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Characteristics of Faceted-Quality Ruby from Longido, Tanzania

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ABSTRACT

The productions of ruby from major sources such as Thailand, Myanmar and Vietnam were plunged due to the scarcity of nice gem-quality crystals. Among the African countries that supply gem corundum, Longido gem field of Tanzania has been known as the source of low-quality ruby in green zoisite rock (aka Anyolite) which is mainly used for carving or decorative purposes for decades. However, in the mid 2017, there was leak information among gem dealers in Chanthaburi and Bangkok gem markets about a new discovery of faceted-quality ruby from this particular area. In this study, the faceted-quality ruby samples showing quite similar inclusion features seen in ruby from other sources in east Africa but the chemical characteristic is quite unique with relatively high chromium (Cr) content in comparison with ruby from other localities in the same region. Thus, this typical chemical character might be useful for origin determination of ruby from this deposit.

Keywords: Ruby, Longido, Tanzania

1. Introduction

Over the last two decades, ruby sourcing from the African continent has dominated the world's gem market since the discoveries of ruby from Tanzania in 1900 (Schwarz *et al*., 2008), Kenya in 1973 (Hughes, 2014), then from Madagascar in 2000 (Pardieu, *et al*., 2015) and recently, from Mozambique which has been introduced to the gem market since 2008 (Hughes, 2014). In late 2017, the Gem Testing Laboratory of Gem and Jewelry Institute of Thailand (GIT-GTL) received a suite of 12 faceted ruby samples from our client who claimed that they were unheated stones originated from a new deposit in the Longido area. Nonetheless, the exact mining location has not been disclosed. Some characteristic features of these rubies (Figure 1) are described.

2. Materials and Method

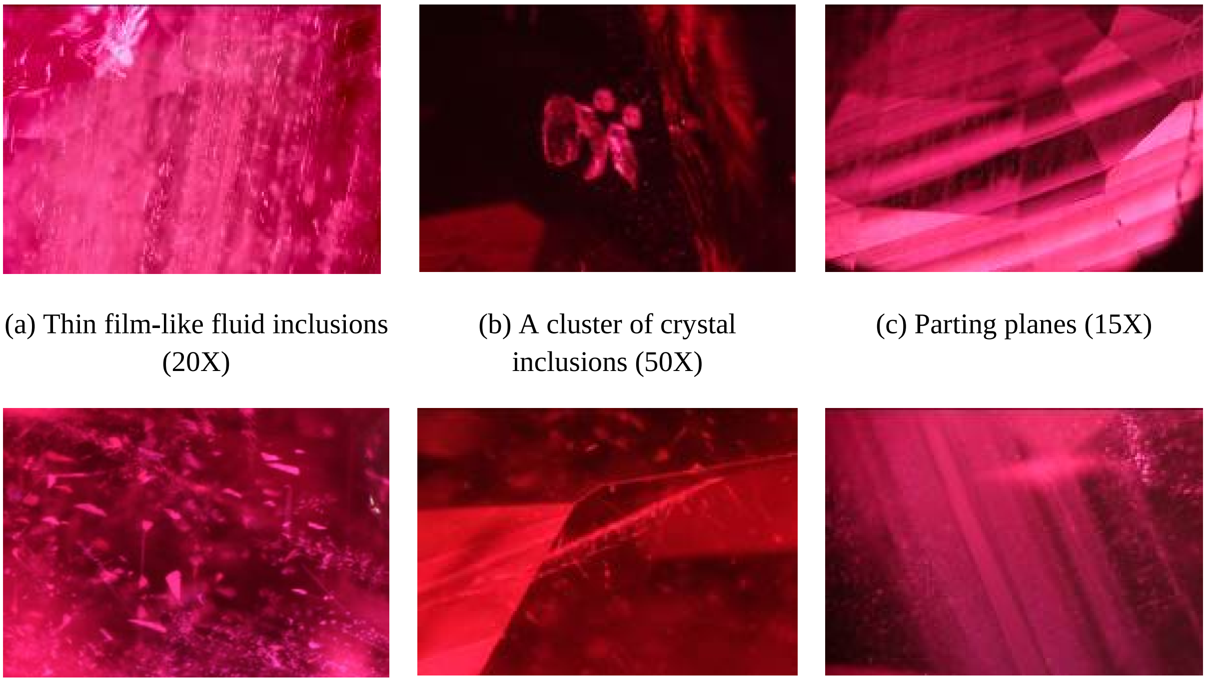
Twelve ruby samples, weighing from 1.01 to 1.24 cts, claimed to be mined from Longido area, Tanzania. General properties and specific features were determined using basic gem equipment and advanced instruments, respectively. The chemical analysis was carried out by an Energy-dispersive X-ray Fluorescence (EDXRF) spectroscopy of Eagle III system, Spectroscopic characteristic analyses were used a Thermo Nicolet 6700 Fourier-transform infrared (FTIR) spectrometer to recorded IR transmittance spectra in the Mid-IR range (4000-500 cm-1) with a resolution of 4.0 cm^{-1} and 128 scans. UV-Vis-NIR spectrophotometer (Model Lambda 950 series, Perkin Elmer) was used for observation of UV-Vis-NIR absorption spectra within the range of 300 – 800 nm.

Figure 1. Twelve ruby samples, weighing from 1.01 to 1.24 cts, claimed to be mined from Longido area, Tanzania. Photo by C. Onlaor.

3. Gemological Property

These ruby samples appear in round (one stone)-, oval (5)-, cushion (4)-, heart (1) - and pear (1)-shaped brilliant cuts and weigh from 1.01 to 1.24 cts (Figure 1). The colors of these stones range from vivid red to deep red in which some can be classified as "Pigeon's blood" based on the GIT's Standard (Table 1). All the stones show moderately red glow in LWUV and weakly red in SWUV. Other basic gemological properties, such as RI (1.763 - 1.775) and SG (~ 4.0) values, are consistent with corundum's properties.

Microscopic examination revealed numerous shiny thin film-like fluid inclusions, fingerprints, mineral inclusions, parting planes, tube-like inclusions and cloudy zones (Figures 2; a-g). These inclusion features are somewhat similar to those of rubies from Mozambique, i.e., short needles, thin films.



(a) Thin film-like fluid inclusions (20X)

(b) A cluster of crystal inclusions (50X)

(c) Parting planes (15X)

(d) Thin films (50X)

(e) Tube-like inclusions (25X)

(f) Cloudy zones (25X)

Figure 2. Different types of inclusions in rubies from Longido, Tanzania. Photomicrographs by M.Maneekrajangsaeng and S. Promwongnan.

4. Chemistry

Semi-quantitative chemical analyses of the Longido faceted-quality stones by EDXRF gave high to very high chromium contents **(**0.67 - 2.02 wt**%** Cr_2O_3**)** moderate iron contents **(**0.15 - 0.29 wt**%** Fe_2O_3**)**, very low contents of titanium, vanadium and gallium **(**Table 1**).** By comparison, the overall trace element contents of these faceted-quality stones are overlapping with the lower-end values of the well-known semi-translucent cabochon-quality ruby samples from the same area **(**see Table 1**).** However, when compared with the Winza and Montepuz deposits, the chromium contents of the Longido faceted-quality stones are somewhat higher but the iron contents are somewhat lower **(**Table 1**).**

5. Spectroscopy

The Mid-IR absorption spectra of these samples revealed strong OH-related peaks (boehmite/diaspore) that could be present in tube-like inclusions.Furthermore, the occurrence of boehmite/diaspore in these stones is a positive indication of unheated nature of these ruby samples (see Figures 3 and 4) similar to IR spectrum commonly obtained from other sources in Africa.

The UV-Vis-NIR absorption spectra typically shows the strong Cr absorption bands and peaks related with iron absorption (377/387 and 450 nm) as normally expected for a ruby having moderate to high iron content from many localities in east Africa. (see Figure 5).

Table 1: Chemical compositions of Longido rubies by EDXRF as compared with those from Longido and Winza of Tanzania and Montepuz of Mozambique.

Element oxides	**Concentration Range (wt%)**			
	Longido (12 faceted-quality ruby samples**)**	Longido **(7** semi-translucent cabochon-quality ruby samples; GIT reference sample, 2009**)**	Winza **(7** faceted-quality ruby samples; GIT reference sample, 2013**)**	Montepuz **(40** faceted-quality ruby samples; GIT reference sample, 2011**)**
Al_2O_3	*97.66 – 99.11*	96.46 - 98.51	99.12 – 99.51	98.02 – 99.44
TiO_2	*bdl – 0.02*	bdl - 0.90	bdl – 0.02	bdl - 0.07
V_2O_5	*bdl – 0.02*	bdl - 0.08	bdl – 0.02	bdl – 0.02
Cr_2O_5	*0.67 – 2.02*	1.18 – 2.38	0.13 – 0.51	0.39 – 1.22
Fe_2O_3	*0.15 – 0.29*	0.29 – 1.14	0.25 - 0.49	0.14 – 0.67
Ga_2O_3	*bdl – 0.01*	0.01 – 0.03	bdl – 0.01	bdl – 0.03

bdl = below detection limit

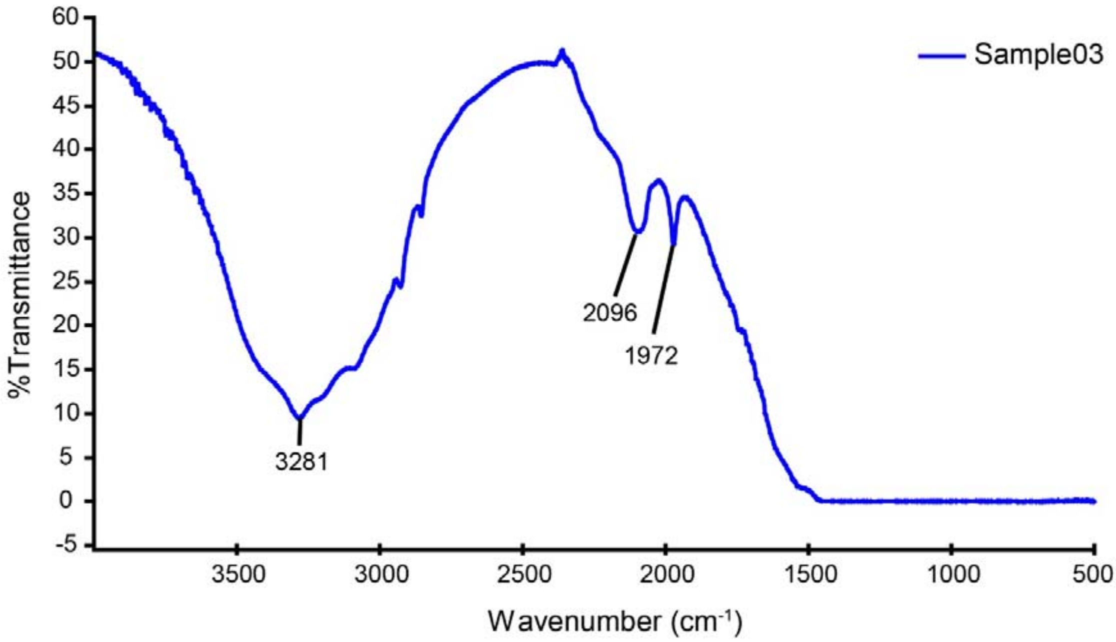


Figure 3. Mid-IR absorption spectrum of boehmite/diaspore in a Longido ruby (sample no. 03) showing peaks at 1972, 2096 and 3281 cm^{-1}.

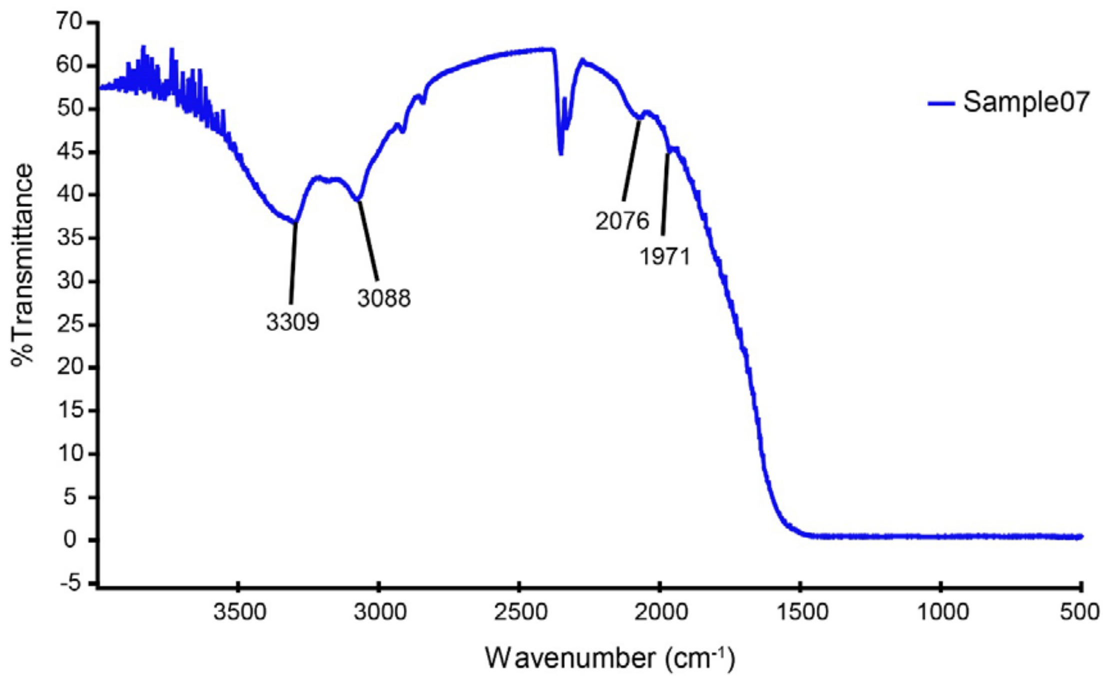


Figure 4. Mid-IR absorption spectrum of boehmite/diaspore in a Longido ruby (sample no. 07) showing peaks at 1971, 2076, 3088 and 3309 cm^{-1}.

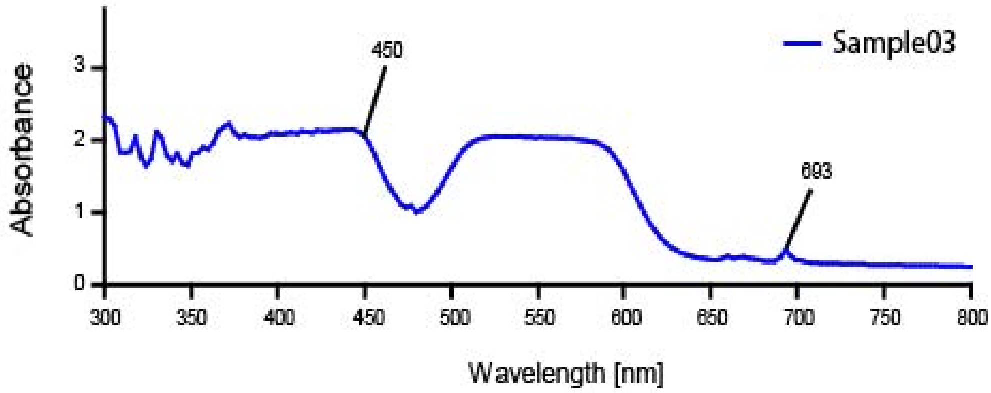


Figure 5. A representative non-polarized UV-Vis-NIR absorption spectrum of a Longido ruby (Sample no. 03).

6. Discussion and Conclusion

By comparison, the inclusion aspects of ruby from this new deposit share many similar features with the Mozambique ruby, such as thin-film fluid inclusions and cloudy zones (Pardieu *et al*., 2013). Moreover, the very low contents of vanadium and gallium are also the common characteristics of rubies originated in the East African region (Kongsomart *et al*., 2017). Nevertheless, the very high chromium content of the Longido faceted-quality rubies are quite unique as such high (Cr) content has never before been found in faceted-quality rubies from other major localities of the region. Thus, this (high Cr) character might be useful for origin determination of ruby from this deposit. Certainly, to improve the accuracy of origin determination, more known samples of various quality from this new deposit must be collected to build up a better reliable database for the discrimination of this new Longido ruby from other sources.

Even though, the gem-quality ruby had been reportedly found in Winza area which led to the ruby rush in Tanzania in 2007, the production was rapidly depleted. As such, ruby from this source was faded away from the gem market within a few years afterward. However, the new discovery of high-quality ruby from Longido area might lead to another ruby rush in this country again.

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