Development history and change of magma plumbing system of Adatara volcano

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Development history of the main volcanic edifices of Adatara volcano is divided into 3 stages. In the first stage, precursory lava eruption occurred at the northern end of the volcano (ca. 0.55 Ma) to form a lava dome, and also southeastern flank (ca. 0.44 Ma) to yield a small strato-cone. All the magmas erupted in this stage show calc-alkaline character. Around 0.35 Ma, episodic volcanism of the low-alkali tholeiitic magma occurred to build up strato-cone (Maegatake and adjacent area) covering southern part of the volcano (stage 2). Calc-alkaline magma also erupted contemporaneously with the tholeiitic magma in the stage 2. After 10,000 years of eruption interval, calc-alkaline magmas have repeatedly erupted to give rise to the main volcanic chain (stage 3). On the bases of dormancy deducted from tephrochronology and distinctive modes of eruption along with volume of eruptives, the stage 3 can be divided into two substages. Voluminous lava flows were dominant through the earlier sequence (3a), building up the plateau-like basal part of the volcanic chain (ca. 0.25-0.2 Ma). After 80,000 years of dormancy, the most violent Plinian eruption in the stage 3 occurred (ca. 0.12 Ma) by ejecting scoria, pumice, banded pumice, and spatter, all of which were to be the essential materials. Subsequently, sub-Plinian to Strombolian eruption occurred intermittently in every 5,000 to 20,000 years, lasting down to 30,000 years ago. More recently, smaller Vulcanian eruptions accompanying phreatic explosions were repeated down to 2,400 years ago.

Temporally (ca. 100,000 years) and spatially (ca. 10 km) separated magmatic activities in stage 1 imply that the two activities must be governed by different plumbing systems. The co-occurred tholeiitic and calc-alkaline magmas in stage 2 show contrastive petrochemical characteristics and mineralogical features, indicating that the two magma series have different origins and also evolved independently under mutually isolated plumbing systems. As for the magmas in the stage 3, compositionally distinctive three types of calc-alkaline magmas were recognized at the eruption episode at 0.12 Ma; one is dacitic and others are andesitic in composition. Dacitic magma had been dominant during early phase that was characterized by Plinian eruption, with associating the andesitic magma of type 1. As the eruption mode changed to sub-Plinian or Strombolian, the dominant magma type was gradually changed from dacite to andesite. Also, andesitic magma had been replaced abruptly, to the other type (type 2) during sub-Plinian eruption. Whole rock major- and trace-element compositions for the type 1 and type 2 show excellent correspondence to the mafic ends of the compositional trends s for the magmas erupted ca. 0.25-0.2 Ma, and those came out less than 0.12 Ma, respectively. Thus, the abrupt change in the characteristics of the andesitic magma must reflect the renewal of the plumbing system for the calc-alkaline magma in stage 3. In addition, the third plumbing system in the stage 3 is inferable beneath the Minowasan cone that was formed in the northern part of the volcano using the isolated eruption center around 0.2 Ma.

By combining the geochemical data with the geological observation, 7 distinct magma-plumbing systems have been identified in the development history of the Adatara volcano. None of the plumbing systems show evidence for their survival lasting more than 100,000 years. Presumably, the life of each plumbing system was several tens of thousand years at most.