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GEM TESTING LABORATORY

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Beryllium Treated Blue Sapphires from Sri Lanka

Following the last issue of Lab Information Circular, Vol. 58, July 2010, this issue highlights the problems associated with the blue sapphires flowing into the gem trade from Sri Lanka. In the last issue, we discussed about the presence of beryllium-treated yellow sapphires from Sri Lanka which appeared very much similar to the natural untreated counterparts as against the typical Bangkok treated yellow sapphires, whose appearance is quite different from those of Sri Lankan. Therefore, there is a general misconception in the trade that Sri Lankan yellow sapphires are only heated and not treated with beryllium; however, there is a huge price difference between the two, heated and beryllium treated.

Similar is the case with blue sapphires especially those originating from Sri Lanka or Madagascar. Sapphires from both these locations are very much similar in appearance, externally as well as internally. This is now widely known that beryllium treatment is commonly performed on various colours of sapphires, ranging from yellow, green, orange, pink, and even blue. In case of blue sapphires, beryllium treatment is more often performed on dark blue to greenish blue sapphires originating from Australia or Thailand to turn them pleasant blue. This is known by many people who deal in blue sapphires, however, presence of beryllium-treatment in sapphires from Sri Lanka is not very well acknowledged in the trade. And an important fact is beryllium treated Sri Lankan sapphires are found in larger sizes of around 5 to 10 carats or above.

a b c

Figure 1: Natural (a), Heat-treated (b) and Beryllium treated (c) sapphires from Sri Lanka

As per one of the technically inclined gem dealer of Jaipur (anonymous), “there is a lack of awareness in the trade regarding the presence of beryllium treated blue sapphires, especially from Sri Lanka. People believe that Sri Lankan blue sapphires are only heat-treated, which is not completely correct. And…. there is a huge price difference between the two. Therefore, traders should understand that a heated sapphire and beryllium-treated sapphire are two different products and hence, should be disclosed separately”. The price difference between the two could be as high as 30 percent or even more.

Being located in one of the major gemstone trading centres of the world, we at the Gem Testing Laboratory quite often receive for identification these beryllium treated sapphires along with traditionally-heated and natural untreated / unheated counterparts. Visual appearance of all the three types are very similar and hence clear separation between the three is not possible just by looking at the stones. Thorough gemmological and analytical measurements are required to define and distinguish each type. Natural (untreated / unheated) sapphires in most cases can be separated from the treated counterparts on the basis of inclusion study, however, not always that simple. Separation of heated sapphires from beryllium treated requires proper spectroscopic studies, especially on FTIR (Fourier Transform Infra Red Spectrometer) in addition to careful microscopic examination, which however provides only some clues.

Features to look for…..

Circular to Semi-circular Rings: The presence of circular to semi-circular rings forming web and spring like patterns are now quite commonly observed in blue sapphires, especially after the introduction of beryllium treatment. Although, these features are not conclusive to prove beryllium treatment, but provides useful clues and suggests ultra high temperatures required to carry out beryllium treatment. This is to be noted, these features have also been seen in some (only) heated sapphires.

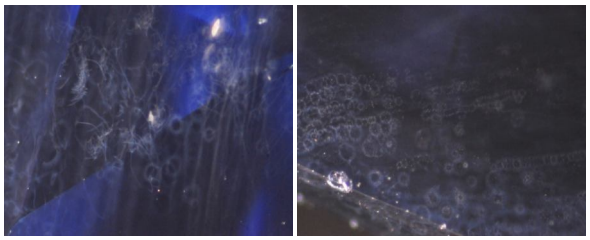

Figure 2: Circular to semi-circular rings forming web like patterns are often seen in beryllium treated sapphires

Melted and Damaged Crystals: Since sapphires contain numerous crystal inclusions, they do not sustain high temperatures required to carry out the beryllium treatment and as a result they damage. They then become white and sugary, and often contain an associated stress crack around it. Such features are also observed in heat treated sapphires; however, with some experience it is possible to judge the differences between the two. Quite often, the crystals melt and display bubble with in it due to the shrinkage of the melt.

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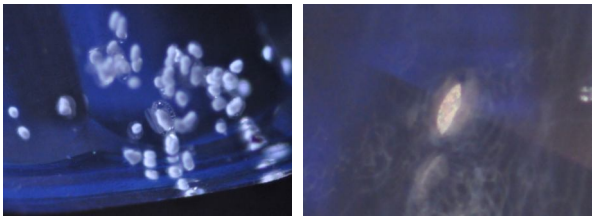

Figure 3: White sugary crystals in sapphire, indicating high temperature heating required to carry out beryllium treatment.

In addition, the whitish / sugary crystals are surrounded by a cloud of fine pinpoints, which was not being observed in stones prior to the development of beryllium treated blue sapphires. Further, as illustrated in figure e of Box A in the last volume, the stress cracks formed around a crystal inclusion may display a fern like pattern in this case as well and indicates high temperature heating, which is usually the case with the beryllium treatment.

Healed Fingerprints: Because of the application of high temperature heat, liquid fingerprints get damaged and become whitish and frosty; often partially with glassy reflections. Such features are observed in heated as well as beryllium treated stones.

Figure 4: Healed Fingerprint

Colour Rim / Zoning: The pattern of colour zoning and / or distribution is one of the key features to distinguish between heated and beryllium treated sapphires, especially when classical gemmological testing is being performed. The key feature in the beryllium treated blue sapphires is the presence of colourless or light coloured rim which may or may not follow the surface. The best method to examine this feature is to immerse the stone table down in methylene iodide liquid and observed in transmitted diffused light. Heated sapphires usually display colour zones along the crystallographic faces and are more pronounced than in a beryllium treated.

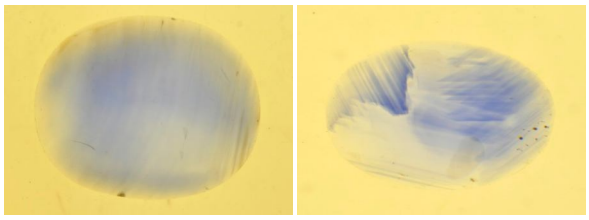

Figure 5: Colour zoning in beryllium treated sapphire (left) and heat treated sapphire (right)

Surface-related features: When subjected to high temperature heating, the fluxes used melt and penetrate into the surface breaks, thereby healing the cracks; these display a fingerprint like pattern. These features however, conclude the high temperature heating but do not indicate whether the stone under test is natural or synthetic. Therefore, one has to be careful when observing such fingerprints. In addition, the use of high temperature melts the surface of the stone which then shows the signs of re-crystallisation; however, such features are often removed by repolishing.

Chemical analysis: Conclusive identification of beryllium treatment is done by performing thorough chemical analyses using LA-ICP-MS or LIBS at various points on the surface of the stone. The presence of beryllium in sapphires indicates the presence of treatment. However, in recent times, beryllium has also been detected in some natural sapphires; therefore, this test has to be done cautiously.

FTIR Analyses: As also discussed in the last volume of LIC regarding the usefulness of FTIR in the identification of beryllium treated yellow sapphires, this instrument is vital in case of blue sapphires as well. At Gem Testing Laboratory, this equipment is routinely used to differentiate between natural (untreated), heated and beryllium treated sapphires.

The characteristic peak seen in beryllium treated sapphires is at around 3050 cm^{-1}, while in heat treated sapphire is 3307 cm^{-1} and in natural both these peaks are missing. However, care has to be taken, when there is no peak; usually natural (untreated) blue sapphires from Sri Lanka do not display any absorption, but some stones have been encountered which have displayed weak absorptions at around 3307 cm^{-1}. In such cases, inclusions become important to distinguish between natural and heated sapphires.

Disclosure: The Gem Testing Laboratory uses microscopic examination and FTIR analyses to disclose the presence or absence of treatments in these blue sapphires. Following comments are given on the identification reports:

1. When natural undamaged inclusions are observed:

Comments: *No indications of thermal enhancement*

2. When inclusions of high temperature heat are observed and FTIR spectra display a peak at 3307 cm-1.

Comments: *Indications of thermal enhancement*

3. When inclusions of high temperature heat are observed and FTIR spectra display a peak at 3050 cm-1.

Comments: *Thermal enhancement and indications of diffusion of chemicals (e.g. beryllium) from an external source.*

Diaspore or Zultanite: A new colour changing gem!

Diaspore [Al(OH)O] is widely known as a mineral with composition similar to that of corundum. Gem quality diaspore was first discovered in early 1950s in Turkey, which is still the major known source. However, in the recent times, the colour changing variety of this mineral which is being marketed and promoted as 'Zultanite' has become quite popular in the trade. Despite of the fact that this gem variety has gained a lot of popularity in the recent times, Jaipur being one of the important gem centres, is still not well versed with this gem.

Figure 6: Diaspore crystal displaying colour change from brownish green (in daylight) to brownish pink (in incandescent light)

Zultanite or Diaspore occurs typically in olive -green to brownish colours in daylight, with varying degrees of saturation, which changes to brownish to purplish pink in incandescent (lamp) light; such colour change effect is analogous to alexandrites.

Diaspore is a major mineral component of bauxite, a primary ore of aluminium and is a dimorph of boehmite; the mineral often found as inclusions in corundum. Today, Turkey is the prime supplier of colour changing variety of diaspore, where it is found in metabauxite fields. The mining area is enclosed by the Bafa lake to the North, the Akbuk and Gulluk bays to the West, the main road between the Soke and Milas districts to the East and the main road between Milas and Bodrum districts to the South. The mine is located in the Kucukcamlik and Buyukcamlik hills of the Ilbir mountains and the nearest village is Pinarick, about 12 kilometres from the mining area. Other than Turkey, diaspore is also found in England, Norway, Sweden, France, Germany, China, USA, etc.

Diaspore belongs to the orthorhombic crystal system, where crystals are usually elongated, often terminated by pyramidal faces. Blocky crystals are also seen with square or rectangular cross section and terminated by pinacoids. Interpenetrant twins are common forming 'vee' shaped crystals. Prism faces are distinctly striated which are present along the length of the crystals. Diaspore has one direction of easy cleavage parallel to the prism face and is rather brittle. Both these properties make cutting and polishing a challenge and hence results in a lesser overall yield. Hardness is relatively good at 6.5 to 7 on the Moh's scale giving diaspore to resist routine abrasions. This moderate hardness makes diaspore a relatively durable gem in spite of the brittality. Specific gravity is measured between 3.30 and 3.50.

Figure 7: Cleavage in Diaspore

The refractive index of diaspore is 1.702 to 1.750 with significant birefringence of 0.048 and is biaxial negative. The high amount of birefringence results in strong doubling of facet edges and of inclusions. Therefore, this aspect is also to be considered while cutting so as to avoid the doubling effects to be visible through the table facet. It displays a strong pleochroism with green and pink as two principle colours (exact colours vary as per the body colour and its depth); these are associated with colour change effects of the stone. Under desk model spectroscope, band at around 450 nm is often seen, associated with the presence of iron. In addition, manganese is also present but UV Vis spectrometer is usually required to observe the absorption features. It has been presumed, that the strong Pleochroism and the colour change effect in Diaspore is attributed to the ratio of iron and manganese.

Figure 8: Liquid inclusions in Diaspore

Diaspore usually displays a variety of liquid inclusions ranging from feathers to phase and negative crystals. Often, cleavage planes are seen with in the cut samples. Tubules or fibre like inclusions have also been seen in diaspore giving them a chatoyant effect.

Currently, this magnificent gem is not widely known in the Jaipur gem industry, but with the increasing popularity, this will give one more option to the consumers to choose from.

Reference: (1)Hatipoglu M. & Akgun M. (2009), Zulatnite, or colour-change diaspore from the Milas region, Turkey. *The Australian Gemmologist*, 23, pp559-563. (2)Diaspore, Zultanite colour-change variety, Gemmological Properties: Editor's Addendum. *The Australian Gemmologist*, 23, pp564-566

Glasses with straight zones

Glasses have been the most popular and widely used gemstone simulant for centuries, which has the capability of imitating any gem material, whether organic or inorganic, transparent or opaque, any colour and even phenomenas like chatoyancy, sheen, adularescence, opalescence, orient, colour change, etc. The identification of this gem simulant is however, not a problem for gemmologists or traders with fair degree of knowledge in gem identification. The presence of gas bubbles, swirl marks, or devitrification effects readily identify the glasses.

Figure 9: These two glass specimens displayed unusual straight zones

Recently, at the Gem Testing Laboratory, we received for identification two green specimens weighing 17.05 and 1.79 carats submitted as emeralds, which turned out to be glasses. The 17.05 carat, octagon step specimen measured 14.94 x 12.10 x 7.43 mm while 1.79 carat, oval mixed specimen measured 8.87 x 6.83 x 4.23 mm. Initial observations indicated these specimens as emeralds because of their typical colour shade; both specimens were of exceptional colour and clarity. These exceptional qualities were sufficient to raise the doubts regarding their origin.

Both the specimens displayed ADR effect under polariscope, which was sufficient to rule out the possibility of emeralds. The 17.05 carat specimen displayed single refractive index reading 1.730 and hydrostatic SG at 4.36, while 1.79 carat specimen displayed RI at 1.630 and SG at 3.03. Both specimens were inert under ultraviolet lamps (LW and SW) and did not display any absorption features in the desk-model spectroscope. These properties indicated these specimens as glasses.

When magnified, striking features were observed. Both the specimens displayed series of sharp and straight lines running throughout the stone from one end to the other. Such lines are associated with the growth lines or zones in natural gemstones. At few angles, some of these lines appeared as planes with sharp edges running throughout the stone. In addition, only few scattered gas bubbles were present in 1.79 carat specimen.

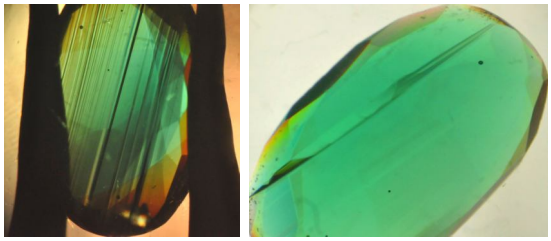

Figure 10: The glasses in figure 10 displayed these unusual straight zones (left) and plane (right)

However, with the use of some of the classical gem testing instruments, these glasses were readily identified, but may pose problem when attempt is made to identify only with a 10x lens as usually the case with the jewellers or field gemmologists.

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GTL now returns the stone on same day

The Gem Testing Laboratory Jaipur will now return the stones on the same working day. The laboratory which is offering its quality services for the past 38 years has stepped further in providing quick services to the trade. **Under the revised offer, the stones which will be submitted till 12.00 noon will now be returned back on the same working day between 4.30 and 5.15 pm without any additional charge.** This however, will applicable mainly to single stones and not packets of more than 5 (five) stones.

In case, if the stones submitted during this period are high, an extended time may be taken while returning i.e. it will be returned on the second working day. However, "On-The – Spot (OTS)" category will remain applicable for those who submit the stone after 12.00 noon and wish to get the report on the same working day.

We hope to serve you better in the coming years by introducing many more services and facilities.

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