

## On bismuth resources of Japan and world

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Bismuth is an important rare element in high technology country like Japan; yet the remaining ore reserves in future are only for 18 years. The element is supplied mostly from China; therefore new sources in other countries need to be discovered as soon as possible. Bismuth can be obtained from two sources: primary Bi-bearing minerals, such as bismuthinite and native bismuth, concentrated in Sn-W polymetallic ore deposits, and by-product bismuth from sulfide concentrates from various ore deposits.

Geologically speaking, the first source, which is best shown by the Shizhuyuan skarn-greisen-type Sn-W polymetallic deposits in southern China, is concentrated in impure limestones intruded with high-level, fractionated ilmenite-series granites, like those of the Sanyo Belt and southern China to northern Vietnam. Recent success of development of a low grade Bi-Sn-W-F blind ore deposit at Nui Phao, Vietnam, seems to be a good example of what we should do in future mining.

The second source of by-product bismuth, which is recovered during the refining and smelting processes, much depend on availability of Bi-combined sulfides, such as matildite ( $\text{AgBiS}_2$ ) for silver ores, wittichenite ( $\text{Cu}_3\text{BiS}_3$ ) for copper ores, and galenobismutite ( $\text{PbBi}_2\text{S}_4$ ) for lead ores. Concentration of bismuth in this source appears to be controlled by stability field of Bi-bearing host minerals, rather than the initial concentration in granitic magmas.