



Raman spectroscopy analysis of fluid inclusions as a tool in determination of origin of Colombian emeralds.

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Gemological reports have gained a crucial role in today's gemstone trading because they provide buyers and sellers with information regarding gem features, which in turn can be translated to monetary value. Although there is information about technics to separate Colombian emeralds from other countries, not much information is available about how to differentiate emeralds from the Western Belt (COC), and those from the Eastern Belt (COR), two main produced zones in Colombia, those districts more recognized are, Muzo and Chivor, respectively. This work aims to show the advances made in one of the techniques used in a gemological laboratory to determine the origin of emeralds.

The analysis of fluid inclusions via Raman spectroscopy can yield beneficial information regarding the chemical properties of mineral systems. Primary fluid inclusions trapped by emerald permit us to know the chemistry and the thermobarometric conditions of the mineralizing fluids. Fluid inclusions are usually three-phase inclusions with contain three or more phases including liquids, gases, and salt (halite). Sometimes they are multiphase with solids such as calcite. The gas phases are typically CO₂, N₂, and CH₄ (Cheilletz et al., 1994; Giuliani et al., 1993; Giuliani et al., 1995; Romero & Hernandez, 1999; García-Toloza et al., 2017). Raman spectra of CO₂ exhibit two bands near 1285 cm⁻¹ and 1385 cm⁻¹, this feature is well-known as the Fermi doublet (Fernandez, 1983; Howard-Locke, 1971); the distance between these bands is proportional to the fluid density (Rosso & Bodnar, 1995; Song Y. et al., 2003).

The data of Δ Fermi doublet suggest that values below 103.1 are exclusive from the COR, whereas there is an overlap from 103.1 to 103.4. Additionally, the position of the two main CO₂ bands varies significantly between the two Colombian belts. The location of peaks from the COR are found at lower energy levels. Thus, this method may be used to estimate the provenance of some populations, the Fermi doublet is not only helpful to differentiate between the Colombian emerald belts but also between Colombian emeralds from samples from Brazil and Afghanistan.