THE GEM & JEWELLERY EXPORT PROMOTION COUNCIL

GEM TESTING LABORATORY
Information Circular

Volume 45 August 2006

China-with untapped gem potential

China, a major competitor of Indian economy, who has been associated with the diamond and gemstone cutting now for a long time has the potential to become one of the leading suppliers of gemstones to the world market.

China is a big and geologically diverse country that produces a wealth of minerals, which are widely distributed in more than 20 provinces mainly found along the eastern part running from north to south.

Few of them are Heilongjiang, Jiangsu, Shangdong, Fujian, Heinan, Xinjiang, Yunnan, Sichuan, Qinghai, Hebei, Liaoning, Taiwan, Beijing, Guangdong, Guanxi, etc.

Few of the gemstones found in China include Diamond, Sapphire (dark blue, yellowish green, bluish green), Ruby, Emerald, Aquamarine, Tourmaline (various colours), Garnet (pyrope, almandine, demantoid, colour changing), Peridot, Nephrite, ...and much more untapped deposits.

Pearls and other organic gem materials like Jet, Coral, and Amber are also found in China but we will restrict ourselves to inorganic gem materials only.

Emeralds in China have been found in Wenshan district of Yunnan province with attractive bright shades of green colour.

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In this Issue.....

Trapiche-The Fixed Star

The six spoke-like "rays" emanating from a hexagonal center with the areas in between filled with the green or red or white or otherwise as per the stone in which it is developed. But the term 'trapiche' originally associated with emeralds.

The word 'trapiche' in Spanish is used to describe the spoked wheel used to grind sugarcane.

These rays appear like asterism, but, unlike asterism, they are stable at their positions. Also these are not caused by reflection of light from tiny parallel inclusions, but by the presence of black carbonaceous impurities that happen to form in the same pattern.

Recently at the Gem Testing Laboratory, we had the opportunity to examine a suite of four such Trapiche Emeralds, said to be cut from a single crystal, courtesy M/s Birla Enterprises.

The total weight of the suite was 40.82 carats and the largest stone weighed 17.65 carats. All the four specimens exhibited clear dark trapiche rays along with an intense green body colour. The cutting of the specimen was such that the intersecting point of the rays was at the center.

All the examined specimens exhibited similar, black emanating six rays with a variation in the central core. The core varied from colourless to milky white to black to dark green.

The cores had a tapered appearance similar to a cone, along the 'c' axis of the specimen i.e. the area of core kept increasing along the length. There were some portions, which also gave a strong sheen effect from the central milky white core.

The tested samples mainly consisted many black inclusions arranged along the horizontal axis of the specimen giving the overall appearance of black rays. Other inclusions seen were colourless to milky white crystals, tube like inclusions parallel to the 'c' axis, and jagged 3-phase inclusions indicating Colombian origin the most common source for trapiche emeralds. Deposits are mainly located at Coscuez, La Pena and the Muzo mining districts.

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Though huge roughs have been found, most of the material is of cabochon grade due to poor transparency.

Another emerald deposit has been discovered in Western Mount Kunloon region of Xinjiang province near the border of China and Pakistan. There are reports of a mining area being located in the Taxkorgan region in western Xinjiang Province.

Size of the crystals is too small, but quality is better. Much material is traded in through Pakistan and currently these emeralds are entering Indian market too.

Aquamarine deposits in china are mainly found in xinjiang province (Altai pegmatite area), Yunnan province (Ailaoshan area), and Hunan province. Quality ranges from transparent to translucent, pale to darker sky blue with cat's eye.

Sapphires of mainly dark blue to greenish blue colour are found along the eastern coastline from north to south in Heilongjiang, Shangdong (Changle County), Jiangsu (Liuhe County), Fujain (Mingxi County) and Heinan (Wenchang County) provinces. Due to the over saturated dark blue colour, these sapphires are commonly heated to lighten the colour.

Rubies found here are mainly of cabochon grade, mined in Ailoshan District in Yunnan province. These deposits extend to the Luc Yen ruby deposit in Vietnam. Deposits of Ruby have also been found in Xinjiang, Qinghai and Heilongjang provinces.

Diamonds have been discovered in Wafandian district of Liaoning province, Mengyin district of Shangdong province and alluvial deposits along Yuanjiang River in Hunan province. Most of the diamonds are small and only around 30-35 % is gem quality.

Peridot from China is well known in the gem trade due to good colour and high transparency. Peridot deposits are found in Hebei, Jilin, Shangdong, Fujian, Hainan provinces and Inner Mongolia. The most important production is from Zhangjiangkou County in Hebei province and in Jilin Province. Colour varies from Yellowish green to Olive green.

Gem quality **tourmalines** have been discovered in Xinjiang (Altai), Inner Mongolia, (Daqingshan), Yunnan (Nujiang) and other places in China. Many fancy coloured tourmalines are found including pink, shades of green, yellow and parti coloured.

Garnets include pyrope, almandine, demantoid and colour changing varieties. Gem quality transparent, deep blood red pyrope garnets with good clarity are found in Jiangsu province. Purplish almandine garnet is mined in Xinjiang and Jilin provinces, while bright green, transparent demantoids of generally small sizes are found in Xinjiang province and Tibet. Colour changing garnets are mined in Xinjiang and Qinghai provinces.

Nephrite from china is well known for several decades. Deposits are located in Xinjiang, Qinhai, Sichuan, Liaoning, and Taiwan.

Following are few gemstones, which have been discovered in china.

Stone Name	Locations
• Corundum- (Sapphire / Ruby)	Heilongjiang, Jilin, Qinghai, Shangdong, Fujian, Hainan, Xinjiang, Yunnan,Sichuan,
• Diamond	Liaoning, Shangdong, Hunan
• Beryl- Aquamarine	Xinjiang, Inner Mongolia, Hunan, Yunnan
• Beryl- Emerald	Xinjiang, Yunan
• Peridot	Hebei, Jilin, Shandong, Fujian, Hainan, Inner Mongolia
• Tourmaline	Inner Mongolia, Xinjiang, Yunnan
• Garnet-(including Almandine, Pyrope, Colour Change, Demantoid)	Jilin, Jiangsu (Donghai) Liaoning, Fujian (Mingxi County), Qinghai, Xinjiang (Junggar Basin), Sichuan
• Nephrite Jade	Xinjiang, Sichuan, Liaoning, Taiwan, Qinghai
• Diopside	Xinjiang, Yunnan
• Spodumene	Xinjiang (Altai)
• Rhodonite	Qinghai
• Feldspar Amazonite	Xinjiang (Altai), Yunnan
• Fluorite-Green, Purple, Banded	Zhejiang, Jiangsu, Xinjiang, Jiangxi, Hunan
• Quartz (including Rock Crystal, Smoky, Aventurine, Rose, Tiger's eye, chalcedony)	Heinan, Guangxi, Jilin, Jiangsu, Inner Mongolia, Sichuan, Hainan, Guizhou, Beijing, Heilongjiang, Taiwan Liaoning, Jiangxi, Xinjiang, Hunan, Shaanxi
• Topaz	Guangdong, Guanxi, Xinjiang, Yunnan
• Zircon-	Fujan (Mingxi County), Hainan (Penglai)
• Turquoise	Hubei, Henan, Anhui, Shaanxi
• Malachite	Guangdong, Hubei

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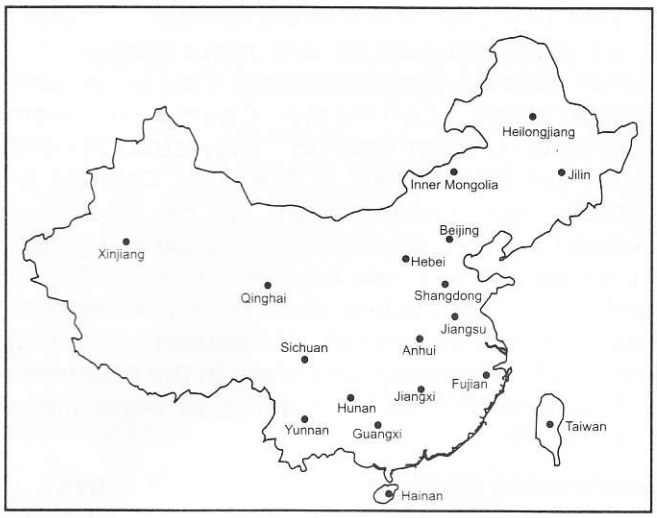

A map showing various gem deposits in China.

Today, all these varieties might not be much important with respect to the trade but definitely reflects the gem diversity of China.

The quality of most of the gemstones found in China is low and is smaller in size but some fine qualities are also encountered like in case of peridot, nephrite or garnets.

China has only recently been developing its gem deposits. In the past, some gem resources were exploited quickly in large quantities without attention to quality, giving a negative connotation to the Chinese goods.

Early aquamarine mines, for example, often used dynamite, fracturing the crystals so that cut gems were either too small or fractured.

Today, careful production of smaller quantities and strict quality standards are changing China's reputation.

Geographically, china is a huge country with a wealth of minerals, but the nature of operations makes it difficult to pinpoint where gemstones are being mined.

Few of the deposits are located at very high altitudes and extreme climatic conditions, which makes mining very difficult. Although china carries such a wealth, but is not reflected in the world market because of the sporadic supply.

The current finds and its position in-between some of the major players in the world gem trade can make China an important gem producer in the world Gem trade.

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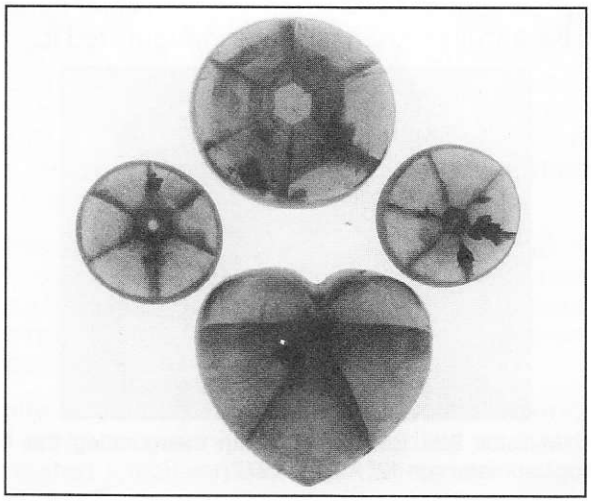
Formation

The exact formation process of trapiche is still a question unanswered but is a result of the growth of



an Emerald crystal with the dark impurities oriented along specific horizontal crystallographic axis.

It has been established that the formation of the black rays was primary and not secondary (i.e. inclusions formed during growth and not trapped after the host grew). Trapiche may form due to zones of difference in colour along the rays, or due to growth of other mineral inclusions (such as lutite) or may form due to intergrowth of the same mineral as the host with a slight difference in growth.

Other Stones with Trapiche

Though the trapiche pattern is generally associated with emeralds only, recent years have shown an increase in the number of stones showing this effect.

Myanmar has reported different types of trapiche gemstones including Rubies and Sapphires, Morganite (Beryl), Quartz, Aquamarine, Green Tourmaline etc. There have also been specimen reported which shows trapiche-the fixed ray star as well as Asterism, i.e. moving six ray star in the same specimen.

The pattern of Trapiche stones put them in a most desirable gemstones class. Although the arrangement suggests that the star pattern formed at the same time as the host crystals grew, the exact detailed growth mechanism of the trapiche gemstones cannot be explained at present.

GTL completes 34 years....

The Gem Testing Laboratory is going to complete 34 years of service to the gem trade on 12th of August. For a reminder, GTL came into existence on 12th of august 1972 when the then chief minister Shri Barkatullah Khan formally inaugurated it.

Chief Minister Shri Barkatullah Khan inaugurating the Gem Testing Laboratory on 12th August 1972.

In the decade of 1960's when science and technology was at the stage of advancement all over the world, affected the gemstones trade too, with the introduction of many new minerals, synthetics and treatments.

The leading Indian jewellers were in general ignorant of the technological development outside the country. At that time, to gain the faith of the clients especially, who were involved in the foreign trade, *(Late) Padmashri Khailshankar Durlabhji* dreamt of a body that can provide a technical backup to the Indian Gem and Jewellery Industry.

A few farsighted and dedicated people supported this dream such as *Shri Manubhai Shah, Shri K.V. Dave, Shri. Khosla and Shri Jawaharlal Rakhyan* with the technical support of one of the world's leading gemmologists, Mr. *Basil W. Anderson* of Gemmological Association of Great Britain, who worked out the basic requirements for a laboratory at Jaipur.

The certification of gemstones started right from GTL's inception but could not provide the services on a regular basis due to the lack of technical staff in the country. But until the year 1990 when *Smt. Shyamala Fernandes* took over as in charge, GTL has made gradual progress in terms of certification and training the manpower for the gem trade.

At present, GTL is working with four gemmologists namely, *Shri Mustaqeem Khan, Shri Gagan Choudhary, Smt. Meenu Vyas and Shri Chaman Golecha*. All these are well supported by the Regional Director of GJEPC, Jaipur, *Shri Sanjay Singh*.

Initially GTL started only with a Diploma course in the year 1990, but now it offers number of courses as per individual interest and requirements. The courses include Correspondence Course in Gem Identification, Certificate Course in Gem Identification, Short Courses (Navratna, Specific Stones like emerald etc.), Refresher Courses on Synthetic and Enhancement for Ex- students, Courses for GJEPC members- individual and group. GTL is also an Allied Gem Tutorial Centre (AGTC) for training and conducting Gemmology Exams on behalf of Gemmological Association of Great Britain. GTL is the only laboratory in the country to get "exemption" from the foundation examination of Gem A, UK.

Certification of gemstones is the main activity of GTL. Certification has been divided into different categories as Single stones- Regular / On The Spot, Bead Strings, Packet Lots, etc.

In October 2002, a new category was introduced as *"On- Request"*. This category includes the certification of Treatments like Fracture Filling and Heat Treatment in Corundum. But looking at the needs, certification of Treatments on corundum started on routine in March 2005.

As Jaipur is considered as the major gemstone market, almost all types of gemstones are being encountered including some new discoveries, synthetics, treatments, etc. therefore, certification has become a lot more challenging than ever before like in 1980's or early 90's.

To cope up with the changing scenario, GTL has prepared its own working and laboratory manuals as standards to be followed in which all the rules, conditions, and report wordings for natural, synthetic, treated stones, etc. has been laid down, which helps to keep the testing report neutral and constant. This laboratory manual has been prepared as per CIBJO rules and regulations, after long and tough times spent on discussions and inputs from different gemmologists in India and abroad so as to keep the certification wordings neutral.

GTL has achieved a lot and has gained recognition today, with the joint efforts of *Shri Rashmikant Durlabhji, Shri Vimal Chand Surana,* local working committee members comprising of *Shri Vijay Chordia* (Convener, TEC), *Shri Mehul Durlabhji* (Co-Convener, GTL), *Shri Rajiv Jain, Shri Ashok Singhi*, and *Dr. Nawal Agarwal* and of course *GJEPC.*

We hope, the hard work done and services provided in the last 34 years will improve and GTL will try to give its best to the gem trade of the country.

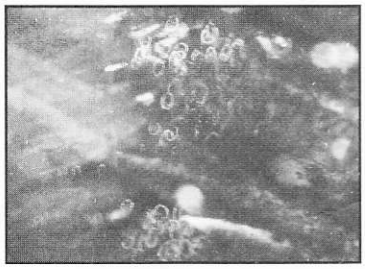
Gem News...Some Interesting stones at GTL...

Circular Rings in Diffusion (Surface) - Treated Sapphire

Recently, we examined an interesting blue-coloured oval mixed cut weighing 6.64 ct. When viewed up uneven colouration of the stone was easily visible commonly associated with surface diffusion of corundum; refractive index of 1.762-1.770; birefringence of 0.008 and specific gravity of 3.98 confirmed the material as corundum. Stone did not exhibited any reaction under ultraviolet light (long-wave and short-wave) and displayed a weak iron band at 450nm in desk model spectroscope.

The cause of blue colour became evident when the stone was immersed in methylene iodide. The colour was following the facets that exhibited patchy colouration; the facets around the culet appeared colourless or light coloured as those were re-polished resulting in the loss of colour causing impurities. This confirmed the material as diffusion treated.

The interesting feature of the stone was observed when it was illuminated with fiber optic light at a magnification of 25x. The stone displayed groups and /or rows of some circular rings composed of fine white particles. These inclusions have been reported previously in Beryllium treated corundum only. (Also mentioned in last issue of Lab Information Circular, Volume 44, June 2006)



A journal of Gem Research Swiss Lab, Contribution to Gemology, No.4, December 2005, pg 54, states that " Circular, curved and white lines associated to former zones of silk. Magnification 50 - 100 x in the microscope. Fiber optic illumination. This inclusion have so far only been detected in Beryllium Treated blue sapphires. Figures C18 to C22 in journal".

Such references provoked us to examine the stone once again and was immersed in methylene iodide to look for the colourless / yellow/ orange coloured rim but we could not succeeded in observing such coloured rims, which are associated with beryllium diffusion of sapphires. Due to the lack of sophisticated equipment like LIBS or LA-ICP-MS we could not detect the presence of beryllium and the stone was simply identified as Diffusion Treated.

This is the time when beryllium treated corundum is playing on our minds, and by observing such inclusions in a simple surface diffusion; every stone now is being looked with suspicion.

Axinite

A pinkish brown colour, pear shaped briolette, with eye visible strong pleochroism; the colours being colourless, purple pink and brown shades. Initially the stone was assumed to be andalusite but refractive index discarded the option. The readings were measured at 1.67 1.68 with a birefringence of 0.010. Specific gravity by hydrostatic method was measured at 3.29. These values overlapped with those for kornerupine and enstatite.

Visible spectrum exhibited several bands at 470, 490, 510 and 570 nm, characteristic for axinite. These bands are not encountered in either enstatite or kornerupine. Under magnification, stone was full of liquid inclusions with iridescent films.

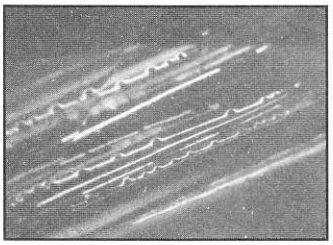
Axinite is divided into two groups as ferro-axinite and magnesio-axinite, the properties observed in the tested specimen indicated Sri-Lankan origin of ferro-axinite group.

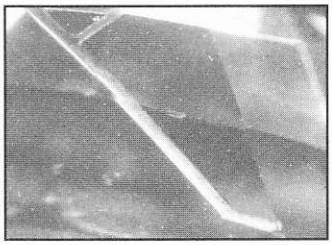
Natural Sapphire with Unusual Inclusions

A 3.56 ct blue cushion-shaped mixed cut was tested and certified at the Gem Testing Laboratory, Jaipur, India. Refractive indices of 1.760-1.770 and a hydrostatic S.G. value of 3.99 confirmed the stone as corundum.

With magnification, the sample displayed some unusual inclusion patterns. Long parallel needle-like inclusions with some semicircular bends were present, along with long slightly wavy fiber- or needle-like structures (below left). The visual appearance of both was similar to etch channels/ tubes seen in stones such as scapolite or diamond.

Additionally, the stone contained a reddish brown to white inclusion, with a hexagonal cross-section, that resembled a hockey stick (below right). Its appearance varied from sugary to wavy to cloudy, and in some areas, the inclusion gave the impression of a hollow tube filled with foreign material (probably goethite).





When viewed at higher magnification using a fiber-optic light, the stone displayed three directions of platelets and short needles that were oriented at approximately 60° to one another, which indicated natural origin. The overall undamaged inclusion pattern indicated that the sapphire had not been subjected to high-temperature heat treatment.

GTL...Results...

Following candidates have been declared successful in the Gem Identification Courses.

Diploma in Gem Identification- Batch 37

1. Apeksha Jain - 1st Overall
2. Ananya Gupta - 1st Practical
3. Amit Soni
4. Sandeep Nischal
5. Harleen Kaur
6. Naresh Anchal

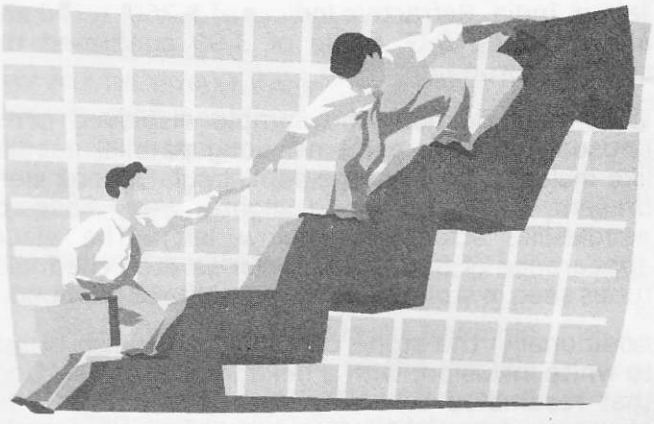
Certificate Course in Gem Identification

1. Diwakar Toshniwal
2. Usman Ali
3. Anuj Manihar

Masters' Diploma in Gem Identification

1. Nidhi Jain

CONGRATULATIONS TO ALL OUR STUDENTS AND WE WISH THEM ALL THE VERY BEST IN ALL THEIR FUTURE ENDEAVOURS. WE HOPE THEY WILL MAKE A VALUABLE CONTRIBUTION TO THE GEM & JEWELLERY TRADE.



A Quote....

"India, is the most agreeable abode on the earth,
and the most pleasant quarter of the world.
Its dust is purer than air,
and its air purer than purity itself:
Its delightful plains resemble the garden of Paradise,
and the particles of its earth are
like rubies and corals"

- Sir H.M. Eliot & John Dawson

(as quoted in "Taziyatu L- Amsar", The History of India As Told By Its Own Historians, Vol.3, p.29.- taken from Dance of the Peacock by Krishnan.U.R.B. and Kumar. M.S)

Gem Identification Certificate - handle with care!!

We regularly receive enquiries regarding the authenticity of the gem identification reports issued by GTL.

The buyers call GTL for the confirmation of the stone with issued reports but they are disappointed since the certificates have been modified during the transaction. Few instances include changing the name of stone, a synthetic stone becomes natural, a treated stones become untreated and....

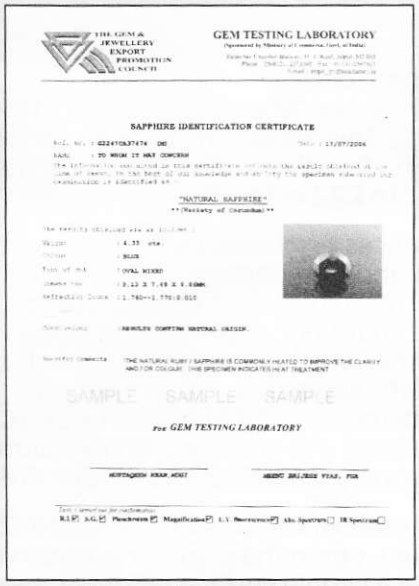
Such malpractices affect the reputation of the buyer as well as the GTL since a synthetic stone becomes natural or otherwise on the tampered certificate, while the same stone is certified as what it is by any other lab.

Such enquiries are encountered almost once in a month where the customers suffer the most as they pay hefty amounts for the stones with a certificate.

Looking at these problems we are trying to find out a way but for the time being it is a suggestion to look at the following.

1. Always ask for an original certificate and not a photocopied.
2. Original certificate carries a coloured photograph and is laminated.
3. The logo of GJEPC on the left hand top corner is coloured and embossed.
4. Try to match the cut, colour, position of inclusions in the stone and the photograph given on the certificate.
5. If not satisfied, call or visit GTL for the confirmation of the certificate.

   Hope you will cooperate us for the benefit of trade.



GEM TESTING LABORATORY

SAPPHIRE IDENTIFICATION CERTIFICATE

"NATURAL SAPPHIRE"

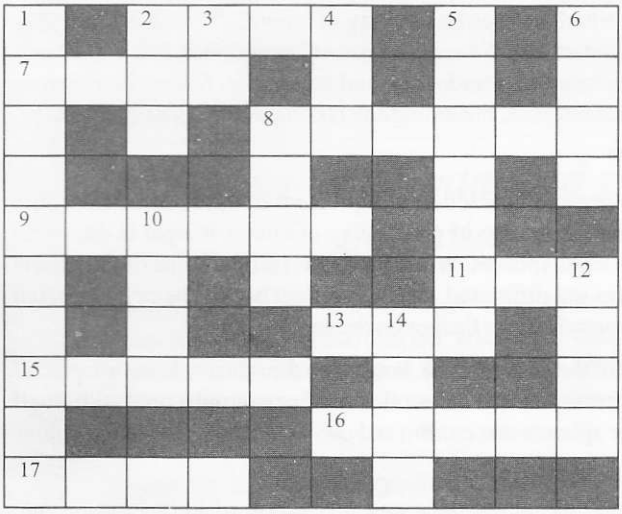
SAMPLE SAMPLE SAMPLE

For GEM TESTING LABORATORY

A sample certificate

GTLian's Corner...

Crossword



HINTS

ACROSS

2. a collective term used for two of the toughest gem materials, highly respected in Chinese culture (4)
7. company involved in fracture filling of diamonds (4)
8. the former name of an island originally associated with 'geuda' sapphires (6)
9. gem material also known as 'titanite' (6)
11. the oxide of this metal is commonly used as abrasive to produce fine polish in gemstones (3)
13. a scale commonly used to represent colour (3)
15. term used to describe when no reaction of a stone is visible under UV light (5)
16. a resin similar to amber but much younger in age (5)
17. channels (inclusions) formed by some dislocations during the growth (4)

DOWN

1. a newer diamond simulant exhibiting a strong doubling and fine needles (10)
2. a balck to dark brown organic gem material with brown streak (3)
3. acronym for a man made material commonly used as a diamond simulant (2)
4. a common variety of quartz which is correlated with the a body part of tiger (3)
5. gem / mineral commonly used in instrument like dichroscope (7)
6. what is common in morganite, kunzite, Thulite (4)
8. sub-unit commonly used to measure the weight of gemstones (4)
10. a famous blue diamond originated from India (4)
12. spicule like inclusions found in hydrothermal emeralds named after the appearance of (4)
14. presence of this impurity retards the fluorescence in gem stones (4)

ANSWERS

Across: 2. Jade; 7. Oved; 8. Ceylon; 9. Sphene; 11. Tin, 13. CIE, 15. Inert; 16. Copal; 17. Etch

Down: 1. Moissanite; 2. Jet; 3. AD; 4. Eye; 5. Calcite; 6. Pink; 8. Cent; 10. Hope; 12. Nail; 14. Iron

Puzzle

Find out all the possible words (Horizontal, Vertical or Diagonal) related to gem and jewellery industry from the box. Hint: Read the complete information circular!!

C	C	J	E	T	M	U	Z	O	J
H	O	P	E	R	I	N	G	S	I
I	N	R	S	A	L	U	M	P	A
N	E	V	E	P	B	P	M	O	N
A	L	U	T	I	T	E	I	K	G
L	I	B	S	C	F	R	R	E	S
C	O	N	C	H	A	I	N	Y	U
J	A	G	G	E	D	D	L	A	L
A	S	H	E	E	N	O	I	M	O
R	U	B	Y	A	L	T	A	I	S

Answers

Core, China, Lutite, Trapiche, Jet, Beryl, Peridot, Jagged, Rings, LIBS, Spoke, Sheen, Films, Altai, Jiangsu, Muzo, Ruby, Cone, Ore, Conch, Hope, Mir, Chain, Lump.

Animals and gemmology...

The body parts or the appearance of animals are often associated with some inclusions or features seen in gemstones. Solve this jumble are realize yourselves...

1. This animal is found lying on the road crossings and is one of the key features in identification natural amethsyt __ __ __ __ __
2. The eye of this animal is what we get on pseudomorphism after crocidolite __ __ __ __ __
3. The skin of this reptile is associated with synthetic Gilson opals __ __ __ __ __ __
4. Tail of this mammal is characteristic inclusion found in green variety of and radite garnet __ __ __ __ __
5. This bird's blood is associated with the best quality of Burmese ruby __ __ __ __ __ __

Now, arrange the highlighted letters to answer the following question:

All these gemstones with associated animals meet for make up commonly in __ __ __ __ __ __ __ __

Answers

1. Zebra, 2. Tiger, 3. Lizard, 4. Horse, 5. Pigeon
Make up (Treatment) is commonly done in Thailand !

What's running these days: - Trend.... Play of Colour

The movement of colours from one position to another as the stone is tilted is described as play of colour.... these colours play making the observer fascinated by this optical effect possess by few gemstones. Few of the natural gemstones that commonly possess this phenomenon include opal, labradorite, spectrolite (dark coloured Labradorite), and ammonite. Stones like opal or labradorite have already made their mark in the gem industry several decades back, but ammonite is comparatively a newer entry.

These materials are still demanded on a routine and are evergreen trend!!

This fascinating optical effect is produced by combination of interference and diffraction of light from minute sub-microscopic particles (as in case of labradorite/ spectrolite) or structure of the stone (as in case of opal). Play of colour in opal is due to its characteristic structure, which is a three dimensional packing of minute silica spheres. When light falls on opal some of the light is reflected back from the surface while some are refracted where the rays get diffracted and then reflect back. The rays reflected back from the surface and inside, interfere with each other to produce spectral colour flashes on the surface.

The intensity or strength of play of colour depends on the compactness of the structure, i.e. how close the silica spheres are placed and the size of these spheres. The closer and larger the silica spheres, better will be the colour flashes. For example, opal with small spheres will exhibit only violet or blue flashes, while opals with larger spheres can exhibit red colour flashes. Better the colour flashes seen, better the price.

Similarly, in case of labradorite/ spectrolite play of colour is produced by interference and diffraction of light from minute particles of magnetite arranged in parallel planes along twin planes.

The play of colour is better observed against a dark background as compared to light. If a white opal is placed on a dark background, its play of colour enhances. This is the reason why opals are commonly cut along with its mother rock as a backing or opal doublets are made or they are dyed black. Similarly, if labradorite and spectrolite are compared, better play colour is seen in spectrolite, which have a darker background or body colour.

Continuous demand for these stones with play of colour initiated to develop and create materials that could be used as effective imitations. Some of the materials are synthetic opal, composites including opal doublets/ triplets and opalite, glass, plastic, and other similar looking natural stones, which become simulant for each other. The properties of various materials and their simulants are described in the following table.

Stone	Optic Character	RI	SG	Inclusions / Other Features
Opal	SR/ ADR(SR)/ AGG	1.43 to 1.46	1.95 - 2.20	*Natural :* Flow patterns, cloudy and dendritic inclusions, crystals, etc *Synthetic :* Lizard skin effect, columnar growth pattern, stable play of colour. *Sugar treated :* Black peppery effect *Smoke treated :* black cloudy effect *Composites :* junction plane, trapped/ flattened gas bubbles.
Labradorite/ Spectrolite	DR/ Biaxial positive	1.560 - 1.570 Birefringence 0.08		Twin planes/ cleavage cracks, black magnetite needles or flakes.
Ammonite	AGG	1.530 - 1.685 Birefringence 0.155	2.70	Mosaic like pattern with iridescent colours, spiral structure
Shell (Mother of Pearl)	AGG	1.530 - 1.685 Birefringence 0.155	2.70 - 2.90	Fish scale pattern with uneven layers, banded structure
Glass	SR/ ADR(SR)/AGG	1.49 to 1.50	2.40 - 2.50	Gas bubbles, swirl marks, coloured flakes, etc
Plastic	SR/ ADR(SR)/AGG	1.485 or 1.57	1.18	Bluish white fluorescence in LWUV.

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