Geophysical Research Abstracts, Vol. 8, 06470, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06470
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Large-scale tectonic interpretation of a 3D seismic model of the Eastern Alps

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The Alps are the result of a long and ongoing tectonic evolution, initiated coevally with the opening of the Atlantic Ocean in the early Jurassic. Major geodynamic processes involved in the orogenesis of the Eastern Alps include the subduction of the Meliata ocean in the Jurassic and Cretaceous, the subduction of the Alpine Tethys in the Tertiary and the following continent-continent collision between the European and Adriatic-Apulian plates. In the Miocene, parts of the Eastern Alps were extruded or escaped eastwards into the Pannonian domain along major fault systems.

Since 2000 several large WAR/R experiments (CELEBRATON 2000, ALP 2002, SUDETES 2003) covered this area by a dense net of seismic profiles. We interpret a 3D seismic model of the Eastern Alps and their transition to the surrounding tectonic provinces (Bohemian massif, Southern Alps, Dinarides, Pannonian domain) derived from CELEBRATION 2000 and ALP 2002 data. The seismic data were processed by different 3D and 2D approaches, resulting in P-wave velocity models of the crust and upper mantle, and a new Moho depth map.

P-wave velocity structures of the upper and middle crust correlate well with geologic

and tectonic units. Examples of regions with relatively low velocities are sedimentary basins and their basement and granitic intrusions in the Bohemian massif. Significant high velocity areas are a deep reaching zone north of the Tauern window, the middle crust of the Tisza unit, and, most pronounced the upper crust of the Adriatic foreland. High velocities in the lower crust are found below the Vienna basin and its north-western and south-eastern surroundings.

The Moho depth map shows a fragmentation into three parts: the European Moho, the Adriatic-Apulian Moho, and the Pannonian Moho. The Moho depth map indicates a southward subduction of the European plate below the Adriatic-Apulian plate and below the Pannonian fragment. However, the Adriatic-Apulian Moho dips in north-eastern direction below the Pannonian Moho. We conclude that the Pannonian fragment was part of the Adriatic-Apulian plate before and during an early state of the collision. Crustal thinning of the Pannonian fragment was initiated during extrusion and escape. Since the Miocene, crustal shortening in the region of the Eastern Alps and Dinarides could have been further enforced by underthrusting of the Adriatic-Apulian plate below the Pannonian fragment.