

Spectroscopic Study of Egyptian Emeralds

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Emeralds have been known since ancient times (dated 2000 BCE) and they appear commonly in jewelry [1]. The most important and historic occurrences of emeralds in Egypt are in the Wadi Nugrus and Zabara areas [2]. The deposit of emeralds can be found in quartz or pegmatite veins which come from partial melting of metasedimentary rocks. These veins are in contact with biotite schists. The later tectonic and metasomatic events led to deformational effects and the albitization of the host rock [3]. This later metamorphic episode transformed the pre-existing Type IA (from Mafic-Ultramafic rocks) emerald deposits into Type IID (Metamorphosed type I deposits with hidden-granitic intrusion) [4]. Spectroscopic data on emeralds from Egypt are scarce. In the present study various non-destructive spectroscopic methods, such as Raman, FTIR, UV-Vis-NIR, and EDXRF along with classic gemmological means, were applied on 8 samples from the Ecole des Mines (Mines Paris - PSL). All analytical methods were implemented at the LFG. Raman and FTIR methods revealed that Type II water in Egyptian emeralds is more intense than Type I water (Fig. 1). This result indicates that the water molecules (H₂O) in the channels of the beryls' structure are accompanied with the presence of alkali ions. Using EDXRF, low levels of Cs and Rb were detected. The UV-Vis-NIR analysis showed that the chromophore ions in Egyptian emeralds are mainly Cr⁺³ and Fe⁺². Under optical microscope and with Raman spectroscopy, quartz, calcite, feldspar, and mica were identified as associated minerals. Further research is currently ongoing, which will hopefully help to better understand the genesis of these emeralds.

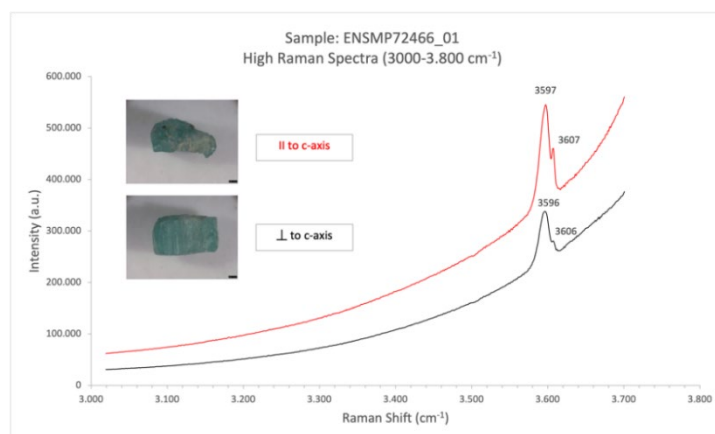


Figure 1. Raman spectra (using a 514 nm laser excitation) from 3000 to 3.800 cm⁻¹ on a single emerald crystal from Egypt; red spectrum acquired with the laser parallel to c-axis and black perpendicular to c-axis.

References

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