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Young orogen-parallel growth of External Crystalline Massifs: insights from low T thermochronology in the Aar Massif (Swiss Alps)

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The External Crystalline Massifs (ECM) represent proximal parts of the former European passive continental margin. In their today's inverted position, they align in an arcuate shape along the Alpine arc. Different driving forces have been suggested for the exhumation of these ECMs (compression-induced thrusting, slab dynamics, climate-driven erosion). Less attention has so far been paid to the timing of exhumation of the ECMs in orogen-parallel direction. The current study closes this gap by performing high-resolution low-T thermochronology analyses (zircon and apatite fission track ages, zircon (U-Th-Sm)/He) for the central to eastern Aar Massif resolving 3D information from peak metamorphism (22-17 Ma) to the present. Our results highlight that maximum exhumation rates were initially located at the central Aar Massif (from ca. 22 to 10 Ma), then gradually migrated towards the east (from ca. 10 Ma to present), while the central Aar Massif continued to exhume en bloc, but at slower rates. Hence, the massif grows non-cylindrically in orogen-parallel direction. Such a scenario is consistent with independent kinematic and age constraints from exposed basement fault zones, suggesting that long-term exhumation is mainly controlled by crustal-scale tectonic processes rather than short-term climate-driven erosion dynamics. Particularly the young exhumation history correlates well with recent the seismic activity and uplift pattern.