

Large vertical-axis rotations in the Alps – do paleomagnetic data contradict structural observations? (Oral)

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Paleomagnetic data define three major vertical axis rotations (see Thöny et al., this volume), observed within the Helvetic, Austroalpine, Southalpine tectonic units, the last two also in the Subalpine Molasse:

- 1) 40° clockwise Early to Late Rupelian (32-29Ma)
- 2) 30° clockwise Middle to Latest Chattian (25-23M a)
- 3) 30° counterclockwise < 5Ma

At the first glance the existence of large vertical axis rotation in the allochthonous units of the Alps is surprising. However, analogue experiments of rotational shortening (Soto et al. 2006) and well-studied field examples (transverse ranges, USA; Onderdonk, 2005) show that also after large finite rotations fold axes and thrust directions will be essentially coaxial. Independent evidence of vertical axis rotations can be deduced from onlap maps of successively younger sedimentary units of the early Alpine foreland basin that show that the present day northern margin of Alpine thrusting is not parallel to foreland flexure and therefore thrusting had a rotational component. This rotational component seems to be well expressed in the large scale map pattern of the slices of the Subalpine Molasse, which disappear east of Salzburg and suggest a decrease of shortening toward the east, which could be an expression of clockwise rotation.

The main change in declinations observed in the studied area occurs at the Northern margin of the Alpine nappes, more specifically between the northern front of the Helvetic nappes and the slices of the Subalpine Molasse. Therefore the main rotational movements should have taken place across the nappe boundary at the base of the Helvetic nappes. According to analogue experiments, the amount of rotation should gradually decrease toward the front of the thrust wedge. Across the out-of-sequence basal Helvetic thrust we observe a sudden ~40° increase in clockwise rotation of declinations, which means that most of the clockwise rotation must have taken place during initial detachment of the Helvetic nappes, before they came into contact with the slices of the Subalpine Molasse. The main problem using models of rotational shortening on large scale vertical-axis rotations in the Alps is that shortening estimates in relation to rotation amounts are generally too small to account for the observed rotations.

ONDERDONK, N. 2005. Structures that accommodated differential vertical axis rotation of the western Transverse Ranges, California. *Tectonics* 24, TC4018.

SOTO, R., CASAS-SAINZ, A. M. & PUEYO, E. M. 2006. Along-strike variation of orogenic wedges associated with vertical axis rotations. *Jour. Geophys. Res.* 111, B10402.

