Investigation of Geuda Gemstones, before and after the Heat Treatment using FTIR Spectroscopy

T.G. Ramesh[1], R.G.C. Jaliya[1*], I.K.M.S.C.K. Illangasinghe[2], S. Diyabalanage[2], N. Jayasinghe[2] and T.S. Dharmaratne[2]

[1] Department of Applied Earth Science, Uva Wellassa University, Badulla, Sri Lanka*
[2]Gem and Jewellery Research and Training Institute, Hidellana, Rathnapura, Sri Lanka

Geuda is a low-quality form of corundum and abundant in the most gem enriched regions in Sri Lanka and can transfer into premium blue sapphires, similar to the natural in appearance through heat treatments. The study intended to identify characteristic features to distinguish heated geuda from natural sapphire using FTIR Spectroscopy. 53 geuda samples were collected from five gem bearing localities Ratnapura, Ridiyagama, Okkampitiya, Bakamuna, and Katharagama and heat treated up to 1800°C for the one-hour soaking period under reducing environmental condition. Study samples were subjected to FTIR analysis before and after the heat treatment and could identify the development of a distinctive peak at 3310 cm^{-1} after treatment. This is due to the diffusion of atmospheric Hydrogen back into the crystal and appears in the absorption spectrum as an interstitial O-H bond in the corundum crystal structure. Further, two absorption bands at 2342 or 2362 cm^{-1} which corresponds to atmospheric CO_2 and CO_2 gas in negative crystals were observant in almost of the samples and as a direct response to CO_2 gas in negative crystals, the intensity of this particular peak is found to be significantly less for Ridiyagama samples with respect to other localities. This reveals that the Ridiyagama samples are with less CO_2 trapped inclusions. Nevertheless, certain 2853 and 2924 cm^{-1} peaks were observed before and after heat treated stones due to the C-H bond resulted in contamination. Furthermore, 3620 and 3697 cm^{-1} absorption bands related to Kaolinite hydrous mineral inclusions have been disappeared with heat treatment. This concludes to identify heat treated sapphires with 3310 cm^{-1} peaks and remaining of 3620 and 3697 cm^{-1} peaks verify it as a non-heat-treated sapphire. Hence, the FTIR technique could be clarified as one of the best methods to identify heat treated blue sapphires.

Keywords: Heat treatment, FTIR analysis, Negative crystals, Absorption spectrum, Inclusions