restricted to pre-orogenic foreland sequences, and may reveal early passive-margin histories, whereas the latter, abundant within syn-orogenic deposits, record the development of foredeep basins. A clear documentation of pre- and syn-orogenic structures from recent and active convergent margins provides, therefore, useful constraints for the study of continental collision processes.

The Central Apennines of Italy, a Neogene belt that originated from the closure of the Mesozoic Tethys Ocean, is an excellent field laboratory for investigating the time-space relationships among pre- and syn-orogenic deformations. The shape of Messinian and Pliocene foredeeps, whose depocentres are systematically located above Triassic and Jurassic fault-bounded depressions, reflects the architecture of the Mesozoic basins and seamounts. This pattern allows for an interpretation of the high differences in subsidence rates during the Neogene in terms of reactivation of Mesozoic passive-margin extensional structures. Integrated surface and sub-surface data show that synsedimentary normal faults within pre- and syn-orogenic sequences inhibited thrust ramp development, thus outlining the dominant controls of pre-existing structures on the geometry of the thrust stack pile. The present arcuate shape of the Central Apennines results from a superimposed structural heritage phenomenon, where the architecture of the Tethyan Mesozoic paleomargin, and the consequent distribution of Miocene–Pliocene syn-orogenic foredeep basins, strongly influenced the construction of the belt. These combined lines of evidence represent, therefore, a critical step towards an improved interpretation and modelling of the Apennines, as well as of other evolving belt – foredeep – foreland systems.

3D finite element models of continental collision zones

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2D finite element models provide valuable insights in the strain history and stress distribution of continental collision zones and orogens, respectively. In addition, fully coupled thermal and mechanical analyses allow to reconstruct the temperature field and the metamorphic evolution of the rocks in the crustal welt. However, 2D models are limited by their plane strain assumption so that important processes like lateral extrusion and orogen-parallel extension cannot be taken into account.

The present study attempts to overcome these limitations by a 3D thermomechanical model. Extending the mantle subduction model of Beaumont & Quinlan (1993) to 3D, it consists of two crustal blocks symmetric about a vertical plane in the center of the evolving model orogen. Continental convergence is described by applying horizontal displacement boundary conditions at the base of one block, while the base of the other is fixed in the direction of convergence.

The vertical model sides are constrained by lithostatic and, optionally, plate boundary forces. A dynamic, i.e. a coupled thermomechanical modeling approach based on the commercial software package ANSYS is used. The model crust is divided into an upper and a lower part, each characterized by specific thermal and mechanical material properties. An elastic-perfectly plastic material law with pressure-dependent yield strength is used to approximate the irreversible deformation in the brittle domain, while ductile deformation is approximated by temperature-dependent creep laws. In order to describe large amounts of plate convergence as well as surface processes a remeshing routine was developed as add-on to ANSYS. This algorithm allows to replace a deformed finite element grid by a new, undeformed one while maintaining the overall model geometry. Marker points of an independent tracking grid, advected by the current finite-element grid, are used to store the material point histories in terms of displacement, deformation and temperature evolution.

3D parameter studies illustrate how rheological properties and temperature field control the amount of lateral extrusion as well as of crustal exhumation. Lateral extrusion is obviously an efficient process to transport rocks away from the center of an orogen both in vertical as well as in horizontal direction. Vertical distribution of lateral transport decides whether this process promotes or obstructs syncollisional exhumation. Lateral extrusion focused on upper crustal levels may drive tectonic unroofing. In contrast, diffuse extrusion distributed over the entire crustal profile results in reduced crustal thickening and decrease in orogenic topography and erosion rate, respectively. Thus, the modeling results show large variations in stress and strain not only between the orogen and its foreland but also within a vertical crustal section.

Finally, the zonation of metamorphic facies and individual pt-paths predicted by the numerical model are compared to field data from the Variscan and Alpine orogens of Central Europe.

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Paleomagnetic data as indicator of folding propagation in Southern Urals

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Main task of our research is the reconstruction of folding history of Southern Urals. This investigation is based on study of well-known secondary Late Paleozoic remanence in Neoproterozoic and Paleozoic rocks from the Southern Urals and uses pre-, syn- and postfolding components.

Determining a degree of folding (dip of layers in per cent) at the time of secondary overprint it is possible to interpret one in terms of temporal and spatial propagation of folding (Stamatakos, Hirt, Lowrie, 1996; Shipunov, 1997). Comparison of the paleomagnetic pole positions of Late Paleozoic secondary magnetizations with a time-averaged reference apparent polar wander path for the East European platform (Khramov 1991, Torsvik et al. 1992, Van der Voo 1993, Pechersky and Didenko 1995, Molostovsky and Khramov 1995, Smethurst *et al.*, 1998) shows that rocks within the southern Urals were remagnetized in the Late Carboniferous–Early Permian. This estimation based on paleomagnetic data is in agreement with time of collision activation of many tectonic events during the Late Paleozoic (orogeny, intensive folding deformation, thrusting, metamorphism, metasomatism, katamorphism, rejuvenation of isotopic data). A number of geological data shows possibility of propagation and decrease in intensities of these processes from the east to the west.

Late Paleozoic component of remanence in Neoproterozoic and Paleozoic rocks from western, south-western and northern areas of Bashkirian anticlinorium and areas of Southern Preuralian acquired as a rule some prefolding time. In contrast, for sites from central and eastern areas of Southern Urals, the Late Paleozoic component acquired syn- and postfolding time. This pattern reflects folding propagation during the Late Carboniferous–Early Permian from the east to the west for southern parts and from the south (central part of Bashkirian anticlinorium) to the north for northern parts of the Southern Urals.

Structural analysis of seismic data in the Baltic Basin: evidences for Silurian–Early Devonian intra-plate compression in the foreland of Caledonian orogen

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The Baltic Basin is a Late Vendian–Phanerozoic poligenetic sedimentary basin, developed at the western margin of the East European Craton. From the west it is bordered by the Tornquist-Teisseyre Zone and North German–Polish Caledonian Deformation Front. During (?Late Ordovician) Silurian the Baltic Basin constituted the foredeep of the North German–Polish Caledonides, which having been thrust over of the western margin of the Baltica plate caused its flexural bending (Poprawa et al. 1999). Simultaneously, the foredeep basin developed in front of Scandinavian Caledonides (Middleton et al. 1996) which also influenced the structural development of the Baltic Basin (Sliaupa 1999).