Figure 2b**. I had the pleasure of hosting Diana Bruce in 2015 when Crystal Classics bought some of my collection but I still have seller's remorse over some of the pieces I let go (one thing I don't like about Word is that the reader can't see the tear stains on the page as the writer recounts harrowing experiences like this).

Figure 2a: Fluorite, Rogerley Mine, UK Cubic penetration twin **Figure 2b: Daylight Fluorescence**

The countryside around the mine is shown in **Figure 3**, with the mine being to the left and the River Wear to the right-centre. The area looks like it has been tended by someone with green fingers?

Figure 3: Rogerley Mine Countryside (Bluecap Productions)

The Jeffrey Mine in Canada is famous for its 'best of species' honey-coloured grossular garnets but it also produced beautiful pink and green garnets. A modest miniature-size specimen of the latter is shown in **Figure 4**. The green colouration is due to the presence of chrome. The mine also produced 'best of species' for vesuvianite, with beautiful green and purple crystal groups, the best specimens featuring both colours. A thumbnail green crystal is shown in **Figure 5**. The mine produced asbestos in its heyday but with the thrust for a 'greener' environment it has been closed and flooded for many years.

Figure 4: Grossular Garnets, Jeffrey Mine, Canada

Figure 5: Vesuvianite Crystal, Jeffrey Mine, Canada

Staying with garnet, **Figure 6** is a plate of small lustrous green *uvarovite* crystals on a *chromite* matrix from the type locality for this species at the Saranovskii Mine in Russia. Garnets from this locality are almost always only of a few millimetres in size and the biggest come from the Outokumpu Mine in northern Finland but these are usually fractured and opaque.

<Figure 6: Uvarovite Garnets, Saranovskii Mine, Russia

Micas don't often get featured in Minchat articles but **Figure 7** rectifies this a bit with *fuchsite*, the so-called chrome mica, a variety of *muscovite*. This example is from an unpronounceable locality in Finnmark, Norway.

Figure 7: Fuchsite, Finnmark, Norway>

Next, we have a vibrant apple-green thumbnail crystal of *tremolite*, from the famous Merelani Hills area of Tanzania. This is an *amphibole* and the green colour is due to the presence of chrome. Tremolite forms by the metamorphism of dolomitic (magnesium plus calcium) limestones.

Figure 8: Tremolite, Merelani Hills, Tanzania

The minerals in **Figure 9** and **10** are both uncommon *phosphate*s, vivianite being an iron phosphate and ludlamite and iron-manganese-magnesium phosphate. The vivianite crystal is from Bolivia and is 10 cm in length. This mineral tends to turn black on exposure to sunlight.

Figure 9: Vivianite, Bolivia

Figure 10: Ludlamite, Brazil

By way of a change, the green colouration in *elbaite* is mainly caused by the presence of iron and this type is often referred to as verdelite. The 4 cm crystal in **Figure 11** is from Minas Gerais, Brazil.

Figure 11: Elbaite, var. Verdelite, Minas Gerais, Brazil

And to finish off, we have another garnet in *tsavorite*, a green *grossular* from the Merelani Hills, Tanzania, this one comprising of a line of small crystals on a *graphite* matrix in **Figure 12a**. The green colouration is due to traces of our old friend chrome. **Figure 12b** is of a single 1.5 cm tsavorite crystal as it was when I bought it online but after the SA Post Office had finished with it, it was in two pieces which I couldn't fit together so presumably a small piece was missing from where they broke it. As the dealer said, how was it possible to break a specimen like this?

Figure 12a: Tsavorite on Graphite, Merelani Hills, Tanzania

Figure 12b: Tsavorite Crystal, Merelani Hills, Tanzania

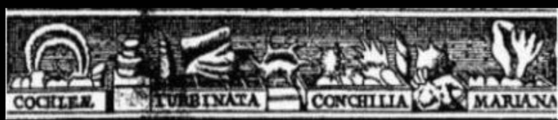
Concluding Remarks

This concludes the mainstream colour-theme series of articles which I hope you have enjoyed, with just purple to come. Not all green-coloured minerals have a green streak and you can't test the streak of minerals with a hardness of about 7 or more because they will scratch a porcelain streak plate.

We end with the usual question: do you get green *diamonds*? As usual with any colour you can think of, the answer is yes but they are very rare. The green colour is caused by radiation from natural elements such as *uranium* and *thorium*. However, it often only affects the outer layer of the diamond and so these gems have to be cut very carefully to make sure the green colour is retained by the cut stone.

Internet image

From the Cabinet of Curiosities



Floyd Rogers has an intriguing mineral specimen, found on the beach at Paternoster.

It is a lump of black mussel shells, interspersed with white barnacle shells. Both of these are examples of *biomineralisation*. Other familiar examples include snail shells, pearls, and even our own teeth and bones. This raises the question of what is a mineral? Straight away, this gets us into deep water. The purist, geological definition, sanctioned by the International Mineralogical Association, is "an element or a chemical compound that is normally crystalline and that has been formed as a result of geological processes" (https://www.mindat.org/a/what_is_a_mineral). This may satisfy geologists and the collectors of pretty crystals, but it excludes a lot of other crystalline materials with the same composition as their corresponding geological minerals. This includes mineralogical components of concrete and slags, as well as biominerals. Of course, the scientists who study such materials simply call them 'minerals'. Biominerals are minerals that are crystalline chemical compounds that have formed naturally, but through the intervention of living organisms. This involves extremely complicated biological activity involving the living tissue that precipitates the otherwise inorganic minerals, often intergrown with organic biological material for additional strength.

In Floyd's specimen the white barnacle shells are made of calcium carbonate ($CaCO_3$) in the crystal structure of calcite. The black mussel shell is also made of calcite, coloured blue-black by included manganese extracted from sea water. But the mussel shells have a white lining, and this is made of calcium carbonate in the crystal structure of aragonite, making this an animal that can control the growth of two different polymorphs of calcium carbonate. Most pearls are also made of aragonite, arranged in overlapping platelets responsible for the iridescent shine of pearls and mother-of-pearl, which is the inner layer of the oyster shell.

While marine organisms use calcium carbonates for their mineral structures, vertebrates – like us – use calcium phosphates, usually as hydroxyapatite [$Ca_{10}(PO_4)_6(OH)_2$] in their bones and teeth (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7599912/). Here the biological processes also produce crystalline structures, with chemical compositions that mimic those of their geological counterparts, and they are classic examples of biominerals.
DM

"FACETIPS – A Gem Cutter's Notebook" by Duncan Miller.

Most of the faceting articles published over the past few years in the Mineral Chatter have now been compiled into a single 128-page document. The pdf file is available for download for free from http://ctminsoc.org.za/articles.php for those interested in having all the articles together.

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