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Lead isotopes in galena as tracers of the underlying basement in the Cyclades, Greece

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The extensional back-arc setting in the Aegean Sea, Greece, hosts polymetallic ore deposits that are temporally associated with the emplacement of Miocene granitoids and occur adjacent to the major detachment systems (e.g. North Cycladic and West Cycladic Detachment Systems). Various types of mineral deposits (e.g. carbonate replacement, skarn, vein-type Pb-Zn-Ag-(Au), and intermediate sulfidation epithermal deposits) formed during different stages of back-arc evolution and can be found in the metamorphic basement (Upper and Lower Cycladic Nappe), unmetamorphosed Pelagonian zone and Quaternary volcanic units along the active volcanic arc. Despite these host rock differences, a common hypogene mineralogical composition can be found across the Cycladic Islands, consisting of galena, sphalerite, pyrite, and minor chalcopyrite and sulfosalts. Galena (PbS) in particular is an abundant and geochemically robust mineral in these deposits. We present new galena Pb-isotope data collected via LA-Q-ICP-MS analysis of twelve deposits from Lavrion, the mainland in the north, across the islands of Tinos, Mykonos, Serifos, and Antiparos to Milos at the active volcanic arc in the south. Mineral separates have been analyzed from 31 samples with 20 spots on a minimum of 12 grains per sample. Galena shows fairly homogeneous Pb-isotopic compositions: 206Pb/204Pb: 18.68–18.91, 207Pb/204Pb: 15.67–15.75 and 208Pb/204Pb: 38.83–39.18, exhibiting a systematic geographic pattern. Whereas in the northern Cyclades predominantly vein-type deposits have low 206Pb/204Pb-isotope ratios (<18.85), the carbonate replacement, skarn and epithermal deposits in the western Cyclades have uniform and higher 206Pb/204Pb-isotope ratios (>18.85). The similarity of the 206Pb/204Pb-isotope ratios of galena from Lavrion and Milos suggests a common metal source underlies both regions, the Lower Cycladic Nappe, which contributed to the shallow crustal deposits in the western Cyclades and was accessible since the Late Miocene. In contrast, a mixture of more primitive metal sources, the Upper and Lower Cycladic Nappes, can explain the lower and heterogeneous 206Pb/204Pb-isotope ratios in the northern Cyclades. Based on Pb-isotope signatures the metal sources of the Cycladic Mineral District can be divided into two groups: a primitive and heterogeneous source in the northern Cyclades and a more evolved and homogenous source in the western Cyclades, and the two groups help define the fault trace of the proposed Trans Cycladic Thrust.