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Subsurface contractional structures of Southern Alps in the Po Plain, Italy: insights from sandbox models

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Southern Alps are the south-vergent fold-and-thrust belt of the two-sided European Alpine chain. Southern Alps are the result of the Eocene continental collision between the European Plate to the north and the Adria Plate passive margin to the south.

Southern Alps are mainly outcropping, even if their outer fronts are buried under a thick pile of sediments belonging to the Po Plain Neogene and Quaternary sequence. In the study area, the central part of the Po Plain, the southverging front of the chain show a non-cylindrical pattern: in the western sector, the chain is much more south-expanded than in the eastern one and also tectonic structures (mainly thrusts) are characterised by lower wavelenghts. Moreover, a “strike” seismic line evidences stratigraphic differences showing a big difference in thickness between the eastern and western Meso-Cenozoic sequence.

Two regional dip seismic lines have been interpreted and depth converted; a strike seismic line helped us to interpret palaeogeographic and stratighraphic differences. The western dip section shows an imbricate fan set-up with two different decollement layers; in the eastern one, a different deformation mechanism produces a single wide intercutaneous wedge with a long wavelenght.

We simulated an oversimplified stratigraphy similar to that of the buried thrust front of the Southern Alps beneath the Po floodplain. Moreover, we reproduced syntectonic sedimentation over the foreland growing structures in two main step. Brittle analogue materials such as sand (ϕ_s=30˚) and glass microbeads (ϕ_m=24˚) have been used to simulate the rheology of competent and incompetent rocks, respectively. Models’ set-

up have been built in order to reproduce the vertical and lateral competence variability due to the geographical distribution of faults and rocks, both in the passive margin and in the syntectonic sediments, responsible for the non-cylindricity of structures. Model PP2 has been constructed with a low basal friction in the western domain and a high basal friction in the eastern domain, with two low competence layers in the syntectonic sediments. Model PP3 contain a single low competence layer in the syntectonic sediments. Only the external domain of each experiment have been analysed and discussed, being the subsurface structures of the Po Plain the subject of the study. Two structures' contour for each model have been produced, at deep structural level, i.e. the top of the pre-tectonic passive margin sedimentary sequence (and corresponding to the Maiolica Fm carbonates) and at shallow structural level, i.e. a layer in the syntectonic silicoclastic sequence (Late Miocene age).

Model PP2: in map view, the shallow map resulted in a western sector characterized by three asymmetric foreland-vergent thrusted periclines with curved fronts and plunging towards the east. In cross section, two of them are detached over the intermediate microbeads layer, whereas the third roots at the base of the model. Only the external thrust front occurred across the whole width of the model, with a salient to the west, a recess in the central domain and a less developed salient to the east. In the central domain, the external thrust became the frontal fault of a box fold, with a backthrust cutting the syntectonic sediment solely. In the eastern domain the contours reached the lowest elevation. The deep structure map shows a single continuous thrust front, with a salient in the western domain and two main culminations.

Model PP3: structure map at shallow depth revealed a long wavelength thrusted fold to the west and a short wavelength structures to the east, connected in the central domain through an array of small faults with opposite vergences. Here the structures culmination occurred. At depth, structures correspond quite well with those at the surface, revealing a more homogeneous deformation mechanism with respect the experiment PP2.

Model PP2 seems to better fit the main characteristic of the buried Southern Alps external domain. Detached structural style of the modelled geology is similar to that of the interpreted thrusts from the western seismic line. In the eastern domain, natural structures appear more complex to model with brittle analogue materials only. In the model, the eastern domain is characterised by a foreland-vergent thrust and a conjugate backthrust with a wavelength longer than the thrusts of the western sectors. In nature, the interpreted structure possess a similar wavelength, being detached at depth, but a more complex structural style with respect to the model.

Sand box models' results have been compared with dip and strike seismic sections

surveying the study area and also with the map showing the arched trend of the buried thrust front of the Southern Alps chain. This comparison highlights that the present geological set-up can be explained mainly regarding at two control factors: differences in the mechanical stratigraphy and the presence of inherited structures.

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Bertotti, G., Picotti, V., Bernoulli, D. and Castellarin, A., 1993. From rifting to drifting: tectonic evolution of the South-Alpine upper crust from the Triassic to the Early Cretaceous. Sedimentary Geology, 86, 53-76.

Cassano, E., Anelli, L., Fichera, R. and Cappelli, V., 1986. Pianura Padana. Interpretazione integrata di dati geofisici e geologici. 73˚ Congresso Società Geologica Italiana, 29-sett.-1986, Roma.

Pieri, M. and Groppi, G., 1981. Subsurface geological structures of the Po plain, Italy. Progetto Finalizzato Geodinamica C. N. R., 414.