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## Uranium Primer - Uranium Extraction Methods

Uranium is found in mineral deposits worldwide, with over one-half of the world's uranium production today derived from mines located in Canada, Australia, and Kazakhstan. Uranium-bearing ores are mined by methods similar to those used for other metal ores. The uranium ore is removed from the ground by conventional mining techniques, in-situ recovery method, or as a by-product of other minerals.

### **Conventional Mining**

Uranium deposits less than 100 meters from the surface can be recovered using the open-pit mining method while deposits more than 100 meters deep in the earth use the underground mining method, both of which are in the category of conventional mining.

### **Open-pit/Opencast/Openpit**

Open-pit mining starts with the removal of overburden (material covering) on top of the uranium to expose the orebody. A pit is then hollowed out to access the deposit. To prevent the pit's walls from caving in, the rock is mined in a series of benches. Holes are drilled into the rock in each bench and loaded with explosives. The explosives are then detonated to break up the rock, which would be taken to the surface by large trucks. The world's largest open-pit uranium mine in operation today is the Rössing mine in Namibia.

### **Underground**

To access a uranium orebody deep underground, vertical shafts are dug to the depth of the deposit. Next, tunnels are cut around the orebody. Drifts (horizontal tunnels) provide direct entry in to the deposit and ventilation pathways. In most underground mines, the orebody is then blasted and hoisted to the surface for milling. For mining to be viable, these deposits must be comparatively high grade. Cameco and AREVA's McArthur River mine is the largest high-grade uranium deposit.

### **In-situ recovery/In-situ leaching/Solution mining**

Uranium ore can also be recovered by the in-situ recovery (ISR) method, given appropriate geological conditions. The ISR method is applicable only to sandstone-hosted uranium deposits located below the water table in a confined aquifer. ISR is a method that leaves the uranium orebody in the ground. The uranium is dissolved in either sulfuric acid or a mildly alkaline solution that is injected into and recovered from the aquifer by means of wells. The uranium-bearing solution is then pumped back up to the surface, leaving the rock undisturbed. Nearly one-quarter of the uranium mines use the ISR method and nearly all of Kazakhstan's uranium mines use this method.

## **By-product**

In some cases, uranium is a by-product of other minerals, such as phosphate, gold, copper, fertilizer, and molybdenum. By-product production is the extraction of uranium from mining operations designed primarily to extract another mineral. For example, uranium is extracted in South Africa from slurries left over from gold mining. The largest uranium deposit is BHP Billiton's Olympic Dam mine in Australia, from which uranium is extracted as a by-product of copper production.

Uranium as a by-product from phosphate production, which occurred in Belgium and the USA, ceased in the late 1990s due to a weakening uranium market. There are about 22 million tonnes of uranium in phosphate deposits around the world, according to the Organization for Economic Cooperation and Development.

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