The influence of the rotation of Adria and extension in the Pannonian Basin on lateral extrusion in the Alps: insights from crustal-scale models

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The influence of slab-pull induced extension in the Pannonian Basin and rotation of the Adriatic indenter on lateral extrusion processes in the Eastern Alps has been studied through analogue crustal scale modeling. Extension at high angle to the shortening direction has been implemented in the models; these are analogues for the northward convergence of the Adriatic plate and the coeval back-arc type extension in the Pannonian Basin.

Cross-sections and top-view images of the models have been analyzed in detail using particle tracing techniques (DPIV) which enables to calculate surface vector fields and visualize strain localization and block rotations. In the models the amount, timing and direction of extension have been the main variables together with a 20 degrees counter clockwise rotation of Adria. Additionally, a rigid buttress simulating the Bohemian Massif has been implemented, thereby decreasing the width of the area that can accommodate deformation.

The modeling results demonstrated that all models feature a compressional, strike-slip and tensional domain from west to east, respectively. The strike-slip (extruding) domain shows 'en-bloc' rotations in response to displacement velocity variations. The crustal blocks are bounded by conjugate strike-slip faults, which is indicative for lateral extrusion processes. When extension is present the amount of rotation increases, the extruding domains propagate further to the west and the direction of extrusion is parallel to the direction of extension. When extension was ceased whilst convergence continued the extruding domain decreased in size but remained active.

The models which included rotation of Adria, are characterized by the absence of conjugate strike-slip faults and the area that accommodated extrusion is decreased. Thus, it is probable that an indenter rotation has a negative effect on the lateral extrusion tectonics and amount of extension. However, when a Bohemian Massif type boundary was present, along with rotation of Adria, the amount of extension and development of conjugate sets of strike-slip faults are similar to models without rotation. Due to the increase in wrenching, in response to a narrow domain that could accommodate deformation, the models actually featured an increase in the amount of conjugate faults.

The results of this study imply that slab-pull driven extension in the Pannonian domain facilitates the lateral extrusion processes in the Eastern Alps and determines the direction of lateral displacements. A 20 degrees counter-clockwise rotation of Adria does not enhance lateral extrusion whereas the presence of the Bohemian Massif type boundary in the north does, as it fosters the formation of extrusion type fault systems. Furthermore, ongoing lateral extrusion despite stagnation of back-arc extension is in line with recent GPS data.

The Alps/Apennines boundary: structures and kinematics of interfering orogens and comparison with other modern analogues

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Although debated for more than one century, the relationship between the Alps and Apennines remains a puzzling geologic question.

The Alps and the Apennines presently form two independent and adjacent segments of the Alpine orogen. They have opposite tectonic vergence, W/NW for the Alps, and E/NE for the Apennines, both oriented roughly perpendicular to their arcuate trends. The junction area of the two chains is characterised by tectonic domains (MOLLI et al., 2010) resulting from the kinematically complex interaction between the opposite dipping subductions active in the last 30 Myr, i.e. east-southeast "alpine" and west-northwest "apennine". At the junction deformation is represented by extensional fault system and basins development overprinting distributed, crustal-scale contractional structures and widespread block rotation.

Our understanding of the tectonic evolution of this junction can take advantage of comparisons with modern convergence systems such as the Ryukyu-Taiwan, Southern Chile-South Sandwich, Colombia-Lesser Antilles, Hikurangi-Puysegur, Manila-Philippine, New Guinea-Solomon-New Hebrides. In these other modern systems we can identify tectonic architectures controlled by both the structural association and the relative evolution of single structures and basins.

Here we analyse the differences of structural/tectonic evolution of junction areas as a function of the ways that plates kinematically interact. We also present the Alpine-Apennine junction as a key area to understand the dynamics of crustal evolution of interfering convergence systems.

MOLLI, G., CRISPINI, L., MALUSÀ, M.G., MOSCA, P., PIANA, F. & FEDERICO, L. (2010): Geology of the Western Alps-Northern Apennine junction area: a regional review. In: (Eds.) Marco Beltrando, Angelo Peccerillo, Massimo Mattei, Sandro Conticelli, and Carlo Doglioni, Journal of the Virtual Explorer, volume 36, paper 10, doi: 10.3809/jvirtex.2010.00215

Low thermal evolution of the Southern Veporic Unit crystalline basement (Central Western Carpathians) constrained by new fission track data

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New thermochronological data, combined with a previous one and geological knowledge enable to constrain the Late Cretaceous to Neogene tectono-thermal evolution of the southern zone of Veporic crystalline basement. Presented zircon and apatite fission track (FT) data can be correlated with sixth principal tectono-thermal stages. During the late Early Cretaceous period (TS1; ~120–90 Ma), the Veporic crystalline basement was buried below the palaeo-Alpine nappe stack in the depths of ~20–30 km and suffered a greenschist- to amphibolite-facies metamorphic overprint (~350–600°C and ~500–800 MPa). The Alpine metamorphism culminated with maximum temperatures at ca. 120–90 Ma and cooled below the 40Ar/39Ar blocking temperature on mica mostly between 90 to 80 Ma ago. After burial an orogen-parallel extensional exhumation and unroofing of the Veporic domain occurred during the Late Cretaceous to Palaeogene (TS2; ~90–35 Ma). The exhumation of the Veporic domain is documented by zircon FT ages of 75–71 Ma and apatite FT ages of 63–55 Ma, indicating a "rapid" cooling phase during the Late Cretaceous to Palaeocene followed by moderate cooling phase from the Palaeocene to Early Eocene. The exhumation of the Veporic domain continued till the Late Eocene–Bartonian, as it was revealed by preservation of its erosion level due to transgression of the Late Eocene sediments. The Late Eocene to Early Miocene period (TS3; ~35–20 Ma) is related to burial beneath the Upper Eocene to Oligocene strata. The Oligocene sedimentary sequences with thickness less than ~1.5–2.0 km were deposited on uncovered Veporic crystalline basement with only minor indication of