

Sulfur

Large particles

Medium particles

Fig. 1. Timeline summarizing the timing, duration, and climate effects of the unknown 45 BCE and Okmok 43 BCE eruptions relative to historical and other events during the waning days of the Roman Republic and Ptolemaic Kingdom (after ref. 1). European summer temperatures are taken from ref. 3.

120

80

40

Sulfur peak not

local eruption

observed in central

Greenland ice cores indicates minor, more

Roman Republic

insoluble

core

0.8

Ice cores

Roman Empire

¹ J. R. McConnell et al., Extreme climate after massive eruption of Alaska's Okmok volcano in 43 BCE and effects on the late Roman Republic and Ptolemaic Kingdom. Proc. Natl. Acad. Sci. U.S.A. 117, 15443-15449 (2020).

² S. Strunz, O. Braeckel, Did volcano eruptions alter the trajectories of the Roman Republic and the Ptolemaic Kingdom? Moving beyond black-box determinism. Proc. Natl. Acad. Sci. U.S.A., 10.1073/pnas.2019022117 (2020).

³ J. Luterbacher et al., European summer temperatures since Roman times. Environ. Res. Lett. 11, 24001 (2016).