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Cretaceous granitic magmatism in Southwest Japan: A large-scale crust-forming event

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The Southwest Japan is a mature arc which has a 30km-thick continental crust including >15km granitictonalitic layer and underlying mafic layer. It is known to be a large-scale granitic province of the similar size to the Sierra Nevada or Peninsular Range batholiths in western North America. They are all included in the Cretaceous Circum-Pacific granitic provinces. Nearly 90% of the surface exposed granites in Southwest Japan are Cretaceous in age. A large amount of coeval ignimbrites are associated with the granites, which has remained in spite of erosion for 70-80Ma. Upper to middle crustal cross section of the granitic province is seen in the Ryoke plutonometamorphic belt that shows a sequence comprising unmetamorphosed pre-Cretaceous accretionary complexes with high-level granites to high-grade metasediments with migmatites and deep-seated gneissose granites. So it is presumed that the present crustal structure of Southwest Japan arc was built up in Cretaceous at the Eurasian continental margin.

The age histogram suggests a highly episodic granitic magmatism concentrated in the range of 50-100Ma, despite a long-lasting tectonic setting of active continental margin since late Paleozoic. Felsic magmatism is going on also in the present Japanese Islands now but the magma production rate of the Cretaceous granitic magmatism is thought to be two-three digits larger than that. Such a large magmatic event cannot take place under the tectonic setting of the steady-state subduction of an oceanic plate. A ridge-trench collision model has been proposed to explain this non-steady-state setting and an eastward younging polarity of the age of granites but the debate is not yet settled.

A large magmatic event also requires a large heat source. It would have been given by extensive supply of mantle-derived mafic magmas that were underplated in the lower crust. Thus, the Cretaceous magmatic event could have involved the whole crust of Southwest Japan.

The Cretaceous granites in the Southwest Japan are mostly of I-type. Their major source is mafic lower crust of mantle-derived basaltic underplate. The contribution of mantle-derived component to the source magma of the granites in the Southwest Japan is more than 60%. So it was a large-scale crustforming event. Considering that all Circum-Pacific granitic rocks are predominantly I-type, the Cretaceous Circum-Pacific granitic magmatism was a major global episode in the earth's history that produced continental crust.

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