



Phosphorus-rich olivine overgrowths: Evidence for additional impact to the Main Group pallasite parent body

Neva Fowler-Gerace (1) and Kimberly Tait (2)

(1) Department of Earth Sciences, University of Toronto, Toronto, Ontario, Canada (neva.fowler.gerace@mail.utoronto.ca),

(2) Department of Natural History, Mineralogy, Royal Ontario Museum, Toronto, Ontario, Canada (ktait@rom.on.ca)

Phosphorus-rich olivine (1-7 wt% P_2O_5) is a metastable phase known from fewer than a dozen meteoritic or terrestrial occurrences. We have thoroughly examined P-rich olivine in the Springwater pallasite to characterise its distribution, textural relationships, and geochemical signature. P-rich olivine is abundant in Springwater as randomly distributed millimetre-scale partial overgrowths on the nominally P-free forsterite crystals. Geochemical analyses support the substitution mechanism of P into the tetrahedral Si site with octahedral site vacancies for charge balance; observed trace element variations, on the other hand, are not related to P substitution. Element mapping reveals fine-scale oscillatory P zoning in unusual serrate patterns, indicating rapid crystal nucleation from a melt and a subsequently variable rate of crystallisation. We constrain P-rich olivine formation in Springwater to at least 10-100 Myr subsequent to the introduction of the metal but before cooling below 700°C. Because the P-rich overgrowths overprint specific host grain boundary modifications, we suggest an impact to the Main Group pallasite parent body may have triggered the episode of extremely rapid cooling necessary to crystallise and preserve this rare phase.