GEM TESTING LABORATORY
(Project of the Gem & Jewellery Export Promotion Council)

LAB INFORMATION CIRCULAR

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DIFFUSED-SPINEL SEEN IN JAIPUR

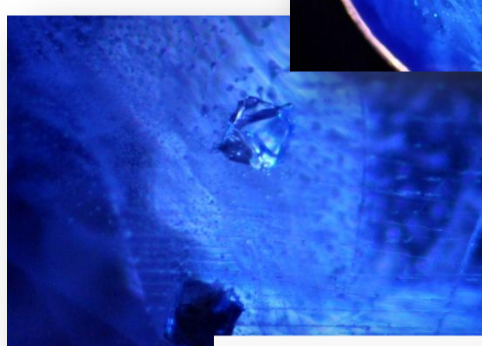
It was Mid 2015 when blue spinel coloured by diffusion process involving cobalt was first reported (e.g. https://www.gia.edu/gia-news-research/cobalt-diffusion-natural-spinel-report). However, we at the Gem Testing Laboratory encountered such treated spinels only in the beginning of 2017. This suggests that the treated counterpart exists in the market but has limited availability and penetration.

1. The studied cobalt-diffused blue spinels

The two encountered rich-blue specimens weighed 0.70 and 0.62 ct (figure 1). Identification of both the samples as spinel was straightforward on the basis of their isotropic optic character and refractive index of ~1.720, however, the unusual rich-blue colour raised doubt on their origin. Further gemmological tests were performed: both samples appeared strong red under Chelsea filter, inert under long-wave and short-wave UV, and a typical three-band cobalt spectrum was observed in desk-model spectroscope; additional iron-related band in blue region was also observed, which indicated that the stones were natural and not synthetic.

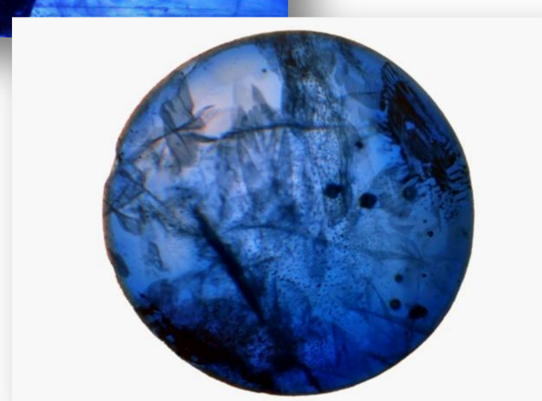
When magnified, both the stones displayed numerous healed fractures along with whitish and frosty appearing fingerprints and distorted octahedrons. These features further suggested that the stones are natural, subjected to high-temperature heating (figures 2 and 3). Since we were aware about the existence of diffusion-treated spinels, the specimens were checked for colour concentration on facet edges by immersing them in methylene iodide liquid. Interestingly, they did not show concentrations of colour on facet edges as typically seen in diffusion-treated corundum, but girdle edge or rim of the stones appeared darker than the central areas (figure 4).

2. Healed fractures and whitish fingerprints in diffused spinels, suggesting high-temperature heat



3. Distorted octahedrons in a treated spinel

In addition to observational features, Photoluminescence spectra, EDXRF and LA-ICP-MS analyses are important tools in detection of this treatment, especially when the stones are free of inclusions. However, for diffusion treatment the starting material is low-quality pale colour spinel, hence we expect them to display at least some inclusions. And in such a case, these treated spinels can be identified for their natural or synthetic origin, as well as treatment.



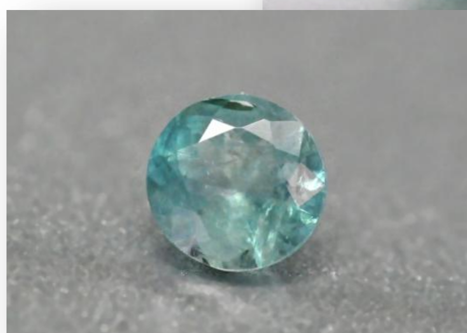
4. Colour concentrations towards the girdle edge is an important feature to identify diffused spinels

GRANDIDIERITE - AN EXTREMELY RARE GEM

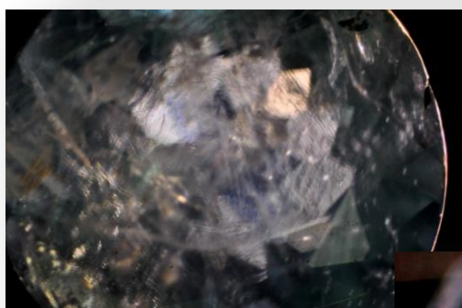
Grandidierite is considered as one of the rarest gems, however, since the recent discovery of a new deposit of this Mg-Fe aluminous borosilicate gem in Madagascar in the year 2016, this is being encountered more frequently. In the period of last one year, we at the Gem Testing Laboratory have also seen few specimens of this rare gem - both rough and cut (figure 6 and 7). The rough specimen weighed 71.69 ct, while the cut ranged from 0.31 to 14.30 ct - these sizes make these samples even rarer.

6. *71.69 ct rough specimen of grandidierite*

All the samples ranged in colour from bluish green to greenish blue colour of medium to low saturation, with distinct pleochroism. The pleochroic colours included colourless, light green and blue. Refractive index measured on faceted stone (0.31 ct) ranged from 1.580 to 1.630 with birefringence of 0.040 and biaxial negative optic sign. Hydrostatic specific gravity (same sample) was measured at 3.04, a faint line / absorption at around 470 nm was seen in desk-model spectroscope, while it remained inert under UV (long-wave and short-wave). Due to the high birefringence, strong doubling of facet edges and inclusions was evident, causing transparent samples to appear hazy (figure 8). All the samples displayed numerous fluid inclusions, including 2-phase forming fingerprint patterns. Also present were liquid films associated with crystals (figure 9), and clusters of whitish crystallites (not identified).



7. *0.31 ct transparent faceted grandidierite*

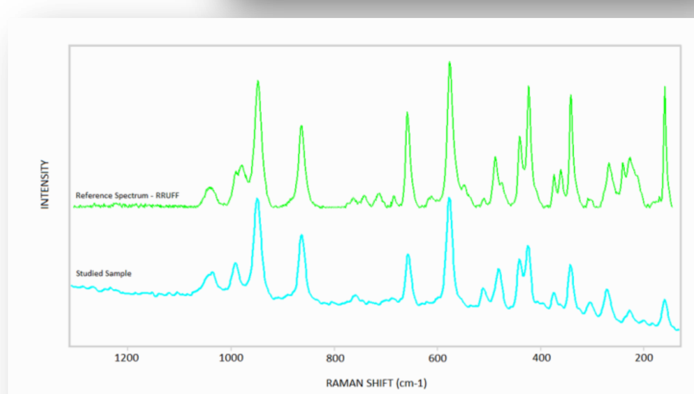


8. *Strong doubling of facet edges and inclusions causing haziness throughput this 0.31 ct grandidierite*

9. *White crystallites and liquid films in grandidierite*

Standard gemmological properties were consistent with that reported for grandidierite in literature (e.g. M. O'Donoghue, *Gems: Their Sources, Descriptions and Identification*, 6th ed., Butterworth-Heinemann, London, 2006), however, Raman spectra was collected for all the samples. Raman spectra (figure 10) revealed major peaks at ~ 230, 268, 303, 376, 425, 441, 483, 513, 577, 618, 657, 741, 758, 864, 947, 992 and 1040 cm-1. The spectral pattern matched with that given in RRUFF database for grandidierite.

The properties measured for these samples were overlapping with those reported for stones originating from Madagascar (e.g. Vertriest et al, "Grandidierite from Madagascar", Winter 2015, *Gems & Gemology*, pp 449-450). As per the depositor also, the stones studied here were reportedly mined in Madagascar. In addition to Madagascar, facet-grade grandidierite is also reported from Sri Lanka.



10. *Raman spectra of studied grandidierite (blue trace) compared with a sample in RRUFF database (green trace)*

SYNTHETIC RUBY FROM MOZAMBIQUE!

Reaching directly to the miners for procuring rough has always been profitable, but involves a huge amount of risk unless one has enough experience in buying at the source, deep knowledge about the stone being purchased, and handling the pressure thereof. Often, there have been cases when dealers tend to forget the possibilities of scams and frauds at mining sites or the markets nearby. The sellers at such locations often present glass, synthetic gems or other cheap natural gems as expensive gems in order to make some quick money. This practice is being followed at most of the major mining regions around the world for decades. Such cases are routinely witnessed at GTL, some of which have also been discussed in past issues of Lab Information Circular.

However, recently we came across a small parcel of rough rubies submitted for identification. All the specimens were tumbled with corroded surface, and interestingly coated with a yellow-brown substance. Most of the samples were free from inclusions, but under immersion microscopy all displayed curved growth lines, characteristic of synthetic ruby grown by Verneuil process. Appearance of these specimens clearly suggested that these were presented as natural. Previous to this, we have seen many more specimens of synthetic ruby and in much larger sizes, presented as natural. Upon discussion with the depositor of the stones, it was revealed that these were purchased in Mozambique!

11. *These rough specimens were identified as synthetic ruby. Similar samples in larger sizes were said to be purchased from mining areas in Mozambique*

12. *One of the specimens illustrated in figure 11 also had coating of yellow-brown substance, imitating mud on natural rough*

PLASTIC IMITATION OPAL WITH 'PLAY-OF-COLOUR'

Plastic imitation opal showing true 'play-of-colour' exists since late 1980s under the trade name "opalite" (e.g. Koivula & Kammerling, "Opalite: Plastic imitation opal with true play-of-color", *Gems & Gemology*, Vol. 25, No.1, p 30-34) . However, in the last one and a half decades at the laboratory, this material was never seen until late 2016. Since then, these plastic imitation opals displaying true play-of-colour have become a regular encounter at the laboratory. Displaying bright play-of-colour patches / spots, these serve as an excellent imitation for opals, especially from Ethiopia.

Spot RI of ~ 1.53 and hydrostatic SG of ~ 1.45 separates these plastic imitations from most natural and synthetic opals; inclusions / growth features assist in separation when seen. Additional test include 'hot-point', which will make an indent in plastic but not in opal; this test however, should be performed with extreme care as not to damage the stone.

13. *This plastic-imitation opal has become a frequent encounter in recent past, although a similar material exists under the trade name "opalite" since 1980s.*

CALIFORNITE - "CALIFORNIA JADE"

Californite - a translucent, compact cryptocrystalline variety of vesuvianite is usually found in green mottled masses and has been used as a jade simulant. It is majorly found in California State of the USA from where it received its name; the mines are located in Siskiyou County at Happy Camp and Preston Peak, at Pulga in Butte County and in Fresno County. Some deposits are also reported in Russia and Switzerland. Further to its jade-like appearance, the term "californite" is also used for a rock, essentially consisting of vesuvianite; other minerals being hydrogrossular garnet, diopside or chlorite. It is often called "California jade" or "American jade", which should be considered misnomer, since this is altogether a different material compared to a jade.

It is mainly found in green colours with mottling of darker green, yellow, brown or white colours, depending on the nature of other minerals present. Strong absorption band at ~461 nm is the most characteristic feature, in addition to the refractive index of 1.700 to 1.725 (birefringence 0.001 - 0.012) and specific gravity range of 3.32 - 3.47, to identify and separate californite from jade (jadeite or nephrite).

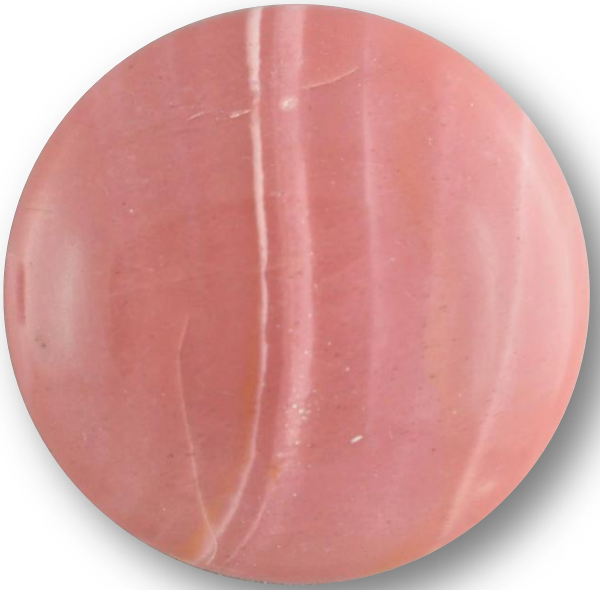
14. A mottled-green californite cabochon like this can be an excellent ornamental gem

Availability of bright colour (example, figure 14) and good durability makes californite a useful ornamental gem.

'PINK OPAL' - A SLICIFIED SILTSTONE

Pink opal has gained a lot of popularity in the recent times, as evident by the number of such stones we receive for identification. Along with the true 'pink opal' originating from Peru / Argentina, we also receive a similar material, being identified as "silicified siltstone" or what is commonly known as "mookaite"; such pink mookaite is however, being marketed as 'pink opal'. Mookaite is basically a silicified siltstone consisting of cryptocrystalline silica with radiolarian (plankton) microfaunal structures. In simple terms, it is formed as a result of silicification of siltstone (a sedimentary rock composed of fine grit which may include sand, clay, plankton or any material). The only source of this material is Carnarvon (Binthalya Prospect) in Western Australia.

This material is always found opaque, often displaying sharp banding patterns and fine granular structure at higher magnifications, with cavities being filled by transparent quartz. While, true opal ranges from semi-transparent to opaque and coloured by inclusions of palygorskite - key to the separation of these two materials.



15. This pink mookaite or silicified siltstone displaying distinct banding is often marketed as pink opal from Australia.

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