TRAPICHE EMERALD
One of the rarest gems in the world

The origin of the name

What is a Trapiche Emerald, a Trapiche Sapphire or any other Trapiche gem? The word “Trapiche” was used by the Spanish Conquistadors named after the gears used to crush sugar cane, due to its six branch characteristic. Any gem can be Trapiche, which means that any gem can present a geometrical figure appearing in the stone, as a result of a high concentration in chemical elements on certain locations of the stone.

In the case of the emerald, we can observe a hexagonal form caused by a higher concentration in chromium. These rays resemble those resulting from asterism, but they remain stable in their positions in the crystal, when either the crystal or the light source is moved. This particularity makes the Trapiche Emerald one of the rarest gems in the world.

Trapiche stones attract and fascinate many collectors and investors which subsequently increases the price for the best pieces. In this project, we will also look at the growing presence of the Trapiche stone in fashion, with design ideas and creations featuring the Trapiche Emerald.

The discovery of the Trapiche Emerald is not recent. During the colonization in America, Spaniards began to report a curious gemstone presented by the Muzo Indians (an indigenous tribe located in the actual region of Boyaca, Colombia) when the first exchange of resources were made. Indeed, archaeologists believe that local tribes began to mine and trade emeralds as early as 1000 A.D.

Brief History

In 1897, the first contemporary report concerning this natural phenomenon from The Société Mineralogique de France (The Mineralogical Society of France) below is an extract from the article:

‘Mr E. Bertrand exposed a couple of curious emeralds; those samples come from Muzo, New Granada (Region corresponding now to Colombia, Ecuador, Venezuela and Panama). They are formed with a pale green hexagon in the middle surrounded by other green zones parallel to this hexagon, giving rise to a six Branch formation.’

In 1970, a new report made by the Mineralogical Society of America presented an analysis of Chivor and Muzo, Colombia’s trapiche emeralds (a thousand crystals were examined) by Nassau and Jackson, who found that the principal coloring agent was vanadium and that those specimens were all monocrystalline. Since this report, mysteries surrounding this rare gem were more understood and resolved by geologist and gemologist.

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Geology of the Trapiche Emerald

Emeralds in general can be found in many localities such as South Africa, Zimbabwe, Brazil, Pakistan, India, Australia, Austria, Mozambique, Tanzania, USA, Afghanistan, Zambia and Colombia. In the case of the Trapiche Emerald, the Mines of Peñas blancas and Muzo (Colombia) were used to be known as the only producers in the world (according to the Mineralogical Society of America, Nassau and Jackson). Then other mines such as Galachà began to present veins of Trapiche.

However, a recent discovery has been made in Madagascar. A greyish green beryl Trapiche of approximately 14 carats has been reported in the GIA’s Gems and Gemology publication.

Trapiche Emeralds occur in metamorphic and hydrothermal deposits, which means that they are formed when hot fluids, released by the crystallization of the magma, penetrate cracks and pores of the rocks in the Earth’s crust when surrounded by heat and pressure.
Geology of the Trapiche Emerald

In Colombia, Emeralds are mined in a specific region called Boyaca. This region is located at the beginning of a long range of mountains called The Andes Cordillera, forming three branches of middle size mountains and basins. Located in the Eastern Cordillera Basin, the Colombian emerald deposits consist of two belts. On the western side we can find the mining districts of Muzo, Peñas Blancas, La Pita, Coscuez and Yacopi. On the eastern side are Chivor, Macanal, and Galachà.

The Eastern Cordillera is a folded belt pushing the Llanos Foreland Basin to the east and the Middle Magdalena Basin to the west. The sediments are characterized by a compound of beds of sandstones, black shale and limestone.

The deposits from the eastern belt are contained in a limestone–black shale line formation, which is overlain by siliceous black shales. In the Chivor mining district, the host rocks compose shale sequences that contain limestone lenses and gypsum beds, mesh and chevron textures, and limestone grading to black shales intercalated with olistostromes (sedimentary deposit).

The deposits from the western belt are contained in the black shales and intercalated dolomitic limestones, calcareous carbon-rich black shales, siliceous black shales, and mudstones.

Map of the Mines in the Region of Boyacà
Concerning the Trapiche crystals, their source used to be a mystery. Later on, geologists found out that veins of trapiche were located in black shale zone called "Banco amarrillo" (yellow level in Spanish; yellow due to the pyrite main composition) bearing veins. The geological map of the region indicates that Banco Amarillo was formed by the breccia zone, albitites, and the emerald. Furthermore it is located under the Company building of the Muzo mine and corresponds to a coat of the calcareous black shale that overthrusts the siliceous black shale. More recently Trapiche stones have been found in the shale close to larger bodies of Cenicero.

On the western side, the deposits measure about 100 meters across and display numerous folds, and tear faults. At the Old Mine (Muzo), thrusts are evidenced by the presence of calcareous black shales over siliceous black shales.

All the tectonic contacts are marked by centimeter- to meter-thick hydrothermal breccias (rock made by broken fragments cemented by matrix) called "cenicero" (ashtray in Spanish). These breccias outline the thrust planes, which are associated with intense hydraulic fracturing due to overpressure. The breccias are metamorphic with calcareous black shales and white albite.

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The mine at 'La Pita'
The structure of the crystal

As we have seen in foundation Class, Emerald is a gem variety of Beryl and has a Hexagonal crystal system. Its chemical composition is mainly made by Beryllium, aluminium and silicate: Be3Al2(SiO3)6. The green colour of emerald is caused by Chromium and/or Vanadium. Despite its particularity, the structure of the Trapiche Emerald is monocrystalline and not macle such as the diamond, or twinned as lamellar twinnings in corundum.

Its rough form is characterized by a central deep green hexagonal prism growing toward one end along the C-axis and with no inclusions. Six prisms parallel with the C-axis are extended from the faces of the central prism and contain opaque inclusions.

A nearly colourless beryl occurs between and within the six trapezoidal prisms and also in the central prism, with opaque minerals observed on and between the beryl grains. An overgrowth is separated from the six prisms by tiny patches of opaque inclusions.

Sketch of a rough Trapiche mineral showing its hexagonal central core along the C-axis in cone surrounded by the six prisms.
Crystal formation

Trapiche emerald is formed during a beryl crystal’s growth. Black shale (albite) infill at the emerald crystal junction to form a six spokes star effect. The crystallization of Trapiche Emerald is processed in different phases:

First, the central, tapered core grows under hydrothermal conditions (fluids supply). Second, growth may slow by less fluids supply or even stop for some time. Next, growth conditions change again, and both emerald and albite are formed in eutectic. However, the hexagonal prism faces of the core crystal are able to maintain their uniform growth, producing pure emerald, while areas growing from the edges between prism faces are not, and are filled by albite. This results in six areas of clear emerald and six of principally albite and minor emerald. Consequently, the central core and the six surrounding sectors of a trapiche emerald comprise a single, non-twinned crystal.

As I have mentioned above, the mix of albite and beryl form a eutectic system, which is one of the biggest specificities of the Trapiche Emerald. A eutectic system is a mix of two pure bodies which melt and solidify at constant temperature. During the fusion, it behaves like a unique pure body. An example of eutectic system is salted water. In winter, roads are treated with salt in order for ice to create a eutectic formation with salt and remain liquid at a very low temperature.

Asterism on Sapphire

The Trapiche Emerald became more attractive and interesting since it has been discovered that trapiche emeralds are not a case of asterism, as many have suggested. Indeed, those branches look like an asterism effect, but in this case they are static and don’t move. Asterism is an optical effect related to gems containing rutile inclusions that, interacting with light, create a loose image of a star on the gem’s surface.
The other specificity of the Trapiche Emerald is, as I mentioned before, its monocrystalline structure. Due to its two phases of growth, it has also been believed that this phenomenon has a twinned structure. A crystal twinning consists of two or more crystals growing together symmetrically, sharing some crystallographic direction or plane, but other parts are in a reversed orientation. Examples of crystal twinning can be seen with the twinned chrysoberyl or the macle diamond.
Trapiche gems are characterized by equivalent growth sectors that are separated by more or less sharp boundaries of inclusions. The boundaries cross to each other in a central point or extend from the edge of a central core. Another characteristic of the trapiche is the symmetry and inclusions of organic substances.

Trapiche minerals are always characterized by high symmetry: cubic for garnet, hexagonal for emerald, trigonal for corundum and hexagonal for emerald. The symmetry influences the number of arms and dendrites in the trapiche texture. Because high symmetry implies that a certain number of directions are equivalent, consequently, the positions of the dendrites can be directed taking into account the crystal system. For instance, in emerald there are six dendrites along the positive and negative sides of the A-axis (perpendicular to the C-axis).

Until now, no trapiche gem has been reported in minerals with low symmetry (orthorhombic, monoclinic, or triclinic), despite the development of dendrites on the corners of minerals. This means that at least two of the three basic vectors a, b, and c have to be even to obtain the trapiche texture, and by consequence the role of symmetry has to be taken in consideration. The presence of transformed organic substances or graphite is observed in trapiche minerals formed in different geological environments, for example, metamorphic deposits such as ruby, garnet, and tourmaline.

In the case of the trapiche-like gems, the phenomenon is caused by the distribution of colour inducing elements or of inclusions in different portions of the crystal. This is the case with sapphire, quartz, and aquamarine.

Cordierite-indialite above (also called cherry blossom stone) is another mineral which presents a very similar characteristic to the trapiche, in that its intergrowths also show a trapiche-like texture formed by intergrowth, phase transition, and twinning.
Another case of Trapiche-like mineral is the Trapiche Pezzottaite presented in an article on the Gems and Gemology magazine (FALL 2015, VOL. 51, NO. 3) by Elise A. Skalwold and John I. Koivula. Indeed, this article introduces species from Burma presenting the characteristics of the Trapiche.

This article has been contradicted by Isabella Pignatelli and Gaston Giuliani, explaining in another article from the Gems and Gemology magazine (WINTER 2015, VOL. 51, NO. 4) that: “this pezzottaite sample can be classified as “trapiche-like” because the texture seems related to the zoning (probably sector zoning)”. Another argument was that: “there are two other reasons to classify this sample as “trapiche-like”: The first is that the inclusions do not form sharp boundaries separating the equivalent sectors. The second is the absence of organic matter observed in all trapiche minerals”.

A member of the mining team at the La Pita Mine in Muzo.
Simulants and Treatments in Trapiche

Emerald is at rank 7 on the Moh’s scale of hardness, putting this mineral at risk for getting chipped and cracked. The many inclusions that are corresponding among emeralds also contribute to their fragility. That is why considerably flawless emeralds are extremely hard to find, and even those that are considered great quality may have been treated in some way. The same goes for Trapiche Emeralds. Treatment takes many forms. The most common is oil or epoxy impregnation of cracks. Unfortunately visitors from Trapiche mines reported treated material being sold as fully natural. It has also been reported that in the gem market in general, glass designed in Trapiche style and “composite” emerald (made of several emerald crystals glued together) can be sold as genuine Trapiche Emerald.

The stone above on the picture had been cut from the same crystal, which resembles a natural trapiche. On the picture we can see the magnification revealing an unevenly distributed dark substance on the original surface of the rough. The pieces of the assemblage were joined with adhesive (polymer) that was colourless in some areas and black in others, to imitate better natural trapiche structure.

Sketch of a rough Trapiche mineral showing its hexagonal central core along the C-axis in cone surrounded by the six prisms
The trapiche phenomenon gems

Even though the trapiche effect is, in general associated with emeralds, recent reports have shown an increase in the number of gem varieties showing this pattern. These concern mostly sapphires, rubies, aquamarine, morganite, tourmaline and quartz. Trapiche rubies represent a new variety of corundum that is similar in appearance to trapiche emeralds. Indeed, most of corundums presenting a trapiche effect are sapphires. Like trapiche emeralds, these sapphires are composed of six triangular or trapezoidal parts formed by the fixed arms of a six-rayed star, with or without a tapered core.

The arms composed by the host material and massive concentrations of inclusions. In trapiche rubies, these inclusions are tube-like structures. The elements in these tubes are calcite and dolomite. The exact growth mechanism of the trapiche ruby formation cannot be explained at present. A new type of Trapiche corundum has been found in Mogok, Burma. Unlike the Trapiche Emerald, the trapiche rubies and sapphires show white spokes instead of the black carbon branches from the Trapiche Emerald.
The Trapiche Emerald in fashion

Trapiche Emerald is generally cut in Oval Cabochon style due to its low hardness and because this cut enhances the characteristics and beauty of the six-branch Trapiche. Other cuts can be observed such as the fancy shallow hexagonal cut without facets, fancy briolette and fancy star cut.

Fancy hexagonal cabochon cut,

10 carat pair of Trapiche Cabochons

“The scarcity of these stones further adds to their appeal for all types of buyers: People seem to have an affinity to rarity.”

Source: worldfinance.com - Elisabeth Matsangou
Simulants and Treatments

This unique variety of Emerald attracts and inspires designers who developed and pushed again the limits of creativity in jewellery. Amal Selim Mouzannar is one of the designers who adopted the Trapiche Emerald and incorporated it in one of his creations.

In this project we have approached a few secrets that conserve this curious formation called “Trapiche” in the Emerald, from its formation to the most famous podiums of Las Vegas. Nevertheless, mysteries are still unresolved such as the reason for its specific localities or the formation of Trapiche Emerald presenting iridescence or chatoyance effects. Considering all of that, the popularity of the Trapiche Emerald is not appreciated at its true value. My visit to the International Jewellery London Fair 2016 confirmed this fact. Only two Trapiche gems were shown to me with most of the 500 Exhibitors not knowing what a Trapiche Emerald looks like.

This is a necklace composed of eight Trapiche emeralds surrounded by forty seven emeralds, all cut in oval and round cabochon, originated for the Muzo Mine in Colombia. The gems are mounted in hexagonal sets on a structure made by eighteen carat rose gold, linked to each other by articulated branches representing abstractly Hope for a united and reconciled humanity. With this unique and wonderful piece, Amal Selim Mouzannar won the Prize of the “Best Coloured Gemstones” at The Couture Design Award 2016 in Las Vegas.
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