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High resolution comparison of U-Pb and U-series ages of a speleothem from the Spannagel Cave, Austrian Alps.

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Dating speleothems from the earlier part of the Pleistocene presents a difficult challenge with few robust methods available. In recent year several studies have shown that U-Pb isotopic dating is a promising option. However this method, in contrast to U-series dating (the method of choice for younger samples), requires the integrity of the whole uranium decay chain and few tests of this requirement have been conducted. Here we present new high resolution data from the Spannagel Cave in the western Tauern Window in the Austrian Alps. The cave developed in a 20-30m thick calcitic marble sandwiched between granitic gneisses. A conspicuous feature of Spannagel speleothems is their high U content which coupled with very low common lead concentration allows U-Pb age determination on samples within the age range of precise U-series dating.

The investigated sample (SPA 4) is a yellow flowstone ca. 5cm thick, with uranium concentrations ranging from 100-400 ppm and $^{238}U/^{204}Pb$ ratios in the millions. It is composed of coarsely crystalline columnar calcite with distinctly coloured layers up to 10mm thick. There are two horizons along which the specimen cracked easily; these are likely to represented significant interruptions to calcite precipitation.

U-series ages were measured on 8 subsamples by TIMS in Heidelberg and range from 263 ka to 362 ka. 8 independent subsamples were analysed for U-Pb in Leeds with corrections for uranium disequilibrium based on ^{234}U excess values measured in Heidelberg on aliquots of the U-Pb sample solutions. Disequilibrium-corrected U-Pb ages

range from 267 ka to 340 ka. For the main part of the sample representing an apparently continuous short growth interval the two sets of ages agree well within analytical error. For the two older growth intervals the difference in sampling scales makes comparison more difficult but there is no disagreement between the two methods.

These results provide strong support for the use of U-Pb dating on speleothem samples that are too old for U-series geochronology and confirm closed system behaviour throughout the uranium decay chain even in samples with exceptionally high uranium concentrations.