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Faceted Eudialyte : A Gemmology Data Capture

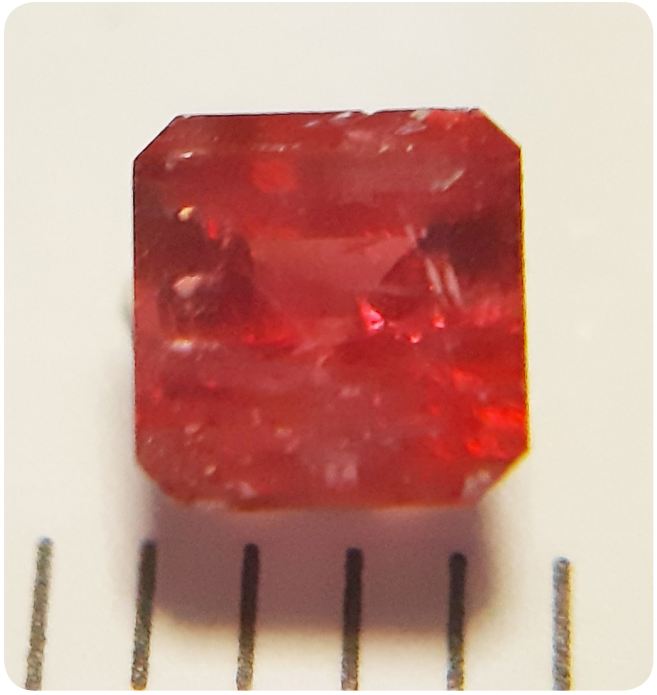

Figure 1 - Photo of one of the cut samples that have been kept as a faceted reference in the GSP collection.

Introduction

Eudialyte is rare deep red mineral for collectors. As this material is soft, very often heavily included and thus quite difficult to cut, Eudialyte is invariably cut as cabochons or 'cachet-cabochons' or in its tumbled form.

To facilitate his own collection of rare faceted stones and to develop his gem cutting expertise, one of the authors (S.C.) chose to cut ten stones from a 'cachet-cabochon' of Eudialyte.

This afforded us the opportunity to collect gem data from this very rarely faceted gemstone (Figure 1) and we thought it would be interesting to share here the laboratory gem phase identification and gemmology data obtained from these samples.

Material and Method:

1. Samples: 10 faceted stones ranging from 0.09 ct to 0.67 ct (Figure 2).

2. Visible-NIR spectrometry was realized with an Ocean Optic USB 4000 spectrometer equipped with a home-made setting involving an integration sphere.

3. Spectroscopy was realized both with diffraction grating and prism spectroscope.

4. Fourier Transform InfraRed (FTIR) spectrometry was done with a Bruker Alpha spectrometer using a low noise DLaTGS detector, equipped with a diffuse reflectance type (DRIFT) signal capture module and was run at 4 cm^{-1} resolution. Two data were recorded. One in 'pseudo-transmission' mode (through the DRIFT module) and one in specular reflectance mode.

5. X-Ray Powder Diffraction (XRPD) was realized on a 2nd generation Bruker D2-Phaser diffractometer. A few milligrams of the mineral was powdered and analyzed as a thin powder layer on a oriented silicon crystal holder.

6. Specific gravity was determined with a homemade set up involving a Dendritic gem scale.

7. Reactions to ultraviolet radiation (shortwave and longwave) were evaluated in a dark box lit with 6W UV tubes.

Results and Related Comments:

The samples displayed the typical deep red color with a tinge of purple and orange (Figure 2).

Under magnification and crossed polarizing filters, anisotropic behavior was obvious. However it wasn't possible to detect any optic axis (Figure 3a).

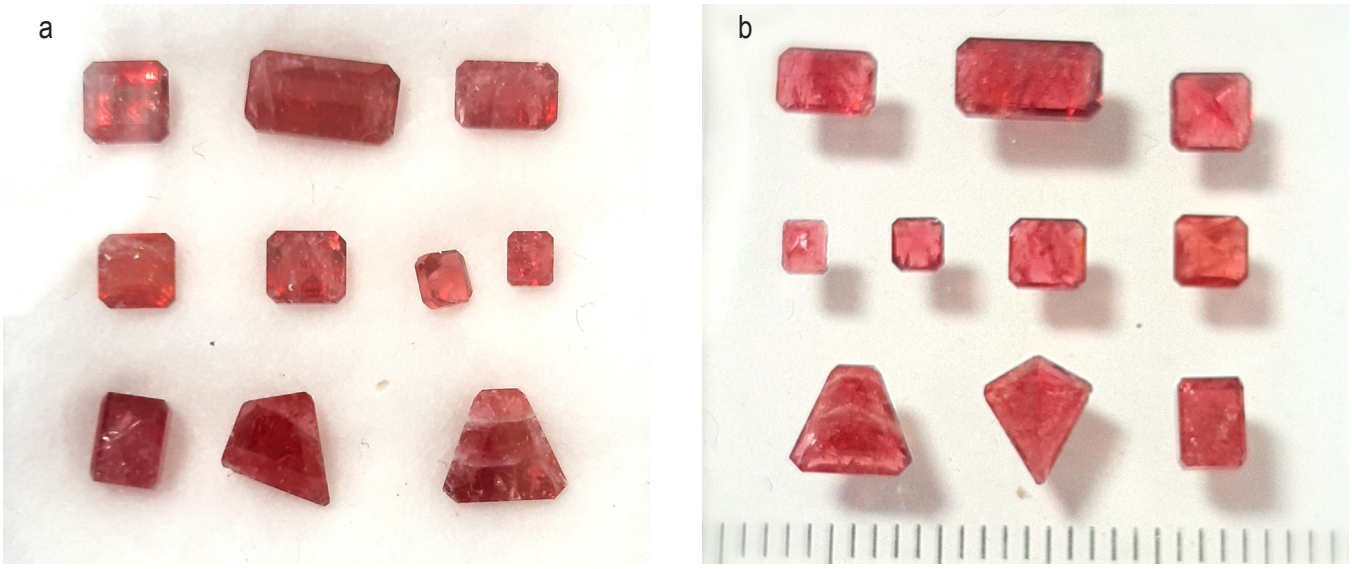

Figure 2 - All samples in this overview range from 0.09 to 0.67 carats a: Face view on a white opaque background. b: Back view with some transparency over a white background.

Interference colors were very often seen and sometimes a patchy interference color was observed (Figure 3b).

The specific gravity (taken on the ten samples for a more accurate measurement) was 2.93.

The refractive index value were roughly (because the shadow edge was not always very clear) no ~ 1.592, ne ~ 1.599, Dn ~ 0.007 with a uniaxial positive behaviour.

All the samples were inert under both short wave ultraviolet or long wave ultraviolet.

Pleochroism was weak but perceptible when using a polarizing filter (Figure 4.)

An observable spectrum through a prism or diffraction grating spectroscope showed absorption bands and lines in the yellow, green and blue parts of the visible spectra (Figure 5).

At the laboratory, visible near infrared (Vis-NIR) spectroscopy indicated a very specific spectrum with a lot of peaks (probably due to rare earth components) (Figure 6).

In order to definitively and structurally identify this mineral phase, some cutting residua were powdered for an X-Ray

Figure 3a - Between crossed polarizing filters, interference colors are very often seen.

Figure 3b - Sometimes, patchy interference color can be seen.

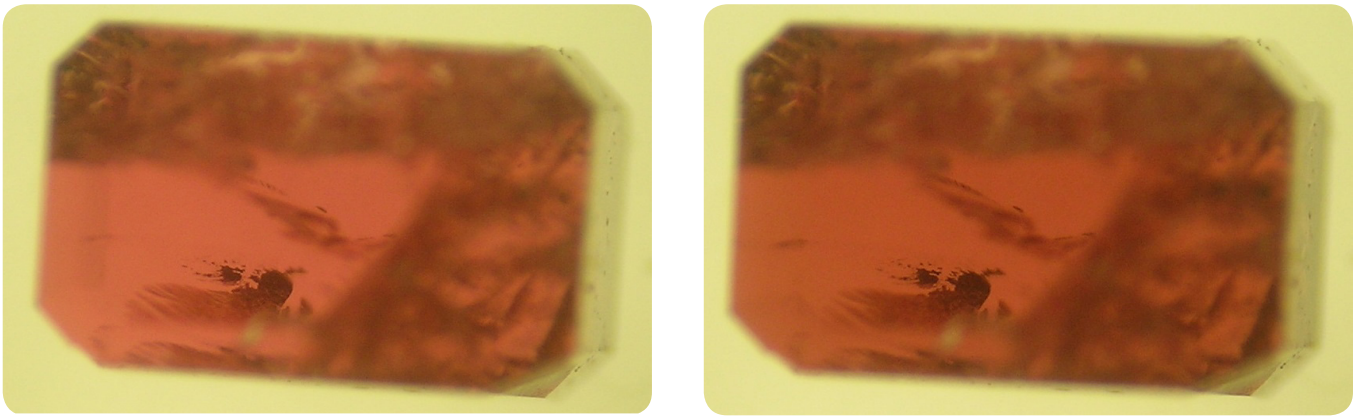

Figure 4 - View of the two colors of the weak pleochroism: Purplish-pink – darker orangey-red

Powder Diffraction (XRPD) analysis (Figure 7). The powder diffraction pattern had a perfect match with Eudialyte mineral phase.

A Specular Reflectance Fourier Transform InfraRed spectrum as well as spectrums in 'transmission mode' were collected so as to properly identify any new samples of Eudialyte, regardless of shape (roiled rough, crystal, cut.) in the future (Figure 8).

Conclusion:

These stones were definitely identified as Eudialyte, allowing us to add the collected data to our existing Gem Solid-Phase Gemlab Collection database.

As Eudialyte has a very pleasant red color and is rarely cut, it was satisfying to add the faceted sample (Figure 1) to our reference collection.

Figure 5 - Very specific absorption spectrum as it could see through a: prism spectroscope or b: diffraction grating spectroscope.

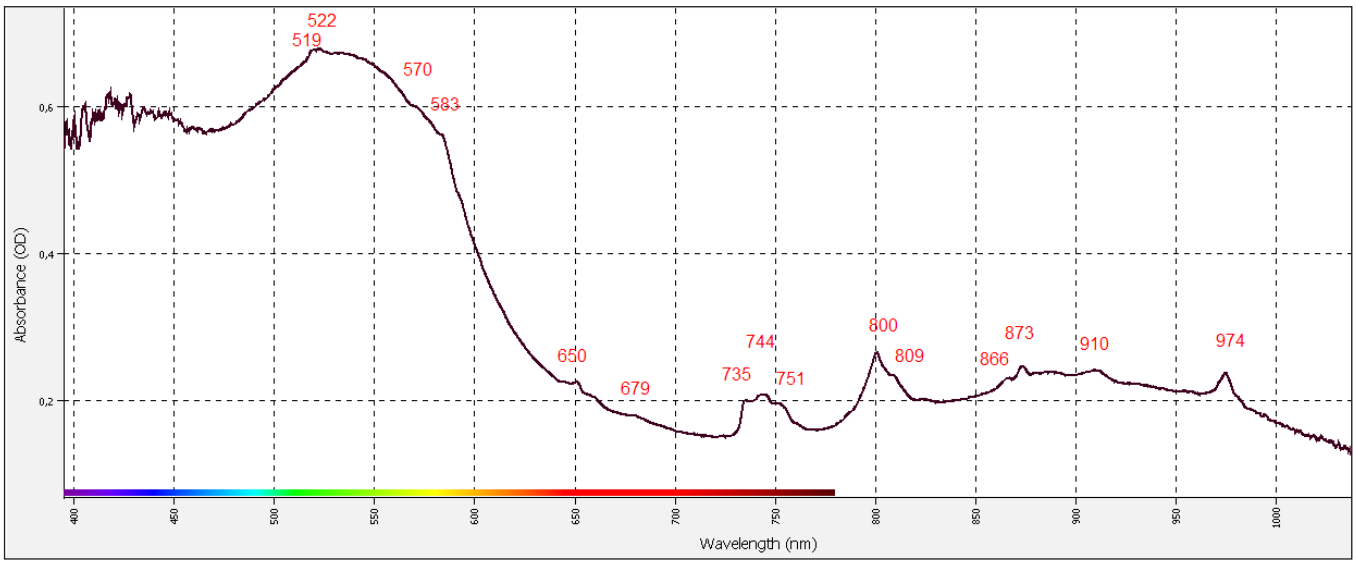

Figure 6 - Typical Vis-NIR spectrum of these Eudialytes. Broad band centered on the green part of the spectrum with a lot of peaks as 519, 520, 650, 735, 744, 751, 800, 866, 873, 974 with some shoulder at 570, 583, 809 and some flat band as at 679 and 910 nm.

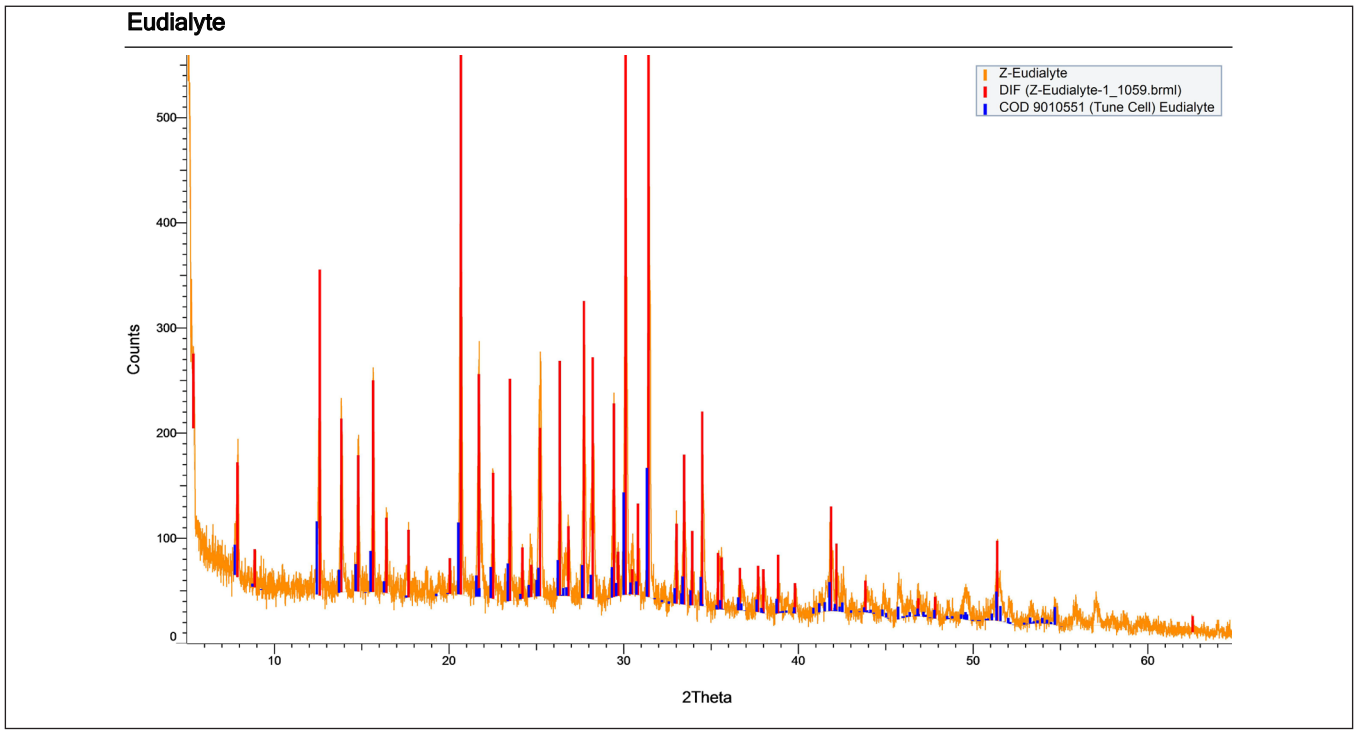

Figure 7 - X-Ray Powder Diffraction (XRPD) pattern (orange trace with red assignments-sticks) of the material studied here. A perfect match with Eudialyte mineral phase was found (blue assignment-sticks).

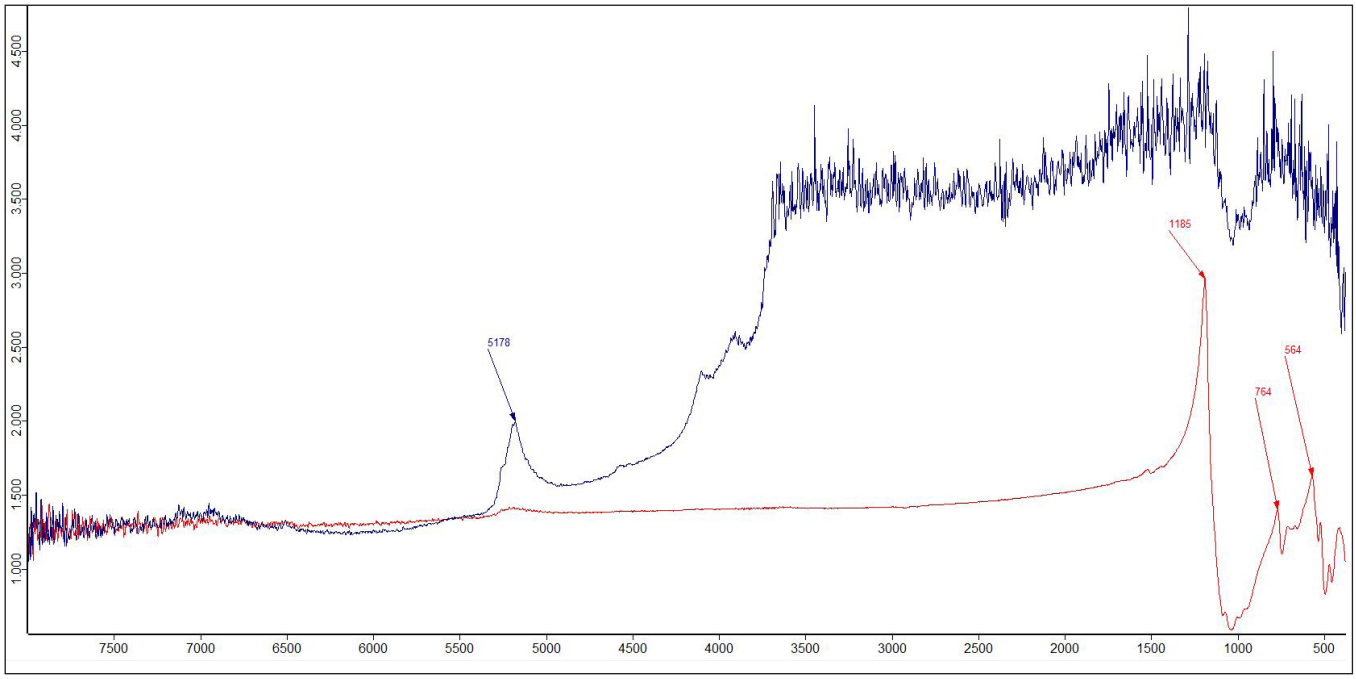

Figure 8 - Typical specular reflectance FTIR spectrum (red trace) and 'transmission-mode' FTIR spectrum (blue trace) of Eudialyte mineral phase. Specular-FTIR indicated most specific peaks at 1185, 764 and 564 cm^{-1}. In 'transmission' mode a specific band was detected at 5178 cm^{-1}.

Data provided in this article can also be used for any new data entry, update, for reinforcing data in an existing gem database or for general gem identification.

Acknowledgment:

Thank you to all the 'adventurer-gem-cutters' for their role in the collection of unusual gemstones.