mechanisms possible. Especially when it comes to mining operations, a multitude of mechanisms has been observed ranging from implosions, so-called compensated linear vector dipoles to explosions despite of simple fault slip. Such events are induced, however, in an environment in which stress changes takes place very fast when compared with the slow tectonic stress built up. So far almost 100 tectonic earthquakes could be studied in terms of their mechanism in Austria. 47 % of these events were of strike-slip nature, whereas 30 % were related to normal faulting. The minority (23 %) could be attributed to thrust or reverse faulting (e.g. Reinecker & Lenhardt 1999, Reiter & Lenhardt 2006)

Other natural tremors can be caused by massive rockfalls, landslides and mountain slides. Few examples of well documented cases of the recent past (Reichenhall, Bad Ischl and the rockfall in South Tyrol at the Einserkofel) are presented, which indicate mechanisms, which deviate from the classic double-couple source usually associated with tectonic earthquakes.

It is anticipated that the introduction of the moment tensor inversion technique for analysing source mechanisms will lead to a new understanding of shallow and deeper seated earthquakes in the Alps in the near future.

Hoernes, R. (1878): Erdbebenstudien. - Jahrbuch der k.k. geologischen Reichsanstalt, **28**, Wien.

Reiter, F. & Lenhardt, W.A. (2006): FPS2 for Windows, a computer program for calculation and visualisation of fault plane solutions. - Abstract. PANGEO AUSTRIA 17.-20.9.2006, University of Innsbruck.

Reinecker, J. & Lenhardt, W.A. (1999): Present-day stress field and deformation in eastern Austria. - Int. Journ. Earth. Sciences, **88**: 532-550.

Gravimetry and Seismotectonics - An example from the Bohemian Massif

Lenhardt, W.A.[1] & Svancara, J.[2]

[1]Department of Geophysics, Central Institute for Meteorology and Geodynamics, Hohe Warte 38, A-1190 Vienna, Austria;
[2]Institute of Physics of the Earth, Faculty of Science, Masaryk University, Tvrdého 12, 602 00 Brno, Czech Republic;
Wolfgang.Lenhardt@zamg.ac.at; Jan.Svancara@ipe.muni.cz

Since 1991 the Department of Geophysics, Central Institute for Meteorology and Geodynamics (ZAMG) in Vienna, Austria, and the Institute for Physics of the Earth, Masaryk University (IPE) in Brno, Czech Republic, have been co-operating in seismological studies. This partnership resulted in a joint project and the establishment of the „Alpine-Carpathian On-Line Research Network“ („ACORN“). The installation of new digital seismic stations with on-line data-transmission to the seismological centres permitted us to study the seismicity across borders.

The seismicity of the geological complexes of the northern part of the Eastern Alps, the Western Carpathians and the Bohemian Massif was investigated by means of these new seismic stations and a review of available earthquake catalogues (Lenhardt et al. 2007). Eleven earthquake catalogues were evaluated and checked for multiple entries, fake earthquakes and mistakes. The final data set of earthquakes covers the time span from 1267 to 2004 and comprises 1968 earthquakes in total. The resulting epicentral map gives a very detailed idea about the seismicity of this region. These data were then compared with gravity data of the region. The data were analysed using the so-called Linsser-method to determine the subsurface trend of fault structures by calculating density contacts and matching them with theoretical models, which fitted the observed data best.

For the computation of density contacts we have interpolated the Bouguer gravity anomalies in a square grid 2 km x 2 km with more than 30 900 grid points. The positions of density contacts at the 4 km depth were computed by choosing a Linsser operator totalling 24 km in length, and at 8 km depth we used an operator of 40 km in length. From a formal point of view it is possible to analyse even deeper crustal levels, however, this requires even larger operator lengths, which cause an undesirable integration of gravity anomalies from different geological units. For that reason the deepest analysed level was chosen to be 8 km below the surface, although some earthquakes might locate even deeper. At the depth level of 4 km the Linsser technique determined 3540 positions of density contacts whereas at the depth 8 km below the surface 1840 density contacts could be calculated. The positions of density contacts at depths of 4 km and 8 km were projected on the shaded topographic relief. This data set enabled us to determine the spatial extent and dip of seismically active fault structures. The ability to assess the potentially seismically active vertical and horizontal extent of fault structures enables improved hazard assessments in future.

Lenhardt, W.A., Svancera, J., Melichar, P., Pazdirkova, J., Havir, J. & Sykorova, Z. (2007): Seismic activity of the Alpine-Carpathian-Bohemian Massif region with regard to geological and potential field data. - Geologica Carpathica, **58**: 397-412.

From the Defereggen-Antholz-Vals (DAV) to the Pustertal-Gailtal fault: Multistage brittle deformation in the Austroalpine basement

Linner, M.[1], Habler, G.[2] & Grasemann, B.[3]

[1]Geological Survey of Austria, Neulinggasse 38, 1030 Wien; [2]University of Vienna, Center for Earth Sciences, Althanstraße 14, 1090 Wien; [3]University of Vienna, Center for Earth Sciences, Althanstraße 14, 1090 Wien; Manfred.Linner@geologie.ac.at, Gerlinde.Habler@univie.ac.at, Bernhard.Grasemann@univie.ac.at

Knowledge of the Oligocene–Miocene evolution of Austroalpine units in the Eastern Alps in the last two decades has been highly improved by numerous structural and geochronological investigations of major fault systems (e.g. Ratschbacher et al. 1991, Peresson & Decker 1997, Mancktelow et al. 2001). Whereas the tectonic evolution of the Northern Calcareous Alps is well constrained, the data set from Austroalpine units S of the Tauern Window remained deficient. There, the transition from ductile to brittle deformation is controlled by two main fault systems, the Oligocene sinistral DAV fault (Borsi et al. 1978) and the dextral Pustertal-Gailtal fault as segment of the Periadriatic fault, which mainly accommodated the Miocene lateral extrusion of the Eastern Alps (Mancktelow et al. 2001).

In the current study, brittle/ductile structural data of the crystalline basement in the Isel valley at the eastern termination of the DAV fault, and in the Schober and Kreuzeck mountains have been evaluated. Sinistral kinematics related with activity of the DAV started with SW-directed thrusting, evolved towards transpressive strike-slip faulting along steep WSW-ENE striking fault planes (Drautal fault), and ceased with NW- and SE-directed normal faulting. During sinistral transpression Oligocene Periadriatic intrusions were emplaced (Müller et al. 2001).

A subsequent change in the stress-field is recorded by subvertical E-W striking faults with ultramylonitic and cataclastic rocks and subhorizontal thrust faults with top to S kinematics. These structural features are most prominent in the basement block between the main fault zones of the DAV and the Gailtal-Pustertal fault, and are interpreted to reflect the switch of major deformation from the DAV north, to the Gailtal-Pustertal fault south of the study area. Later, dextral WNW-ESE trending strike-slip faults formed the remarkable fault systems set up in the Isel, Drau and Möll Valleys. These were linked with dextral strike-slip movement along the Pustertal-Gailtal fault as part of Miocene lateral extrusion. The last stage of significant brittle deformation is characterized by a sinistral reactivation of the Iseltal fault due to E-W compression, which can be correlated with the Late Miocene stress inversion in the Alpine-Carpathian region (Peresson & Decker 1997).

The described structural features characterize the deformational evolution from Oligocene sinistral kinematics of the DAV fault to Miocene dextral kinematics along the Pustertal-Gailtal fault, and may help to understand the processes related with the switch from Oligocene to Miocene kinematics in the Eastern Alps.

Borsi, S., Del Moro, A., Sassi, F. P., Zanferrari, A. & Zirpoli, G. (1978): Mem. Ist. Geol. Mineral. Univ. Padova, **XXXII**: 17 pp, Padova.

Mancktelow N, Stöckli D. F., Grollimund B., Müller W., Fügenschuh B., Viola G., Seward D., Villa I. M. (2001): Int. J. Earth Sciences, **90**: 593-622.

Müller, W., Prosser, G., Mancktelow, N. S., Villa, I. M., Kelly, S. P., Viola, G. & Oberli, F. (2001): Int. J. Earth Sciences, **90**: 623-653.

Peresson, H. & Decker, K. (1997) - Tectonics, **16**: 38-56.

Ratschbacher, L., Frisch, W., Linzer, H.-G. & Merle, O. (1991): Tectonics, **10**: 257-271, Washington.

Structural correlation between the Northern Calcareous Alps (Austria) and the Transdanubian Central Range (Hungary) and its hydrocarbon potential.

Linzer, H.-G.[1] & Tari, G.[2]

[1]RAG, Schwarzenbergplatz 16, 1015 Vienna, Austria; [2]OMV, Gerasdorfer Str. 151, 1210 Vienna, Austria;
Hans-Gert.Linzer@rohoel.at

In the East Alpine-Pannonian transitional area significant amount of syn-rift extension occurred during the Middle Miocene. In the Rába River extensional corridor a metamorphic core complex-style extensional period was shortly followed by and partly overlapped with a wide rift-style one. Based on the correlation of Eoalpine (Cretaceous) structural markers, about 80 km of ENE-WSW-directed extension can be documented for metamorphic core complex-style extension. The magnitude of later wide-rift-style extension in a NW-SE direction is less constrained, but it is on the order of tens of kilometers (>40 km) based on cross-sectional balancing efforts. These findings have an important corollary for the relative, pre-extensional position of the Northern Calcareous Alps (NCA) and the Transdanubian Central Range (TCR). Taking also into account the displacement on Miocene strike-slip faults in the NCA, e.g. the Salzach-Ennstal-Mariazell-Puchberg fault with a sinistral displacement of about 60 km, the restoration of Neoalpine deformation brings the NCA and the TCR unexpectedly close. In fact, some WNW-trending right-lateral strike-slip faults in the TCR are interpreted to be analogous to those described from the NCA. These Cretaceous tear faults were reactivated during the Late Miocene as it can be documented by reflection seismic data in the subsurface of the Danube Basin. The structural correlation between the NCA and TCR based on the characteristic fault pattern provides evidence for contiguous Triassic to Cretaeous carbonate platform which is in its recent separated position hydrocarbon productive in its eastern part, that is covered by Neogene sediments (Vienna basin, Pannonian Basin). The western NCA mountain chain remains a frontier area for hydrocarbon exploration.

Hydrogeology of the Hartkirchen protection area in the southern Eferding Basin (Upper Austria)

Loidl, J.[1], Häusler, H.[1], Moser, G.[2], Rank, D.[1], Papesch, W.[3] & Körner, W.[1]

[1]Department of Environmental Geosciences, Center of Earth Sciences, University of Vienna, Althanstr. 14, 1090 Wien; [2]Moser & Jaritz, Ingenieurbüro für Geologie, Hydrogeologie und Geotechnik, 4810 Gmunden, Oberösterreich; [3]Austrian Research Centers GmbH, Forschungszentrum, A-2444 Seibersdorf;
treerunner@gmail.com, hermann.haeusler@univie.ac.at, dieter.rank@univie.ac.at, wilfried.körner@univie.ac.at, g.moser@moser-jaritz.at, wolfgang.papesch@arcs.ac.at

The southern Eferding Basin comprises two major rivers, the River Danube, and the River Aschach, which joins the River Danube from the west. The hydrogeologic diploma thesis (Loidl 2007) resulted from a project of the State Government of Upper Austria, which was conducted at the Technical Bureau Moser & Jaritz in Gmunden 2004-2007. The project aimed at compiling the geology and hydrogeology, and in particular investigating the geohydrologic and geohydraulic situation south of the village Aschach. The purpose of the project was to assess conflicts between the further extension of gravel mining by wet excavation and the yield of bank filtration for drinking water west of River Danube. The Eferding Basin belongs to the Molasse Zone and consists of Miocene deposits, the so-called Schlier. Pleistocene fluvial deposits of the Paleo-Danube filled an erosional relief in the Schlier basement up to 5-15 metres. Borehole drilling and multigeoelectric resistivity profiles revealed the sediment distribution and geometry of this porous aquifer along the Danube River. Precipitation is about 800 mm/year, in total about 300-400 l/s of groundwater discharge the southern Eferding Basin and a consensus for the use of about 140 litres/s has been committed. Groundwater isolines were interpolated from 51 wells for high and low groundwater situations and the groundwater balance was calculated. Pumping tests were performed in two testing wells yielding k_f values of about 5.10^{-3} m/s and a medium transmissivity of 0.08 m^2/s. From a monitoring program of in total 30 wells hydrochemistry from 19 wells was compared to River Danube and River Aschach. In addition ^{18}O content of 21 samples from wells in the vicinity of the Danube River was interpreted. The study of the southern Eferding Basin revealed two hydrogeologic provinces, namely the groundwater body of the River Aschach and the groundwater body of the River Danube. South of the village Aschach a long retaining wall paralleling the Danube isolated the groundwater body from the River Danube itself. The groundwater system of the western part of the Danube floodplain receives influx from the western and northern slopes of the basin as well as local bank filtration water of the River Aschach. The groundwater of the eastern part of the Danube floodplain, north of and close to the retaining wall, is a mixture of bank filtration water of the River Danube, local groundwater and groundwater of the western Danube floodplain. Because the monitoring program for the differentiation of these two local groundwater bodies only lasted for one hydrologic year, we cannot give evidence for dynamic processes of mixing of these two groundwater systems.

Loidl, J. (2007): Hydrogeologie des Eferdinger Beckens im Raum Hartkirchen (Oberösterreich) mit besonderer Berücksichtigung der Grundwassersituation im Bereich der Aschauer Au. - Unveröffentlichte Diplomarbeit, 90 S., zahlr. Abb., Anhang, Fakultät für Geowissenschaften, Geographie und Astronomie (Department für Umweltgeowissenschaften), Universität Wien, Wien.