The influence of neotectonics and strike-slip faulting on arc magmatism : the example of the South Aegean arc

Georgia Pe-Piper[1] and David J.W. Piper[2]
1. Department of Geology, Saint Mary's University, Halifax, NS, B3H 3C3. <gpiper@smu.ca> ¶ 2. Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, NS, B2Y 4A2.

The Pliocene-Quaternary South Aegean arc is related to subduction of the African plate beneath the Aegean microplate. Hydrothermal circulation within the volcanic rocks is responsible for significant gold, barite, and manganese mineralisation. The western part of the arc has typical arc-related andesite - dacite volcanism, predominantly of Pliocene age, associated with E-W listric faulting with slow slip rates. Nd and Sr isotopes and trace elements show that their petrogenesis included substantial partial melting or AFC in the lithospheric mantle and viscous felsic magmas were trapped in the lower crust. In contrast, the mid to late Quaternary of the central and eastern part of the arc consists of tholeiitic and calc-alkaline minor basalt, andesite, dacite and minor rhyolite, including voluminous pyroclastic rocks. Major pyroclastic eruptions include the 0.16 Ma Kos Plateau Tuff eruption and the Minoan eruption of Santorini. These younger magmas result from melting both hydrated mantle (calc-alkaline magmas) and asthenosphere (tholeiitic magmas), influenced by regional extension. This young volcanism began at the same time as ENE-trending strike-slip faulting resulting from indentor collision with thinned African plate continental crust. The strike-slip faults provided efficient pathways for all magmas to rise, but also resulted in rapid mid-to-late Quaternary subsidence, at rates > 2 mm/yr.

The role of strike-slip faulting is particularly clear at Santorini and Kos. Near Kos, older dacitic rocks and young volcanic centres lie on a NE-SW-trending lineament, initiated in the early Pleistocene. ENE-WSW sinistral strike-slip faulting initiated in the middle Pleistocene in the area from Santorini to Kos would have produced extension on this older lineament, permitting the ingress of water to the magma conduit, thus triggering the very large Kos Plateau Tuff eruption. A similar mechanism was responsible for the voluminous pyroclastic eruptions of Santorini since 0.2 Ma. Santorini is located at a pronounced change in fault patterns in the South Aegean Arc. To the west, active faults trend E-W, whereas to the east, active faults trend ENE and a slightly older set trend NE. The initiation of the ENE strike-slip faulting led to extension on the older NE faults, which define the major volcanic lineaments around Santorini.

This study shows that rapid changes in fault patterns as a result of progressive plate convergence, on time scales almost un-resolvable in Paleozoic and Precambrian orogens, can result in major changes in volcanic style and eruptive products. Such changes also influence the pathways and style of mineralisation.