Tanzanite

Facts, Fears and Fakes

By: Jeffery Bergman
Facts, Fears and Fakes

- Geology - The Big Picture
- Gemology - What Makes it Tanzanite
- Treatments - The Heat is On
- Fears - Tanzanite Treatment Rumors
- Real Fakes - Tanzanite Look-Alike's
I have not been paid by anyone to produce this presentation
Facts
Geology of the Merelani deposit

- The Mozambique Orogenic Belt is one of the most highly mineralized zones in the world.
- Extensive metamorphism formed a witch’s brew of unusual minerals where pressure and hot fluids cannibalized them for their chromophores – vanadium, chromium, manganese.
- The result is one of the richest gem belts on the planet.
Geology of the Merelani deposit

The Merilani Tanzanite mines are in the middle of one of the largest deposits of graphite in the world. Crystal specimens with native graphite in contact with the Tanzanite are common.
Gemology of Tanzanite

- Tanzanite is the mineral zoisite
- Zoisite is a complex calcium aluminum silicate (Sorosilicate)
- Predominant chromophore is vanadium responsible for blue color
- Secondary chromophores are chrome, iron and manganese which are responsible for green, yellow and pink
Classic Tanzanite
Green, Yellow & Pink Tanzanite / Zoisite
Color “Shift” in Tanzanite

Called “Color Change” in Other Gems
Cat’s-Eye Tanzanite
Gemology of Tanzanite

- Crystal habit: Flattened prismatic, may be fibrously curved
- Crystal system: Orthorhombic
- Cleavage: Perfect {010} imperfect {100}
- Fracture: Uneven to conchoidal
- Mohs scale: Hardness 6.5
- Luster: Vitreous, pearly on cleavage surfaces
- Specific gravity: 3.10–3.38
- Optical properties: Biaxial positive
- Refractive index: 1.69–1.70
- Birefringence: 0.006–0.018
- Pleochroism: Dichroism or trichroism depending on color and heat treatment.
Tanzanite is Strongly Pleochroic

Pleochroism: Different Colors from Different Directions
Tanzanite is Strongly Pleochroic

Pleochroism: Different Colors from Different Directions

Photo © Chip Clark
The vast majority of tanzanite is heat treated at approximately 500°C which converts the brown color to blue.

The GIA states “Heat treatment is undetectable, but is assumed because of its prevalence.”

Some labs will issue reports stating “No evidence of heat enhancement.”
Before and After
Before and After

Photo © Ken Nakane
Before and After

(left) (right)
The effects of heat treatment on transparent brown zoisite in the production of the commercially successful violet blue variety, tanzanite, are really shown by this 64 carat faceted east African gem both before and after the treatment. Photographs by Tino Hermes.

Photoatlas of Inclusions in Gemstones
Volume 2, Eduard J. Gübelin & John I. Koivula
Color Coated Tanzanite

In the Summer 2008 issue of Gems & Gemology, GIA researchers Shane McClure and Dr. Andy Shen offered an extensive analysis of these treated stones and the means to identify them.
Color Coated Tanzanite

These two 5 mm stones were originally the same color. After re-polishing, the one on the right was significantly lighter.
Color Coated Tanzanite

- Various surface features were discovered making them relatively easy to identify

Photos by S.F. McClure © 2008 GIA
Fears
Tanzanite Fears

Erroneous And Damaging Claims Pertaining to Tanzanite
Refuted By Well Known Gemologists and Laboratories Professionals:

What They Are, How They Evolved
And How The Evidence Was Misinterpreted
Over the past several months The International School of Gemology (ISG) and World Gem Society (WGS) - has published an extensive amount of information causing widespread fear and concerns about Tanzanite now being sold in the market, and undermining confidence in reliable dealers in Tanzanite.

We think it is important to clarify the facts revealed by other laboratories and gemologists who have conducted additional research on this disturbing news.
This section will present the assertions made followed by explanations from research scientists with greater experience in working with this product, making it clear that ISG/WGS observations have been misinterpreted.

We think it is important for AGA members to familiarize yourselves with the facts in order to deal with consumer and trade questions that are now starting to surface.

This is not meant to challenge or criticize any person or organization, but simply to clarify an unfortunate situation for everyone who buys and sells Tanzanite.
Published Claims of Tanzanite Treatments

- Dyefusion - 2010
- Dyefusion of Gemstones Part 3: June 2010
- Tanzanite Trepidation I - November 1 - 2012
- Tanzanite Trepidation II - December 7 - 2012

Proposed Treatments:

- Diffusion
- Dyefusion aka Color Infusion
- Irradiation + Grain Boundary Diffusion
Why should We pay Any Attention to These Publications?
Tanzanite Trepidation II

A follow up to our report on the color infusion of zoisite
trep-i-da-tion  noun  \troʊ-pə-ˈdā-shən\n
Definition of TREPIDATION

1  archaic : a tremulous motion : TREMOR

2  : a nervous or fearful feeling of uncertain agitation :

APPREHENSION <trepidation about starting a new job>

Related to TREPIDATION

Synonyms

alarm (also alarum), anxiety, dread, fearfulness, fright, horror, panic, scare, terror, fear

Related Words

phobia; creeps, jitters, nervousness, willies; pang, qualm, twinge; agitation, apprehension, consternation, discomposure, disquiet, funk, perturbation; concern, dismay, worry; cowardice, faintheartedness, tidiness, timorousness
Over 70,000 people have viewed these reports which have create Unfounded Fear in our Already Damaged Industry
Be aware of fake tanzanite

The International School of Gemology has an excellent discussion/explanation of the increasing prevalence of fake tanzanite. http://tywkiwdbi.blogspot.com
Diffusion treated Tanzanite?
“I'm hearing word of diffused Zoisite - Tanzanite hitting the market in Thailand. Large quantities, cheap, all the same color.”

Gemology Online - Jan 30, 2013
“Once information is released on a large enough scale that is not confirmed with the rest of the gemological community and it turns out to be incorrect, steps have to be taken so that the confusion does not spread.”

Bear Williams of Stone Group Labs and Bear Essentials
GemologyOnline June 2009
“Regarding the supposed diffusion treatment of tanzanite, to date I have not seen any.”

Christopher P. Smith, AGL Lab - Gemology Online - February 19, 2013
Diffusion Treated Tanzanite is an Unfounded Fear
But what about Dyefusion & Color Infused Tanzanite?
The sudden surge of large quantities of previously rare and expensive gemstones on the market always gives cause for investigation here in the ISG office, and tanzanite is no different. As always, we believe the only way to accurately test the market conditions of any gemstone is to spend significant resources to procure specimens from the open market, and from a variety of locations and dealers. Allowing a select group of dealers to submit stones for a test is always a recipe for failure as this allows dealers to control the outcome of a study. As such, the ISG always procures our study specimens on the open market, as we have done with tanzanite. Here is what we found...a great deal of Tanzanite Trepidation regarding all of this new and inexpensive material that has suddenly shown up on the market in the last couple of years.
What Surge
of
New & Inexpensive Tanzanite?

Over the past two years I have Twice been to the Tucson and JCK Las Vegas shows

Twice to the Hong Kong and Bangkok September shows

Twice to the Hong Kong and Bangkok March shows

I have not seen any of this supposed new and inexpensive tanzanite

Have you?
Tanzanite prices had been rising steadily over the past several years.

A slight drop (7%) took place only AFTER the ISG/WGS publications were released.
The final test that exposed the condition of this tanzanite crystal was quite unexpected and profound. This crystal, viewed through a London Dichroscope below, clearly demonstrated that something very strange has taken place with this crystal. This image clearly exhibits four separate colors coming from this tanzanite crystal, with the blue and purple coming from the fractures and fissures, and the crystal itself offering a colorless and strong yellow reaction. One direction of viewing through a London Dichroscope, but producing four distinct colors. We believe that 2 of the colors are optical reactions from the gemstone, and 2 are due to optical reactions of the treatment material.

4 Colors - 2 Natural - 2 Due to Treatment?
London Dichroscope and Tanzanite
Blue, Purple, Red, Yellow, Green

Note: Presence of green or yellow may indicate natural color.

<table>
<thead>
<tr>
<th>Gemstone</th>
<th>2-Dichroic</th>
<th>3-Trichroic</th>
<th>Intensity of Color</th>
<th>Colors Seen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoisite</td>
<td></td>
<td>3</td>
<td>S</td>
<td>blue/purplish or reddish/green or yellow; or blue/lighter blue/purplish or reddish [Note: the presence of green or yellow may indicate natural color.]</td>
</tr>
<tr>
<td>Tanzanite</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Blue, Purple, Red, Yellow, Green

**Note:** Presence of *green* or *yellow* may indicate *natural* color.
Dyefused Tanzanite

“We will revisit this image from a tourmaline crystal in a short time to see the end result on a faceted tourmaline that demonstrates the dyefusion of this type of gemstone. Below right are these same formation of tubes in a dyefused tanzanite.”

ISG Dyfusion 2010
Dyefused Tanzanite

Tanzanite showing needle inclusion that looks like laser drill but is a natural inclusion of tanzanite....

30x using YourGemologist

Microscope
Normal Tanzanite Inclusions

"... Solid inclusions noted in tanzanite include calcite, gypsum, graphite, rutile, sphene, xenotime, quartz, diopside, and tremolite-actinolite. Some of these minerals occur as acicular needles which could impart a cat's-eye effect to some tanzanites."

ISG Evidence of Color Infusion

We first noticed a change in the tanzanite treatment when we started finding melted metal on the surface of certain rough crystals, much the same as we previously found on Tibet andesine. This proved to be annealed graphite, as previously found to be used in treatment crucibles. A specimen example is seen at left. In virtually all of these cases the color of the tanzanite appeared to be somewhat neon in color with reactions to the Chelsea filter and dichroscope appearing skewed to what we know to be natural based on our control specimens from World Gem Society member dealers who are Tanzanite One Siteholders.

Below is another image panel of the annealed graphite from some of these color infused tanzanites. Unlike the naturally occurring graphite inside the above gemstone, these crystals are totally void of any trace of the natural internal graphite. However, they are covered in areas with melted metal that tests as annealed pyrolytic graphite.
ISG Evidence of Color Infusion

#1. Graphite is pure carbon, not metal

#2. The melting point of graphite is 3650 °C

Center for Solid State Science
Arizona State University

#3. Zoisite undergoes dehydration melting at 780-820 °C

Journal of Petrology Volume 43 No. 2 February 2002 pg 292

#4. Graphite anneals at 250 °C

**Tanzanite Inclusion Evidence**

Below is a 90x image of a damaged tube inside one of our color infused tanzanites clearly showing the presence of the purple coloring material in the tube.

This otherwise colorless zoisite is colored by this purple liquid material that you see at left, clearly congregated inside this internal tube.

This is this same internal tube in this purple zoisite, sold as natural tanzanite, showing the purple coloring material partially filling this tube feature.

“purple liquid material - inside this internal tube”
Tanzanite Inclusions


Without advanced testing, it is impossible to conclude this is a foreign substance.

If it was identified as a foreign substance, we would just conclude it is a dyed Tanzanite.
Natural Tanzanite Inclusions
Let’s look at more ISG/WGS evidence
First of all the ISG/WGS does not even own this specimen. It was briefly loaned to them by GemologyOnline member “Barrett” several years ago.
“along the predicted path of a fracture
you see the purple coloring material
from the color infusion process”

Below this you see the result of high magnification of this area. The yellow color is obviously due to a foreign substance in the stone, we believe this is a flux material of some type. But broken into this area and along the predicted path of a fracture in the stone, you see the purple coloring material from the color infusion process. Over the past months we have had several professional tanzanite dealers inspect these images and none could explain the features below by anything other than some kind of artificial color treatment.
Trichroism and Reflection
Trichroism and Reflection

A Tanzanite crystal displaying trichroism

Trichroic Tanzanite displays Different Colors from Different Angles

Photo Copyright Lapigems 2012
Trichroism and Reflection

Trichroic Tanzanite displays Different Colors from Different Angles
Trichroism and Reflection

Internal Fractures act as Mirrors in Gemstones
Anything Looking Familiar Here?
Trichroism and Reflection
The mysterious “purple coloring material” is just a reflection...
Dyefused & Color Infused Tanzanites are Unfounded Fears
But what about Irradiation and Grain Boundary Diffused Tanzanite?
Grain-Boundary Diffusion

“But we do have plausible information, as well as verification through specimens, that radiation plays a major role in the preparation of the gemstone crystal for the diffusion process.”

Irradiation & Grain-Boundary Diffusion

Irradiation theoretically opens up channels in the crystal lattice of a gemstone.

A vacancy is the absence of an atom from a point that it would normally occupy in a crystal.

Vacancies can be created by the impact of radiation on the crystal.

In the so-called Frenkel defect, an atom moves to a new position between other atoms of the solid.

The empty space created by the migration of the atom is a vacancy.
Let’s also make the huge assumption these vacancies create a channel through which a foreign element might be introduced.

Zoisite is Ca$_2$Al$_3$(SiO$_4$)(Si$_2$O$_7$)O(OH).

Now we must inject an artificial coloring agent into the crystal structure.

Suppose irradiation displaced the largest of the atoms; Ca – Calcium.

The artificial dye “Indigo” has a chemical formula of C$_{16}$H$_{10}$N$_2$O$_2$.

In order to color the gem with Indigo, we must squeeze this THIRTY atom molecule into the space once occupied by a ONE calcium atom.
Zoisite is Ca$_2$Al$_3$(SiO$_4$)(Si$_2$O$_7$)O(OH).

Calcium (Ca) is the largest atom in zoisite.

\[
\text{IF we could get irradiation to displace calcium atoms and fill the holes they left behind with INDIGO dye, we still have a MAJOR physics problem...}
\]

How do you squeeze 30 atoms into the space previously occupied by only 1?
How do you squeeze 30 atoms into the space previously occupied by only 1?
Now, suppose we actually DID accomplish this feat

The resulting artificially colored gem would easily be detectable in any modern and fully equipped gem lab

It would not be called “dyefused” or “color infused” or “grain boundary diffused”. It would simply be identified as:

**Tanzanite Dyed with Indigo**
"We do not need to invoke bulk or grain-boundary diffusion to explain these features."

Dr. Mary Johnson - Harvard PhD in Mineralogy and Crystallography

And Finally...

Hayley Henning
Tanzanite Foundation
42 W 48th Street #1702
New York, NY 10001

Dear Hayley,

Enclosed please find the tanzanite specimens that we discussed in our phone conversation today. Due to sending these via FedEx we have had to limit the number of specimens to 10 due to lack of shipping insurance. But I felt the importance of getting these to you as quickly as possible warranted a bit of risk taking.

As I have spent a great deal of time on this issue I have added to this letter a brief outline of our work, our findings and photographs of those findings in hopes it will save some time for others to see how and why we are sending these.

Once Chris and Mervyn have had an opportunity to view and evaluate these please return them to the address listed above. I appreciate your time to help us with this issue and look forward to hearing from you at your earliest convenience.

Sincerely,

Robert James FGA, GG
President, International School of Gemology
In January 2013 ISG/WGS sent ten Tanzanite specimens they suspected had been subjected to some sort of treatment to the Tanzanite Foundation in New York. These specimens were examined by Tanzanite experts in New York, at the Tanzanite One mine in Merelani, Tanzania, and by Chris Smith of the American Gemological Laboratory.

All concluded they could find “Nothing Unusual” in any of the specimens.
After examining suspect Tanzanite specimens presented by ISG/WGS, Chris Smith of AGL said: “Nothing Unusual”
NO FEAR
Tanzanite Fakes
Synthetic Zoisite

Zoisite crystals form up to 30 μm in size. 30 μm = 0.03MM
Good News!
Synthetic Tanzanite Does Not Exist
Tanzanite Imitations

Synthetic Forsterite

Synthetic Spinel

Coranite™ Synthetic Sapphire

Tanavyte™ YAG - Yttrium Aluminium Garnet

Tanzation™ Synthetic Spinel/Cobalt Glass Triplets

Alexite™ Man Made Color Change Glass

Zandrite™ Man Made Color Change Glass

U.M.Tanzanic™ Man Made Glass

Cubic Zirconia
Synthetic Forsterite
Forsterite Detection - Double Refraction

Tanzanite has low birefringence
Therefore no facet doubling

Synthetic Forsterite has high birefringence
Therefore distinct facet doubling
Synthetic Forsterite Detection
It’s Doubly Refractive
Hanneman Filter

Most stones that are used to simulate tanzanite can easily be separated by optical properties and/or the use of a Hanneman Tanzanite Filter

Photos © Robert Weldon

Hanneman Tanzanite Filter
For detecting Fraudulent Forsterite

Photos © Kassoy

synthetic forsterite, Tanavyte™ tanzanite, tanzanite, Coranite™ synthetic forsterite
UV Diagnostics

Virtually all Tanzanite Imitations are Fluorescent - Tanzanite is Inert
Synthetic Spinel

Photo © JTV
Coranite™ YAG - Yttrium Aluminum Garnet

Photo © Gem Lab Marseille

Photo © JTV
Tanavyte® Synthetic Sapphire

Tanavyte

Tanavyte is a relative newcomer to the gemstone market. First found in 1967 in Tanzania, it was stumbled on by accident. It was marketed by Tiffany & Co.® as Tanzanite, a relatively inexpensive alternative to sapphires. Known for exquisite shades of blue and purple, the gemstone now rivals sapphires, rubies and emeralds in popularity. The only problem with a natural Tanzanite gemstone is that it lacks sufficient strength to keep from scratching over time.

After more than three long years in development, Lannyte came up with the perfect solution. In February 1996, at the Tucson Gem Show, Lannyte revealed the Tanavyte® gemstone. The Tanavyte gemstone has a hardness of 9 on the Moh’s scale, meaning that it is exceptionally durable. But its true beauty is still in the color of the stone. Fantastic shades of blue and purple enhanced with the perfect cut create an eye-catching piece. Tanavyte gemstones can only be purchased through authorized Lannyte dealers.

Please see our authorized dealers page to find a store near you or contact us for information on becoming a Lannyte reseller.
Man-Made Glass

A variety of purple and blue man made glasses are used to imitate tanzanite
Alexite® Color Change Glass
Zandrite™ Color Change Glass
U.M. Tanzanic™ Color Change Glass

Sorry, no photo available...
Purple and Blue Cubic Zirconia
Tanzation™ Synthetic Spinel/Cobalt Glass Doublets/Triplets
And Finally
If I have made Any Errors, Please:

☐ Forgive Me
☐ Correct Me
☐ I Love to Learn
☐ Contact: Jeffery@Primagem.Com