

## Niobium (Columbium)

*U.S. Geological Survey mineral commodity specialist John F. Papp compiled the following information on niobium (also called columbium) for which coltan (short for columbite-tantalite) is an important mineral source.*

It's not just diamonds associated with conflict in Africa. Coltan, short for columbite-tantalite (a blend of niobium — also called columbium — and tantalum minerals), is linked with the recent conflicts in the Congo that involved several African countries. The metallic ore, which is processed to separate out niobium and the very valuable tantalum (see [\*Geotimes\*, August 2004](#)), is believed to be smuggled out and sold to help finance the armed conflicts.

Niobium is also valuable, especially in industrialized countries. A transition metal with a very high melting point, niobium is used mostly to make stainless steel and high-strength, low alloy steels. Such steels are used in large-diameter pipelines for oil and natural gas, in frames and wheels of cars and trucks and as microalloyed steel in structural applications. Niobium is also vital as an alloying element in superalloys for aircraft turbine engines, is used in pacemakers and other medical devices and can act as a superconductor when lowered to cryogenic temperatures. It is critical to the United States because of its defense-related uses in the aerospace, energy and transportation industries.

Fortunately, there is plenty of it. Estimated world reserves of niobium in 2006 were more than 73 times the current rate of world consumption (about 60,000 metric tons of niobium per year). Most niobium resources occur as pyrochlore in carbonatite deposits in Brazil and Canada. Brazil is the world's major niobium-ore-producing country, accounting for 93 percent of world production in 2006. Together, Brazil and Canada accounted for more than 99 percent of world production that year.

The United States has not produced niobium since 1959, as deposits are low-grade and economically unrecoverable. The United States imports 100 percent of its niobium because, although some niobium is recycled as part of the incorporation of steel and superalloy scrap in the alloy production process, no alloys are recycled for their niobium content. Quantities of niobium reused in alloys are not known, but may be as high as 20 percent of apparent consumption.

About 80 percent of reported domestic niobium consumption is in steel. Niobium-containing microalloyed steels are used in automobiles, bridges, buildings and oil and gas pipelines in applications where a high strength-to-weight ratio is an important engineering consideration. Niobium-containing high-strength, low-alloy steels permit designers to reduce weight and fabrication costs. Niobium is used in cobalt-, iron- and nickel-based superalloys for jet-engine components, rocket subassemblies and combustion equipment in applications where strength at high temperature is an important engineering consideration.

In nature, the element niobium is closely associated with tantalum in carbonatite rocks, where it is almost always found as an oxide. Pyrochlore and bariopyrochlore are the primary ore minerals for niobium. They are commonly found in the interior parts of alkaline igneous complexes, frequently associated with minerals containing thorium, titanium, uranium and rare-earth

elements. Columbite is also a mineral source for niobium. It occurs mostly as an accessory mineral disseminated in granitic rocks or in pegmatites associated with granites. In most cases, economic mineral concentrations have been produced by weathering of pegmatites and the formation of residual or placer deposits.

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Sample of niobium. Image from *Minerals in Your World*