Constraining the multi-stage burial and tectonic history of northern Switzerland over the last 200 Ma with carbonate clumped isotopes and LA-ICP-MS U-Pb dating

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Diagenetic carbonates form by various processes in a wide range of marine, burial or meteoric diagenetic environments and at different stages in the evolution of a sedimentary basin. If they are preserved and datable, they allow to define absolute time frames for diagenetic and tectonic events and to reconstruct the evolution of temperature and oxygen isotope composition of the precipitating fluids during burial.

In this study, we combine carbonate clumped isotopes and in-situ laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) U-Pb dating of diagenetic carbonates to reconstruct the multi-stage burial and tectonic history of the Late Triassic and Early Jurassic formations in northern Switzerland over the last 200 Ma.

Analyzed calcite, dolomite, and aragonite phases include fine grained matrices, various diagenetic cements, nine different generations of veins, and recrystallized as well as mineralogically well-preserved fossils. Our extensive dataset is consistent with a previous basin evolution model based on vitrinite reflectance, apatite fission tracks, and biomarker isomerzation data, but in addition allows to precisely date different diagenetic and tectonic events. Furthermore, our data reveals the existence of new thermal events that were not previously recognized. We succfully dated tectonic events between 196 and less than 1 Ma ago. Carbonate precipitation temperatures range between ambient and 120 °C in dolomite and calcite veins and the calculated oxygen isotope compositions of precipitating fluids show variations of up to 20 ‰.