Gemological Characteristic, Chemical Composition and Cause of Color of Tsavorite claimed to be from Tanzania

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INTRODUCTION

Tsavorite is a gemstone in the garnet group, specifically of the grossular type, with an emerald color. It was first discovered in 1967 in Tanzania and later found in Kenya. Gemologists agreed to give it a trade name, and the green garnet was named "Tsavorite" in honor of the Tsavo National Park, located in the northeastern part of Tanzania. Tsavorite is a natural gemstone that requires no enhancement processes, as it already has beautiful color. It can range in color from light green to dark green. The green color in Tsavorite is believed to be cause of color by the presence of vanadium (V) and chromium (Cr).

MATERIALS AND METHODS

- twenty-four Tsavorite (Figure 1) cliamed to be from Tanzania (numbered Tsa001 to Tsa024) were slected for investigation. The sample color ranged from light green to dark green

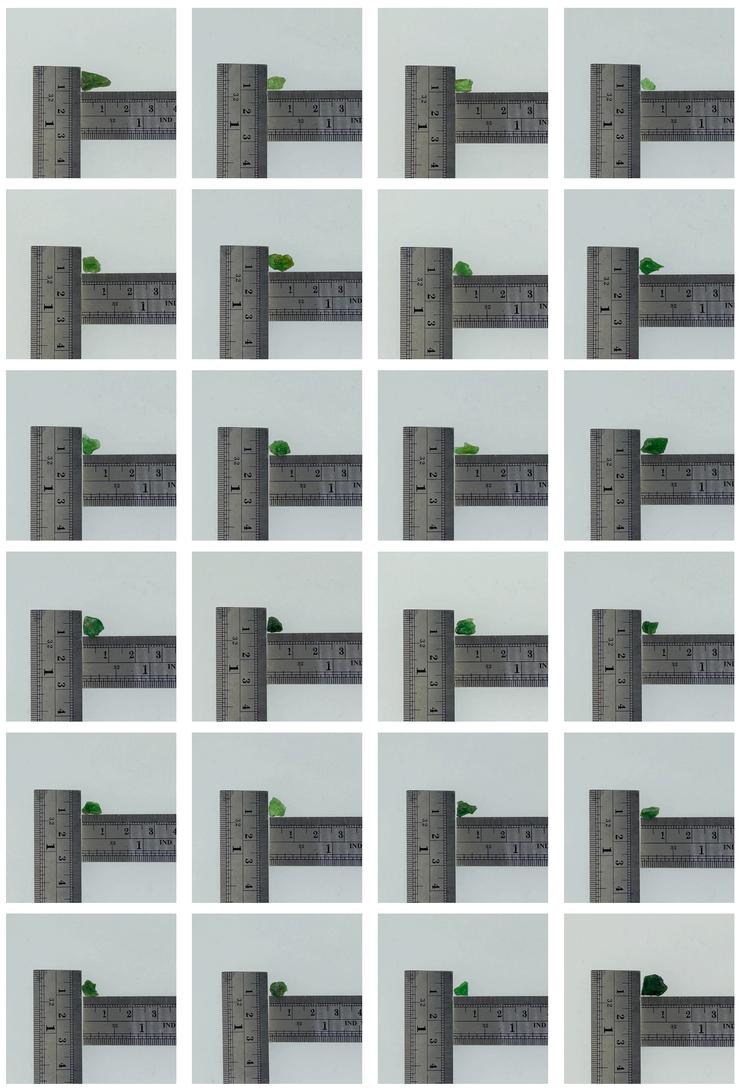


Figure 1 24 Tsavorite samples cliamed to be from Tanzania in this study.

- Standard gemological instruments were used to investigate gemological properties including specific gravity, refractive index, absorption spectra, Fluorescence, and inclusions. The Scanning Electron Microscope and Energy Dispersive X-ray Spectrometer (SEM-EDS) will meticulously examine surface features and chemical composition. Investigation into samples coloration will be conducted through UV-VIS-NIR absorption spectroscopy. Experiments and analyses were done at Faculty of Science and Advanced Science Instruments Unit, Chiang Mai University

RESULTS AND DISCUSSIONS

- **Gemological properties**

The studied Tsavorite samples were transparent to translucent. That were studies had a light green to dark green. The samples were 0.621 – 4.950 grams with specific gravity in range of 3.271 – 3.598 and reflective index were 1.743Tsavorite were inert in longwave and shortwave ultraviolet light. Absorption spectra in range of 400 – 430 and 680 – 700 nm. The studied for their internal characteristics with microscope were found, including fingerprint, solid inclusion and fracture. (Figures 2 - 5)

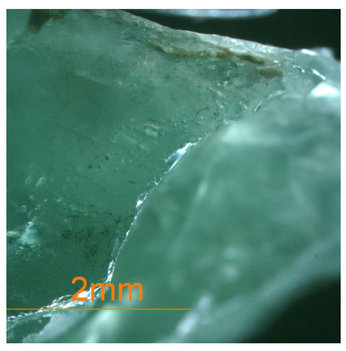


Figure 2 solid inclusion

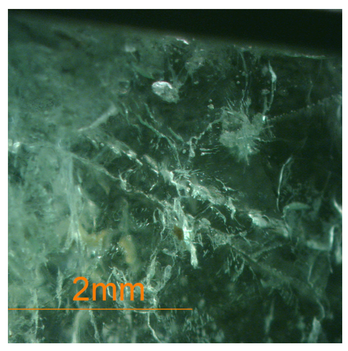


Figure 3 fracture

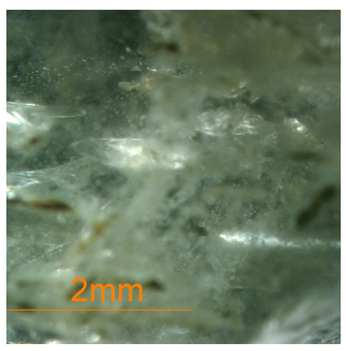


Figure 4 fingerprint

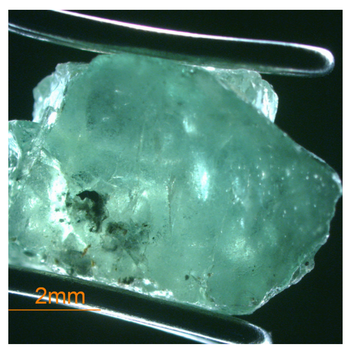


Figure 5 black crystalline

- **UV-VIS-NIR spectrophotometer**

The specimens display absorption bands at approximately 430 nm and 608 nm that indicated by the joint action of V^{3+} and Cr^{3+}. The absorption band at 430 nm is related to the substitution of Al^{3+} by V^{3+} in the coordination octahedron. The absorption peak at 590 nm can be attributed to the transition absorption of Cr^{3+} (Figure 6)

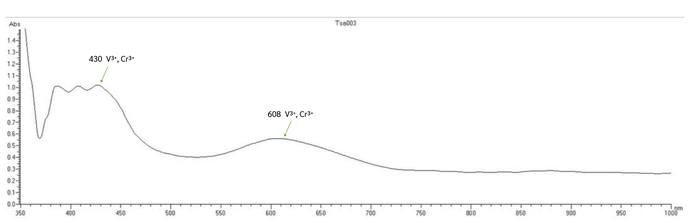


Figure 6 UV-VIS-NIR absorption spectra of sample Tsa003

- **SEM-EDS**

SEM analysis revealed that the surface of the Tsavorite exhibits irregularities. (Figure 7)

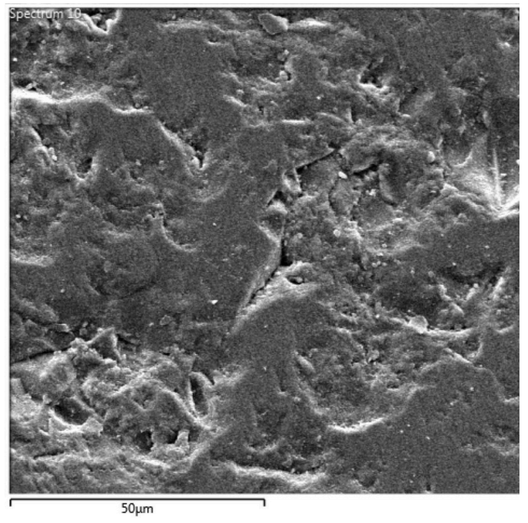
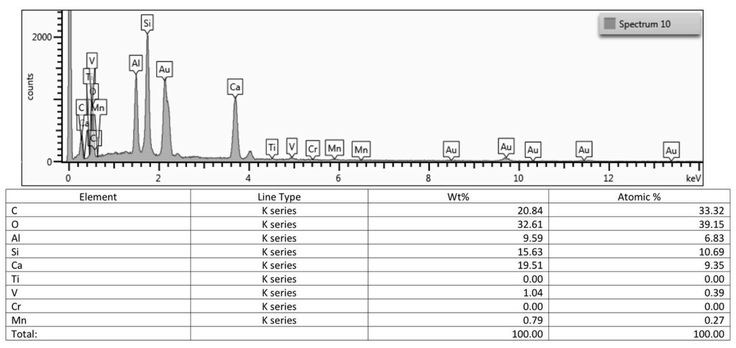


Figure 7 SEM image of Tsavorite sample Tsa023



Element	Line Type	Wt%	Atomic %
C	K series	20.84	33.32
O	K series	32.61	39.15
Al	K series	9.59	6.83
Si	K series	15.63	10.69
Ca	K series	19.51	9.35
Ti	K series	0.00	0.00
V	K series	1.04	0.39
Cr	K series	0.00	0.00
Mn	K series	0.79	0.27
Total:		100.00	100.00

Figure 8

The chemical composition with EDS has shown with the composed of Tsavorite has a oxygen, carbon, aluminum, silicate, titanium, magnesium and The elements responsible for causing color are vanadium and chromium. (Figure 8)

CONCLUSION

The characteristic green color under natural light is caused by the V^{3+} and Cr^{3+}

The chemical composition of the gem quality crystals indicates that this variety of garnet is composed by O > Ca > Si > Al as major elements and V > Mn > Cr ~ Mg ~ Ti as minor elements.

REFERENCES

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