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Relationships between subduction and extension in the Aegean region: evidence from granite plutons of the Biga Peninsula, NW Turkey

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The Biga Peninsula is a tectonically complex region in western Turkey characterized by Tethyan sutures overprinted by extensional grabens, active fault strands of the North Anatolian Shear Zone, and numerous granitoid plutons. Two end-member models for the initiation of extension in the Biga region have been proposed, both of which focus on the role of igneous assemblages. The first model involves the emplacement of a hot mantle plume that thins and weakens crust and isostatic doming drives extension. The second has regional tensional stresses as the driving force, and magmatism is a consequence of decompression. Here we focus on understanding the timing and geochemical evolution of three granitoid plutons located in and just south of the Biga Peninsula to understand which end-member model could be applicable to the Aegean region. The Kestanbolu pluton is located north of the proposed Vardar Suture Zone, whereas the Eybek and Kozak plutons are north of the Izmir-Ankara Suture Zone. These sutures may mark regions of the closure of branches of the NeoTethyan Ocean. To better understand their sources and tectonic evolution, we acquired geochemical and geochronological data, and cathodoluminescence (CL) images of the rocks. Previously reported ages of the plutons range from Late Eocene to Middle Miocene. Here we acquired in situ (in thin section) ion microprobe U-Pb ages of zircon grains found in a range of textural relationships. Ages from the Kozak pluton range from 37.8±5.4 Ma to 10.3±2.4 Ma (^{238}U/^{206}Pb, $\pm 1\sigma$) with two ages from a single grain of 287±26 Ma and 257±18 Ma. We also found Oligocene to Late Miocene zircon grains in the Kestanbolu pluton, whereas zircons from the Eybek pluton range from 34.3±4.8 Ma to 21.2±1.7 Ma. Samples collected from the Kozak and Eybek plutons are magnesian, calc-alkalic, and metaluminous, whereas the Kestanbolu rocks are magnesian, alkali-calcic, and metaluminous with one ferroan sample and one peraluminous sample. Trace element data suggest the Kozak and Kestanbolu plutons have a volcanic arc source, whereas the Eybek pluton is syn-collisional. CL imagery documents a complex history of these granites including magma mixing, multiple episodes of brittle deformation, and fluid alteration. Microveins, microcracks, and myrmekite textures are present, indicating brittle deformation and fluid alteration. Plagioclase grains display a range of compositional zoning and some show distinctly cracked cores that are evidence of magma mixing. The Kozak, Eybek and Kestanbolu plutons may be sourced from the melting of the subducting Mediterranean oceanic crust with a contribution from the overlying Eurasian continental crust. These granites intruded into the Vardar and/or Izmir-Ankara Sutures, entraining the Permian zircon grain. The Oligocene zircon ages are consistent with magmatism propagating from north to south in the Aegean region, whereas the Late Miocene results are consistent with ongoing extension throughout the region at this time. In this scenario, slowing subduction along the Hellenic arc led to the formation of extensional structures that provided space for the accommodation of these magma bodies.