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The potential of ingrowth 226-Ra as a new dating tool for late Holocene carbonate deposits

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One of the most commonly used methods for dating carbonate deposits, such as speleothems or calcareous sinter deposits, is the ^{230}Th/U-disequilibrium method. With this approach, ages up to 500 ka can be obtained. However, especially for late Holocene samples, substantial detrital contamination may represent a major problem for radiometric dating. The high ^{232}Th content, which is an indicator for the amount of detrital contamination, leads to elevated U/Th-ages and generally larger uncertainties, which limit the potential of the corresponding samples for paleoclimate reconstructions. Ingrowth ^{226}Ra shows the potential to be used as an alternative dating method. In combination with Ba, U and Th, it is possible to date samples with ages up to 8 ka.

In general, there are three sources of ^{226}Ra in carbonate samples. (i) excess ^{226}Ra incorporated during deposition of the material, (ii) detrital material present in the carbonate, and (iii) ingrowth ^{226}Ra produced by the radioactive decay of its parent ^{230}Th. Due to the geochemically similar behavior of Ra and Ba, it is possible to correct for the amount of excess ^{226}Ra. As for the ^{230}Th/U-disequilibrium method, ^{232}Th can be used to correct for detrital contamination.

To test our new method, we applied it to several calcareous sinter samples from different Roman aqueducts, which supplied drinking water to ancient cities such as Jerash or Cordoba . The separation of Ra, Ba, U and Th from the matrix of the samples is performed using a single aliquot of material and different ion exchange resins. Prior to the separation process, a calibrated mixed Ra-Ba-Th-U spike solution was added and equilibrated with the sample solution. The results are not only compared to model simulations for the new system, but also to ages obtained with the conventional ^{230}Th/U-method.