What Happened 5 Million Years Ago in the Alps?

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There is rising evidence that some 5 million years ago a surface uplift event started in the Alps that caused a renewed and ongoing phase of tectonic activity. This uplift event appears to encompass not only the Alps, but also the surrounding regions including the foreland basins (in particular the northern Molasse basin), the Styrian and Vienna basins in the east and parts of the Bohemian Massif. The event is particularly visible in the eastern half of the orogen where topography is lower, convergence is more active and pervasive Miocene strike slip tectonics provides a backdrop against which the Post-Miocene events may be evaluated more clearly than in the west. The evidence includes (i) young karst-cave formation ages at elevations high above current ground water tables, (ii) the indirect evidence of ancient fissions track ages at surface elevations above 2000 m, (iii) bimodal landscapes with substantial planation surfaces about 500 meters above current valley floors (iv) coalification and compaction studies in the sedimentary basins surrounding the eastern Alps, (v) current geodetic surface uplift rates, as well as: (vi) numerical modeling evidence that appears to indicate that the Alps are geomorphologically premature. Overall, it appears that some 1000 m of surface uplift occurred within the last 5 million years. Along the eastern margin of the Alps, the event has been described as an inversion event in the sedimentary basin and has been brought in connection with the cessation of a subduction zone underneath the Carpathian arc. However, the event appears to be associated with little horizontal tectonics and it is regionally widespread, so that we suspect that more deep-seated drivers are responsible. The implications of the event for the discussion around tectonic versus climatic drivers as causes or consequences of young erosion and tectonics in the Alps are profound: Modern consensus holds that the global deterioration of climate some two million years ago is the principal driver for the youngest phase of uplift and erosion in the Alps. We argue here that the glaciation of the Alps was only possible because the 5 million year tectonic event uplifted the range enough so that an icecap could form. As such, we diplace the "chicken or egg debate" (currently in the vogue of climatic drivers) one step back: We argue for a deep seated uplift event as the cause for glaciation in the Alps.

Statistical analysis of a huge fault database around the bend of the Western/Eastern Alps

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The internal arc of the Western and Central Alps underwent an important brittle deformation stage, expressed on the field by meso-scale to kilometric scale brittle structures. Regional paleostress studies achieved all around the arc highlights two distinct extensional phases.

The first is an orogen-parallel extension phase, dated of about 10 Ma using pseudotachylites in the Lepontine Dome (Allanic & Gumiaux, 2013). The strike of the extensional axes turns with the alpine arc, from the Lepontine Dome to the back of the Argentera massif. This major signal increases to the NE of the belt, and could be compatible with the roughly E-W extension observed in the Eastern Alps, particularly within the Tauern

Window, where the maximum age of the brittle deformation at 20 +/-1 Ma is given by the ZFT ages, whose closure temperature is ~240°C±10°C (BERTRAND et al., in prep.).

The second brittle deformation phase corresponds to an orogen-perpendicular extension. This last one becomes more important toward the South of the belt, especially in the Briançonnais zone, from the Vanoise massif to the North of the Argentera massif. This phase appears to be linked to the current activity of the belt, as shown by seismotectonics, especially in the Briançon area (review in SUE et al., 2007).

This paper focus on a new global statistical approach of the sub-databases available, that we compile in a huge database of more than 12.000 individual measurements all-around the bend of the Western/Eastern Alps. Beyond the paleostress mapping, we propose to statistically characterize both extensional phases. Assuming that the second one (perpendicular) is linked to the current activity of the belt, itself ruled out by isostatic processes, we concentrate on the first orogen-parallel extension, which origin remains a matter of debate. “Unfolding” the alpine arc, using a simple geometrical modeling of the belt, allowed unraveling the surprising stability of the orogen-parallel extension in the Whole Western, Central, and Eastern Alps. This approach rises up the issues of (i) the geodynamic origin of this extension developed during Miocene times within an active collisional belt; (ii) the precise timing of its development; and (iii) its continuity between Western and Eastern Alps in terms of both kinematics and time.

ALLANIC, C. & GUMIAUX, CH. (2013): Are there any active faults within the Lepontine Dome (Central Alps)? – Bull. Soc. Geol.. Fr., 184, in press.

SUE, C., DELACOU, B., CHAMPAGNAC, J.-D., ALLANIC, C., TRICART, P., BURKHARD, M. (2007): Extensional neotectonics around the bend of the Western/Central Alps: an overview. - Annu. Rev. Earth Planet. Sci., 96: 1001–1029.

The abandoned Remshnig mine, occurrence of rare minerals; Palaeozoic or Tertiary ore mineralization?

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Parallel with the Pohorje mountainous chain and north of the Drava River, a hilly area of Kobansko extends in northern Slovenia. In the central part of the region, polymetallic Remshnig mine is situated in the thrust zone of weakly metamorphosed old Palaeozoic rocks of the Magdalensberg formation, the Remshnig nappe in the hanging wall, and the retrogressed schists of the Pohorje formation in the footwall. Though the Remshnig ore deposit is known more than 250 years, its origin and mineral association is still not known completely. Some new findings are presented in this contribution. The results are based on field observations and SEM investigations.

Macro- and microstructures of the rocks reveal several phases of tectonic activity, including twice reactivated subhorizontal shear movements, due to which dynamometamorphic imprint can be followed in all rocks. The first one reflects as ductile deformations, yielding mylonitization and foliation. The second shear produced slaty cleavage, which broadly follows foliation. The origin of these two structures is associated with upper Cretaceous nappe stacking and Tertiary Austroalpine eastward escape (e.g. FODOR et al., 1998, 2002, 2008). Own unpublished model of the Pohorje tectonic block origin suggests that Pohorje and Kobansko/Kozjak were still one common block at the time of the Pohorje granodiorite magma emplacement in Lower Miocene and were separated later.

Hydrothermal ore mineralization and silicification follow slaty cleavage in partly brecciated marmorized dolomite lenses and subordinately in metatuffites and phyllites. Younger oblique