

# Gem Notes

## COLOURED STONES

---

### Large Aquamarine Overgrown by Synthetic Emerald

Hydrothermal synthetic emerald overgrowth on natural beryl is nothing new. It is a well-known product from the Lechleitner company in Austria, which produced these hybrid natural/synthetic gems for more than two decades, beginning in 1959. In the Lechleitner method, a faceted natural beryl (typically colourless or pink) was used as the seed, over which a thin layer of synthetic emerald with very high Cr content was grown to impart a more-or-less intense green colour (Nassau & Nassau 1980; Schmetzer *et al.* 1981). Today, such hybrid natural beryl/synthetic emerald gems are very rarely encountered in the trade, because Lechleitner produced limited quantities and ceased production in the 1980s. The specimens produced by this method were usually rather small (typically <5 ct).

In 2022, a pendant with a large green stone (with an estimated weight of 75 ct) declared as emerald was submitted to GGTL Laboratories in Liechtenstein for testing (Figure 1). Although Fourier-transform infrared (FTIR) spectroscopy clearly identified it as beryl without any apparent clarity enhancement, the details of the spectrum were unusual for natural emerald, and looked much more like beryl of another colour (e.g. aquamarine). In addition, the size, clarity and colour of the specimen made it highly suspicious. A closer look at minor details of the FTIR spectrum revealed small absorption features attributed to deuterated water (D<sub>2</sub>O or HDO) in the 2830–2550 cm<sup>-1</sup> region, as well as many other minor spectral features that resemble those known for aquamarine from various sources, rather than any of the signatures known for natural emerald.

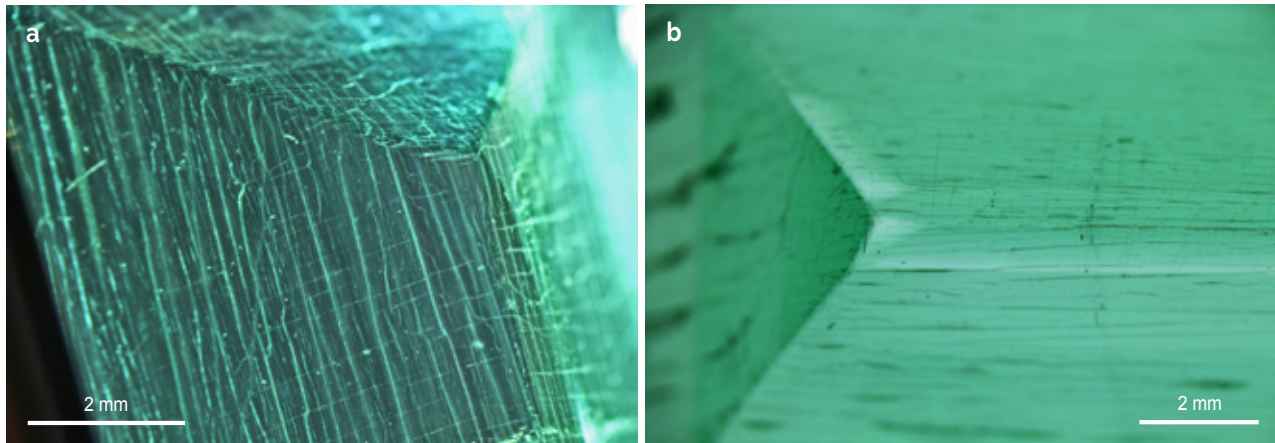
Viewed with a microscope, we noted various natural-appearing inclusions (mostly fluid- and gas-filled growth tubes parallel to the optic axis), as well as fine crazing within a thin surface layer on the specimen (Figure 2a). Such features are highly characteristic of Lechleitner ‘hybrid’ products (Schmetzer *et al.* 1981). Immersion in alcohol revealed a thin, intense green surface layer present on the pavilion facets



**Figure 1:** The 75 ct specimen in this pendant, surrounded by diamonds, was submitted as a natural emerald. Photo by T. Hainschwang.

(Figure 2b). The FTIR spectroscopic identification of the sample as beryl, combined with these microscopic features, unambiguously identified it as a natural beryl overgrown by synthetic emerald.

To investigate the colour of the underlying beryl



**Figure 2:** (a) Under magnification, abundant fine cracks with very little penetration depth were visible on the pavilion of the specimen. Such cracks are highly characteristic of epitaxial overgrowth of synthetic emerald on natural beryl. (b) Immersion in alcohol revealed the darker green layer of synthetic emerald, part of which had been removed when the specimen was repolished, resulting in irregular areas of lighter colouration. Photomicrographs by T. Hainschwang.

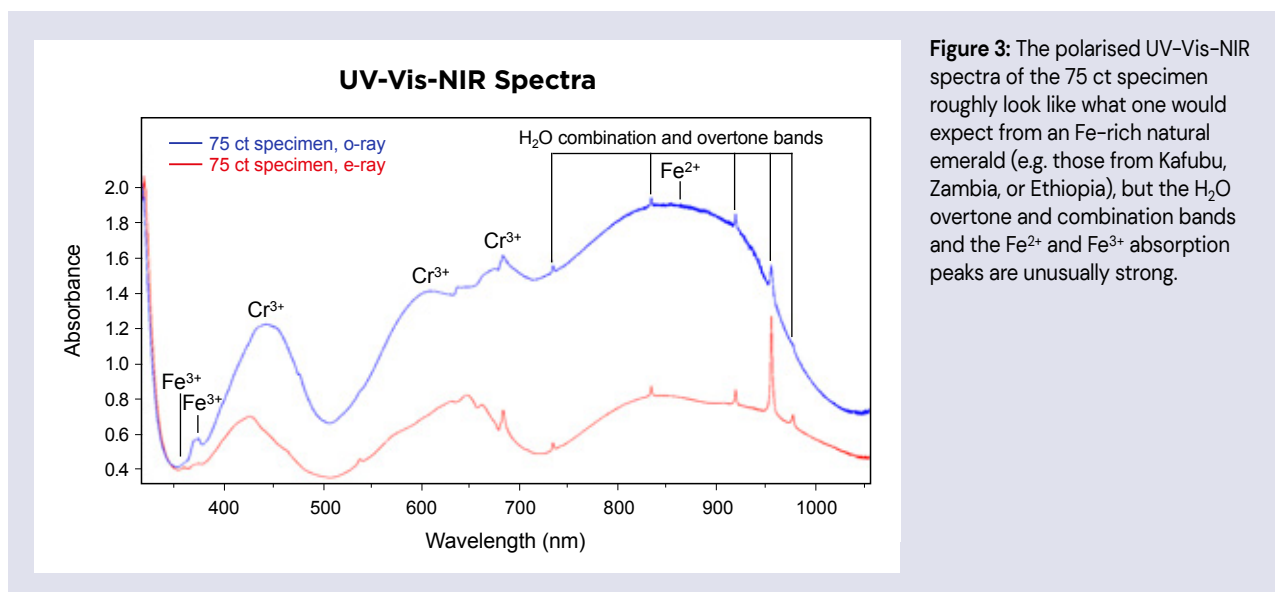
and verify our assumption that it was an aquamarine, we recorded polarised ultraviolet-visible-near infrared (UV-Vis-NIR) spectra of the sample (Figure 3). The spectra were characterised by distinct Cr absorptions, very strong Fe-related bands and intense water peaks attributed to H<sub>2</sub>O overtone and combination bands.

To demonstrate the spectral effect of overlaying synthetic emerald on aquamarine, we acquired polarised spectra of both a hydrothermal synthetic emerald and an aquamarine (Figure 4a), and then combined the two spectra; that is, we added the ordinary ray spectrum of the aquamarine to the ordinary ray spectrum of the synthetic emerald, and we added the extraordinary ray spectrum of the aquamarine to the extraordinary ray spectrum of the synthetic emerald. The resulting spectra (Figure 4b) resembled those we obtained from

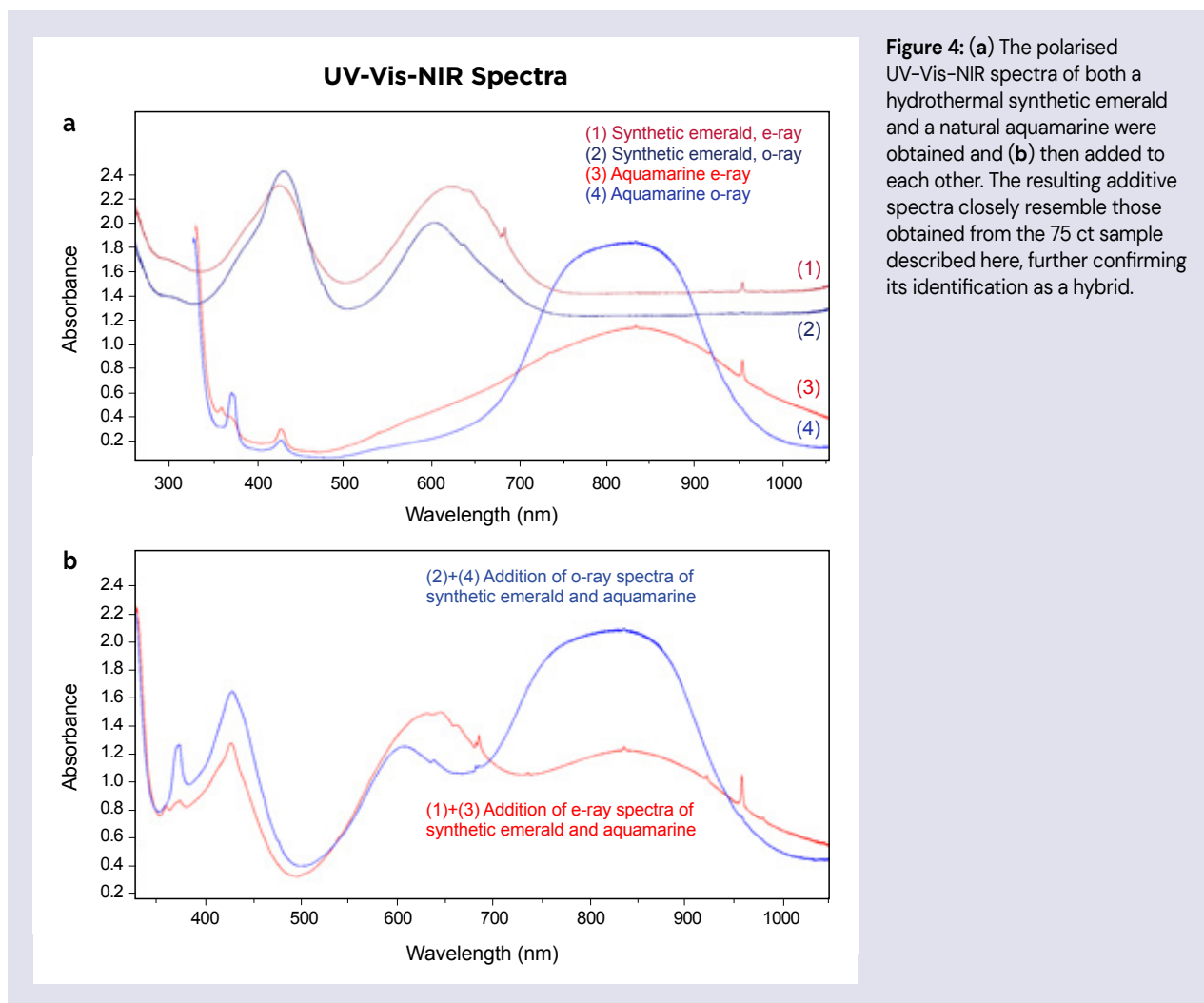
the 75 ct sample described here.

Chemical analyses by energy-dispersive X-ray fluorescence (EDXRF) spectroscopy were recorded for an area of the pavilion coated with synthetic emerald and for the table of the sample, which lacked any visible coating. The coated pavilion yielded 30,000 ppm Cr, while the Cr content of the table, where the overgrowth had been completely removed when the sample was repolished, was below the detection limit of the instrument. The very high Cr content of the coated area, which is significantly greater than the highest measured values of natural emerald, is consistent with the Cr contents published for Lechleitner synthetic emerald overgrowth (Schmetzer *et al.* 1981).

To the authors' knowledge, this is the largest documented Lechleitner-type hybrid natural beryl/



**Figure 3:** The polarised UV-Vis-NIR spectra of the 75 ct specimen roughly look like what one would expect from an Fe-rich natural emerald (e.g. those from Kafubu, Zambia, or Ethiopia), but the H<sub>2</sub>O overtone and combination bands and the Fe<sup>2+</sup> and Fe<sup>3+</sup> absorption peaks are unusually strong.



**Figure 4:** (a) The polarised UV-Vis-NIR spectra of both a hydrothermal synthetic emerald and a natural aquamarine were obtained and (b) then added to each other. The resulting additive spectra closely resemble those obtained from the 75 ct sample described here, further confirming its identification as a hybrid.

synthetic emerald. Whether it had originally been sold as a Lechleitner hybrid is unknown, but after being mounted in the jewel it was represented as natural emerald.

*Dr Thomas Hainschwang*  
 (thomas.hainschwang@ggtl-lab.org)  
 and *Gianna Hainschwang*  
 GGTL Laboratories Liechtenstein  
 Balzers, Liechtenstein

## References

- Nassau, K. & Nassau, J. 1980. The growth of synthetic and imitation gems. *In: Freyhardt, H.C. (ed) Growth and Properties*. Springer Verlag, Berlin, Germany, 1–50, [https://doi.org/10.1007/978-3-642-67467-9\\_1](https://doi.org/10.1007/978-3-642-67467-9_1).
- Schmetzer, K., Bank, H. & Stähle, V. 1981. The chromium content of Lechleitner synthetic emerald overgrowth. *Gems & Gemology*, **17**(2), 98–100, <https://doi.org/10.5741/gems.17.2.98>.

## Burbankite from Kola Peninsula, Russia

Burbankite is a rare-earth carbonate mineral with the chemical formula  $(\text{Na,Ca})_3(\text{Sr,Ba,Ce})_3(\text{CO}_3)_5$ . It ranges from colourless, greyish yellow, pale yellow, and pink to pale green, with a Mohs hardness of 3½–4 and fair cleavage on {1010} (<https://www.mindat.org/min-803.html>). Gem-quality material was initially reported by

Koivula *et al.* (1992a) from Mont St-Hilaire, Quebec, Canada. They described it as ‘a newcomer to the gem world, which shows a remarkable color change from greenish brown in fluorescent light to reddish brown in incandescent light.’ They further indicated that clean gemstones up to 6.62 ct had been faceted from