

Characteristics of the primary tin deposit, Pangkalan Baru area, central Bangka, Indonesia

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Indonesia is the 2nd largest tin producer in the world, a metal which the country has exploited since the 5th century with placer deposits as its main source. On the other hand, primary tin deposits have been exploited only in few locations, such as at Pemali and Tikus on Bangka and Belitung Islands. Therefore, although tin mining in Indonesia has been going on for centuries, our understanding of primary tin is still very limited. Therefore, PT Timah, the largest tin mining company in Indonesia, began in 2015 to focus on the study of and exploration for primary tin. Our study of primary tin is located in one of PT Timah concession areas in Pangkalan Baru, Central Bangka island. The aims of this study are to understand the geological aspects, mineralogy and alteration, and genesis of primary tin deposits in the area. Research methods include geological-alteration mapping, as well as laboratory analysis using petrography, ore microscopy, XRD, ICP-AES/MS, XRF, and fluid inclusion microthermometry.

The results of this research indicate mineralization styles are vein systems hosted by Triassic metasediment and Jurassic syenogranite, and greisen float in areas of argillically altered rock. The geological structures that control the alteration-mineralization are reverse faults with NW-SE to WNW-ESE orientations that are cut by dextral strike-slip faults with a NW-SE orientation. These geological structures control the ore-bearing vein systems that are in the form of low dip angle ore shoots and en-echelon tension veins. The vein systems in the research area consist of three types. The oldest quartz+tourmaline veins, with NW-SE orientation, are mineralized with <10-3426 g/t Sn. This vein set is cut by quartz (<10-156 g/t Sn) or mica+quartz (<10-135 g/t Sn) veins with a NE-SW orientation. Moreover, float of greisenized medium-grain granitoid are assayed with 2852-7900 g/t Sn. The tin in greisen is mainly present as disseminated cassiterite, whereas in veins cassiterite is associated with arsenopyrite, pyrite, and sphalerite. The alteration zones can be classified into three groups: a silicified zone (quartz+mica+tourmaline+cristobalite), sericitized zone (mica+quartz+tourmaline+illite+zunyite), and argillic zone (smectite+illite+kaoline+mica+tourmaline+quartz).

The host rock for the greisen is interpreted to be a concealed younger granitoid body with a syn-collisional tectonic origin based on geochemical data. This tin-bearing granitoid is the youngest stage of the composite batholith present in the research area that is dominated by syenogranite and minor alkali granite porphyry. The tin-bearing granitoid is depleted 8-11 times in heavy rare earth elements, as well as in Zr, compared to the main batholith. Similar patterns are also found in other tin-bearing granitoids at the Pemali and Tikus mines. Hydrothermal fluid chemistry is characterized by boiling of mixed magmatic-meteoric fluids with salinities that range from 1.6-17.3 wt. % NaCl eq. The mineralization temperatures in the vein systems range from 130-460 °C with depth estimates of 2.6-15.8 km from the paleosurface. On the other hand, mineralization

temperatures in the greisen range from 180-375 °C with estimated depths from the paleosurface of 7.8-18.1 km.