

Is Ryukyu Subduction Tectonic Activity Driving Intraplate Volcanism in Korea?

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The driver(s) of volcanism in intraplate settings and its relationship to plate tectonic processes are themes of broad debate in the geological and geophysical community. Several Quaternary intraplate volcanic centres are located in and around the Korean peninsula, beyond the reach of modern subduction-related fluids as drivers of magmatic activity. The reason for their existence is enigmatic and controversial. They have been linked to mantle plume activity, or to local mantle upwelling and decompression driven by the subducting Pacific and Philippine Sea tectonic plates. We present a new dataset of Ar/Ar ages from Jeju Island and integrate these with the existing database of ages of Jeju rocks. We use these data to construct a temporal volumetric model for the construction of Jeju Island. The data show that the locus of volcanism was initially in the western half of the island and moved eastward over time. This eastward migration is controlled by lithospheric extensional structures likely related to splays from the Tsushima Fault Zone and gave the Island its elliptical shape. A magmatic trend starting from early eruption of High-Al alkali at c. 1.8 Ma, followed by transitional alkali, and finally contemporaneous Low-Al alkali and subalkali magma occurred in the western locus, and was entirely repeated at the later eastern region. The latter (post c. 400 ka) locus was volumetrically most important, building the bulk of the Island. A twofold increase in magma output rate from c. 400 ka at Jeju is coincident with other tectonic and magmatic events in the Korean region. A sudden increase in magma output rate is also observed in the Abu Monogenetic Volcano Group in southwestern Honshu at c. 400 ka, and two large basaltic lava flows erupted in central Korea soon after 500 ka. Additionally, volcanic activity in the Ryukyu Arc became increasingly explosive in the last 500 ka producing a higher density of large caldera structures compared to the previous 1.5 Ma. The onset of these volcanic events is temporally linked with a doubling of the extension rate of the Okinawa trough, which lies behind the Ryukyu subduction zone. This increase in extension rate is likely responding to a change in the subduction/convergence rate, which in turn changed the crustal stress regime in the Korean area, including Jeju. We therefore suggest that rates of volcanism on Jeju Island are linked with crustal stress that is influenced by changes in the subduction rate at the Ryukyu subduction zone.