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INVESTIGATION OF CARBONATE DEPOSITS OF ANCIENT ROMAN AQUEDUCT SYSTEMS IN THE MEDITERRANEAN AREA VIA LASER-ICP-MS AND INAA

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Terrestrial carbonate deposits such as speleothems, travertine and tufa are important archives for paleoclimate. Carbonate deposits also form in Roman aqueducts, and these have recently been proposed as an alternative high-resolution climate proxy. The number of layers in the carbonates can be used to establish how long an aqueduct functioned, and the stable oxygen isotope distribution in the material gives information on temperature in the channel, which is related to external temperature. Besides information on paleoclimate, the carbonate deposits can also give information for archaeology and earthquake research. Many Roman cities, such as Rome, Constantinople, Lyon and Ephesus are fed by several aqueducts, and it would be interesting to know how the water distribution in the city worked. If the source water was of different chemical composition, it may be possible to determine which source fed the different parts of the water supply system. This can be investigated by detailed chemical analysis of trace elements in the carbonate deposits. The same applies to aqueducts that were fed by more than one source: in this case, it may be possible to establish how the source water was used, and if both sources functioned all the time. Finally, changes in land use such as deforestation will gradually change the composition of source water of an aqueduct, and such changes may therefore be detected in the trace element record.

Trace element chemistry of calcium carbonate as occurs in the aqueducts was analysed by Laser-ICP-MS and INAA. Laser-ICP-MS comes up with a good spatial resolution respecting the seasonal variation of the trace element ratio in the deposits, whereas INAA delivers concentration profiles on a wide spectrum of trace elements. INAA data should be analysed with multivariate statistical methods to carry out provenance analysis in order to deliver insights into the function of the former aqueduct system. Previous results indicate that the homogeneity of trace elements in the collected samples is high enough for this purpose. Further samplings and measurements to confirm this assumption are in progress. The Laser-ICP-MS measurements were performed at the Institute for Geosciences of the Johannes-Gutenberg University of Mainz, Germany. For INAA the research reactor TRIGA Mark II of the University of Mainz was used as neutron source. The reactor provides multiple irradiation facilities for INAA purposes: The rotary specimen rack allows simultaneous long time irradiation of up to 80 samples, a higher flux for detecting low element concentrations can be reached in the central irradiation tube, and the pneumatic transfer system is available for activation products with shorter half-life. Results of the detailed seasonal behaviour as well as the ongoing provenance investigation via INAA will be presented.

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