Characteristics of Granitic Rock from Western and Eastern of the Bentong Raub Suture, Peninsular Malaysia

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Abstract

A first order difference between the Western and Eastern Belt Granites of Peninsular Malaysia is the S type nature of the former and the expanded compositional range of the Eastern Belt (SiO2: 50 to 78% SiO2) compared to that of the Western Belt (SiO2 > 65%). Magmatic evolution of the Western Belt Granites was controlled by K-feldspar, plagioclase and biotite whereas in the Eastern Belt granite, hornblende, K feldspar, plagioclase and biotite was the important mineral assemblage in the magmatic evolution. Zircon inheritance ages for of the eastern Belt Granite give a range from 900 to 1400 Ma younger than the Western Belt Granite dated between 1500 to 1700 Ma.

Keywords: Bentong Raub suture, plutons, Perhential Kecil

1. Introduction

The Peninsular Malaysian granites are distributed into three parallel belts, i.e. Western, Central and Eastern belts. The Bentong Raub line separated the Western to both Eastern and Central Belts. The Western belt granites is characterised large batholith or complex plutons of restricted compositional range comprise of a suite of tin bearing S- type granite. Two main batholith masses can be distinguished in the Western Belt Granite. These are the Main Range batholith on the eastern flank and the adjacent Bintang batholith immediately to the west. Smaller granitic bodies occur further to the west e.g Bukit Mertajam-Kulim, Penang, and Langkawi complexes. Each granitic batholith and complex consists of individual plutons. The main rock type is a coarse to very coarse grained megacrystic biotite muscovite granite. Two phase variants, however, developed almost everywhere and may be volumetrically important.

The Eastern Belt granite consists of smaller batholiths of zoned and unzoned plutons of compositionally expanded, but dominantly monzogranite with I type affinities which lies to the east of the Bentong Raub line. Rock types ranging from monzogranite to granodiorite to diorite to gabbro are found in composite batholiths characterised by hornblende and biotite as the main mafic phases. The dioritic and gabbroic rocks sometimes form single pluton or form the margins of granitoid bodies. Rare occurrences of rocks belonging to the alkalic series are found at Perhentian Kecil Island and Benom Complex. The Syenite consists of a variety of igneous rocks ranging in composition from syenitic to monzonitic and even gabbroic, characterised by high-K shoshonite affinities. Zircon inheritance ages for of the eastern Belt Granite give a range from 900 to 1400 Ma younger than the Western Belt Granite dated between 1500 to 1700 Ma.

2. Petrography

The Eastern Belt granitoids have more expanded composition from granite to diorite whereas majority of the Western Belt rocks restricted to monzogranite and syenogranite. The granitic composition of the Eastern Belt rock is made up of K-feldspar, quartz, plagioclase, low Al biotite, hornblende, sphene, magnetite and ilmenite. Pyroxene, olivine and Ca-plagioclase dominated in the gabbroic and dioritic rocks. Hornblende and biotite are the most common mafic phase in the Eastern Belt rocks. Both mineral occur as a mafic clot with the size up to 1 cm. Minerals occurring in Western Belt Granite, in decreasing abundance, are K-feldspar, quartz, plagioclase, biotite, muscovite, allanite, zircon, sphene, apatite, secondary epidote, tourmaline, ilmenite, amphibole, andalusite and garnet. Amphibole found in the northern part of the Western Belt granite is mainly actinolitic hornblende in composition with an atomic Mg/(Mg+Fe) range from 0.5 to 0.6.

3. Geochemical Differences

The SiO2 content of the Eastern Belt Granite and associated mafic and intermediate rocks range between 50 to 78%, in contrast to the Western Belt granites which are confined to SiO2 > 65%. Majority of the rocks from the Eastern Belt Granite plot in the I type field, contrast to those from the Western Belt Granite plot in the S type field. The Eastern Belt Granite rarely contains less than 3 % Na2O, while the Western Belt granites rarely exceed 3 % Na2O. Both Western and Eastern Belt Granite (s.s.) of Peninsular Malaysia show well developed trends typical of high –K calc –alkali suites. Rb/Sr ratios are much higher in the Western Belt Granites (1 to 200) compared to those of the Eastern Belt Granites (0.1 to 3.1). However there are some overlaps between 70 to 75% SiO2. The high Rb/Sr ratio of the Western Belt Granite reflects the highly evolved nature of the magma compared to the Eastern Belt Granite magma. The Eastern Belt Granite have wider ACNK ratios ranging 0.62 to 1.29 compared to the Western Belt Granites (0.9 to 1.19) 95% of the samples from the Eastern Belt and 70 % of the Western Belt samples fall into the I type granite field of Chappell and White (1974). The Eastern Belt Granite is less enriched in uranium (5-10 ppm) and thorium (18 to 40 ppm) than the Western Belt Granite. On modified ACF plots (Liew 1983), the field of the Western Belt granites lie above the plagioclase-biotite tie line whereas bulk of the Eastern Belt Granites plot in the metaluminous region below the plagioclase-biotite tie line.

Large ion lithophile content of the Eastern Belt is more irregular compared to the Western Belt Granite. The rocks from the Western Belt have low Sr and Ba (< 1000 ppm) and higher Rb compared to the Eastern Belt (< 500 ppm). LIL modeling of the Western Belt show that the magmatic evolution is controlled by K-Feldspar, plagioclase and biotite, while in the Eastern Belt Granites hornblende also plays an important role in the magmatic evolution.

4. Concluding Remarks

A first order difference between the Western and Eastern Belt Granites of Peninsular Malaysia is the S type nature of the former. This is contrast to the expanded compositional nature of the Eastern Belt rocks where I type, S type granitoids and mafic rocks are all recognized. Among the geochemical differences between these two granitoids province are:

(i) The expanded compositions range of the Eastern Belt Granite (SiO2: 50 to 78% SiO2) compared to that of the Western Belt granites (SiO2 > 65%).

(ii) The Western Belt Granites have lower Na2O contents and high Th, U, Sn, Pb and Cs contents compared to the Eastern Belt Granite

(iii) Magmatic evolution of the Western Belt Granites were controlled by K-feldspar, plagioclase and biotite whereas in the Eastern Belt granite, hornblende, K-feldspar, plagioclase and biotite was the important mineral assemblage in the magmatic evolution.