The Jewel of Kashmir

GIA Monograph

GIA REPORT 5131173673

GIA
GEMOLOGICAL INSTITUTE OF AMERICA®

5355 Armada Drive | Carlsbad, CA 92008-4602
T: 760-603-4500 | F: 760-603-1814

GIA Laboratories
Bangkok Carlsbad Gaborone
Johannesburg Mumbai New York

www.gia.edu

SAPPHIRE ORIGIN REPORT

March 16, 2011

Weight .... **10.88 carat**
Measurements .... **13.89 x 10.09 x 8.83 mm**
Shape .... **Cushion**
Cutting Style: Crown .... **Brilliant Cut**
Cutting Style: Pavilion .... **Modified Step Cut**
Transparency .... **Transparent**
Color .... **Blue**

CONCLUSION

Species .... **NATURAL CORUNDUM**
Variety .... **NATURAL SAPPHIRE**
Source Type .... **CMT Type II**
Geographic Origin .... **KASHMIR**

TREATMENT

No indications of heating (NTE)

Comments:
Any statement on geographic origin is an expert opinion based on a collection of observations and analytical data.

Duplicate printed on October 25, 2013

Image is Approximate

5131173673

No Indications of Heating	Indications of Heating (no residue)	Indications of Heating with Residue in Fissures				
NTE	TE	TE1	TE2	TE3	TE4	TE5
No Indications of Heating	Indications of Heating	Minor Residue in Fissures		Moderate Residue in Fissures		Significant Residue in Fissures

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Color: Blue
Shape: Cushion
Crown Cutting Style: Brilliant Cut
Pavilion Cutting Style: Modified Step Cut
Country of Origin: Kashmir

Introduction

The Jewel of Kashmir is a wordless answer to the question of what constitutes a fine gem. Many years ago, gemstone connoisseurs such as gem merchant Jean Baptiste Tavernier referred to exceptional specimens as "gems of fine water." This comparison is not confined to the surface, but applies to the whole volume of the gem. Like a glass vessel full of water, truly fine gems are typically highly transparent, enlivened by gentle rocking and tilting to produce a dynamic interplay between crystal and light. For blue sapphires, the analogy with water is particularly potent.

Although the quality of a gemstone does not depend on its origin, some mining areas have gained renown for producing numerous exceptional gemstones, their mere names now capable of creating visions of allure and beauty. In this respect the gem trade is not so different from art, fashion, or other luxury markets, where the name of the artist, brand name, or provenance of the object will have an important influence on its market value.

A Kashmir origin is typically considered the finest pedigree for blue sapphires. Record-setting auction prices attest to this sensibility. In addition to their pleasing cornflower blue color, gems from this locality tend to host bands of extremely fine-grained particles. In fine specimens, these particles do not reduce transparency; in fact, they have the beneficial effect of scattering light such that the overall color appears richer and more evenly distributed. This effect causes the sapphire to appear velvety, with a color that seems to glow from within. This is likely the reason that so many gem connoisseurs consider cornflowers as an apt comparison for the color and play o flight in Kashmir sapphires.

A sapphire with the felicitous combination of color and inclusion scene to produce this effect is rare indeed. A large, well-cut gem with a particularly electric cornflower blue color is even rarer still. The Jewel of Kashmir, with its graceful cut and captivating color, is therefore a fitting subject for detailed documentation in a GIA Monograph.

The Jewel of Kashmir

THE JEWEL OF KASHMIR

The deep celestial blue of Kashmir sapphires strongly contributes to their otherworldly beauty. The vivid blue color, along with a characteristic velvety appearance, gives them a majestic and heavenly appearance. These characteristics make Kashmir sapphires immediately recognizable and immensely captivating. Although the quality of a gemstone does not necessarily depend on its origin, mining areas such as Kashmir have gained renown for producing numerous exceptional gemstones. Simply uttering this name can create visions of allure and beauty.

The Jewel of Kashmir, presented as a cushion mixed cut, was determined to have its country of origin as Kashmir, a metamorphic source type. It displays many of the attributes that characterize fine Kashmir sapphires. It is characterized by a saturated Royal Blue color and good transparency. Distinguishing inclusions include fine-grained particle bands, wispy cross-hatch or "ladder-like" like particle arrangements, and clouds resembling snowflakes or starbursts. The very fine nature of these inclusions causes light to be scattered with minimal loss of transparency. The resulting optical effect is an evenly distributed, glowing color often referred to as "velvety" or "sleepy."

The coloring and physical properties of this sapphire are distinctive. Faceted Kashmir sapphires over 10 carats are rare. In addition to its size, this velvety blue Jewel of Kashmir has the further distinction of being untreated, making it a truly notable gemstone.

Sapphire Background

The modern English word sapphire can be traced to the old French *safir* and Latin *sapphirus*, and to the Greek *sappheiros*. Similar words also exist in Hebrew (*sappīr*), Persian (*saffir*), and Arabic (*çafīr*). The ultimate source may be the Sanskrit *sanipriya*, meaning "precious to the planet Saturn."

Today we know sapphire as one gem quality variety of the mineral corundum—Al_2O_3—that derives its blue color from trace amounts of iron and titanium. Ruby is another variety of corundum, colored in this case by trace amounts of chromium. Corundum varieties are the most popular colored gemstones. With a hardness of 9 on the Mohs scale (diamond, at 10, is the only harder material) and a variety of available colors, sapphire is well suited for use in jewelry.

Until the early 1800s, gems were classified by their color and origins, not their chemistry, somewhat obscuring their mining history. Blue "sapphires" reportedly mined 6,000 years ago in what is now Afghanistan, for example, were likely lapis lazuli. Nonetheless, the Romans were clearly importing sapphires from the island of Sri Lanka as early as 2,000 years ago.

Sri Lanka remained the primary source for sapphire up through the nineteenth century. The Kingdoms of Siam and Burma were also known producers of sapphire during this time, but their mines did not gain worldwide fame until the arrival of the French and British in Southeast Asia at the end of the century. New sapphire deposits were also discovered in Australia (1851) and the U.S. (1894) around this time.

Natural blue sapphire crystals, such as the one shown opposite, commonly form hexagonal bipyramids during growth.

KASHMIR AS A SOURCE. Among the sapphire deposits discovered and popularized in the nineteenth century, the reputation of Kashmir sapphire mines was unrivaled. This was due both to the quality of gems produced there, and by the mystery and romance surrounding the locale. The mines were located in the Himalayan Mountains at an elevation of approximately 15,000 feet, in a remote part of the Princely State of Kashmir and Jammu. Kashmir, as part of the British Raj, was considered "the Jewel in the Crown" of the British Empire and favored as a vacation retreat for wealthy British visitors to India.

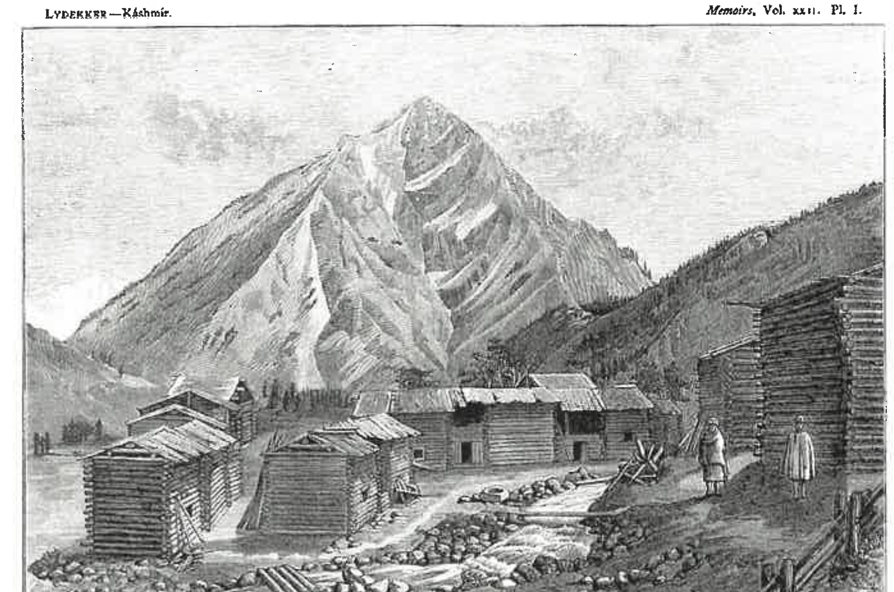
Gem-quality blue crystals were discovered in Kashmir after a landslide in the mountainous area sometime in 1881 or 1882. Word of the find quickly reached the Maharajah of Kashmir, who sent a regiment to take control of the mines. The "Golden Age" of the mines occurred during a period from 1882 to 1887. In 1883 the Maharajah prohibited trade of Kashmir sapphires, and further required the finest specimens be secured in his royal treasury. Meanwhile, the India Geological Survey was dispatched to report on the area, and the results of this survey were published in 1883.

By 1887, the Maharajah was forced to ask the British Indian Government for assistance because of declining production and mine revenues. From this point, the deposit was worked only sporadically because of the challenges of mining a remote, high-altitude location. Furthermore, mining during the twentieth century was complicated by the 1947 partition of the British Raj into India and Pakistan. The former Princely State of Kashmir and Jammu became the center of a Pakistan–India–China territorial conflict. The mines are currently located in Indian-controlled Kashmir, and are under the control of the Indian government.

The Kashmir sapphire mines, high in the Himalayas, are accessible only to the most intrepid adventurers; vacationers might prefer the lush meadows in the foothills.

GEOLOGICAL SURVEY OF INDIA.

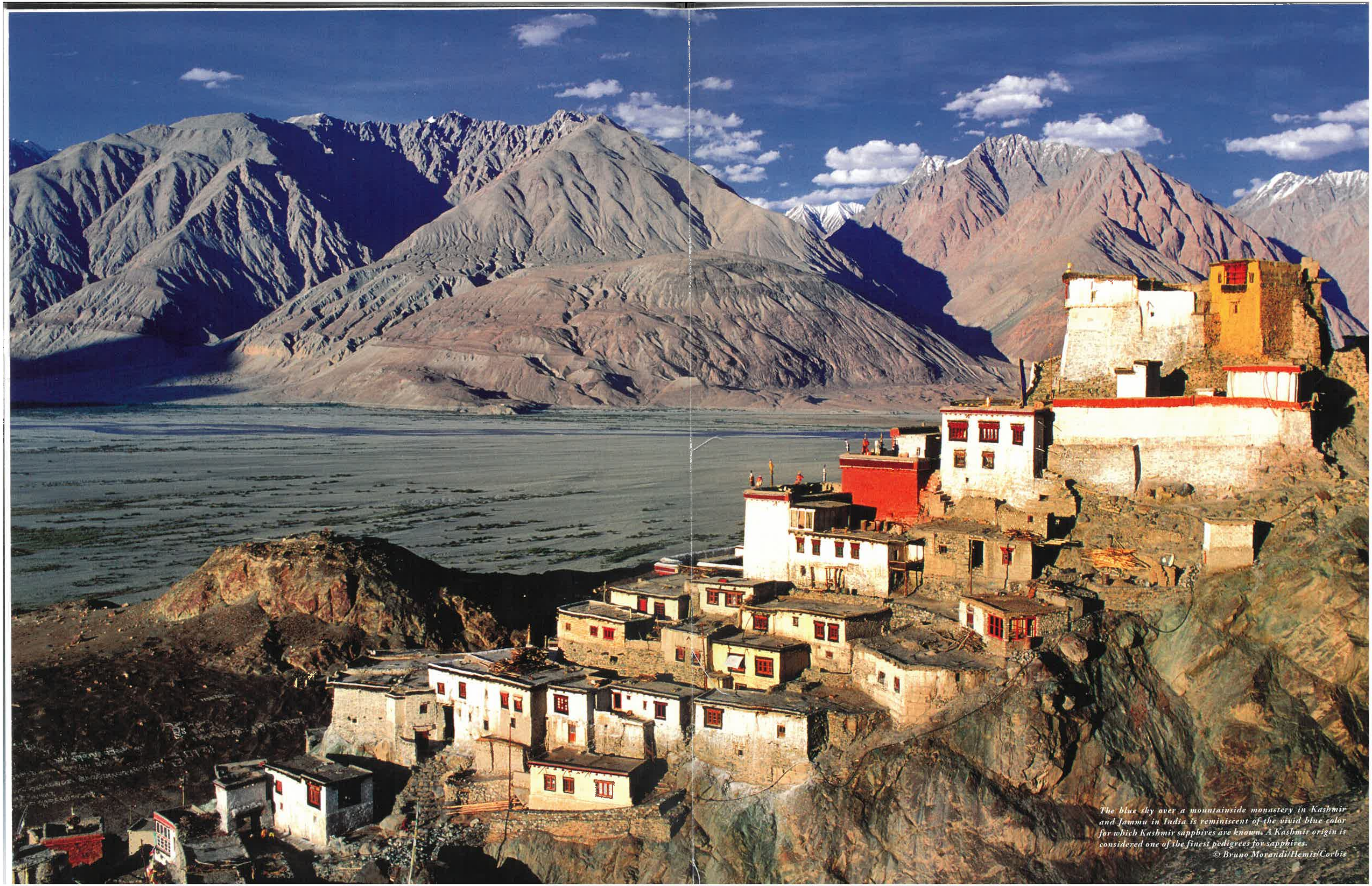
LYDEKKER—Káshmír. *Memoirs*, Vol. xxii. Pl. I.



H. C. B. TANNER, *Pinxit.* H. F. WOODWARD, *Sculpsit.*

THE GÚREZ VALLEY.

This illustration from the first report on the Kashmir region was issued by the India Geological Survey, published in 1883.



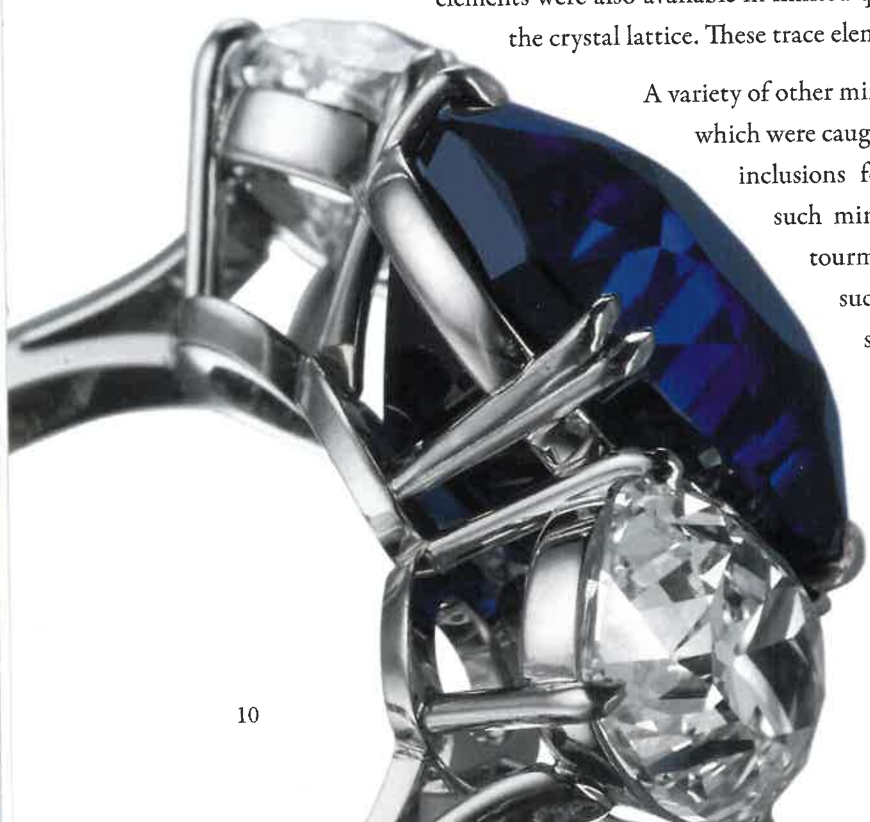
The blue sky over a mountainside monastery in Kashmir and Jammu in India is reminiscent of the vivid blue color for which Kashmir sapphires are known. A Kashmir origin is considered one of the finest pedigrees for sapphires.

KASHMIR SAPPHIRES. Of all sapphires, currently none carries the mystique of a Kashmir sapphire. Their venerable combination of beauty and rarity is considered unparalleled by sapphires from other sources. Unlike Burmese rubies and other famous gems from the Silk Road, Kashmir sapphires are not steeped in centuries of lore. Their stellar beauty ignited a rapidly growing fame, fueled by the mystery surrounding them. Their origin, even the word Kashmir, is permeated by an exoticism that conjures the glory of a lost empire and the stunning majesty of top of the world.

Fine Kashmir sapphires possess a saturated blue color and good transparency. Many of them host bands of extremely fine-grained particles that scatter light with minimal transparency loss to the overall stone. This produces an optical effect in which the stone has an enhanced, more evenly distributed color that appears to glow from within. Gem connoisseurs describe this as a "velvety" and "sweet" appearance, and the trade name "Kashmir blue" has become synonymous with the trade name "velvet blue."

Kashmir sapphires come from a high, difficult to reach region of India in the Zanzkar mountains, a part of the greater and well-known Himalayan mountain range. The tectonic event forming these mountains buried marine sediments, which recrystallized at very high temperature and pressure into various types of metamorphic rocks such as marbles, gneisses, and schists. Sapphires found in these rocks—including the Kashmir sapphires—are geologically classified as metamorphic sapphires. These were influenced through close contact with igneous intrusive rocks called pegmatites, altering the pre-existing metamorphic rocks to produce impure marbles and altered feldspars with the sapphires forming at the contact margins in pockets and open lenses. In addition to the aluminum and oxygen required to produce sapphire, more "exotic" trace elements were also available in limited quantities during growth and incorporated into the crystal lattice. These trace elements can influence the color of the crystal.

A variety of other minerals formed along with the sapphires, some of which were caught up as inclusions. Protogenetic and syngenetic inclusions found in the Kashmir include crystallites of such minerals as allanite, pargasite, plagioclase, rutile, tourmaline, uraninite, and zircon, as well as micas such as biotite and muscovite. So in addition to the soft velvety slight cloudiness caused by myriads of minute light-scattering rutile particles that Kashmir sapphires are so famous for, the presence of these other inclusions also assist gemologists in determining sapphire origin.



Gemological Assessment of the Jewel of Kashmir

Characterization of a colored gem in the GIA Laboratory involves a full range of analytical techniques. A variety of traditional approaches—such as measuring refractive index and specific gravity—along with advanced spectroscopic testing builds a thorough understand of a gem's identity and treatment history.

Because the gap in market value between stones of equivalent quality but different origin can be enormous, and also because there is a growing concern in the market about gems being mined with sustainable techniques from ethical sources, gemological laboratories like the GIA Laboratory are regularly asked to identify the geographic origin of gemstones.

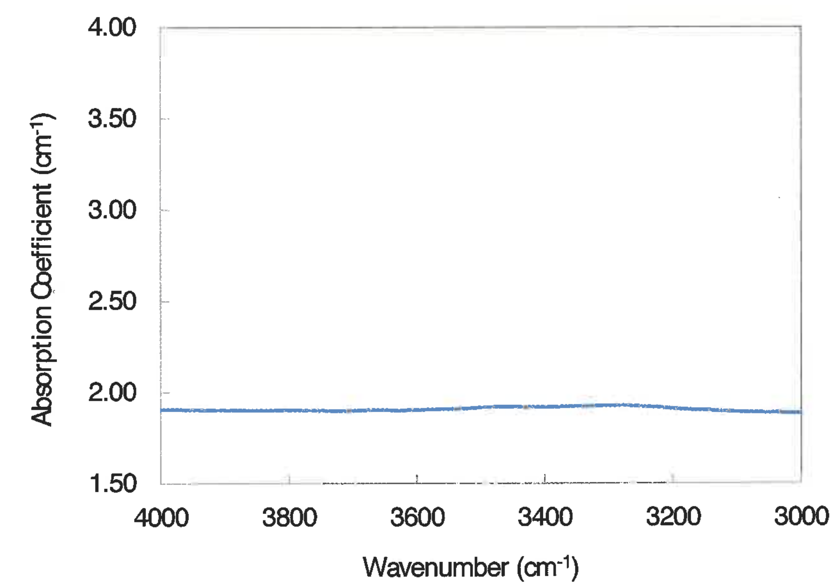
Furthermore, routine treatment of all types of gemstones is commonly performed to enhance their appearance or durability. Often treatments are undetectable—and undisclosed—to the purchaser. The GIA Laboratory has the necessary analytical instrumentation and industry experience to identify most treatments. Because gems that are untreated have a huge premium placed upon them, GIA also screens each stone and reports on whether any treatments are detectable.

The Jewel of Kashmir was studied with all available instrumentation by a team of experienced GIA gemologists. Their combined observations and data interpretation, which are detailed below, indicate that the Jewel of Kashmir is indeed an unheated Kashmir stone.

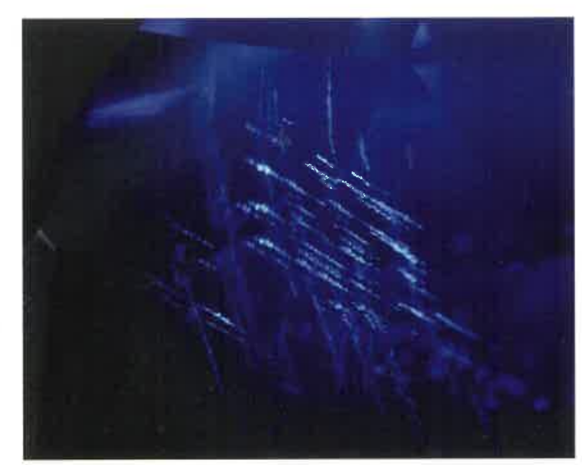
MICROSCOPY. The gemological microscope is the single most useful piece of equipment in a gemological laboratory. With a good-quality binocular microscope and various illumination techniques, an experienced gemologist can make detailed observations and highly accurate assessments. Microscopic observations are useful in determining gem identity, natural versus synthetic, treated versus non-treated, and country of origin.

GIA gemologists observed that the internal characteristics showed features considered highly consistent with sapphires mined in Kashmir. The Jewel of Kashmir presents milky, fine-grained banded clouds, considered a characteristic internal feature of Kashmir sapphires. They are also what give these stones their classic "sleepy" or "velvety" appearance. The Jewel of Kashmir also contains bands that are more particulate in nature, along with wispy cross-hatch or "ladder-like" strings of particles associated with pennants of fine particles.

INFRARED SPECTROSCOPY. Fourier-transform infrared (FTIR) absorption spectroscopy was performed to substantiate that the Jewel of Kashmir is unheated. The FTIR absorption spectrum from the Jewel of Kashmir did not show any treatment-related features. Furthermore, the Jewel of Kashmir did not have a feature at 3309 wavenumbers in its spectrum. Typically, heated blue sapphires do show a large feature here. However, it is not unusual for unheated sapphires to show an extremely weak feature at 3309 wavenumbers. While the absence of a line at 3309 wavenumbers is not conclusive evidence for lack of heat treatment, in the case of the Jewel of Kashmir this observation is consistent with the conclusion.



No discernible features were observed in the infrared spectrum of the Jewel of Kashmir. Shown above is the spectral region where treatment-related features in sapphire are expected to occur. None of these features were observed, supporting the conclusion that the Jewel of Kashmir is untreated.



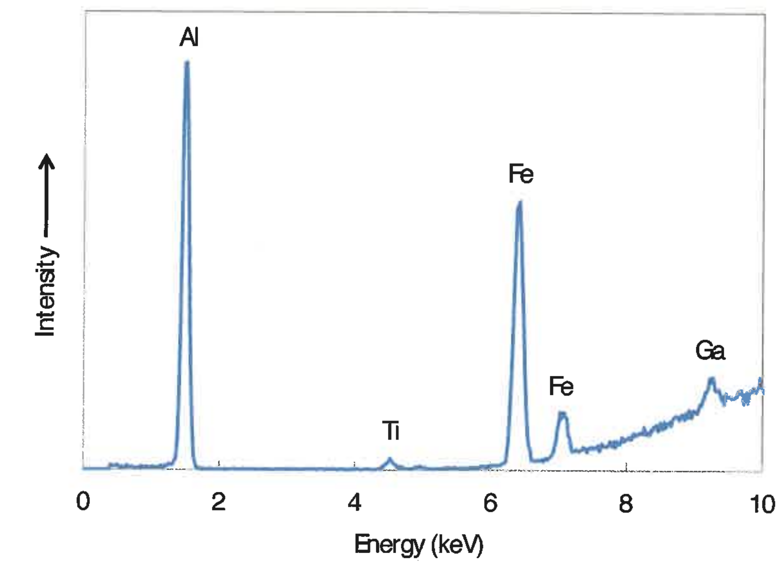
Ladder-like inclusions, magnified 30×.

Milky bands and ladder-like inclusions, magnified 30×.

X-RAY FLUORESCENCE SPECTROSCOPY. Chemical analysis is particularly useful because it permits gem identification by determining chemical composition. Furthermore, it can also be used detect treatments such as glass fillings or metallic coatings. Chemical information is also pertinent to determining country of origin for sapphires. As discussed previously, sapphire is mostly made of aluminum and oxygen; however, the presence of certain trace elements and their concentration is controlled by the geological environment hosting sapphire growth. The rock assemblages at different geographic locations provided slightly different chemical environments for the sapphires to grow in. Consequently, different mines leave a distinct chemical "fingerprint" that helps determine source type and country of origin.

Quantitative chemical data for the Jewel of Kashmir collected by energy-dispersive X-ray fluorescence (EDXRF) spectroscopy was used to characterize the trace element chemistry. This non-destructive technique uses X-rays to excite electronic transitions in atoms, and then measures the energy released when the electrons return to their stable states. The particular energies are specific to each element, and therefore are used to determine the presence of different elements.

Chemical data for the Jewel of Kashmir is shown in Table 1. Predictably, titanium (Ti) and iron (Fe) are the most abundant trace elements. Electron charge transfer between Ti^{4+} and Fe^{2+} ion pairs is responsible for the blue color of sapphires. The amount of Fe—112 parts per million atomic (ppma)—is nonetheless considered low for a sapphire. This indicates that it is from a metamorphic source rock. Sapphires from metamorphic deposits typically have low Fe content, since they crystallize in Fe-poor marbles and schists. For comparison, sapphires that form in Fe-rich magmatic rocks like basalt can contain several thousand ppma of Fe.

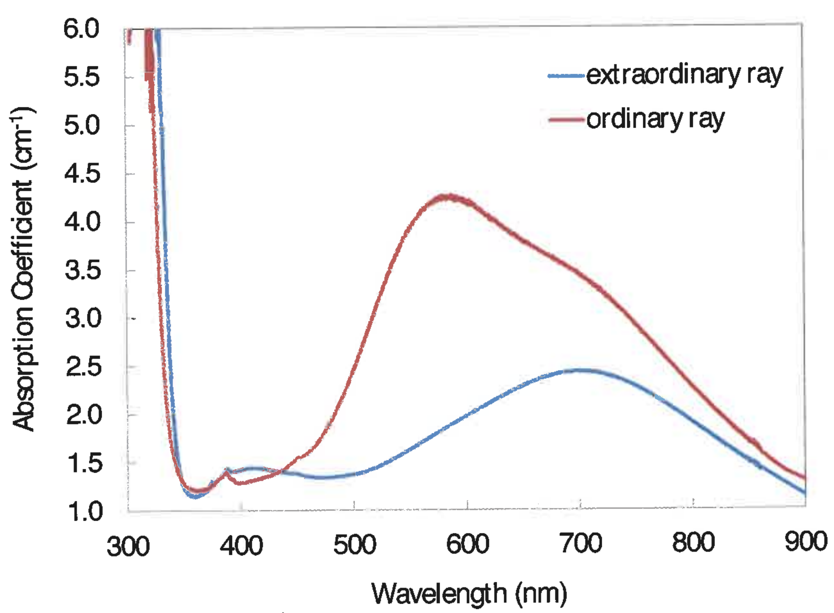


This representative EDXRF spectrum from a Kashmir sapphire shows a feature related to the major element chemistry, aluminum (Al). It also indicates the presence of natural trace elements titanium (Ti), iron (Fe), and gallium (Ga).

	TiO_2	V_2O_5	Cr_2O_3	Fe_2O_3	Ga_2O_3
weight percent oxide	0.07	0.003	0	0.044	0.008
	Ti	V	Cr	Fe	Ga
parts per million atomic (ppma)	179	6.73	0	112	17.4

ULTRAVIOLET-VISIBLE-NEAR INFRARED SPECTROSCOPY. Ultraviolet/visible/near-infrared (UV-Vis-NIR) absorption spectroscopy is a complementary technique to EDXRF for examining sapphire chemistry. Because trace element chemistry controls color in gemstones, a UV-Vis-NIR spectrum for a gem provides information about the color-inducing elements it contains.

The UV-Vis-NIR spectrum for the Jewel of Kashmir has an absorption edge at approximately 335 nanometers (nm), Fe^{3+}-related features at 375, 387, and 450 nm in the ordinary ray spectrum, and a weak chromium (Cr^{3+})-related feature at 400 nm in the extraordinary ray spectrum. These features are typical of a low-Fe metamorphic sapphire containing trace amounts of Cr.



The dominant features in the polarized UV-Vis-NIR spectra from the Jewel of Kashmir are broad bands centered at 560 nanometers (ordinary ray) and 700 nanometers (extraordinary ray). These absorption bands are caused by intervalence charge transfer between divalent iron and tetravalent titanium. This absorption behavior, which creates a relative "transmission window" at shorter wavelengths, is responsible for the perceived blue color of the Jewel of Kashmir.

Summary

Where shall we look for an apt analogy for the Jewel of Kashmir, to sky or to sea? With its celestial glow and ultramarine hue, we could liken it to heavenly bodies or to oceanic depths with equal fairness. It is a truly remarkable gem, all the more magical because it has been plucked from atop the high peaks of the Himalayas of Kashmir. Requiring only polishing to bring forth its perfection, then delivered in a regal and sparking ring setting, the Jewel of Kashmir definitively answers our question of what constitutes a fine gem.

About GIA. Established in 1931, the Gemological Institute of America is the world's foremost authority on diamonds, colored stones, and pearls. A nonprofit institute, GIA's mission is to ensure the public trust in gems and jewelry by upholding the highest standards of integrity, academics, science, and professionalism through education, research, laboratory services, and instrument development. Visit www.gia.edu