Genting Sempah Volcanic Complex: Genetic implications for the Main Range Granite

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The Genting Sempah Volcanic Complex is one of the few known examples of acid volcanism that is related, both temporally and spatially, to the Triassic Main Range Granite. The complex comprises units of tuff lavas, lavas and porphyries. They are all peraluminous rhyodacitic in composition, and are generally highly porphyritic with 30 to 60 per cent phenocrysts consisting of plagioclase (commonly andesine), quartz, K-feldspar and biotite. A distinctive porphyry unit (subvolcanic intrusive?) also contains phenocrysts of orthopyroxene which has reaction relationship with biotite. There is a perceptible chemical difference between the orthopyroxene bearing rhyodacite porphyry (OBR) and the orthopyroxene lacking other rhyodacitic rocks (OLR). In the present study, more emphasis has been given to the OBR.

The origin of the phenocrysts, whether magmatic or restitic/xenocrystic, is a critical issue that needs to be resolved for proper understanding of the petrogenetic history of these rocks. Textural and petrographic features such as occurrence of phenocrysts mainly as discrete individual crystals, euhedral to subhedral nature of some phenocrysts, general scarcity of granoblastic crystal clots, provide permissive evidence in favour of magmatic origin. However, the possibility of some deformed biotite phenocrysts and irregular labradoritic cores of some zoned plagioclase crystals being restiteocrysts cannot be completely ruled out. Further support for magmatic origin comes from the chemical composition of the rocks. Neither OBR nor OLR show any significant intragroup chemical variation despite having differing proportion and amount of phenocrysts. Evidently the bulk compositions of the rocks, by and large, represent liquid compositions. The phenocrysts can, therefore, be regarded as products of crystallization at slow rate of cooling prior to rapid undercooling.

The phenocryst assemblage of plagioclase + orthopyroxene + quartz + K-feldspar + biotite in the OBR is quite analogous to the hypersolidus crystallization sequence observed in experimental studies of similar bulk composition at low water content. The OBR magma attained K-feldspar and quartz saturation before complete resorption of orthopyroxene possibly through a reaction like: orthopyroxene + liquid = biotite + quartz. This suggests that the water content of the OBR magma was less than 3 percent and that the temperature was more than 800°C when the rapid undercooling of the groundmass occurred. Since the OBR magma was about 50 per cent crystalline at that stage, it is reasonable to assume that the initial temperature of the magma was much

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higher, probably 900°C or more. Such a dry and high temperature magma would require dry source rocks and could have been derived from psammopelitic granulites, charnockite or similar rocks. Although not observed in the present study, granoblastic aggregates of orthopyroxene + plagioclase + cordierite + biotite + quartz has been previously reported from the OBR and has been interpreted as restite. If this interpretation is correct, then it would limit the depth of magma generation to about 20 km. A temperature of 900°C or more, as discussed earlier, at such a depth would require a high geothermal gradient of about 45°C/km. This aspect warrants further study regarding heat source and heating mechanism.

The compositions of both OBR and OLR lie on or very close to the variation trends of the associated Main Range granitic suites, but they are not more felsic or more evolved than the granites. To the contrary, the OBR is compositionally less evolved than most of the granitic suites of the Main Range. Evidently the Genting Sempah rhyodacites and the Main Range granites are not comagmatic; that is they are not complementary fractions of a common parental magma which produced the granites as early differentiates and the rhyodacites as residual liquids.

The Genting Sempah Volcanics is likely to be underlain by the Main Range Granite. This possibility coupled with the fact that they are temporally related would imply that the depth of granite emplacement in this region was probably nor more than the maximum thickness of the volcanic pile.
