

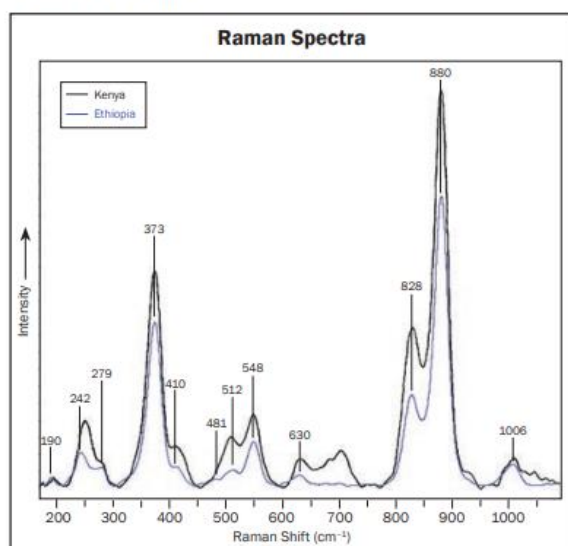
## Tsavorite Reportedly from Ethiopia

Tsavorite, the green grossular garnet originally found in the Tsavo area of Kenya, today comes mainly from various mines situated in the East Africa region, including Kenya, Tanzania and Madagascar; additional occurrences are known in Pakistan and eastern Antarctica (Feneyrol et al., 2014). However, a new mining area reportedly in Ethiopia recently has produced gem-grade tsavorite, and some of the authors acquired samples from various sources for analysis. The Bahrain Institute for Pearls & Gemstones (DANAT) received three rough samples (0.2–1.4 g; Figure 15, top) from Simon-Bruce Lockhart (Chanthaburi, Thailand), and Stone Group Laboratories received three faceted samples from Jason Doubrava (Poway, California, USA) and seven faceted samples from Meg Berry (Megagem, Fallbrook, California). The faceted samples weighed 0.25–3.56 ct, and were cut from several pieces of rough obtained by Steve Ulatowski (New Era Gems, Grass Valley, California, USA; see, e.g., Figure 15, bottom). The garnets ranged from yellow-green to deep green, sometimes resembling the colour of tsavorite from other sources (Figures 15 and 16).

The RI of the Ethiopian samples fell within a narrow range of 1.740–1.745, and their hydrostatic SG values were 3.62–3.65. All were inert to long- and short-wave UV radiation, and they did not change colour under the Chelsea filter. Semi-quantitative EDXRF analysis revealed Ca, Al and Si as major elements and confirmed the samples as grossular. Compared to tsavorite from other localities, these Ethiopian samples contained very low V (<200 ppm) and relatively high Fe (up to 2%). Preliminary ultraviolet-visible-near infrared (UV-Vis-NIR) spectroscopy showed that their green colour is mainly due Cr<sup>3+</sup>, with absorption bands situated at ~430 and 600 nm. An absorption peak at ~370 nm also was observed and has been linked to Fe<sup>3+</sup> (Schmetzer and Bank, 1982). In addition, a continuum of unknown origin that gradually increased in absorption from the UV to the NIR region was responsible for a yellowish hue in some samples. The exact role of iron in the coloration of the samples is still under discussion. The Raman spectra of our samples were consistent with tsavorite from Kenya (Figure 17) and Tanzania in our reference collections.

Some yellowish green to green grossular (tsavorite) with relatively high iron (up to 8%) has been found in Mali (Johnson et al., 1995). However, those stones contained a relatively large andradite

Figure 17: The Raman spectra of tsavorite from Ethiopia and Kenya are very similar.



Johnson M.L., Boehm E., Krupp H., Zang J.W. and Kammerling R.C., 1995. Gem-quality grossular-andradite: A new garnet from Mali. *Gems & Gemology*, **31**(3), 152–166, <http://dx.doi.org/10.5741/gems.31.3.152>.

Schmetzer K. and Bank H., 1982. Gelbgrüner Grossu-

Figure 15: These crystal fragments and broken pieces of Ethiopian tsavorite weigh 0.2–1.4 g (top) and 1.4–4.5 g (bottom). Samples courtesy of Simon-Bruce Lockhart (top) and New Era Gems (bottom); photos by Hasan Abdulla © DANAT (top) and Jordan Wilkins (bottom).



Figure 16: The three faceted gemstones in the top photo are all Ethiopian tsavorite (1.66–3.55 ct). In the bottom image, the stone on the left is a 0.60 ct Ethiopian tsavorite, and is shown for comparison with a 1.10 ct tsavorite from Kenya. Photos by Orasa Weldon (top) and B. Williams (bottom); the Ethiopian samples were faceted by Meg Berry.

component, as well as higher RI and SG values, compared to those from Ethiopia. The Ethiopian samples have similar characteristics (chemical composition, RI and SG) to green grossular from the Jeffrey mine (Quebec, Canada; Wight and Grice, 1982), although lower Ti.

It appears likely that the geological environment of Ethiopian tsavorite differs from that of the 'classic' tsavorite deposits in East Africa. More research is needed to better understand the geological origin and spectroscopic features of the Ethiopian tsavorite.

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Wight W. and Grice J.D., 1982. Grossular garnet from the Jeffrey mine, Asbestos, Quebec, Canada. *Journal of Gemmology*, **18**(2), 126–130, <http://dx.doi.org/10.15506/JoG.1982.18.2.126>.