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Microscopic, Spectroscopic and Chemical Analysis of Emeralds from Habachtal, Austria

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Abstract: Studies on emeralds from Habachtal (Austria) are scarce and non-exhaustive. However, they represent a significant interest to the community, as they have been assumed to be present in historical pieces of jewelry. Along with Egypt, Habachtal is suggested to be one of the main sources of gem-quality emeralds of archaeological significance. In this regard and due to their similar macroscopic look and geological context, it has always been challenging to distinguish Austrian and Egyptian emeralds set in historic jewelry. In this paper, a first comprehensive study of several Habchtal emeralds is presented based on a combination of classic gemology, chemistry and spectroscopy, using non-destructive to micro-destructive methods. Spectroscopic analyses, such as via Raman, FTIR and UV-Vis–NIR spectroscopies, showed that emeralds from Habachtal (Austria) contain Type II H_2O molecules with alkalis and they are colored by chromium and iron, similarly to emeralds from Egypt. Under an optical microscope (and identified by Raman spectroscopy), actinolite needle-like inclusions are frequently observed in Austrian emeralds. Other inclusions, such as quartz, plagioclase, albite, phlogopite and pyrite, can also be observed in Austrian samples. Chemical analysis of Austrian emeralds' trace elements by LA–ICP–MS show similar results to those from Egypt, with the exception of V, K and Rb, which show a lesser content in Austrian emeralds. Thanks to the determination of inclusions combined with a careful examination of specific chemistry, this study shows that Austrian emeralds can be distinguished from their Egyptian counterpart.

Keywords: emeralds; Austria; inclusions; micro-Raman; PL; FTIR; UV-Vis–NIR; EDXRF; LA–ICP–MS

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