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Thermal overprinting of accretionary complex by a specific magma in Pacific type orogenic belt

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A Pacific-type orogenic system with oceanward growth has been documented in Southwest (SW) Japan and New England Fold Belt (NEFB), eastern Australia since Early Paleozoic time, as supported by geological, biostratigraphical, and geochronological data of weakly metamorphosed accretionary complexes. The growth history is essentially characterized by a series of orogen-parallel oceanward growth of accretionary complex and syn or post-orogenic activity of calc-alkaline plutons. It has been postulated that granitic magmatism accompanied with low pressure/temperature (P/T) type metamorphism enhanced growth and modification of continental arc crust in a Pacific-type orogen.

Since the paired metamorphic belt hypothesis of Miyashiro (1961), Japanese geologists have believed that the sillimanite-grade metamorphic rocks of the low P/T type metamorphic belt represented a part of lower crust beneath the active volcanic arc, where metamorphic recrystallization and partial melting had been caused by the arc-type magma activities. This idea suggested a continuous formation of low-P/T rocks and associated granitic rocks beneath an active volcanic arc. However, the geological evidence in SW Japan suggests episodic formation of low-P/T rocks and the associated granitic intrusions, and does not support the traditional idea.

We propose the following new scenarios: (1) peraluminus granitic rocks of Ryoke belt formed by the partial melting of the Jurassic accretionary complex; (2) the low P/T type metamorphism was caused by underplating of unusual magma activities (high-Mg andesite, high-Nb basalt, and adakite). This type of magma activities is distinct from a typical subarc magmatism produced by the steady-state subduction of oceanic plate. The new K-Ar dating of hornblende from the volcanic rocks yields about 100 Ma; they are coeval with a range of metamorphism and granitic activities of the Ryoke belt. The old and thick oceanic plate subducted under the SW Japan in early Cretaceous (100 Ma). The rollback or shift back of the subducting slab of oceanic plate and the subsequent upwelling of high-temperature asthenosphere might have changed environment of subarc mantle to produce the specific magma such as the adakites.

The Tia Complex in the southern NEFB is a poly-metamorphosed Late Paleozoic accretionary complex. It consists mainly of high-P/T type pumpellyite-actinolite facies (rare blueschist facies) schists, phyllite and serpentinite (T = 300 C-degree and P = 5 kb), and low-P/T type amphibolite facies schist and gneiss (T = 600 C-degree and P $<$ 5 kb) associated with S-type granodioritic plutons (Tia granodiorite). Biotite and white mica K-Ar ages distinguish Carboniferous subduction zone metamorphism and Permian granitic intrusions. The systematic K-Ar age mapping along a N-S traverse of the Tia Complex exhibits a gradual change. The white mica ages become younger from the lowest-grade zone (339 Ma) to the higher-grade zone (259 Ma). In contrast, Si content of muscovite changes drastically only in the highest-grade zone. The regional changes of white mica K-Ar ages and chemical compositions of micas indicate argon depletion from precursor high-P/T type phengitic white mica during the thermal overprinting and recrystallization by granitoids intrusions. Our new K-Ar ages and available geological data postulate a model of the eastward shift of a subduction zone in Permian time. The eastward rollback of a subduction zone system and subsequent magmatic activities of high-Mg andesite and adakite might explain formation of S-type granitoids (Hillgrove suite) and coeval low P/T type metamorphism in the Tia Complex.

Keywords: K-Ar geochronology, accretionary complexes, thermal overprinting, low-P/T metamorphism, S-type granites, adakitic magma