from N to S the Bajuvaricum, Tirolicum and Juvavicum, mostly separated by Cretaceous to Palaeogene synclines, which are overthrust lateron, in the case of the Gießhübl syncline during Paleocene time.

In the Carpathians the tectonic subdivision is similar to that of the Calcareous Alps, but facial arguments suggest that the outcropping Krizna nappe system is the former frontal part of the Bajuvaricum, which has been left behind, whereas the main part has been thrust further toward NW, as the Slovakian drillings show. On surface the Tirolicum covers this northern part carrying a segment of Gosau at its frontal part (Brezova Gosau).

With the Neogene sediments in the Vienna Basin the nappe systems were also lowered down by faulting. In general no horizontal displacement along the faults is evident and the pull apart mechanism, which causes the tension is obviously caused by lateral slipping along the Alpine thrust planes either during or after thrusting.

Below the Alpine thrust complex the autochthonous subthrust floor is known by some deep wells. East of the Crystalline spur of the Bohemian massif Jurassic and Cretaceous sediments in a distinct facial arrangement are extending eastward, covered by Molasse.

The basement dips downward under the orogene in a moderate manner in the south of the basin and to a larger amount toward its northern part. Signs of a rifting within the Middle Jurassic are evident showing synsedimentary half graben tectonics, which ceased in the uppermost Middle Jurassic.

The geodynamic evolution of the Alpine-Mediterranean region: from structure to dynamics

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The geodynamical evolution of the Alpine-Mediterranean region is generally considered in the context of the interaction (convergence) of the Eurasian plate and the African plate. In analyses of this interaction the distribution of earthquake hypocentres and the focal mechanisms of earthquakes - in particular those occurring in subduction zones - have been an important source of data. New information concerning the nature of this interaction has been obtained by the application of seismic tomography techniques (Spakman, 1988, 1991; Spakman, Van der Lee, and Van der Hilst, 1993). The resulting three-dimensional seismic velocity structure provides insight into the history of plate convergence in the region on a time scale much beyond that contained in the distribution of present-day seismic activity. This new information allows for new ways of exploring the kinematics and dynamics of the geodynamical evolution of the region.

First, the 3D structure enables us to investigate the merits of various (published) regional aleogeographic/tectonic reconstructions. To this purpose we investigate the quantitative agreement between such reconstructions and the structure of the upper mantle, as obtained by seismic tomography. This is done by forward numerical modelling - on the basis of kinematic reconstructions - of the temperature distribution in the upper mantle, converting the calculated temperature distribution into seismic velocity structure and comparing these model results with the tomographic results (de Jonge, Wortel and Spakman, 1993,1994).

Secondly, from the seismic velocity structure we have inferred that - in the depth range of about 100 to 200 km - deeper parts of subducted slabs have become detached from lithosphere near the surface and we hypothesize that this detachment process has migrated laterally along the strike of the subduction zones. This process is referred to as: lateral migration of slab detachment (Wortel and Spakman, 1992; see also Yoshioka and Wortel, 1995). The process of lateral migration of slab detachment is envisaged to have geodynamical implications on a variety of scales. In particular, the formation and evolution of island arcs and their back-arc regions are adequately accounted for.

With slab detachment as a key element we presented a hypothesis for the Cenozoic evolution of the Alpine-Mediterranean region, with emphasis on the dynamical basis for observed kinematic patterns (Wortel and Spakman, 1992). On the basis of this hypothesis quantitative predictions can be derived for several areas in the Alpine-Mediterranean realm which can be tested against geological and geophysical data. Examples of some tests will be given. Of special interest in this respect are the spatial and temporal variations - implicit in the model of lateral migration of slab detachment - in state of stress, in vertical motions and in volcanic activity along the strike of convergent plate margins.

Analysis of pertinent observables (Miocene to recent) supports our hypothesis of slab detachment (including lateral migration) in the Hellenic and the Apenninic-Calabrian arcs and also in the Carpathian arc, and leads us to conclude that these three arcs are in different stages of evolution (Wortel and Spakman, 1993). The advancement of the slab detachment process and the associated processes increases in the given order: the Hellenic arc being the youngest and the Carpathian arc being the oldest (evolved) version. Finally, a very noteworthy result is that - for all three arcs - the migration patterns associated with the inferred lateral migration of slab detachment appear to originate in the region of the present-day Alps.

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The complex evolution of the Western Outer Carpathians: implications of flexure- and gravity modelling

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Vertical movements in the Western Outer Carpathian foreland system are investigated by lithospheric flexure- and gravity- models carried out along 5 profiles crossing the foredeep and thrust belt. Special attention is paid to the possible influence of pre- and post- orogenic processes on the deflection of the foredeep and thrust belt.

In the west the Neogene foredeep, resulting from the SE underthrusting or subduction of the North European plate under the Carpathian mountain belt, is very steep and narrow. This implies weak lithosphere and high bending stresses. Seismic observations of nearly horizontal Moho are explained with two possible scenarios: (1) a post- orogenic process of slab detachment and (2) the subduction of thinned lithosphere (pre-orogenic passive margin). Furthermore, post-orogenic regional scale uplift, about 150 to 300 m, is proposed for profiles crossing the Western and Central Carpathian foreland, in order to explain erosional surface, elevated distal foreland deposits and the low amplitude of the Bouguer gravity anomaly. A possible thermal uplift, associated with the Pannonian basin evolution is ruled out as possible explanation. Such uplift would imply a negative contribution to the gravity anomaly.

In the eastern part, the foredeep becomes more wider. Although the lithosphere is proposed to be slightly stronger, the effect of widening is explained by the interference of the East European plate, underthrusting or subducting the Carpathians to the SW.

Jointing in the Polish Outer Carpathians: hints for stress field reorientation

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The Polish segment of the Outer Carpathian fold-and-thrust belt is composed of a number of north-verging nappes. Studies of joint pattern within the different lithostratigraphical units of these nappes, as well as within the discordantly overlying younger strata, enable one to constrain the Late Cretaceous through Pliocene stress field of that region.

In the medial segment of the area studied, joints have been analyzed in several nappes, most of the data coming from the Magura nappe. In the last one, joint pattern reveals a clockwise rotation of the reconstructed maximum stress axis (s1) from the Late Cretaceous through the Middle Miocene strata. The maximum stress axis, inferred from the position of the acute bisector between conjugate Coulomb-shear or hybrid-shear fractures, is oriented N-S within the Turonian-Campanian strata, NNE-SSW in the Maastrichtian strata, ENE-WSW within the Palaeocene strata, and NNW-SSE within the Eocene through Middle Miocene strata. This gives 150° of clockwise rotation of s1 in the time-span considered. The maximum stress axes reconstructed for post-Cretaceous strata of other nappes are oriented NNE-SSW to NE-SW, being nearly perpendicular to fold axes.

On the other hand, the Pliocene molasses of the Podhale region display joint pattern indicating the N30-40°E oriented s1. This suggests a further clockwise rotation of the maximum stress axis by