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Deciphering the 4-D evolution along and across the Insubric Line using a multi-method geo- and thermochronological approach

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The Lepontine dome, the Insubric Line, and the adjacent Southern European Alps are an archetypal example of indentation tectonics. There, indentation of relatively stiff Adriatic lower crust and upper mantle into the weaker continental Eurasian plate led to unroofing of the Penninic Lepontine dome, as well as strike-slip motion along the Insubric Line. Late-stage collision led to a highly asymmetric exhumation pattern with vertical displacement across the fault line in the range of 15 (±5) km. The brittle faulting and exhumation history has so far received only little attention, and particularly S of the Insubric Line, large-scale interpretations of cooling and exhumation are based on very little quantitative knowledge. Exploring the faulting and exhumation history of the suture between European and Adriatic plates by applying multiple geo- and thermochronometers on both sides of the fault is the main goal of this project.

In this ongoing study (U-Th)/He dating on 44 apatite and 28 zircon samples as well as apatite fission track dating on 25 samples was applied along densely-spaced horizontal as well as vertical transects across and adjacent to the Insubric Line. Apatite (U-Th)/He ages, which monitor cooling below ca. 80 °C, from north of the fault line prominently cluster around 8-12 Ma. Apatite fission track (with a closure temperature of ca. 110 °C) as well as zircon (U-Th)/He ages (with a closure temperature of ca. 210 °C) are only slightly older. These results point to a Late Miocene phase of pronounced cooling and exhumation, significantly younger than previously assumed. Thermochronological results are embedded into paleostress analyses as well as the endeavour to date slickensides.

Additionally, we attempted U-Pb dating on pseudotachylites and mylonites. This methodically challenging approach yielded an age of about 30 Ma for a pseudotachylite sample from the southernmost Lepontine dome in the vicinity of the Insubric Line. The signal was measured for a fine-grained mineral assemblage consisting of chlorite among other minerals. This age corresponds to the phase of major updoming, which we confirmed by mylonite dating, yielding a similar age of 33 Ma. Additional U-Pb apatite data from N or the fault range from 20 to 30 Ma and monitor post-Insubric cooling below ca. 500 °C.

The age pattern will be completed by zircon fission track analyses (with a closure temperature of ca. 240 °C). Upon completion new age and structural data shall lead to a refined model of distinct cooling and exhumation along this prominent segment of the Periadriatic fault line.

Session: *Pangeo workshop: Regional Geology*
Keywords: *Alps, Lepontine dome, Insubric Line, exhumation, faulting*