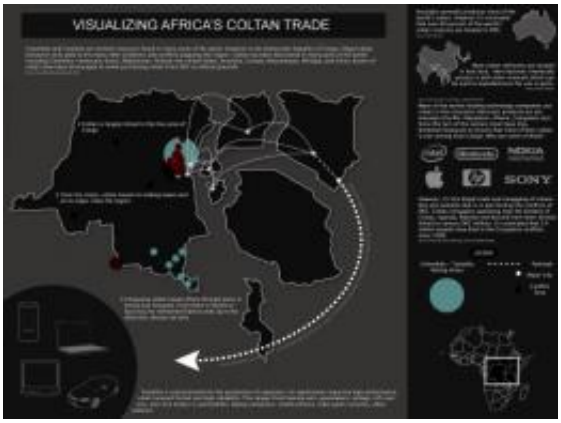
Tracking conflict minerals in Congo

December 8 2010, By Chris Gorski



Credit: Appfrica via flickr

Eastern Congo's hillsides are rich in an element that most people have never heard of, a metal that is inside most of the mobile phones, laptops, and other electronics that we use every day.

The metal tantalum has a high melting point and an exceptional ability to conduct electricity, helping to combine high performance and small size for today's devices.

However, it has also been blamed for fueling the ongoing war in Congo. Armed groups involved in the conflict often control the mines for metals such as tantalum, tin, tungsten, and gold and tax the trading routes along which the materials pass. Electronics companies, governments and human rights organizations have been developing methods to prevent the

sale of these conflict minerals.

As part of this effort, scientists are inventing new techniques that could spot the chemical fingerprints of a sample of metal ore and identify its place of origin. Because of its importance to modern electronics and its accessibility in Congo, tantalum is an important metal to be able to trace. The most valuable of the conflict minerals -- minerals mined in areas of armed conflict and other human rights abuses -- is gold, but it is often chemically altered at the mine and is at this point essentially untraceable.

Tantalum is often found combined with several major and minor components in an ore called coltan, the industry term for a mineral called columbite-tantalite. In Congo, low technology techniques are often used to mine for coltan. The mineral-rich hillsides are broken down by hand, often by children and other forced laborers. Unwanted materials are washed away, and bags of ore are packaged and sold to traders.

Even when obtaining the ore is not directly connected to the armed groups, the taxing of trading routes can provide them with income. Traders transport the ore out of Congo using a limited number of roads that can support the large shipments -- often travelling through nearby Uganda and Rwanda -- on their way to east African ports. The ore is eventually refined in plants in Asia into forms useful to electronics companies.

Tracking each stage of that process is complicated. Current systems of verifying ore shipments mimic the Kimberley Process that quelled the blood diamond trade. That effort aimed to exclude conflict diamonds from the international market by establishing stringent standards before rough diamonds could be certified as conflict-free and shipped.

The scientific verification efforts, called fingerprinting, carry an extra

advantage, however. If they analyze ore samples before processing takes place, geologists might be able to pinpoint the mine or region from which a sample comes and independently verify its legitimacy.

"Minerals from eastern Congo are the chief fuel driving the world's deadliest war," said Sasha Lezhnev, a consultant to the Enough Project, an organization that works in Africa to end genocide and crimes against humanity. "Over 5 million people have died as a result of the war and it has the highest rates of rape and sexual violence in the world."

Lezhnev estimated that armed groups in Congo made about $185 million from mining in 2008. Eliminating the passage of money from mining to the armed groups is a major effort of human rights groups in Congo.

Concerns about working conditions, stability and other factors have led many tantalum suppliers to avoid using ores from Congo. Pressure from the international community and a government ban on mining in the eastern part of the country have led to rising international prices for tantalum. Prices more than doubled in the last eight months, from $30 per pound of tantalum in ore to current prices exceeding $80, said Tom Donizetti, a U.S.-based metals broker who sells tantalum.

Tracking tantalum's path from mine to miniature electronics is difficult. Last summer, when sent an e-mail by a reader of Wired magazine about how Apple sources their components, Steve Jobs replied that they take steps to avoid using conflict minerals, but that "until someone invents a way to chemically trace minerals from the source mine, it's a very difficult problem."

Scientists envision a test that pinpoints the origin of a truck- or boatload of ore by matching its profile to one of hundreds or thousands of master samples, before the smelting and refining processes remove the chemical information that makes it possible to trace coltan back to its source.

"Somewhere along from the mine to the smelter you have the possibility to use this kind of technology to interrogate a coltan raw material and ask, did it come from the Democratic Republic of Congo or not?" said Russell Harmon, a geochemist at the Army Research Office of the Army Research Laboratory in Raleigh, N.C.

Scientists at the BGR -- Germany's Federal Institute of Geosciences and Natural Resources -- began working in 2007 on a two-stage method to find the chemical fingerprint of a piece of tantalum ore and discern its origin. The first stage used custom software and an electron microscope to analyze and identify 10,000-20,000 mineral grains of the product derived from a coltan mine, called an ore concentrate. The second uses a type of laser analysis to zoom in on 50 of those grains, analyze major and minor components, and also the isotopes -- atoms of the same element that contain different numbers of neutrons -- to provide more detail about the age of the sample.

"The chemistry is highly variable from deposit to deposit," said Frank Melcher, a geologist with the BGR. He said that his technique can often pinpoint the origin of an ore to a limited area within a given country, and sometimes to a specific deposit.

Even if a scientific test could say that a shipment of ore came from within 100 miles of a given point in Congo, Lezhnev said that still might not be good enough. He stressed that the volatility of control of a given area or mine increases the need to resolve the origin down to a small area.

"If you can pinpoint it to a 10 mile radius or a 5 mile radius or something like that, then that's actually helpful," Lezhnev said.

Melcher's technique also requires two expensive laboratory instruments and two to three days to do the tests. No lab in Congo is currently

sophisticated enough to perform these tests.

American researchers are working to adapt a different, faster technique for ore sample fingerprinting: laser-induced breakdown spectroscopy, which is also being investigated for anti-terrorism efforts such the detection of chemical and biological agents and explosives. The instrument shines a pinpoint laser at a sample's surface, heating and breaking down a small portion into plasma. The unique wavelengths of light released in this process reveal the chemical profile of the material.

"It's the only system that is field portable, gives you real time answers, and can analyze all elements," said Harmon. "You can instantaneously acquire that information and know right away what's in the sample that you're looking at."

Harmon said that the laser-induced technique could screen ore shipments before they are refined.

Depending on how specific the technique proves to be, it could flag for further analysis samples that might be linked to the militia groups, either at the mine or by taxed trading routes.

"[Laser-induced breakdown spectroscopy] seems to be easy enough that you could really use it on site and that is really a big advantage," Melcher said. He cautioned that he was not sure the technique could measure enough parameters to distinguish between closely related locations, but his group is purchasing an instrument to investigate its capabilities.

Currently, Harmon and his colleagues at Juniata College in Huntingdon, Pa., have accumulated and analyzed a small fraction of the samples that they need to develop a comprehensive profiling tool. More trials will be needed, as well as access to additional samples.

"We're very excited about the particular project, but it is a big problem to get your arms around," said Harmon. "It's a problem outside the domain of what scientists often work on."

If the technique proves to be successful, it could provide an invaluable tool for companies trying to abide by a provision attached to the July 2010 U.S. financial regulation bill, which called for the Securities and Exchange Commission to establish standards for companies to follow in disclosing the steps they take to avoid purchasing conflict materials.

Provided by Inside Science News Service