

Rhenium

Michael J. Magyar, the rhenium commodity specialist for the U.S. Geological Survey, has compiled the following information on rhenium, a rare metal used in turbine blades and catalysts.

Rhenium, an exotic, heat-resistant metal, has grown in importance since its discovery nearly 80 years ago. First isolated by a team of German chemists studying a platinum ore, the mineral was named for the Rhine River. From then until the 1960s, only 2 metric tons of rhenium were produced worldwide. In 2004, worldwide production was 40 metric tons.

Its high melting point (3,180 degrees Celsius) and heat-stable crystalline structure make rhenium an excellent refractory metal. Metallurgical applications are now the single biggest market for rhenium (about 60 percent).

In the late 1960s and early 1970s, rhenium was used in rocket thrusters, which reach temperatures of up to 2,230 degrees Celsius. Other early uses included filament wires in mass spectrographs and flashbulbs, and anodes of X-ray machines and thermocouples. In the early 1970s, Chevron Corp. developed a series of platinum-rhenium catalysts that would not react with sulfur to assist in the production of lead-free gasoline at oil refineries. As a response to the OPEC oil crisis in the 1970s and early 1980s, a second generation of more efficient catalysts was developed with double the platinum-rhenium content, boosting refinery efficiency and octane levels.

Since the late 1980s, rhenium's main use has been in nickel-base superalloys to make single-crystal turbine blades. The rhenium allows turbine engines to be designed with closer tolerances for increased thrust and high operating efficiency. Jet-engine turbines now account for 45 percent of U.S. consumption of rhenium. Increased rhenium consumption is forecast for the next generation of fighter jets, the F-22 Raptor and the F-35 Joint Strike fighter, as well as in new gas-fired turbines for power generation.

Rhenium is one of the rarest and most dispersed metallic elements in Earth's crust, with abundance estimated to be about 1 part per billion. Although traces of rhenium occur in some minerals, molybdenite is the only significant host mineral.

Most of the world's reserves of rhenium are found in the Western Cordillera of North America and South America, extending from Alaska and British Columbia through the United States and Central America to the Andes Mountains of Peru and Chile. Other rhenium-bearing sedimentary copper deposits are located in Kazakhstan and neighboring countries. Chile and the United States possess about 75 percent of the world's reserve base of rhenium.

Chile, Kazakhstan and the United States (in descending order) provided most of the world's production of rhenium in 2004. Molibdenos y Metales (Molymet), a private company in Santiago, Chile, produces about half of worldwide production. Molymet processes concentrates from mines in Chile and Peru, but does not own any mines.

The United States' share of world production in 2004 was 12 percent, about the same as in 2003; however, the United States presently consumes about 75 percent of world's rhenium production.

Originally published as *Geotimes* Mineral of the Month, June 2005
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Traces of rhenium occur in a variety of minerals; however, molybdenite is the only significant host mineral. Image from *Minerals in Your World*