



## Chapter 2

# Magmatic and Metallogenic Framework of Au-Cu Porphyry and Polymetallic Carbonate-Hosted Replacement Deposits of the Kassandra Mining District, Northern Greece\*

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### Abstract

The Kassandra mining district in the eastern Chalkidiki Peninsula of northern Greece contains ~12 Moz Au in porphyry and polymetallic carbonate-hosted replacement sulfide orebodies. Zircon U-Pb geochronology defines two distinct magmatic episodes in the late Oligocene (27–25 Ma) and early Miocene (20–19 Ma). Both suites are characterized by high K calc-alkaline magmas with the younger early Miocene porphyritic stocks and dikes having indications of shoshonitic geochemistry. Normalized rare earth element patterns support plagioclase fractionation among the late Oligocene suite, whereas amphibole or garnet fractionation is more likely for early Miocene porphyries.

Carbonate replacement mineralization is hosted in marble contained within the semibrittle Stratoni fault zone. Mineralization varies along the 12-km strike length of the fault zone from Cu-bearing skarn adjacent to the late Oligocene Stratoni granodiorite stock westward into Au-Ag-Pb-Zn-Cu carbonate replacement deposits at Madem Lakkos and Mavres Petres. Piavitsa, at the western end of the exposed fault zone, hosts siliceous Mn-rich replacement bodies associated with crustiform Au-rich quartz-rhodochrosite veins. Structural and alteration relationships suggest that carbonate replacement mineralization is syn- to postemplacement of the late Oligocene Stratoni granodiorite stock at  $25.4 \pm 0.2$  Ma. The Olympias Au-Ag-Pb-Zn carbonate replacement deposit, located north of the Stratoni fault zone, is hosted in marble and associated semibrittle structures. Olympias is broadly similar to the Madem Lakkos and Mavres Petres deposits. Early Miocene Au-Cu mineralization at Skouries is associated with a narrow pipe-shaped multiphase porphyry stock emplaced into the hinge zone of a regional antiform.

Late Oligocene and early Miocene magmatism overlaps spatially within the district but defines distinct petrogenetic events separated by about 5 m.y. Carbonate replacement massive sulfide deposition was largely controlled by an extensional structure and receptive host rocks within the fault zone, whereas a major regional fold axis localized the Skouries porphyry system. The change in character of mineralization with time may reflect a combination of factors including preexisting structural control, magmatic-hydrothermal processes, and the availability of reactive host rocks.

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\*Digital Appendix Tables for this paper are available online at [www.segweb.org/SP19-Appendices](http://www.segweb.org/SP19-Appendices).