

Title : Heat Treatment of Amethyst from Brazil to Green Quartz.

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Major : Gemology

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Type of presentation* (choose 1) : Oral Presentation (เฉพาะ ตัวแทนค.ที่สาขาเลือกให้นำเสนอแบบบรรยาย)
 Poster (กรณี นำเสนอผลงานปัญหาพิเศษ/การค้นคว้าอิสระ)
 Cooperative Education (กรณี นำเสนอผลงานสหกิจศึกษา)

ABSTRACT

The main objective of this study is to find the optimum temperatures from heating experiments for changing the purple of amethyst samples from the Federal Republic of Brazil to green. This study also focuses on the gemological properties of the samples from this deposit. A total of 30 amethyst samples were divided into 3 groups according to the apparent colors, including the dark purple, medium purple, and light purple groups. The sample weighed in the range of 1.03 to 4.88 carats. The specific gravity value ranged from 2.62 to 2.64. The refractive indices ranged from 1.542 to 1.553 with birefringence between 0.007 and 0.011. They showed the phenomenon of double refraction and were inert under ultraviolet radiation in both the short and long wavelength ranges. These properties were unchanged after heating experiments. The amethyst samples were heated 2 times, using an electric furnace, under reduction conditions at 400°C and 420°C, maintaining at each temperature for 1 hour. The heating results revealed that at 400°C, the dark purple samples changed to a slightly yellowish green color, some of the medium purple samples turned pale yellow, and the light

purple samples turned slightly lighter color. At 420°C, the dark purple samples changed from a slightly yellowish green to yellow-green with a shade of yellow, some of the medium purple samples turned nearly colorless, and the light purple samples turned colorless or developed a slight yellow shade. Absorption spectra investigated by UV-Vis-NIR spectrophotometry revealed absorption bands at approximately 345 nm and 545 nm before heat treatment. These bands are associated with the purple coloration in amethyst. After the heat treatment, the absorption intensity at 545 nm decreased as the purple color. The inclusions observed under the microscope revealed an increase of fractures, expansion of healed fractures, and enlargement of liquid inclusions after heat treatment. From this study, it can be concluded that the dark purple samples were the most suitable initial colors to transform amethyst into a green color, and the optimum temperature is 420°C. However, their transparency commonly decreased by fracture increases during heating experiments.