Late Cenozoic Alkalic Basalt and Gabbro in the Subsurface in the Phetchabun Basin, Thailand: Implications for the Southeast Asian Volcanic Province

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Late Cenozoic igneous rocks are widely distributed in Thailand and adjacent parts of Southeast Asia. Igneous activity began at least 24 million years ago and continued as recently as 1923, when an eruption occurred on an island offshore from Vietnam. Much of this magmatism was associated with extensional basins formed during the Oligocene to late Miocene in response to complex regional tectonic stresses generated by the collision of India with Asia and the onset of sea-floor spreading in the Andaman Sea, although the exact mechanisms of rifting are still subject to debate. Most of the igneous rocks are mafic and fall into two main groups: (1) more highly alkalic basanitoid rocks and (2) less alkalic to tholeiitic basalt. However, published petrological studies have been restricted generally to igneous units exposed at surface. Basaltic and gabbroic rocks encountered in the subsurface in the Phetchabun Basin in central Thailand provide an an opportunity to examine the petrological characteristics of both extrusive and intrusive components of this magmatic province. This study focuses on cuttings from 15 wells drilled in the Petchabun Basin.

Magnetic susceptibility measurements were effective in the initial identification of cuttings with high content of igneous material. Representative samples from these high-susceptibility cuttings were thin sectioned for petrographic study and mineral analyses, and hand-picked to obtain material for whole-rock chemical analysis. Although unequivocal distinction between extrusive material and fine-grained intrusive material is difficult in the cuttings, which are generally smaller than 1-2 mm, the presence of vesicles/amygdales and abundant interstitial altered material which may originally have been glass were used as evidence of an extrusive origin. In addition, hornfelsing and spotting are typically evident in host rocks in the vicinity of intrusive units. Most samples contain abundant zeolite minerals, likely a result of hydrothermal activity and/or low-grade burial metamorphism. The zeolite occurs interstitially and as veins in metasedimentary fragments, and as interstitial material, in amygdales, and replacing feldspars in the igneous fragments. Three thick sill-like bodies have been recognized, two of which consist mainly of ophitic and subophitic alkali gabbro and the third dominated by biotite-bearing potassic leucogabbro. One of the gabbro sills has an inferred age of ca. 12 Ma based on correlations with previously reported ages from subsurface units elsewhere in the basin. The main igneous minerals are plagioclase, clinopyroxene (diopside), rare olivine, and scattered opaque minerals (magnetite). Extrusive amygdaloidal basalts occur both above and below the intrusive units. Based on petrochemistry, the overlying flows may be related to the ophitic gabbro sills. Although all are alkalic and formed in a within-plate setting, chemical differences suggest that the igneous units represent at least five separate episodes which, combined with surface outcrops in the area, may span much of spectrum of known activity in the Southeast Asian Magmatic Province.