Marginal Facies Variation of Granite Porphyry in the Kumano Acidic Rocks: Reappraisal for Facies-Transition to Tuffs

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We reappraised an origin of gradational transition between tuffs (TF) and granite porphyry (GP) in the Kumano Acidic Rocks at Okuji, southern Kii peninsula. The petrographical and volcanological techniques were used to study what resulted in such a boundary zone between TF and GP at Okuji area.

Facies of the TF is a banding structure consisting of alternation of dark muddy layer and white porphyritic one. Microscopically, the former layer contains quartz, plagioclase and biotite minerals, mudstones, their fragments, lensoidal fragments of white porphyritic layer, and the muddy matrix; thus, it is regarded as a muddy tuffaceous rock. The latter layer is a porphyritic rock, and its matrix shows microfelsitic and/or microgranitic texture. It contains quartz, plagioclase and biotite minerals, which is principally the same as the mineral assemblage in the upper GP. Aramaki (1965) regarded the banding structure of dark and light rocks as stratification, whereas we observed not straight and regularly rugged boundary surfaces there. In addition, presence of fiamme (pumice) in the TF was pointed out, and this finding suggested that the rock was the tuff deposited from pyroclastic eruptions (Aramaki, 1965). This evidence in the TF, however, is the lens-shaped structure that is the same texture as dark muddy layer, and there is no microscopic evidence indicative of the eutaxitic texture in the TF. As results of appraisals, we regard TF as a marginal facies of the upper GP, where the host rock material was mingled with the GP magma. On the other hand, we found out that brecciation of the GP and mudstone was contemporaneous at the northeast Okuji area. So far, it is probable that the muddy materials was originated from the mudstones of regional host rocks (the Kumano Group).

The mingling (ML) facies of the GP shows various deformations of the banding structure. The average ductility of deformation is variable toward the lower part of ML facies. Most of deformation structures at the Okuji area are plastic and fully ductile deformation. In the lower part, some fragments become blocky, formed by brittle deformation. The muddy layer in the lower ML facies contains more voluminous host rock materials than those in the upper part. These field observations strongly suggest that the lower ML facies was increasingly cooled down efficiently, and that the ductility of deformation (transition from ductile to brittle) is correlative with the degree of cooling.

An emplacement model of GP magma was discussed from style of deformation and orientation of slip in the structure of ML facies. Most of deformation structure is intrafolial (overturned) fold with low-angle fold axial plane, which are formed under compressional stress regime. Measurements in the slip-orientation and -sense reveal that the most of low-angle thrust folds slipped toward NE. Therefore, it is considered that the northeastern-slipped folds were finally formed in association with the deformation of viscous magma body due to NE-SW compression. On the other hand, a certain volume of GP magma was fed from the arcuate pyroclastic conduit of the Kumano caldera (Miura, 1999). Extension part of the conduit may be very close, or within 2-3 km toward NE from Okuji area. In assuming migration of GP magma toward SW from the NE conduit, an endogenous doming or sill-type intrusion of GP magma is a plausible model to explain the fold structures slipping northeastward. These ideas are not in conflict with the laccolith-type intrusive model of GP magma by Miura (1999). Thus, in order to explain the above field and laboratory observations reasonably, we proposed a following model; the laccolith of GP magma intruded into the caldera through the arcuate conduit at northeastern Okuji area, and it finally mingled with the poorly-consolidated mudstone at the marginal part.