A Contribution to Indicating the Low Temperature Heat Treatment of Ruby Samples from Myanmar and Vietnam

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Rubies and sapphires are commonly enhanced by heat in order to obtain their preferable colours and clarity. The natural unheated stones are, therefore, very rare, and hence, deserve very high prices. Evidences for determining the unheated and heated ruby samples were published by several workers (e.g., Smith, 1995; Beran and Rossman, 2003; Paretti, 2008). However, problems in indicating, at which temperature the ruby samples were undergone low temperature heating have still existed and been discussed among the gem laboratories due to their inconsistent results. While some gem lab may report only the treatment on heating or unheating, but some are able to indicate the heating extent as the low temperature (compared to the temperature around 1650-1700 ^{o}C that has practically been used in gem corundum heat treatment). However, there is still the unclear boundary, how to indicate the low temperature heating or warming of ruby samples.

The experiments on heating of ruby samples at 800, 1200, and 1650 ^{o}C for 1 and 2 hours in an oxidizing atmosphere were carried out. Ruby samples from Mong Hsu, Myanmar, and from Lucyen, Vietnam, were collected for these experiments. The results showed that with the unheated stones from both localities, the broad absorption of molecular water at approximately 3000-3500 cm^{-1} appeared with two significant absorption peaks at 2310, 1996 cm-1, which are assigned for boehmite and diaspore, respectively. Samples undergone 800 ^{o}C heating mostly showed no boehmite and diaspore absorption peaks, whereas the broad absorption of molecular water obviously decreased. For those samples undergone heating at 1200 ^{o}C, the absorption at 3309 cm^{-1} which is designated for structural -OH, strongly appeared, and further heating at this temperature for two hours or longer, the 3309 cm^{-1} absorption mostly decreased. Heating the samples at 1650 ^{o}C, the 3309 cm^{-1} absorption peak became weak, but mostly still presented at very minor absorption to no show in some ruby samples when the heating was extended for 2 hours or longer.

The above experimental results can be used to indicate, not only whether or not the ruby samples were undergone heating, but also to clearer indicate and solve the argument of low temperature heating, i.e., 800 ^{o}C or 1200 ^{o}C based on the presence or absence of boehmite, diaspore, and structural -OH absorptions at 2310, 1996, and at 3309 cm^{-1}, respectively.

It needs to be noted here also that the CO_2 absorption at 2345 cm^{-1} that has normally been neglected as thought for being the CO_2 from the measuring environment; nonetheless, these experiments found that this CO_2 absorption is useful in indicating the heating process as well as sample locality, especially in those samples from Vietnam.

References:
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