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Where the Gems Are

Technique adds new facet to emeralds' origins.

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The brilliant, deep-blue-green emeralds that come from the mines of Colombia outshine their Austrian and Zambian cousins in both beauty and value. For an emerald, a Colombian pedigree confers not only spectacular color but also eye-popping prices. Both historians and gem dealers have a stake in figuring out an emerald's origins.

Now, researchers in France have found a novel way to track down the birth records of these precious stones. By measuring the ratio of two different isotopes of oxygen in the gems, they can pinpoint an emerald's source?down to the exact mine. Combined with traditional gemology techniques, the oxygen-isotope analysis could bring new insights to the history and formation of these coveted gems.

Collectors and curators prize Colombian emeralds for their deep-green color. This 75-carat stone, known as the Hooker Emerald, is part of the Smithsonian's National Gem and Mineral Collection.
Dane A. Penland/Smithsonian

Emeralds are a kind of beryl-beryllium aluminum silicate with a dash of chromium, which produces the characteristic green. The primary method of distinguishing one emerald from another is by looking at the gem's inclusions, microscopic cavities within the crystal. If the inclusions contain gas, liquid, and solid components, says Fred Ward, a gemologist, author, and photographer from Bethesda, Md., "you're 99 percent sure it's a Colombian emerald."

Emeralds of excellent quality, however, don't have many inclusions, often making it hard to settle disputes over sources.

A team of scientists led by Gaston Giuliani of the Petrographic and Geochemical Research Center in Vandoeuvre-lès-Nancy, France, discovered several years ago that emeralds from different mines possess unique isotopic signatures. "There was a big difference in the data between the oxygen isotopes of [emeralds from] Brazil and Colombia," says Giuliani. "This was a result of the different geology of the two sites."

Cataloging isotopic ratios

The researchers systematically catalogued the isotopic ratios of emeralds collected from different mines around the world. Using this information, they analyzed the origins of nine emeralds of historical interest. In the Jan. 28 *Science*, they report that they were able to confirm the sources of many of the gems and learn some surprising things about them as well.

The test uses an instrument called an ion microprobe, which blasts a few atoms from the gem's surface. The damage is far too small to be detectable. Four of the emeralds belong to the treasury of the Nizam of Hyderabad in India. According to folklore, the gems had been unearthed from long-lost Indian mines. The oxygen-isotope analysis revealed that three of the emeralds came from Colombia?each from a different mine?and one originated in Afghanistan.

The tests "forever put to rest a nagging historical problem," says Ward. He once had the opportunity to examine some of the Nizam emeralds, and to his trained eye, their rich bluegreen color gave away their Colombian origins. Still, experts disagreed.

"Now, someone can come in with an instrument and say, 'They're Colombian,' no matter what the lore is," he

concludes.

The ability to distinguish Colombian emeralds from Afghani ones is interesting, says Jeffrey E. Post, curator of the National Gem and Mineral Collection at the Smithsonian's National Museum of Natural History in Washington, D.C. "Trade from Afghanistan previously has not been well-documented. . . . It shows that we have to be much more open to sources."

Dating emeralds

Giuliani and his colleagues also examined four emeralds belonging to France's National Museum of Natural History in Paris. One, the oldest dated jewel analyzed by the group, is set in a Gallo-Roman earring. A second, 51.5-carat emerald was mounted in the Holy Crown of France by Louis IX in the 13th century. The other two emeralds once belonged to the 18th-century French mineralogist René Just Haüy.

The isotopic ratio for the earring gem showed that it came from Pakistan, which lay along the ancient Silk Road trade route. The analysis of the emerald in the Holy Crown confirmed gemological work pointing to its Austrian origin. Haüy's two stones came from Austria and Egypt.

Emeralds, a kind of beryl, get their green color from traces of chromium.
Dane A. Penland/Smithsonian

The ninth emerald studied by the researchers belongs to the Mel Fisher Maritime Heritage Society in Key West, Fla. It was one of 2,300 stones recovered from the wreck of a Spanish galleon, the *Nuestra Señora de Atocha*, which sank off the coast of Florida in 1622. According to Giuliani and his team, the gem is without doubt from the Tequendama mine in Colombia.

Though powerful, the technique is best used in combination with standard gemological analysis, says Giuliani. Post adds, "Not every gemologist will have an ion microprobe at his disposal, but it's nice to know the tool is there."

The oxygen-isotope technique might be able to ferret out stones that have been touched up with epoxy or treated with heat or radiation to brighten their color, says Post. Also, it could significantly affect the market for emeralds, says Ward, since collectors pay top dollar for stones that come from desirable sources. It's clear that scientists won't be the only ones seeing green.

Letters:

> I read with interest your article on determining the origin of emeralds by measuring oxygen isotopes. While there is great potential for legal and historical applications, I think that using this method to determine the source of gems for purely economic reasons is ludicrous. At least for myself, whether an emerald originated in Austria or Columbia would be of less importance than its intrinsic beauty. And from experience managing a jewelry store, I can state that most of my customers would react the same way.
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> *RuthAnn Nichols*
> *Champaign, Ill.*

References:

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