Would Tanzanite by Another Name Sell as Sweet?

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Scientists as a whole are always searching for something new which in turn may be quite unrelated to the field of expertise. One of us as a toxicologist was interested in the words 'cyanide' and 'cyanite' [1] and also in the stimulating reports of Dr. Patrick Voillot, pharmacist, gemmologist and Conservator of the Mineral Collection of the University of Paris XI, on the origin, occurrence, mining, work-up and uses of various precious and semi-precious stones [2].

In one report, Voillot described the highly sought-after blue tanzanite, a variety of the mineral zoisite first discovered in the 1960s. Our mineralogical excursion will now describe the importance of tanzanite and why this semi-precious stone awoke the interest of a toxicologist!

Zoisite[1] is a calcium aluminium silicate with the chemical formula $Ca_2Al_3[OIOHISiO_4ISi_2O_7]$ [3,4]. Occasionally, naturally occurring zoisite forms transparent, well developed crystals of several centimetres in size in gemstone quality. Aggregates with small columnar or prismatic crystals are more common. Zoisite is often present (in paragenesis) with other minerals and rock building components. In Tanzania it occurs together with rubies, a red variant of corundum (Al_2O_3) (Figure 1), more commonly, however, together with quartz (SiO_2) or feldspar as in Bavaria [3-5].

The natural colour of zoisite covers the complete spectrum with several mixed colours [3-7]. Usually it is grey, yellowish, brown or green and may contain up to 1.8% Fe_2O_3, 0.6% FeO_2 and also TiO_2 and MgO [6]. These and the presence of other ions are responsible for the various variations in the colour of zoisite. For example, the rose-red variety, known as thulite, contains manganese ions (Mn^{3+}) [3,6], the blue variety known as tanzanite, vanadium ions [2-11] with the formula $Ca_2(Al,V^{3+})_3[OIOHISiO_4ISi_2O_7]$ [6].

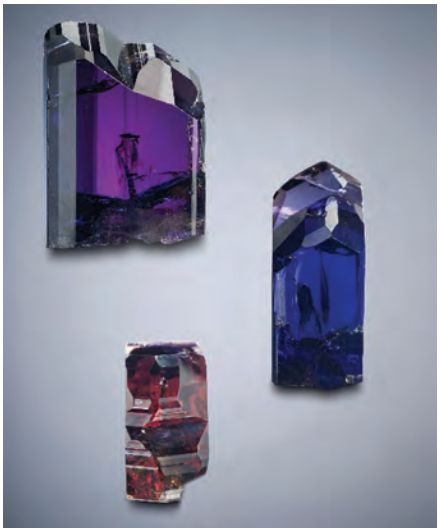
Natural blue zoisite is extremely rare and is found only in one small area in Northern Tanzania (Merelani) in the former Masai District near the border with Kenya [2-11]. This blue zoisite (tanzanite) and especially those crystals with a strong-to-vivid blue colour are held in very high regard by the gemstone industry [7].

Tanzanite has a rare optical feature namely trichroism[2]: naturally occurring tanzanite crystals show 3 different colours – violet, blue and yellow-brown - depending on the angle of light or observation (Figure 2). For jewellers, the trichroic effect of tanzanite is of the utmost importance when deciding the cut of a crystal so that only the intense blue colour shines and glitters [7].

Towards the end of the 1960s, the New York jewellers Tiffany – among others – started a marketing campaign extolling the 'beauty' and rareness of blue zoisite. The natural occurrence, however, was unable to meet the demands of the jewellery trade [3,6,7,9]. (For the extremely difficult underground mining of tanzanite, actually up to 700 meters below sea level, see [10]).

Figure 1. Green zoisite rocks (anyolite) from Tanzania with red ruby (image width 23 cm). (Photo/Collection: Torsten Arndt, Koblenz, Germany).

Figure 2. A zoisite crystal, blue tanzanite variety (ca. 3.8 cm) in gemstone quality showing trichroism depending on the angle of illumination: violet (front); blue (side); yellow/brown (above). (Photo: with kind permission from Jeff Scovil, Phoenix, USA scovilphotography.com; Collection: Mike Keim, Larkspur, California, USA marinmineral.com).



[1] This previously unknown mineral was originally named Saualpit after the locality in Carinthia in Austria where it was first found. Later it was named zoisite after Baron Siegmund Zois von Edelstein (1747-1819) from Laibach (now Ljubljana in Slowenia), the patron of the alpine expedition which discovered it. (Klemun M, Thiedig F. Die älteste geognostische Beschreibung der Saualpe (Kärnten) und der Naturforscher Sigismund von Hohenwart (1745-1825). Carinthia II 2009;199./119. Jahrgang:85-120, Klagenfurt)

[2] Trichroism (transmission of light of 3 different colours in the 3 spatial axes) and dichroism (transmission of light of 2 different colours in 2 of the 3 spatial axes) are subtypes of a phenomenon called pleochroism which means the absorption of light of different wave lengths depending on the spatial axis by optical anisotropic transparent crystals.

To combat demand, use was made of another remarkable property of zoisite, namely the colour change caused by heat. At temperatures of approximately 500-530°C [6,7,9] for a few minutes, the undesirable yellow-green-brown shades caused by Ti^{3+} ions are changed by oxidation of Ti^{3+} to Ti^{4+} whilst maintaining the intense blue colour due to the V^{3+} ions [6]. This mechanism is, however, still controversial [9]. From the optical point of view, the trichroism of natural zoisite or tanzanite crystals is changed into dichroism and the 'heat-treated' crystals display an intense blue or blue-violet colour in the 3 spatial axes (but no longer the undesirable yellow to brown shades in 1 of the 3 axes) [6-9]. Most zoisite crystals on the market today are 'heat-treated' [7] and thus dichroic[3].

At the end of our excursion one may ask "What does this have to do with toxicology?" and could say "Not very much!"

However, in the English language, the pronunciation of 'zoisite' and 'suicide' is very similar – a so-called homophone [2,6]. Apparently, this caused a problem for Tiffany's and their marketing experts – who wants to buy a gem named 'blue suicide'! – so they renamed the blue 'zoisite' as 'tanzanite' [2,6]. Thereafter Tiffany's original campaign advertised that tanzanite could be found in two places: "in Tanzania and at Tiffany's" [11]. So began the rapid rise in popularity of tanzanite throughout the world. We find this quite fascinating and we hope our readers do too!

Editor's Note: *This is an edited version of an article that was first published as "'Suicide' without a victim" in the Bulletin of The International Association of Forensic Toxicologists (TIAFT Bulletin 2021;51(1):4-5) and in German in the Bulletin of the Society of Toxicological and Forensic Chemistry (GTFCh; Toxichem Krimtech 2021;88(3):167-169), and is reproduced with permission.*

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[3] This can be used for the differentiation of (very expensive) natural blue zoisite crystals from (comparably less but still quite expensive) 'heat-treated' crystals.