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Synthetic Beryl - "Paraiba" Colour

Synthetic Beryl in various colours and varieties is known in the gem trade for many years. The various colours / varieties include emerald, aquamarine, red, blue, pink, etc; all being produced by the hydrothermal process.

Recently "Paraiba" coloured synthetic beryls have been launched in the market on commercial scale. The term "Paraiba" is being used for the electric neon blue to green coloured tourmalines typically originating from Paraiba state in Brazil (refer Lab Information Circular, Vol.43, January 2006).

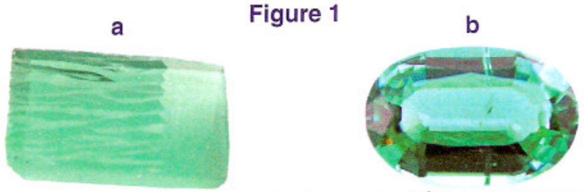
The popularity of "Paraiba" tourmaline has remarkably increased in last two decades and currently is one of the most sought after gems; the reason being their bright electric blue- green colours. "Paraiba" has slowly evolved in recent past as a particular shade of copper bearing elbaite tourmaline rather than a source in Brazil, a fact that is also reflected in identification reports of various laboratories.

Even similar coloured tourmalines originating from any other locality like Nigeria or Mozambique are described as "Paraiba" type.

"Paraiba" coloured synthetic beryls have been recently launched by Tairus Co. Ltd. at the September Bangkok Gem & Jewelry Show 2007. Both rough and cut stones were on a display ranging in size approximately from 0.20 to 3.00 carats. All the specimens were 'electric' greenish blue in color as typically encountered in "Paraiba" elbaite tourmalines. Two pieces (rough & cut – one each) of these synthetic beryls were purchased for the study by Chaman Golecha, Executive (Technical & Training) of the Gem Testing Laboratory, Jaipur.

The flat rough and cut specimens bought for study weighed 2.61 ct (figure 1a) and 0.42 ct (figure 1b) respectively; both specimens displayed a bright 'electric' greenish blue color.

Figure 1

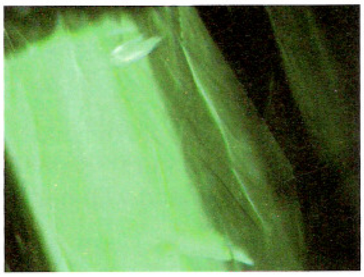


Visually, the rough sample was readily identifiable as a product of hydrothermal technique by the presence of typical wavy features on the surface this followed inside the stone as chevron. The cut specimen also exhibited strong chevron growth patterns even to the naked eye.

Hydrostatic specific gravity was recorded for both samples at 2.75; cut sample displayed uniaxial optic figure and refractive index of 1.594- 1.600. The RI and SG values were much higher and quite unusual for synthetic beryls. No absorption spectrum was visible in desk model spectroscope and both samples were inert under long-wave and short-wave UV lamp. Both samples displayed a moderate pleochroism with light blue and greenish blue as the colours.

Under magnification, as expected, both samples exhibited strong undulating growth patterns also known as chevron (figure 2); described as irregularly changing subgrain boundaries between sub individuals and a typical cellular structure.

Figure 2



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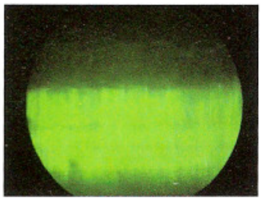
The rough specimen also exhibited "hounds tooth" pattern originating from the planes parallel to the wavy surface (figure 3).

Figure 3



Qualitative EDXRF analysis revealed the presence of Al & Si as expected for a beryl, in addition, Fe & Cu were detected in high concentrations. Be or any other light element could not be detected as these are too sensitive to be detected by EDXRF spectroscopy. This analysis indicated the cause of color as Cu and Fe, which has also been reported as a color causing impurity in blue beryls; the higher values of RI and SG are possibly due to the presence of these impurities.

FTIR absorption spectra exhibited a general absorption till 2200 cm^{-1}, an absorption band ranging from 3400 to 4000 cm^{-1} and a sharp peak at 5266 cm^{-1}. The overall absorption pattern was more like natural emerald and unlike "traditional" hydrothermal emeralds (figure 4.a).

Figure 4 a

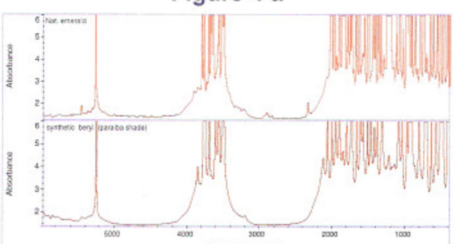
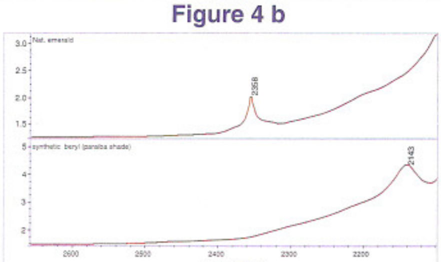


Figure 4 b



However, the spectral pattern in the region 2600 and 2000cm^{-1} revealed difference in peaks of Natural emerald and the synthetic beryl (figure 4.b). Since this is the first time the paraiba shade of synthetic beryl has been encountered, we could not compare with a similar beryl, rather a comparison with natural and synthetic emerald were made.

The popularity and price of "Paraiba" shade tourmaline has remarkably increased in the last decade or so; and in cases, where certain laboratories encourage it by mentioning on their identification reports, trade has won the confidence of customers in marketing this "special" product.

This has led to number of products simulating the shade and encouraged the jewelers, miners, or manufacturers of various synthetic products to provide a cheaper alternate. Some of the known simulants include apatite, glass, triplets (consisting beryl or topaz), cubic zirconia and now synthetic beryl.

Publications in International magazines.....

Apart from educational and certification activities, GTL is also involved in research and updating the worldwide gem trade and gemmologists by way of contributing articles in some highly reputed and renowned magazines like Gems & Gemology, Journal of Gemmology, and Gems & Jewellery. Some of the contributions in the recent post are as:

Gems and Gemology

- *Yellow hydrothermal synthetic sapphires seen in India, Summer 2005*
- *Unusual emerald with conical growth features, Fall 2005*
- *Sapphire with unusual colour zoning, Spring 2006*
- *Two unusual Star emeralds, Summer 2006*
- *Natural Sapphire with unusual inclusions, Summer 2006*
- *Diffusion treated synthetic sapphire, Summer 2006*
- *Circular ring like inclusions in a diffusion-treated sapphire, Winter 2006*
- *Diffusion treated sapphire with unusual fluorescence, Winter 2006*
- *Emerald with unusual growth features, Spring 2007*
- *Glass object with circular bands, Spring 2007*
- *Synthetic star sapphire with hexagonal features, Spring 2007*
- *A study of Nail-Head spicule inclusions in Natural gemstones, Fall 2007*
- *A remarkably large fire opal carving, Fall 2007*

Journal of Gemmology

- *A remarkably lage clinohumite, January / April 2007*

Gems and Jewellery

- *A magnificient suite of Trapiche Emeralds, December 2006*
- *Some convincing glasses, August 2007*

In addition to these contributions, numbers of other articles are awaited to be published in the coming issues.

Two Unusual Synthetic Sapphires

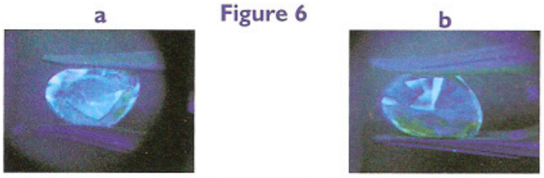
Natural and synthetic gem materials are commonly and conclusively differentiated and identified on the basis of magnification features. Often, there are cases when a natural stone possess some of the features of synthetic materials and vice versa (See past issues of Lab Information Circular).

Recently, we at the Gem Testing Laboratory encountered two such yellow sapphires. On initial observations, both sapphires appeared to be natural but careful examination revealed the true nature.

Sapphire 1: The tested stone was brownish orange similar to the colours seen in beryllium treated corundum (figure 5). The standard properties (RI and SG) were consistent with those of corundum. Under desk model spectroscope, fine lines in the red region were easily visible indicating presence of chromium. Under long-wave ultraviolet it exhibited a strong chalky blue fluorescence; when viewed from table this fluorescence followed the surfaces (figure 6.a) while from pavilion side some zones were visible (figure 6.b).

Figure 5

a Figure 6 b



When magnified, some surface reaching fingerprint like inclusions (figure 7.a) were observed, commonly seen in corundum exposed to high temperature heat. In, addition a trail of dotted inclusions (figure 7.b) was also observed giving impression of a broken needle.

a Figure 7 b

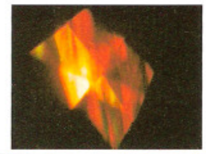
The overall features indicated that the sapphire has been exposed to high temperature using beryllium and hence we immersed the stone in methylene iodide to look for colourless (or light coloured) rim. By immersing we were reaching closer to the conclusion as the girdle area appeared colourless and most of the colour was concentrated towards the centre (figure 8.a); the feature indicated a beryllium treated sapphire.

a Figure 8 b

But, as the stone was rotated and viewed in various directions, we were deceived by the presence of some curved coloured zones running almost parallel to each other (figure 8.b).

The pattern created a doubt regarding the origin. The origin was further confirmed by the presence of strong "plato" lines seen along the optic axis direction (figure 9).

Figure 9



Sapphire 2: This tested sapphire was light yellow (figure 10) typically associated with Srilankan origin; there was no problem in determining it as sapphire. When magnified, we observed some white cloudy zones (figure 11.a) commonly seen in natural sapphires; some of the zones composed of fine dotted inclusions as well. At some angles, these zones appeared to be wavy which created a doubt regarding the origin.

Figure 10

Other features observed were some wavy needle like inclusions (figure 11.b) similar to etch channels seen in natural sapphires; all these needle-like inclusions were confined to a single plane. This plane appeared to be slightly iridescent with a wavy edge, similar to 'half-way' twin plane seen in synthetic corundum.

Figure 11

a b c

These features restricted us to conclude the stone; therefore we switched over to 'crossed polars' to observe "plato" lines which were easily seen even under polariscope without further magnification.

In addition, we performed short-wave ultraviolet transparency test, under which synthetic sapphire appears transparent while a natural opaque. See figure 11.c where the central piece is the tested synthetic sapphire compared with known synthetic (left) and natural (right).

If not observed carefully, both these stones could have easily been misidentified.

*Stone News....*Some interesting stones through GTL......

Painite: The material considered as one of the rarest mineral on earth is now being mined out in larger numbers from Burma. The major locations include Onhgaing- Central Mogok, Namya-Kachin state and Kyank Pya That- West Mogok. This is reflected by recent reports on Painite from various laboratories and dealers who have seen this rare mineral in fairly good quantities. Recently, at GTL we also had a chance to see this rare mineral.

Figure 12

a

b

Both rough and cut studied pieces were below 1 ct with deep reddish brown similar to garnets, displaying a bright vitreous to sub-adamantine lustre (figure 12. a & b). Gemmological properties were consistent with those reported for Painites.

Painite belongs to hexagonal crystal system but the crystal encountered displayed a pseudo-hexagonal to pseudo-orthorhombic system. The faces exhibited smooth glassy reflection with curved edges and a complex pattern of etching.

Painite is a uniaxial mineral which was easily concluded in the cut samples as they displayed uniaxial optic figure right on the table. All samples exhibited a moderate to strong degree of dichroism with brownish red and orange yellow as two colours.

Refractive index values are 1.787 – 1.816 with birefringence of 0.029 which could not be determined on standard refractometer. Further, no doubling of inclusions or back facets was observed as optic axis was on the table and the stone became too dark to see anything from sides. Under desk model spectroscope, complete absorption was seen till 470 nm and all samples were inert under ultraviolet light. Specific gravity measured hydrostatically gave values of 4.01 for all samples.

Under magnification, large fingerprints were seen composed of negative crystals, some of which also forming two-phase inclusion. In addition, weak colour zoning and iron staining were also seen.

FTIR analyses displayed a complete absorption till 1800 cm^{-1}; two narrow bands in the region 2200 – 2800 cm^{-1} and weak peaks at around 3450, 3895 & 3600 cm^{-1}. Qualitative EDXRF analyses revealed the presence of Al, Zr and Ca as the major elements; this is consistent with basic composition of Painite ($CaZrBAl_9O_{18}$). Other trace elements included Ti, V, Cr, & Fe.

This mineral was once recorded in the Guiness Book of World Records for the rarest known mineral indicating the rarity of this gem.

An interesting incidence: *Recently, a transparent faceted fire opal was submitted for certification. The specimen was readily identified as opal by its RI and SG; it exhibited a white cloudy patch at the centre which was also visible with unaided eyes (figure 13.a). The certificate was issued and the depositor was shocked as he saw the stone. He claimed that when the stone was submitted the cloudy patch was not there and it has developed during the testing procedure. But we could not believe this as when the packet was opened for testing, it contained the white patch.*

Next morning, the client again landed in the lab and shown us the same piece and we were amazed with what happened to the stone! The white patch was not visible at all (figure 13.b). On enquiry, he stated that the stone was kept in water for whole night and he was still carrying the stone in a container filled with water.

Figure 13

a

b

The white cloudy patches in opals are a result of loss of water from the structure leading to dehydration. This is a common practice followed by the traders to keep opals in water thereby keeping the moisture intact and saving them from crazing. But, this incidence was really an interesting one and no one could have expected these results....

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