# Introducing Hyperion: Inclusion Photos from Lotus Gemology 分享寶石微觀內含物圖片庫

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想要瞭解更多神秘美麗的寶石微觀世界,便要 一看此文。作者不但與讀者公開分享他們的寶 石內含物的照片及圖片庫(Lotusgemology.com), 而且詳細解釋和比較本文內各圖片所代表的意 義,是一篇既有觀賞性又有深度的文章。

## Abstract

An introduction to Lotus Gemology's Hyperion gem inclusion database, along with a selection of inclusion photos that are grouped according to their relationship with one another. These are available to the public.

## **Hyperion Inclusion Pairs**

In Greek mythology, Hyperion was the god of Watchfullness, Wisdom, and Light. It is said that, through careful observation, he was the first to understand the movements of the cosmos, and freely shared his knowledge with others. The world of gemstones is no different, where light and careful observation are paramount to our understanding of precious stones.

In June 2015, Richard Hughes, Wimon Manorotkul and I opened Lotus Gemology, a Bangkok-based laboratory specializing in ruby, sapphire, and spinel. At Lotus we not only issue reports on stones, but also conduct research. We started collecting data, both on stones we were testing and from stones in our lab's specimen collection. This included an internal system to record inclusion photos. What started as a few images developed into a searchable database of hundreds of photomicrographs. As we began to rely on this database for staff training, we realised it could be a great educational reference, not just for us, but also for gemmologists worldwide. Thus, we have made it available to the public, free-of-charge on Lotusgemology.com. In honour of the Greek god of Light, we dubbed it Hyperion. To date, Hyperion contains more than 600 inclusion photos. Images can be searched by stone type, origin, treatment, or keyword.

However, we realised there was still something missing. Some of the photos tell the full story best when they are grouped with others. By viewing them together, side-by-side, we begin to see the relationships not visible when viewed alone. To bridge this gap, we have paired a selection of photos that can be found in our database.

Inclusion pairs are selected based on the following criteria:

## Lighting

When viewing gems, lighting is just as important as the microscope. The key is not that there is one particular light source that is better than another, but that a variety of light sources should be used. The light sources and specimens should also be moved and held in different positions, which can reveal features that otherwise go unseen. The following are a few examples of the importance of lighting.



Fig. 1 Negative crystals can be seen in this untreated Mogok, Myanmar (Burma) sapphire in transmitted light (left). However, when illuminated with oblique fibre optic light, small exsolved plates that were previously invisible appear (right). Photos: E. Billie Hughes





Fig. 2 These transparent crystals can be seen in transmitted light (left), and are hard to distinguish from negative crystals. When observed between crossed polars (right), however, they reveal their doubly refractive nature in this untreated sapphire from Sri Lanka (Ceylon).

Photos: E. Billie Hughes





Fig. 3 With oblique fibre optic illumination (left) these primary rutile crystals in an untreated Madagascar ruby present a dark red appearance. However, with the addition of reflected light (right) we can also see that they display a submetallic luster where they were cut through on the surface. Using reflected light can also help distinguish other surface features, such as gas filling.

Photos: E. Billie Hughes

![](_page_1_Picture_10.jpeg)

Fig. 4 It's important not only to use different light sources, but to move the light and stone around into different positions. Both of the above photos were shot with the same diffused fibre optic light. On the left, the light is held so that the stone is illuminated with transmitted light, which makes it easy to see the frozen gas bubble in a negative crystal in this heated basaltic sapphire. On the right, the same inclusion is illuminated from a different angle, and a glassy, heat-altered fissure appears around the negative crystal. Without moving the light source around, we could not have seen this fissure. Photos: E. Billie Hughes

### Natural vs. Synthetic

Hyperion not only includes natural gemstones, but also examples of synthetic stones. Within the synthetics category, users can even search by type of synthetic. By learning the features of both natural and synthetic stones, we can distinguish between the two.

### Treatment

One of the most pressing issues in the trade today is detecting treatment in gems. Here we have just a few examples of how some types of inclusions can be useful.

![](_page_2_Picture_4.jpeg)

Fig. 5 Angular growth zoning can separate natural corundum (left) from flame fusion synthetic corundum (right), which has curved growth lines. The specimen on the right was photographed immersed in di-iodomethane with diffuse light field illumination. Photos: Richard Hughes (left) and E. Billie Hughes (right)

![](_page_2_Picture_6.jpeg)

Fig. 6 Mozambique silk before, (left) and after (right) heat treatment. In the dart-shaped crystal on the left, we see exsolved rutile silk (in high relief) and the daughter crystal (in low relief). In the image on the right, note the breakdown of the daughter crystal after heating. In the heated example, instead of a smooth, uniform appearance, the daughter crystal shows a mottled, uneven surface with white spots in the lower relief area.
Photos: E. Billie Hughes

![](_page_2_Picture_8.jpeg)

![](_page_2_Picture_9.jpeg)

Fig. 7 "Fingerprints" are a type of secondary inclusion that form from the healing of a fissure after the host gem has formed. They are made up of tiny negative crystals. In this example we see Sri Lankan (Ceylon) sapphire, both untreated (left) and heated (right). Note that in the image on the left, the negative crystals appear undamaged. Once a stone is heated, the fingerprint develops tiny microfractures. In the image on the right, the negative crystal channels have burst, creating shiny discoid areas and a melted appearance. Photos: E. Billie Hughes

![](_page_3_Picture_0.jpeg)

Fig. 8 On the left, we see what John Koivula calls "chromophore cannibalization." (Koivula 1978) As titanium is drawn out of solid solution to form exsolved rutile silk, the area around the silk is decolourized. This effect is seen in untreated stones, such as in the untreated Sri Lankan (Ceylon) sapphire pictured above. In the image on the right we have "internal diffusion," where the reverse happens, in this case in a heated Thai sapphire. Heating sends titanium back into solution, creating blue colour zones around the partially dissolved rutile silk. Photos: E. Billie Hughes

![](_page_3_Picture_2.jpeg)

Fig. 9 In unheated sapphire, such as in this example from Sri Lanka (Ceylon) (left), undissolved rutile silk often appears in long, unbroken needles. When a silky sapphire is heated to a high enough temperature, titanium from the rutile silk is forced into solid solution, colouring the stone blue. But the silk may also contain other elements that cannot dissolve into sapphire so readily, leaving behind silk "skeletons" (right).

Photos: Patharaphum Sudprasert (left), Richard Hughes (right)

![](_page_3_Picture_5.jpeg)

Fig. 10 Negative crystals are a typical inclusion in Sri Lankan (Ceylon) sapphire. In unheated examples (left), we often see clear growth markings and sharp, angular edges. In contrast, when these specimens are heated (right) we see a rounding of the crystal edges and a shiny, glossy surface appearance. Note that the figure on the right also shows some glassy discoid inclusions.

Photos: E. Billie Hughes

![](_page_4_Picture_0.jpeg)

Fig. 11 Mobile bubbles in negative crystals, as seen in this Madagascar ruby, cannot withstand heat treatment and thus are proof of natural origin. Note how, unlike in Fig. 4, the bubble here changes position. By gently tilting the stone we can distinguish the bubble from the frozen gas bubbles that are sometimes found in heated stones. Photos: E. Billie Hughes

#### Summary

There is much that we can learn from the study of inclusions in gemstones. To further this research, Lotus Gemology has made its Hyperion inclusion database available to the public at Lotusgemology.com. Here we have provided a sampling of grouped inclusion photo pairs whose relationships can teach us more about gems.

Many of these photos will also appear in our upcoming book, *Ruby & Sapphire: A Gemologist's Guide*, to be published in 2017.

#### References

- Eppler, W.F. (1966) The origin of negative crystals in gemstones. *Journal of Gemmology*, Vol. 10, No. 2, April, pp. 49–56.
- Hughes, R.W. and Koivula, J. (2005) Dangerous curves: Verneuil synthetic corundum. Bangkok, *Lotusgemology.com*.
- 3. Hughes, R.W., Manorotkul, W. et al. (2015) Let it bleed: New rubies from Madagascar. Bangkok, *Lotusgemology.com*.
- Koivula, J.I. (1987) Internal diffusion. Journal of Gemmology, Vol. 20, No. 7/8, pp. 474–477.
- Pardieu, V., Sangsawong, S. et al. (2013) Rubies from the Montepuez area (Mozambique). Gemological Institute of America, October 5, 84 pp.
- Pardieu, V., Saeseaw, S. et al. (2015) "Low temperature" heat treatment of Mozambique ruby: Results report. Gemological Institute of America, 16 April, 34 pp.

![](_page_4_Figure_12.jpeg)