

Pink-orange gem quality euclase from Bahia, Brazil

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Figure 1. This 2.99 ct shield-shaped euclase was studied for the article Gilles-Guéry *et al.* (2022-b). Courtesy of D. Clauwet; cutting and photo by B. Kosnar.

Euclase— $\text{BeAl}(\text{SiO}_4)(\text{OH})$, monoclinic crystal system—is a seldomly occurring mineral and with a Mohs hardness of 7 and a perfect cleavage to (010) rarely faceted for use in jewellery, but crystal specimens are highly sought after by collectors. The mineral is most often colourless but can also be blue (mostly with colour zoning), bluish green, green and yellow (e.g. Chaves & Karfunkel, 1994). Few millimetre-sized pale pink euclases have been reported from the Borborema Pegmatitic Province in Brazil (Eeckhout *et al.*, 2002; Cassedanne & Philippo, 2015).

In 2016, finds of pink-orange euclase in Brazil have attracted considerable attention due to the material's unusual and beautiful colour, relatively high clarity and well-formed crystals. If the first samples were wrongly identified as Imperial topaz by a gemlab in Belo Horizonte, it was rapidly identified as euclase using Raman spectroscopy and standard gemmological testing at the Centro de Tecnologia Mineral (CETEM) laboratory and then analysed at Sorbonne University in Paris, France, to study the cause of their colour (Gilles-Guéry *et al.* 2022-a). The origin of the samples was reported as Livramento de Nossa Senhora in Bahia State. Pink euclases begun to spread in mineral

fairs: in 2018 at Sainte Marie aux Mines and in 2020 at Tucson (Figure 1). Rapidly, it appears that the euclase samples look slightly different and were coming from two different places. In December 2020, part of the team (LAVQ and JS) visited the occurrence located approximately 18 km west-north-west of the town of Livramento de Nossa Senhora in the Paramirim mountain range of Bahia State. In October 2021, three members of the team (LG-G, LAVQ and JS) made a second trip to Livramento de Nossa Senhora to investigate the second source of the pink-orange euclase : Catoles mountain range, Bahia State, located approximately 30 km north-north-east of the first occurrence (Gilles-Guéry *et al.*, 2022-b).

The pink-orange euclase samples were characterized by classic gemmological and Raman spectroscopy (plus a confirmation by X-ray diffraction). Both samples from the first and second occurrences had RIs of 1.652–1.673 (birefringence 0.021) and an SG value of 3.10. They were inert to long- and shortwave UV radiation.

Both samples displayed a strong pleochroism (Figure 2) (from orange to pink for the first occurrence and from pink to pale pinkish for the second occurrence) that was visible to the unaided eye by turning or by using a dichroscope. While the colour of the sample from the first occurrence was an almost homogenous pink-orange (Figure 3a), samples from the second one were strongly colour zoned (hourglass-shaped) (Figure 3b), varying from orange-pink at the pointed end of the faceted stone to almost colourless at its wider end.



Figure 2. Strong pleochroism from pink to pale pinkish is shown on the shield-shaped euclase from the second occurrence. Photo by C. Williams.

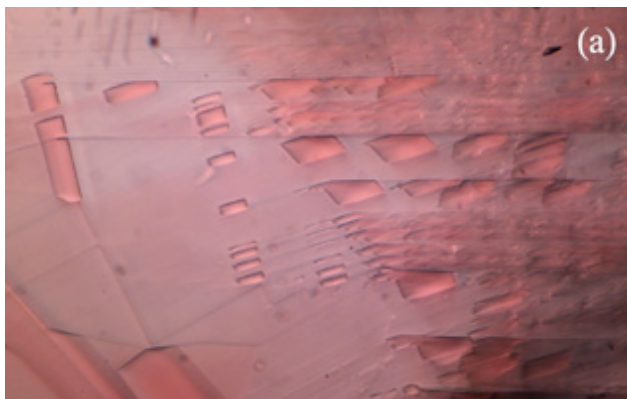
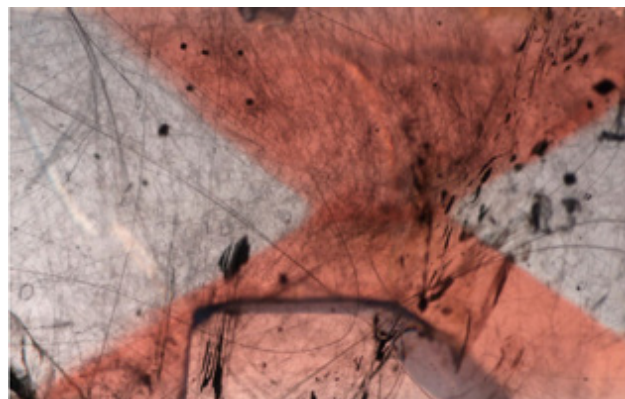


Figure 3. (a) the complex color zoning from pink to pinkish of the sample from the first occurrence and (b) the strong hourglass-shaped color-zoning from orange-pink to almost

The samples from the first occurrence were typically less included than those from the second occurrence. Partially healed fissures with fluid inclusions were commonly observed, including those consisting of a liquid and a vapour phase. The samples from the second occurrence exhibited lower transparency. The most characteristic inclusions in our samples consist of various types of fibrous channels: straight fine-to-coarse ones (Fig. 4a) and curly/wooly fibers (Figure 4b). Other inclusions encountered in euclase from the second occurrence were dolomite, quartz, prismatic euclase and also partially healed fissures consisting of two-phase fluid inclusions. Moreover, some inclusions are still unidentified: flattened circular negative crystals, curly fibres and a hydrated La-Al phosphate/arsenate mineral (Gilles-Guéry *et al.*, 2022-b).



colourless of the sample from the second occurrence. Photomicrographs by J. Schnellrath and L. A. V. de Queiroz; image widths (a) 3.2 mm and (b) 6.0 mm.

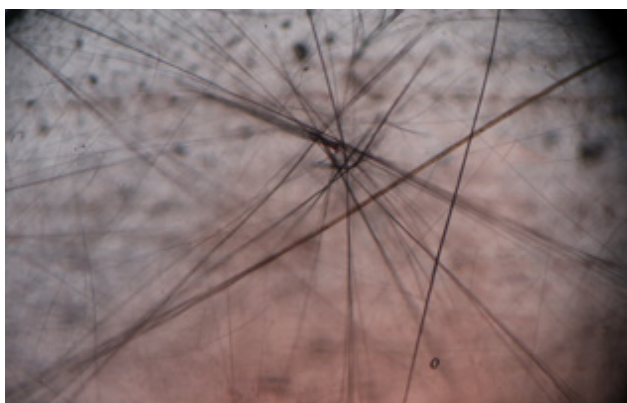
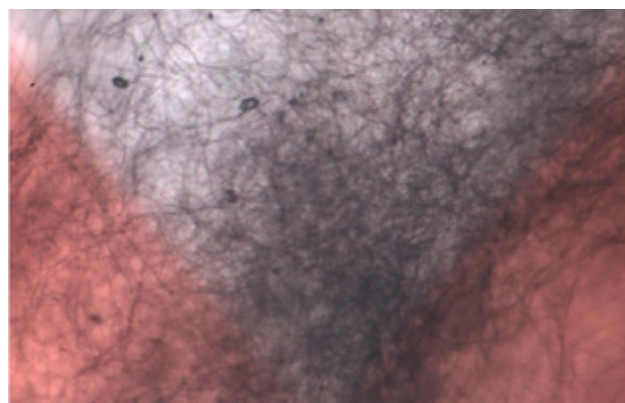


Figure 4. Various types of fibers observed in euclase from the second occurrence (a) straight fine-to-coarse inclusions and (b)



curly/wooly fibers. Photomicrographs by J. Schnellrath and L. A. V. de Queiroz; image widths (a) 3.9 mm and (b) 2.5 mm.

Chemical analyses performed by EPMA reveal the presence of minor and traces elements: Fe (average content of 992 ppm), Mn (average content of 73 ppm), Ti (average content of 46 ppm), Ge (average content of 142 ppm).

The combination of spectroscopic techniques: unpolarized, polarized, low temperature, or in situ high temperature optical absorption spectroscopy, Electronic Paramagnetic Resonance (EPR) spectroscopy, and X-ray Absorption Near Edge Structure (XANES) spectroscopy (at SOLEIL synchrotron) allows Gilles-Guéry *et al.* (2022) to determine the causes of colour, pleochroism and heat-induced change of colour in pink-orange euclases. EPR and XANES spectroscopy prove that iron was only in ferric state (no redox change after heat treatment) and substitutes Al^{3+} in slightly distorted octahedral sites. EPR also shows the absence of

paramagnetic radiation-induced defects. Thus, the colour and pleochroism from orange to pink have been related to the substitution of Mn^{3+} in the octahedral Al sites. An additional component, which might contribute to thermally unstable defects together with the rising slope towards the UV region, was assigned to an $\text{O} \rightarrow \text{Fe}^{3+}$ oxygen–metal charge transfer. Gilles-Guéry *et al.* (2022-a) found that heat treatment modifies the colour of this euclase from pink-orange to a stable pure pink by removing the thermally unstable defects that cause the yellow tint (Figure 5).

The formation of the pink-orange euclase from Bahia, Brazil appears to be in hydrothermal veins hosted by a schistose unit within metaarenite. The presence of many green Mn-bearing andalusite crystals in nearby schists indicates local oxidizing conditions. The presence of Ge in the samples is consistent with the contamination of the hydrothermal fluid by the surrounding rocks, as for Colombian euclase (Pignatelli *et al.*, 2017). According to the overall gemmological properties and chemical composition, the euclase samples from both occurrences have the same geochemical signature but different internal features which allow their distinction (Gilles-Guéry *et al.*, 2022-b).

The pink-orange euclase is still under research for unidentified inclusions and Mn content analyses of the color-zoning by LA-ICP-MS (LAVQ). Thus, euhedral pink-orange euclases have been given to the mineral collection of l'Ecole des Mines and of Sorbonne Université, in order to conserve samples for future research. Moreover, the School of Jewellery Arts has enriched its collections with a faceted pink euclase to introduce this rare gem to a wider audience.

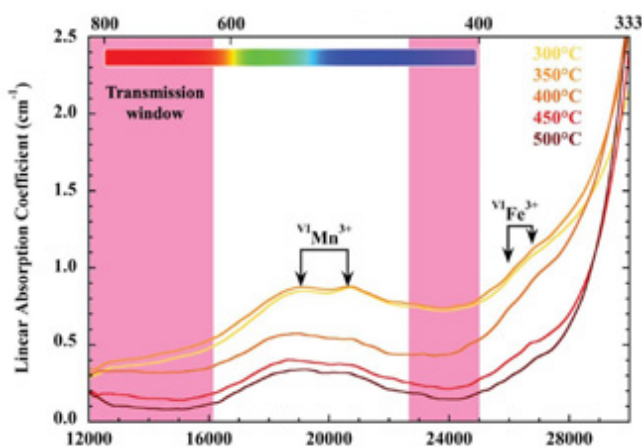


Figure 5 : Optical microspectroscopy study of the isochronal in situ measurements between 300°C and 500°C of pink euclase.

References:

- Cassedanne, J., Philippo, S., 2015. Mineral and gem deposits of eastern pegmatites. Musée National.
- Chaves, M.L.S.C., Karfunkel, J., 1994. Novas ocorrências de euclásio em Minas Gerais. Boletim IG-USP. Série Científica, 25, 53–60.
- Eeckhout, S.G., Castañeda, C., Ferreira, A.C.M., Sabioni, A., De Grave, E., Vasconcelos, D., 2002. Spectroscopic studies of spessartine from Brazilian pegmatites, American Mineralogist, 87(10), 1297-1306.
- Gilles-Guéry, L., Galois, L., Schnellrath, J., Baptiste, B., Calas, G., 2022-a. Mn^{3+} and the pink color of gem-quality euclase from northeast Brazil. American Mineralogist, 107 (3): 489–494.
- Gilles-Guéry, L., Queiroz L.A.V., Schnellrath, J., Williams, B., Williams, C., Laurs B.M., Galois, L., Calas, G., Barbosa, T.C., 2022-b. Pink-orange euclase from Bahia, Brazil, Journal of Gemmology, 38(1), 50-68.
- Pignatelli, I., Giuliani, G., Morlot, C., Rouer, O., Claiser, N., Chatagnier, P.Y., Goubert, D., 2017. Recent Advances In Understanding the Similarities and Differences of Colombian Euclases, The Canadian Mineralogist, 55(4), 799-820.