

Thorium: Geology, occurrence, deposits and resources

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The average content of thorium in the upper crust of the earth reaches 6 to 10 g/t, about 3 to 4 times that of uranium. Thorium is widely distributed, however not as metal, but in mineral form as oxides, silicates, phosphates, and lesser in various other minerals.

Thorium deposits, in simplified form, are divided into four major types, which are: placers, carbonatite-hosted, vein-type and alkaline rock-hosted deposits.

Placer deposits are formed by weathering of country rocks, transportation and wave/current action near shore.

Commonly they are known as black sands or heavy mineral sands. The main thorium mineral is the rare earth phosphate monazite with generally less than 10% Th. Other commercial minerals are e.g. ilmenite, rutile, magnetite etc. Monazite can be separated and, if thorium is required, it can be extracted as by-product. Placers range in age from Archean to Tertiary and to recent deposition.

Carbonatite rocks are of magmatic origin, consisting of more than 50% carbonate minerals (calcite, dolomite, ankerite), often enriched in magnetite, apatite fluorite and accessory Nb-Ta minerals, containing Th. Other economic minerals may be present. Carbonatite deposits are common world-wide. Presently commercial interest is primarily on Nb and Ta, thorium may be recovered as by-product, if required.

Vein-type deposits are wide-spread too and mainly of hydrothermal origin occurring in spatial relation to intrusive or extrusive igneous rocks, often related to carbonatite intrusions. They are generally elongated, vein-and lense-like in shape or in sheets, filling joints and fissures. Common thorium minerals are thorium oxide and thorium silicate. Veins are frequently polymetallic. Thorium could be a by-product, if required.

Alkaline rocks are of igneous origin characterized by high amount of alkali feldspar (alkali granite, syenite). Frequently a delimitation to peralkaline rocks can not be drawn. Alkaline and peralkaline rocks are often spatially related to carbonatite intrusions. Mineral composition is various. Similar to other deposits types, thorium may be a by-product.

Thorium resources can be classified according to confidence in estimates of tonnages. In many cases official figures are either not available or not in agreement with established standards. Therefore uncertainties remain in reporting numbers. However, latest estimates for the world indicates more than 6.2 million t Th.

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