peak pressures recorded in different parts of the nappe were lithostatic and combine the depths thus obtained with radiometric ages. In all published kinematic restorations, the Adula nappe is therefore restored to a depth from which it could only be exhumed to mid-crustal levels by a major to-to-the-south normal fault for which there is no evidence in the structural record. As an alternative to such models accepting that large part of the structural history during exhumation may have been completely erased by later shearing, we propose a purely structural restoration of the central part of the NFP20-East cross section. Benefitting from a probably unmatched wealth of structural and geochronological studies performed along this cross section, the new three-step restoration not only takes into account folding and relative movements between individual units but also nappe-internal thinning resulting from shearing which significantly contributed to the exhumation of the Adula nappe. The restoration results in maximum burial depths of the Adula nappe reaching from c. 47 km in the north to c. 62 km in the south. Assuming a density of 2700 kg/m^3 for the overburden, these depths would correspond to pressures between c. 12.4 and 16.6 kbar while the pressures actually observed are c. 40% (north) to 80% (south) higher. Various numerical and analytical studies have shown that tectonic overpressure, i.e. the isotropic part of the stress tensor exceeding lithostatic pressure, can be up to about the same amount as lithostatic pressure for realistic rheological properties and strain rates of rocks. Admitting such an amount of tectonic overpressure would therefore reconcile the petrological and structural records of the Adula nappe. Hence, we suggest to consider the possibility that tectonic overpressure rather than excessive deepening caused the high- to ultrahigh-pressure metamorphism in the Adula nappe.

The central Alps - eastern Alps boundary in western Austria: a crustal-scale cross section

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A N-S oriented crustal-scale cross-section was constructed east of the Rhine valley in Vorarlberg, western Austria, addressing the central Alps - eastern Alps boundary. The general architecture of the examined area can be described as a typical foreland fold-and-thrust belt, comprising, from bottom to top, the Subalpine Molasse, (Ultra-)Helvetic, Penninic, and Austroalpine nappes. These units overthrusted the autochthonous Molasse along a south-dipping listric basal thrust. The European basement together with its autochthonous Mesozoic/Cenozoic cover is found below this basal thrust.

In the northern part of the section seismic data allow to place the top of the autochthonous Mesozoic at a depth of 3500 m BSL with a moderate dip to the south along the cross section. Several seismic sections show normal faults offsetting the top of the European basement as well as the autochthonous cover and the overlying autochthonous Lower Marine Molasse. In the wider area of Lake Constance and the Rhine Valley (SW Germany, NE Switzerland, SE France) the European Basement is characterised by a mostly ENE – WSW striking Palaeozoic trough system. The observed faults are interpreted as fault structures originally belonging to this Palaeozoic trough system and reactivated during the flexure of the lower plate, due to the N-S convergence of the European and the African plates.

This flexure resulted also in the formation of the North-Alpine foreland basin, filled first with Flysch deposits followed by Molasse sedimentation. Due to the ongoing shortening the Subalpine Molasse was multiply stacked, forming a triangle-zone. The shortening within the Subalpine Molasse in the cross section has been calculated using the Lower Marine Molasse as a reference and amounts to approx. 46 km, (~70%).

During top to the N thrusting of the Austroalpine and Penninic nappes the Mesozoic – Cenozoic sediments of the European continental margin were detached from its basement, stacked and thrusted to the N, until reaching their actual position on top of the Subalpine Molasse. This stack is known as the Helvetic nappe stack. The internal structure of the Helvetic nappe stack differs east and west of the Rhine Valley; e.g. the Swiss Säntis nappe contains only Cretaceous sediments, whereas the Vorarlberg Säntis nappe, holding the same tectonic position in the nappe stack, is build up by Jurassic and Cretaceous strata. Former studies supposed the presence of a major fault structure parallel to the Rhine Valley to decouple the tectonic evolution. Based on our data we alternatively trace these differences back to lateral level changes of the detachment horizons, caused by the reactivation of the lateral ramps and the differences in the original thickness of incompetent lower Jurassic basement strata in pre-existing Jurassic basins.

Plio-Quaternary deformation of the Jura mountain belt: a quantitative geomorphology approach

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The Jura mountain belt is the westernmost and one of the most recent expressions of the Alpine orogeny. The Jura has been well studied from a structural point of view, but still remains the source of scientific debates, especially regarding its current and recent tectonic activity. It is deemed to be always in a shortening state, according to old leveling data and neotectonic observations on paleo-meanders of the Doubs river. However, the few GPS data available on the Jura don't show evidence of shortening, but a small extension parallel to the arc. Moreover, the traditionally accepted assumption of a collisional activity of the Jura raises the question of its geodynamic origin. The Western Alps are themselves in a post-collisional regime and characterized by a noticeable isostatic-related extension, due to the interaction between buoyancy forces and external dynamics.

The quantitative morphotectonic approach coupled with neotectonic study applied to Quaternary deposits and speleothems aims to characterize the current tectonic regime of the Jura. In particular, the analysis of watersheds and associated rivers profiles allow quantifying the degree and the nature of the equilibrium between the tectonic forcing and the fluvial erosional agent. Slope profiles of rivers are controlled by climatic and tectonic forcing through the expression:

$$S = (U / K)^{1/n} A^{m/n}$$

(with U: uplift rate, K: erodibility, function of hydrological and geological settings; A: drained area, m, n: empirical parameters).

We present here a systematic study of these profiles coupled with a morphological study of oxbows, which help to identify and characterize the morphological evolution of rivers in response to vertical movements, hence potential tectonic forcing. Associated to this morphotectonic approach, the tectonic analysis of karst cavities located in the vicinity of the main faults of the belt, allowed to characterize tectonically active zones, both in terms of age and displacement's quantification.