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The Oligocene Xanthi Plutonic Complex (N. Greece): Petrogenetic implications inferred from major and trace element and Sr, Nd and Pb isotope geochemistry

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The Xanthi Plutonic Complex (XPC) belongs to a series of Oligocene subduction-related high-K calc-alkaline plutonic intrusions cropping out in the Rhodope Massif (N. Greece). It is located on the ENE-trending Kavala-Komotini fault zone, which probably originated as a strike-slip fault. Geophysical data suggest that XPC is a laccolith-shaped body, extending several kilometers southwards. It is in magmatic contact with gneisses, mica-schists, amphibolites, calc-silicate rocks, marbles and Eocene-Oligocene sedimentary rocks, forming an extensive contact metamorphic aureole with skarn mineralization. The XPC is distinguished into two main rock groups, the “acid” group and the “basic” group. The “acid” group comprises granodiorites grading into monzogranites bearing microgranular mafic enclaves (MME) of quartz diorite composition. The “basic” group occurs in the eastern part of the complex and is composed mainly of monzonite/quartz monzonite, quartz monzodiorite, and subordinate monzogabbro and olivine gabbro. A small marginal exposure of monzonitic porphyry occurs at the northeastern part of the XPC. The main mafic minerals in the “acid” group and MME are biotite and hornblende, whereas in the “basic” group are pyroxenes (ortho- and clinopyroxenes), biotite, ± hornblende and olivine. Silica content of the XPC ranges between 44-61 wt. % for the “basic” group, 53-57 wt. % for the MME and 62-69 wt. % for the “acid” group. The distinction of the rocks into the two groups is obvious in most element variation diagrams at about 62 wt.% silica. A characteristic feature of the XPC rocks is their high potassium content (up to 6 wt.% for the “basic” group) which classifies them as high-K calc-alkaline to shoshonite. REE patterns show LREE enrichment both in the “basic” group [(La/Yb)CN = 3.5-18.6] and the “acid” group [(La/Yb)CN = 6.3-13.4] as well as in the MME [(La/Yb)CN = 5.8-16.9]. All rocks have negative Eu anomaly except a few gabbroic rocks showing cumulitic characteristics. The most mafic rocks of the “basic” group and MME can be considered as mantle-derived magmas, and initial ratios (based on 28 Ma) of 87Sr/86Sr (0.7045-0.7077) and 143Nd/144Nd (0.512300-0.512550) claim for a K-enriched upper mantle source probably metasomatized by crustal components. Lead isotopic compositions (206Pb/204Pb = 18.620-18.845, 207Pb/204Pb = 15.652-15.708, 208Pb/204Pb = 38.225-39.100) support the above origin.

Regarding evolution, MME presence, mineral disequilibrium, and trace element variations indicate open-system evolutionary processes for the two groups, ruled by magma mixing rather than crustal assimilation. Sr, Nd and Pb isotopic compositions of both the “basic” (see above) and the “acid” group (87Sr/86Sr = 0.7060-0.7069, 143Nd/144Nd = 0.512346-0.512496, 206Pb/204Pb = 18.786-19.076, 207Pb/204Pb = 15.666-15.932, 208Pb/204Pb = 38.931-39.547) strongly support such a hypothesis.