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Evolution of Magmatism and Metallogeny along the Western Edge of the Indochina Terrane
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チャルシリ パンニャ[1*]
Punya Charusiri[1*]

[1] チュラロンコーン大学
[1]Chulalongkorn University

K. Kampawong (MIH, Laos), S. Meffree (Univ. Tasmania), A. Salum (Univ. Tasmania), T. Y. Lee (NTNU, Taiwan), C. H. Lo (NTU, Taiwan), K. Hisada (Univ. Tsukuba), W. Lunwongsa (Issara Min. Com.)

Igneous rocks and their associated mineral deposits form north-south trending belt with the dimension of about 1700 x 100 km2 along the edge of the Khorat Plateau from central Lao PDR to southeastern Thailand. These igneous rocks are predominantly felsic to intermediate plutonic and volcanic rocks with minority of mafic and ultramafic exposures. The latter which are usually Late Paleozoic in ages are regarded as to be temporally and spatially associated with the Loei suture which subdivided Indochina terrane from the Paleotethys Ocean. Based on U-Pb zircon, Rb-Sr whole rock, and 40Ar-39Ar dating, magmatism and associated mineralization are inferred to have a prolong history of tectonism from compression to extension and ranging in ages from Middle Paleozoic to Miocene. The first stage of tectono-magmatic episode includes calc-alkaline magmatism during Middle Paleozoic (ca. 405 ? 399 Ma) ages and associated with their mild Kuroko type mineralization of Fe, Cu, Pb, Zn, Ba and Mn minerals. They are mainly in the northern part of the belt and may have been part of Caledonian Orogeny. This igneous activity was formed as a result of calc-alkaline magmatism due to subduction of paleothethystic oceanic slab beneath the western edge of Indochina terrane. The second stage of magmatism took place within the early Indosinian Orogeny (ca. 260 ? 240 Ma). The igneous rocks are of calc-alkaline I-type affinity and thought to have been responsible for the late stage mineralization including porphyry copper, volcanogenic sulfide, skarn type, and hydrothermal Au-Ag vein styles which are mainly occurred in the northern belt. Such the strongly mineralized magmatism is believed to have formed in response to the continuous oceanic subduction beneath the Indochina terrane. Though associated unexplained Sn mineralization was reported in Lao PDR, it was virtually absent in Thailand. Associated accretionary complex and weak Cyprus type Cr and Ni mineralization may also have formed at this stage. The third stage of magmatism may have occurred in the very late stage of Indosinian Orogeny (ca. 190-210 Ma), and it was thought to have occurred in the extension environment giving rise to mainly alkaline magmatism, particularly along the suture zone. Stitching plutons with weak poly metallic vein-style mineralization may have formed due to the relaxation of the crust after intense compression. The fourth stage of magmatism may have formed in association with reactivation of major strike ? slip northwest ? trending faulting in response to early Himalaya Orogeny. Mylonitization of earlier granitoid rocks may have been occurred at this stage along with the post tectonic minor intrusions of water poor pegmatites and aplites with weak vein-style mineralization of Sb + Au-Ag hydrothermal ores. The fifth stage of magmatism is found in the central belt, and it was formed as a result of crustal relaxation during Miocene time (18-25 Ma). This rift related alkaline magmatism may have formed due to crustal thinning, and mantle upwelling by high heat flow activity may be responsible for partial melting of the lower crustal materials. Poly-metallic mineralization and Au-Ag veins of high sulfidation systems may have took place along the north-south ? trending open fractures, particularly in the central to eastern Thailand. Continental rifting event may have been continued to the last episode of magmatism during ca. 0.5 to 7 Ma along the Loei suture in response to high heat flow by upwelling mantle materials. Tectonic activity is geomorphologically and geochronologically evident to continue to the present time and gives rise to the presence of reactivated northwest ? trending active faults in the central belt. Only non-mineralized hydrothermal veins are encountered along these faults.

Keywords: Indochina, Metallogeny, Tectonic, Magmatism, Thailand, Laos