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Environmental and depositional controls on laminated freshwater carbonates: an example from the Roman aqueduct of Patara, Turkey

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Carbonate deposits in Roman aqueducts are a new high-resolution data source for environmental changes during the time of the Roman Empire, notably in the fields of palaeoclimate and spring hydrology. In order to separate environmental effects from those related to depositional setting, laminated carbonate deposits were systematically compared along the entire length of one exceptionally well-preserved ancient aqueduct channel, that of Patara, Turkey. The carbonate deposits are composed of alternating dense, coarse-grained and porous, fine-grained laminae. The former formed in the dry, warm season and the latter in the wet, cool season. The relative importance of both laminae types depends on the location within the aqueduct: dense, coarse-grained laminae dominate in steep sections of the aqueduct, while porous, fine-grained laminae are mostly found on gentle slopes. This is attributed to the flow velocity of the water, since fast flow on steep slopes hampers the development of biofilms. Oxygen isotope data measured in carbonate profiles show oscillations with increasing amplitude downstream reflecting increasing water temperatures in the channel, while evaporation plays a minor, damping role on these oscillations. Carbon isotope values show an abrupt increase where an open masonry channel replaces a closed conduit made of ceramic pipes. This increase is probably due to stronger degassing of CO_2 in the open channel. If these local parameters are taken into consideration, carbonate deposits in Roman aqueducts hold high promises as seasonally resolved archives of hydrology, climate and - in tectonically active regions - recorders of large, destructive earthquakes. Bringing such data from several aqueducts together will be a powerful tool for reconstructions of palaeoclimate, spring hydrology and historical earthquakes in the Mediterranean region.