

3D AUSTRIA – A Geological Framework model of Austria

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INTRODUCTION

In order to provide a large-scale overview of the Alpine geology and adjacent areas for colleagues, students and the public, a supra-regional 3D framework model of Austria was established. The modelling domain covers a rectangular area of about 175 000 km² and a depth to -60 km below sealevel. The finalized model depicts the top horizon of the Eurasian and Adriatic plates, the main geological units of the Alpine orogenic wedge and the synorogenic sedimentary basins in the foreland and within the Alps (Fig. 1). Seven modelling units have been defined in collaboration with the Division of Geological Mapping of the Geological Survey of Austria, which are ordered according to their paleo-geographic origin and tectono-metamorphic history. Boundaries between these units exhibit important sedimentary and tectonic features (e.g. unconformity at the base of Neogene sedimentary basins, Alpine frontal thrust, thrust between Penninic and Sub-Penninic Superunits). Due to the large-scale character of the model, relatively small constituents of the Alpine Orogen (e.g. Meliata Superunit, intrusive rocks along the Periadriatic Fault, minor Neogene basins atop the Austroalpine Superunit) were not included into the model (Fig. 2). Fault surfaces have not been implemented into the model. However, major faults are depicted when they represent a border between two modelling units.

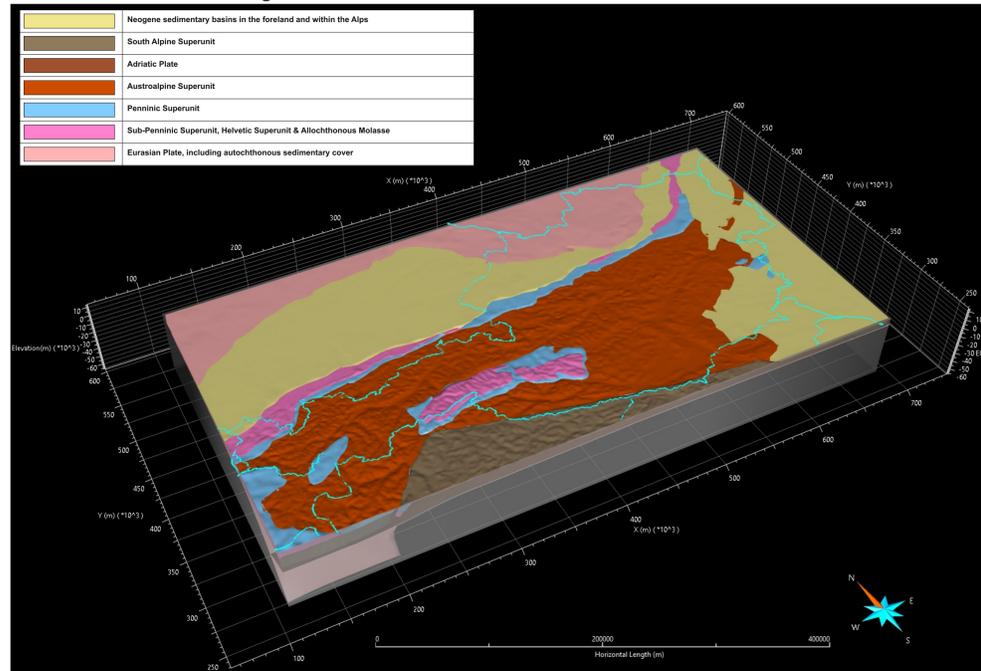


Figure 1: Southwest view towards the 3D framework model of Austria, showing top horizons of respective modelling units. National border of Austria and neighbouring countries indicated for orientation.

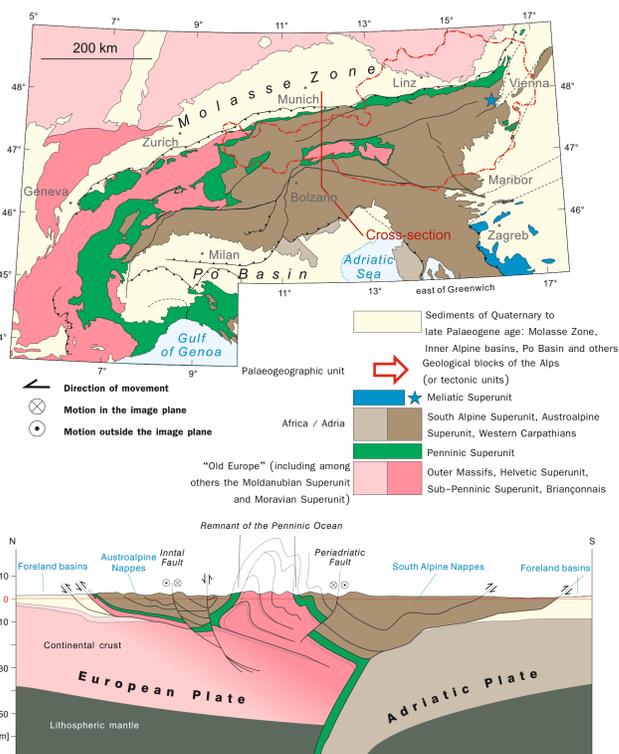


Figure 2: Overview of the main geological superunits of the Alpine orogen (Schuster et al., 2014). The depicted cross section is based on the interpretation of the TRANSALP profile (Schmid et al., 2004)

INPUT DATA

The outline of the modelled units at the surface is based on the map „Multi-Thematic Geological Map of Austria 1:1 000 000” (available via <https://www.geologie.ac.at/services/webapplikationen/multithematische-geologische-karte>), a result of the popular publication „Rocky Austria” on the regional geology of Austria (Schuster et al., 2014, <https://www.geologie.ac.at/rocky-austria/>).

Input data on subsurface geology included:

- 29 Large-scale, vectorized cross sections, roughly trending N - S through the Alpine Orogen (Fig. 3)
- 3 Contour depth maps of the major Neogene basins basements in Austria (Vienna Basin, Styrian Basin, Molasse Basin)
- Contour depth map of the Mohorovičić-Discontinuity (Ziegler & Dézes, 2006)
- Modelled layers of the base of Neogene sedimentary basins from neighboring Geological Survey Organisations, acquired via personal communication:
 - Bavaria/Lfu (Stephan Sieblitz, Robert Pamer)
 - Slovenia/GeoSZ (Dejan Sram)
 - Croatia/HGI-CGS (Tamara Marković via DARLINGE project)
 - Hungary/MBFSZ (Réka Farkas)

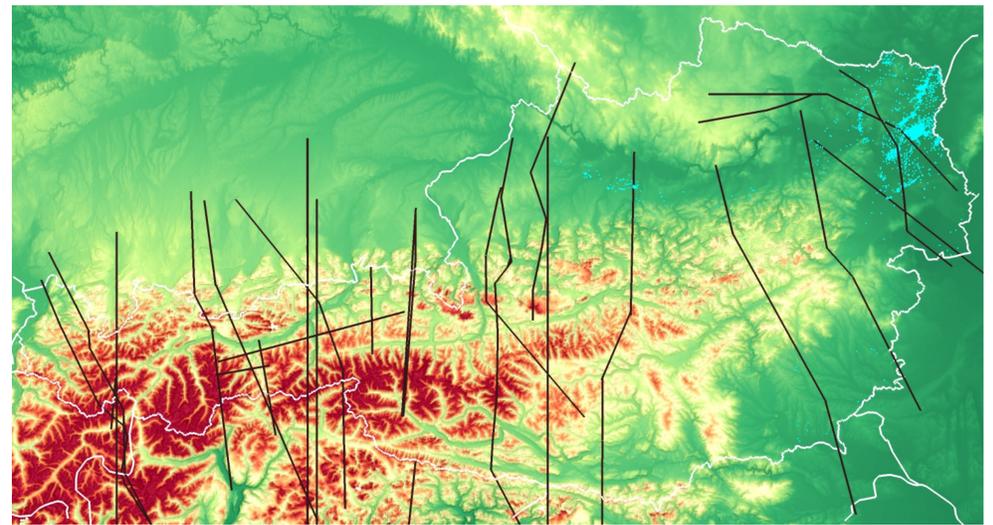


Figure 3: Location of Large-Scale Cross sections and deep wells from the Oil & Gas Industry.

GEOLOGICAL SETTING

The geology in the modelling area is dominated by the collision of the Eurasian plate to the north with the Adriatic plate to the south, representing the basement of the Alpine orogenic wedge. In the lowermost section of the Alpine wedge, sheared off sedimentary parts of the Eurasian Plate build up the Helvetic Superunit on the northern edge of the Alps, while farther south completely metamorphosed pieces of crust form the Sub-Penninic Superunit, which is compressed and eroded at the surface (Tauern Window). In turn, these superunits are covered by the remnants of the Penninic Ocean (Penninic Superunit), which are found on the northern margin of the Eastern Alps and in the area of the Central Eastern Alps, where they emerge in the Engadin Window in the west, the Tauern Window in the central part of Austria and the Rechnitz Window in the east under the Austroalpine Superunit. The uppermost section of the Alpine orogenic wedge is composed of geological nappes which were located at the northern margin of the Adriatic plate before the formation of the Alps. During the formation of the Alps the southernmost nappes were backthrust along the Periadriatic Fault towards the south, representing the Southalpine Superunit. On the other hand, the Austroalpine Superunit summarizes all nappes located to the north of the Periadriatic Fault (Northern Calcareous Alps, Grauwackenzone etc.) which are exposed at the surface in large parts of Austria. In the easternmost part of the modelling area the Austroalpine Superunit is covered by Neogene sediments of the intramontane basins (Vienna Basin, Styrian Basin & Pannonian Basin).

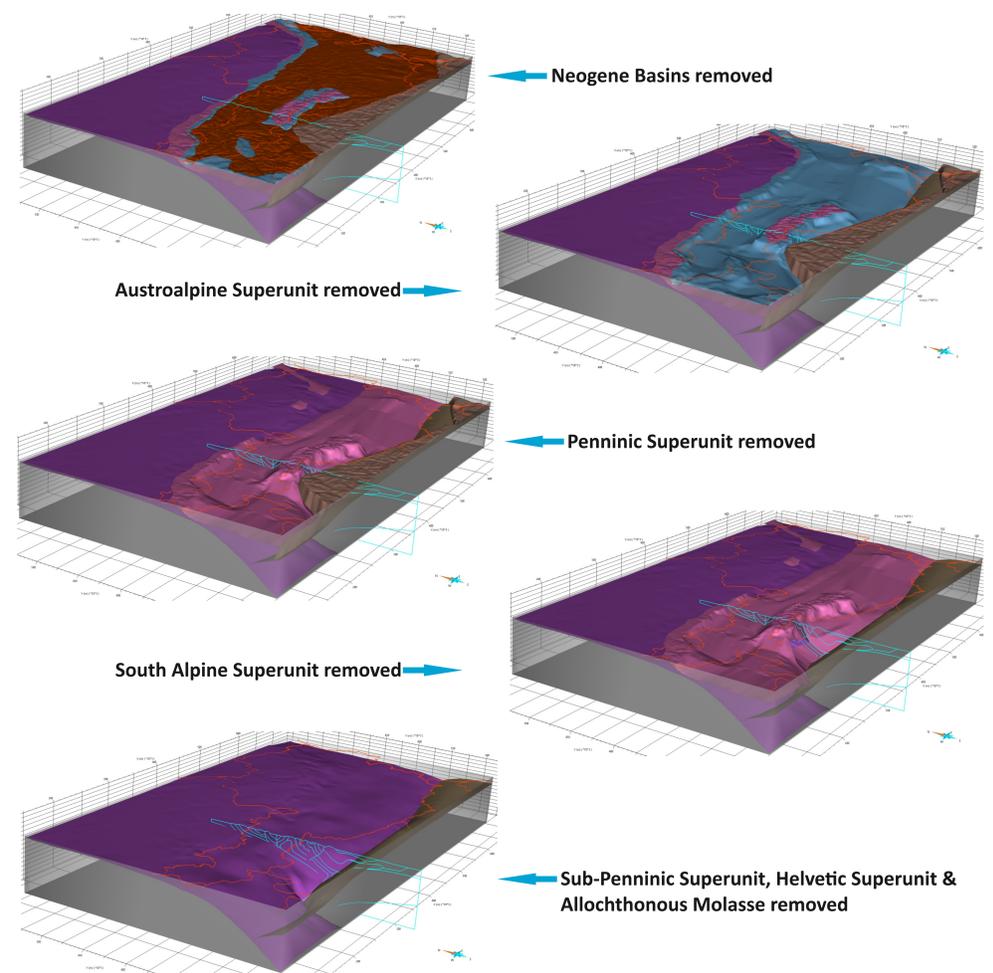


Figure 4: View from southwest towards „3D AUSTRIA”. Modelled top horizons are stepwise removed from top to bottom image for better visualisation. Vectorized TRANSALP profile from Fig. 2 and national borders included for reference and orientation.

DISSEMINATION

The framework model “3D AUSTRIA” is intended to act as an information tool for subsequent regional modelling projects as well as for educational use for colleagues, geology students and the broader public. 3D AUSTRIA shall therefore be made publicly available via the Web 3D Viewer of the Geological Survey of Austria (<https://gisgba.geologie.ac.at/3dviewer/>) and as a physical, multi-part model using 3D printing technologies.

References:

- Schmid, S.M., B. Fügenschuh, E. Kissling, and R. Schuster. 2004. Tectonic map and overall architecture of the Alpine orogen. *Eclogae Geologicae Helveticae*, 97, p. 121-133.
- Schuster, R., A. Daurer, H.G. Krenmayr, M. Linner, G.W. Mandl, G. Pestal, J.M. Reitner, K. Histon. 2014. Rocky Austria: The Geology of Austria - brief and colourful. Geological Survey of Austria, 80 p.
- Ziegler, P.A., & Dézes, P. (2006). Crustal evolution of Western and Central Europe. Geological Society, London, Memoirs. <https://doi.org/10.1144/GSL.MEM.2006.032.01.03>