THE GEM & JEWELLERY EXPORT PROMOTION COUNCIL

GEM TESTING LABORATORY

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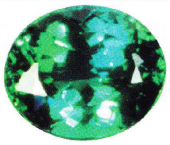
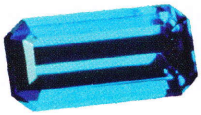
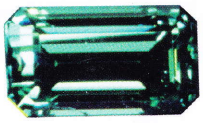
Country of origin in Gems....

Is it necessary?







Tourmalines from Paraiba *Nigeria*

Apart from the visual beauty, the 4c's, there is another factor playing role in certain exceptional quality gemstones. It is the origin of the gemstone i.e. from where has it been mined. There are some gem deposits that have been reputed by the visual splendour of the gemstones it has consistently produced over a period of time that has got it fame and publicity. Such deposits become well known with an associated glamour. Burmese Rubies, Kashmir sapphires, Colombian emeralds and more recently Paraiba tourmalines are to name a few.

Burmese Ruby

When a certain deposit of rubies was discovered in Burma, the qualities ascribed were different and unique; later on, rubies from any deposit from Burma were termed as "Burmese Ruby", to express the colour shade and quality of stones. The similar case is with Colombian emeralds too. But with the exploratio n of new sources, having similar colour shades of "Burmese Ruby" or "Colombian Emerald", traders went for discrimination of these sources and the gemological labs helped in this.

Colombian Emerald

Kashmir Sapphire

In the meanwhile, pioneers like Dr. E. Gubelin made several mine visits, collected samples, studied them and discovered that certain features of a gem are unique to a source and so began a scientific methods of origin determination.

Origin of a gemstone indicates the geographical location from which the gem has been mined; it may indicate a country or a part of it; it may be a primary deposit or a secondary deposit. Origin refers to a geographical location only and should not be used to express any colour or quality. Though a deposit may be best known for a specific quality; using the name of the country or deposit to express the shade or quality should be avoided. For example: the Paraiba tourmalines which are known for their bright blue- green colours caused by copper; the similar material has now been discovered from Nigeria and Mozambique.

Gemstones form in various kinds of environment and during formation it captures in itself the evidence of the surrounding nature. This evidence acts as a signature which may be unique to a particular source- this is very much similar to the human DNA. These signatures captured during and after growth are then retrieved by analysis. Some of the factors that affect the features of the gem are the conditions during formation, igneous or hydrothermal formation, the host rocks, the temperature and pressure conditions, the growth fluids, events taking place before and after formation, for example the rate of cooling, the transportation process, etc.

The captured signatures are retrieved by the visual colour, crystallography, study of inclusions (includes the nature and appearance), chemical analysis of the stone, for example, certain deposits of sapphire may have higher iron content as compared to others leading to indicative source identification, spectral features, the physical and optical properties etc. On retrieval of these trapped signatures by various studies leads to an indication or conclusion of a particular source or mine.

Few signatures....

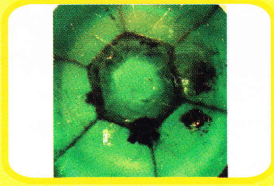
Jagged phase in Colombian emerald

Actinolite Blades in Russian emerald

Long silk in Sri-Lankan Corundum

Short silk in Burmese Corundum

Swirly zoning in Burmese ruby



Trapiche in Colombian emerald

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Retrieval of data includes these Requirements

- The lab must be technically well advanced with highly sophisticated advanced instruments to be able to analyze the gem and produce results.
- Sound gemologists to be able to analyze the results and co-relate it with geology of a gemstone.
- An extensive database covering all applicable deposits. Database preparation is the most difficult task and one of the factors which limits various laboratories in not doing origin

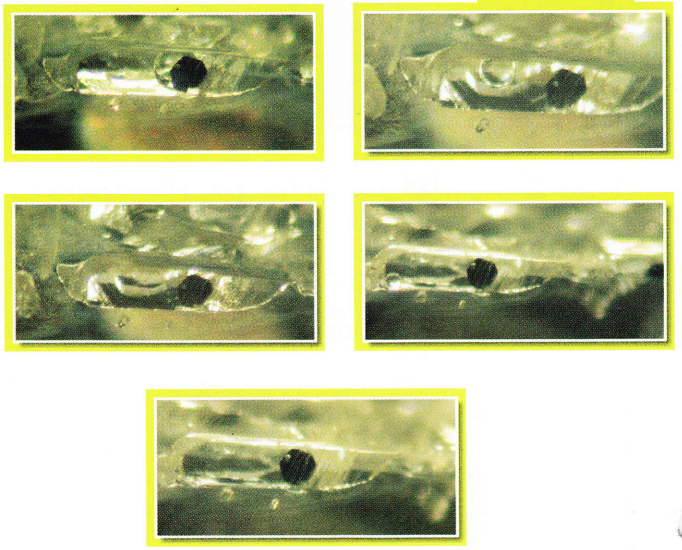
Certain factors which limit origin determination are as Follows.

- The same property or inclusion is observed in stones giving overlapping results, or
- Lack of internal features may limit origin determination,
- Lack of information or database on a particular source like some new deposit discovered lately and,
- Features destroyed or modified by treatments like heat; eg. the central blue core seen in Mong-Hsu rubies is removed by heat treatment.
- Many gem producing countries were once together and so there may be a similarity in the deposits though now they may be separated by many miles, land or water.
- Deposits crossing international boundaries like the case of Thailand and Cambodia or Tanzania and Kenya.

There are cases, where a single country produces a range of quality of same gemstone like, Brazil; it produces emerald, at Minas Gerais, Bahia, Goias, etc and the quality varies as per the source. But all are considered as "Brazilian Emeralds". On the contrary, Kashmir produces the finest quality of Blue Sapphire as compared to other sapphire deposits in India, but in this case the term, "Kashmir Sapphire" is used rather than "Indian sapphire".

Origin determination is not possible in all cases. So should this criterion prevail or is it only the visual splendour and the untreated nature that affects the price or preference of a gem. For example diamonds, nobody asks if a diamond is from Botswana or Canada, it is only the 4 c's. Finally, for gems from the other lesser known deposits have no human history associated with them and the trade is not yet comfortable promoting them as what they really are.....beautiful gems, no more, no less. On one side there is market force acting and on the other side people take this as discrimination for certain sources.

Spot the bubble.....



The above series of photomicrographs show a moving gas bubble (Carbon dioxide) in a Negative crystal of a Natural Untreated Sapphire. Also seen is a black crystal as if stuck on the wall of the cavity (negative crystal). Note the position and the size of the gas bubble in each of the figures. In one case, the bubble disappears.

Why it happens...

The concept is just similar to a water bottle. When the bottle is kept upside, water fills the lower part and the remaining is gas at the top; when bottle is inverted, the same happens. The air or gaseous part is always at top. In the series of photomicrographs, the gas bubble appears moving, but in fact the liquid is moving inside the cavity and the space left appear as a gas bubble.

Negative crystals are commonly partly filled with carbon dioxide ($CO_{2)}$ in the liquid form giving rise to a two-phase inclusion. This liquefied CO_2 starts expanding at approximately 32°C. Below this temperature, the liquid carbon dioxide remains in its original state and an empty space is visible as a gas bubble (two-phase inclusion). As the stone is gently heated even under a microscope lamp liquefied CO_2 starts expanding and fills up the space, thereby the gas bubble disappears. On further heating, the liquid CO_2 becomes a high pressure fluid and has the ability to explode, resulting in the crackling of stone. Therefore, this inclusion is one of the characteristic identifying features of unheated nature of the stone.

So what you need to see such inclusions.....a little patience, creativity, imagination and above all the passion for gemstones.

Gem News.....

Some Interesting Stones through GTL.....

An Interesting Symmetrical Fluorescing Sapphire....

Recently GTL received for identification a 5.85 ct specimen, which on initial testing proved to be sapphire, natural or synthetic. Under the SWUV, the stone gave an interesting patchy blue fluorescence following some symmetry. On magnification, the specimen had no inclusions but under diffused illumination, colour confinement along certain facets was seen proving diffusion treatment. Interestingly, the colour followed some symmetry; careful observation proved that the colour was only along table, kite and pavilion facets (figure 1.a). The stone was again observed under SWUV, a striking feature was observed where the star and the upper girdle facets gave the reaction but the table, kite and pavilion facets were inert (figure 1.b).

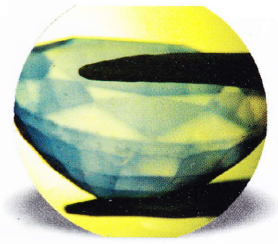


Figure 1.a

Figure 1.b

The facets with colour were inert while the repolished facets were fluorescing bright blue, exposing the underlying synthetic portion. The conclusive identification of the stone as synthetic was made on the basis of Plato lines.

Nail Head spicules in natural sapphire

Nail head spicule inclusions are generally associated with synthetic hydrothermal materials, mainly in emerald and quartz. Recently a blue specimen was submitted to GTL, initial testing of which proved it to be a natural sapphire. The natural origin of the sapphire was confirmed due to the presence of many crystal inclusions, elongated phase inclusions, hexagonal colour and growth zoning. Interestingly, the natural sapphire also had inclusions very similar in appearance to Nail Head Spicules (figure 2). These spicules were oriented along the optic axes. Most of the spicules had a conical projection but some had a rectangular. Nail head spicules are not generally seen even in synthetic hydrothermal sapphire but it has unusually found a home in this natural sapphire.

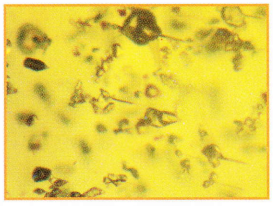


Figure 2

Synthetic sapphire with natural like inclusions

Magnification is the key to natural or synthetic separation as the other properties are generally the same. After the synthetic like inclusion in a natural stone (Nail Head spicule inclusions in Natural sapphire) as above, we now report a natural like inclusion in a synthetic sapphire. A blue specimen submitted for identification proved to be a synthetic (Plato lines) diffusion treated (colour concentration along facets) sapphire. But the stone had a slightly wavy fingerprint across the stone (figure 3.a and figure 3.b) and looked very similar to mineral trail like inclusions seen in natural sapphires or spinels. The fingerprint consisted of many non-reflective flux like particles in a square or rectangular shaped arrangement and was identified as flux because of its appearance and its surface breaking nature. Flux is commonly added during the diffusion treatments and a pre-existing surface breaking fracture must have trapped these inclusions. But how the square or rectangular pattern was formed is still a question.

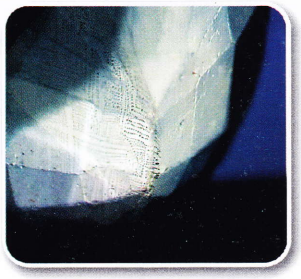


Figure 3.a

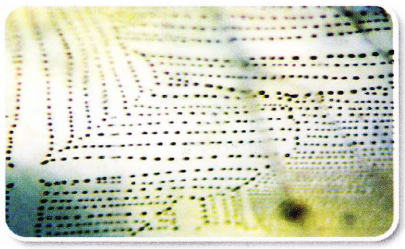


Figure 3.b

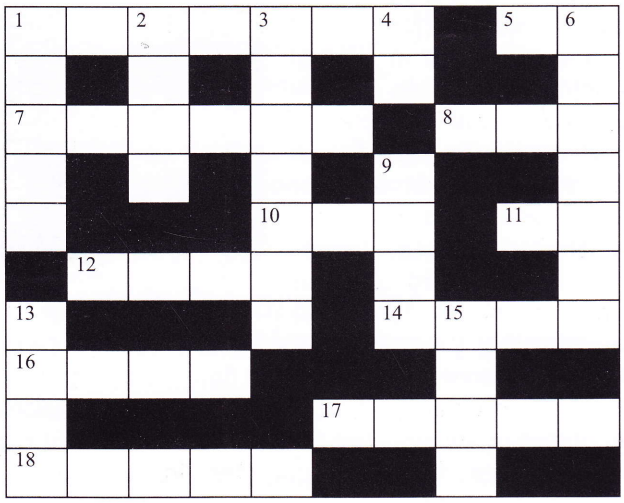
A remarkably large Clinohumite

Clinohumite is a collector's gem belonging to the humite group of minerals and found generally below 3 carats. Recently a 9.45 carat of this gem was identified at the GTL, Jaipur (figure 4). The stone was magnificent due to its size, bright brownish orange colour similar to hessonite or spessartine garnets, and its photogenic inclusions. The properties matched with those reported in earlier literatures. This was the first time that we have encountered this gem, which is found in Tajikistan, Siberian and Tanzania. The stone depositor had the knowledge that this gem was mined from near spinel mines in Tajikistan and had made its way to Jaipur through Afghanistan. More and more gems from Afghanistan, Pakistan etc. are entering the Jaipur market as reflected in the increase in the stones received from these regions for testing.

Figure 4

GTLian's Corner.....

Crossword



Hints

Across

1. A source of diamond in South Africa located in south eastern part. (7)
5. the state in which famous golconda diamonds were found (2)
7. synonym for graded (6)
8. a medium whose refractive index is 1 (3)
10. an abbreviation for a body which distributes 80% of the world's rough diamonds (3)
11. symbol of an element responsible for the blue colour in sapphire (2)
12. the national stone of Australia (4)
14. lower layer of earth consisting of silica and magnesium rich rocks (4)
16. the source for red beryls (4)
17. glass filling in rubies and diamonds can be identified by this effect (5)
18. the percentage of finished product obtained after going through the process of cutting and polishing of gemstones (5)

Down

1. acronym for a monochromatic light also used in improving clarity of diamonds (5)
2. a brown coloured variety of chalcedony (4)
3. swirls like growth pattern found in Burmese ruby (7)
4. blood of this animal is associated with best quality of red coral (2)
6. locality in Brazil famous for its electric colour tourmalines (7)
9. a variety of chalcedony with dendritic inclusions (4)
13. as per Indian astrology, the stone related to the Sun (4)
15. the best source for turquoise (4)

Answers:

Across: 1. Lesotho, 5. A.P., 7. Sorted, 8. Air, 10. CSO, 11.Ti, 12. Opal, 14. SIMA, 16. Utah,17. Flash, 18. Yield.
Down: 1. LASER, 2. Sard, 3. Treacle, 4. Ox, 6. Paraiba, 9. Moss, 13. Ruby, 15. Iran

Continued.....interesting stones through GTL...

Natural Emerald with unusual growth features

Recently, at GTL, we encountered an emerald with some unusual growth feature (figure 5.a) similar to "lizard skin" effect seen in synthetic opals. The optical and physical properties were consistent with those for emerald. On magnification, numbers of liquid fingerprints were observed, often containing jagged three-phase inclusions typically seen in Colombian emeralds. Other major inclusions encountered were number of growth tubes similar to 'rain' inclusions (figure 5.b), which was one unusual feature for an emerald of Colombian origin. When immersed in liquid, a striking growth pattern was observed, similar to "lizard skin" effect seen in synthetic opals. But, careful examination revealed that these were actually the boundaries of individual crystals grown together as aggregate; all these individual crystals followed the same orientation. A number of crystals appeared darker green as compared to the others, giving an impression of a rock mixture. The physical and optical properties along with FTIR analyses confirmed the stone as natural emerald rather than a rock mixture.

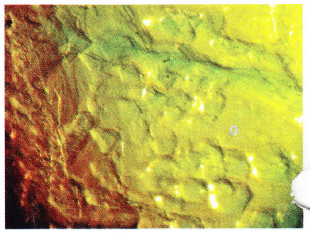


Figure5.a

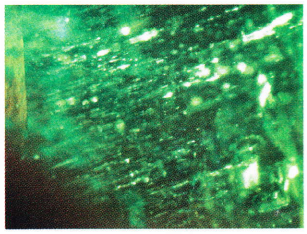


Figure 5.b

Seminars and Conferences

Mr. Chaman Golecha, Executive (Technical &Training) represented GTL at the Indian Gemmological Seminar (IGS) - 8, held at Mysore from 26th to 30th October 2006. He presented papers on "Origin Determination of Gemstones- Is It necessary?" and "Interesting Stones Tested at GTL". Gemmologists from all over the country participated in the seminar which made it very informative as it reviewed the developments taken during the year in the field of gem and jewellery. Mr. Golecha's paper, "Interesting Stones Tested at GTL" was selected as best presentation of the IGS-8.

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