

Petrology and Geochemistry of the Langkawi Granites, North of Peninsular Malaysia

ABSTRACT

The Langkawi Islands comprises a group of 99 tropical islands lying off the northwest coast of Peninsular Malaysia. The Langkawi granite makes about 40 % of the Langkawi. It can be divided into two main bodies: Gunung Raya and Kuah granites. The Gunung Raya biotite granite shows very coarse- to medium-grained texture, some are strongly porphyritic with K-feldspar phenocrysts reaching 6 cm in length whereas the Kuah granite consists of highly evolved fine- to medium-grained tourmaline granite. Tourmaline occurs in both Gunung Raya and Kuah granite. The tourmalinization is clearly observed in the Kuah granite. Geochemically, the Kuah granite (75.1-77 %SiO₂) has more siliceous and evolved magma than the Gunung Raya granite (68.1-75.3 %SiO₂). The highly evolved magma for the Kuah granites is also supported by high Rb/Sr ratio (~20.55), compared to the Gunung Raya granite which is much less it is differentiated (~7.84). The distinct negative anomalies for Nb, Sr, and Ti are showing typical upper crustal compositions. In addition, the negative anomalies in Ba, Nb, Sr, and Ti that become increasingly marked towards the most felsic and fractionated granitic facies: such trends are typical of collisional peraluminous granitoids. All granites have ASI >1 which is peraluminous. Both the Gunung Raya and Kuah granite show fundamental S-type feature like peraluminous composition, high K₂O / Na₂O ratio (~1.56 %), low total Fe and restricted composition range dominated by high SiO₂, normative corundum > 1%. Strongly negative Eu anomaly is normally subscribed to fractionation of plagioclase due to the similar ionic radius and charge of Eu²⁺ and Ca²⁺. The rare earth element (REE) pattern of the Langkawi granite constitutes familiar birds-wing REE pattern and strong negative Eu anomaly which is similar to the dominant S-Type granites of the Main Range. Major and trace elements Harker diagram and large ion lithophile (LIL) modeling suggest that the Gunung Raya and Kuah magmas were derived from the different magmatic pulses. Both pluton are controlled by the same mineral assemblages (plagioclase + K-feldspar and biotite) suggest that they may be formed from the same magmatic source. The Langkawi granite has K - Ar and Rb - Sr dates (217 ± 8 Ma and 209 ± 6 respectively). The Late Triassic age suggested that the granites may falls within the syn-collisional granites. The S-type characteristic associated with the tin mineralization clearly indicates that it is related to the Indosinian Orogeny.

Petrologi dan Geokimia Batuan Granit di Langkawi, Utara Semenanjung Malaysia

ABSTRAK

Langkawi terdiri daripada gugusan 99 buah pulau tropika yang terletak di luar pantai barat laut Semenanjung Malaysia. Batuan granit merangkumi 40% daripada Pulau Langkawi yang boleh dibahagikan kepada dua pluton utama iaitu Gunung Raya dan Kuah granit. Biotit granit Gunung Raya menunjukkan butiran yang sangat kasar ke sederhana halus. Terdapat batuan biotit granit Gunung Raya yang menunjukkan tekstur porphyritic dengan K-feldspar sebagai fenokris mencapai 6 cm panjang. Kuah terdiri daripada granit turmalin dan menunjukkan butiran sederhana ke halus. Selain itu, terdapat juga sebilangan biotit digantikan oleh muskovit dalam granit Gunung Raya. Tourmalinization ini jelas diperhatikan dalam granit Kuah. Secara geokimia, granit Kuah (75.1-77 % SiO₂) mempunyai magma lebih bersilika dan berevolusi daripada granit Gunung Raya (68.1-75.3 % SiO₂). Nisbah Rb / Sr tinggi (~ 20.55) yang ditunjukkan oleh granit kuah menunjukkan magma berevolusi dengan pesat manakali Granit Gunung Raya pula menunjukkan differensiasi yang kurang pesat (~ 7.84). Anomali negatif yang jelas untuk Nb, Sr, dan Ti menunjukkan komposisi biasa seperti kerak benua atas. Di samping itu, anomali negatif dalam Ba, Nb, Sr, dan Ti yang menjadi semakin ketara ke arah komposisi yang paling felsik adalah tipikal bagi granit yang terbentuk semasa perlanggaran antara kerak. Semua granit mempunyai nilai ASI > 1 yang menunjukkan sifat peralumina. Sifat granit yang peralumina, nisbah K₂O/Na₂O yang tinggi (~1.56), jumlah Fe yang rendah, normative aluminium oksida > 1 % telah mencirikan kedua-dua granit Kuah dan Gunung raya adalah granit jenis S-jenis. Anomali negatif Eu yang hebat biasanya menunjukkan fraksinasi plagioklas kerana jejari ion Eu²⁺ dan Ca²⁺ yang sama. Corak REE granit Langkawi menunjukkan corak 'sayap burung' dan negative anomali Eu yang hebat menunjukkan ciri dominan yang sama dengan granit main-range Jenis-S. Elemen- elemen utama dalam gambarajah Harker dan model 'Large Ion Lithophile' menunjukkan bahawa Gunung Raya dan Kuah magma berasal daripada magmatik yang berbeza. Kedua-dua pluton ini dikawal oleh mineral-mineral yang sama (plagioklas+K-feldspar and biotite) menunjukkan punca magma yang sama. Granit Langkawi mempunyai umur K-Ar dan Rb-Sr (217 ± 8 Ma dan 209 ± 6), iaitu Triassic lewat dimana ia terbentuk semasa syn-perlanggaran (syn-collision). Ciri-ciri granit Jenis-S yang berkait rapat dengan mineral bijih timah itu jelas menunjukkan bahawa ia adalah berkaitan dengan Orogen Indosinia.

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