commonly known as Gosau basins in the Eastern Alps, in all parts of the ABCD belt. Similar collapse basins occur all along the northern, Alpine-Carpathian-Balkan strand as well as in Dinarides. Common features include: (1) age postdating oceanic, Meliata - Vardar, closure; (2) an age postdating the formation of the Cretaceous-aged nappe stack and peak conditions of the Early Alpine metamorphism; (3) synchroneity with exhumation of metamorphic orogenic wedge and exhumation of metamorphic core complexes as well as of previously subducted continental crust; and (4) deposition of high proportions of siliciclastic material reflecting relief, exhumation and denudation of metamorphic crust. In the eastern part of the Carpathian-Balkan strand, these Gosau basins are associated with a linear belt of calcalkaline volcanic and shallow-plutonic successions known as Banatite Suite. A lateral diachroneity in onset is observed.

A summary of existing and new own Ar-Ar single-grain age data from these Gosau basins covering the entire ABCD-belt reveals a direct connection with exhuming metamorphic crust. The proportion of Cretaceous-aged white mica is high in the west, and low in the existing reflecting the exhumation of the high-pressure belt in Alps and Apuseni Mountains.

The Meliata/Vardar oceanic basin started to close during the Middle Jurassic. The final closure of the Meliata basin occurred during the Early Cretaceous with the formation of a deep sea trench. The overall process is A-subduction and high-pressure metamorphism of the distal Austroalpine continental margin, and subsequent exhumation of high-pressure rocks and in overall transpressional setting. Geochronologic data monitor continuous footwall accretion of cover and basement/cover nappes between 120 and 50 Ma. Late Cretaceous Gosau basins seal the Meliata suture and nappe stacking structures. Formation of these basins in the Eastern Alps was associated with sinistral wrenching, northward tilting of the orogenic wedge, normal faulting at shallow crustal levels and exhumation of eclogite-bearing crust within Austroalpine units. A model with trench retreat of the subducting Austroalpine/Penninic lithosphere can explain exhumation of high-pressure rocks, accretion of subducting material and subsidence in the upper plate, where Gosau-type basins formed.

Geochemical characteristics of the Miocene Volcanism in SE Styria, Austria

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The Styrian basin, the westernmost sub-basin of the Pannonian basin system, is located at the eastern margin of the Eastern Alps. The majority of the studied samples were revealed by drilling cores in the southeastern part of the Styrian Basin. The rest of the samples have been collected from quarries.

The rocks are high-K calc-alkaline (andesites and dacites) and alkaline (latites and shoshonites). K/Ar-ages range from 16.3 to 13 Ma with high-K calc-alkaline rocks representing the oldest suite. A striking petrographic difference between both groups is that the calc-alkaline rocks are amphibole bearing and lack of clinopyroxene. Some zoned clinopyroxenes from the alkaline rocks have magmatic corroded cores overgrown by more basic rims suggesting basic magma reflux.

In the spiderdiagrams all the samples show remarkable negative Nb and Ta troughs and high contents of LILE. Additionally the clalc-alkaline rocks have negative P anomaly. However, the calc-alkaline rocks are characterized by low contents of LILE and HFSE when compared to the alkaline rocks.

The calc-alkaline rocks from Styria are similar to those from the Carpathian-Pannonian area that have long been recognized as being typical for subduction related-magmas (SEGHEDI et al. 2004). They can be modelled by an AFC-process controlling the composition of an IAB-magma with F=0.6 and r=0.4. As contaminant is proposed the upper continental crust.

While high-K calc alkaline rocks can be explained by an AFC-process the composition of the alkaline rocks (latites and shoshonites) seems to be a consequence of batch melting processes of a pre-enriched mantle, which can be derived by mixing of primitive lithospheric mantle with material from the continental crust. Model calculations reveal that the fraction of continental material in the mixture was 4% and the batch melting process took place in the stability field of spinel-lherzolite at 5%.

From the geodynamical point of view, the calc-alkaline lavas can be seen as a consequence of the subduction of the Rhenodanubian-flysch or the subduction of the West-Carpathian-Flysch. This subduction was related to the N-S convergence of Africa and Europe in the Early Miocene. In contrast the alkaline magmatism was the result of decompressional melting of a metasomatic pre-enriched mantle. The process of decompresional melting may be related to the extension that characterizes the western margin of the Pannonian Basin during the Middle Miocene (SEGHEDI et al. 2004).

SEGHEDI, I., DOWNES, H., SZAKACS, A., MASON, P.R.D., THIRWALL, M.F., ROSU, E., PECSKAY, Z., MARTON, E. & PANAIOTU C. (2004): Neogene-Quaternary magmatism and geodynamics in the Carpathian-Pannonian region: a synthesis. - Lithos, **72**: 117-146.

Multiple Particle Interactions

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A mathematical model is developed to account for the rotational disturbances of rigid ellipsoids caused by interactions between neighbours. The equations of motion of rigid particles in isolation are adapted via the Kuramoto model which implements synchronisation among the set of interacting particles. The orientation of the ellipsoids is determined by three angles (the Euler angles) which in turn determine the angular velocity at any point in time. Rather than adjusting the perturbed velocity field, a noise term is appended to the equations that determine the angular velocity. This term depends on the neighbouring particles' degree of coupling, proximity and relative position. Simulations reveal a preferred orientation at an angle to the shear direction that increases with the degree of coupling.

Slump structures and paleoslope: Case study in pelagic limestones of the Ammergau Formation, Ampelsbach gorge, Northern Calcareous Alps, Tyrol, Austria

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One method to estimate paleoslope orientation is to study and interpret slump folds. Existing methods for analysis of slump structures require collection of orientation data on a scale similar to the size of the slump body. Given the nature of a typical outcrop, which is usually 2D and some ten meters long, this requirement will not be met, and the sample will be incomplete, giving unreliable information. In the outcrop described here, typically 1-4 slump fold axis measurements per slumped bed could be made, which is not sufficient to interpret slump dynamics. Only the assumption of unchanged slope throughout deposition of the Ammergau Formation and the treatment of all collected data together allows an interpretation.

The Upper Jurassic to Lower Cretaceous Ammergau Formation of the Ampelsbach gorge in the Achensee region has many slumps. They are typically restricted to single or multiple beds between undisturbed beds. Some slumps are erosionally truncated or sealed at the top, whereas the base shows gradual increase in deformation. Slump folds have typically axial surfaces parallel or slightly inclined to bedding and fold style of most folds is similar, only few parallel folds were observed. Facing of folds is not systematic. Type 3 fold interferences are more common than type 2 fold interferences. In the latter case, the refolded fold is of similar type, whereas the overprinting fold is of parallel type. Lineations on folded bedding planes are parallel to hinges of similar folds. Tensional structures, i.e. listric normal faults and boudins are abundant, but are not observed together with folds. Axes of similar style slump folds cluster about an E-W direction, hinges of parallel folds trend N-S. Neither slump folds nor normal faults do indicate a preferred direction of slump movement. However, total thickness of the Ammergau Formation increases to the west from 80m in the studied section to 600 m 10 km to the SW (Nagel et al. 1976), giving an independent estimate of paleoslope orientation. Therefore we interpret a westdirected slump movement.

Various aspects of slump sheet kinematics can be described by (1) a dislocation model (Farrell 1984) and (2) a shear zone model (Ortner 2007). The first model describes orientation of fold axes on the scale of the slump as a function of the maximum offset across the basal glide plane relative to its size. It neglects the effects of large simple shear strain during transport, which leads to a downslope reorientation of foldaxes, change of fold style from parallel to similar and rotation of axial planes of folds toward parallelity with bedding, and formation of stretching lineations. Therefore we suggest (also) to use a shear zone model when interpreting slump deposits.

Farell, S.G. (1984): A dislocation model applied to slump structures, Ainsa basin, South Central Pyrenees. - Jour. Struct. Geol., **6**: 727-736, Oxford.

Ortner, H. (2007): Styles of soft-sediment deformation on top of a growing fold system in the Gosau Group at Muttekopf, Northern Calcareous Alps, Austria: Slumping versus tectonic deformation. - Sed. Geol., **196**: 99-118, Amsterdam.

Stratal patterns of clastic wedges in transpressive systems: Gosau Group of Muttekopf revisited

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Cretaceous nappe stacking in the Northern Calcareous Alps took place in a transpressive setting. Initial thrust sheet detachment and subsequent (N)NW-directed transport was accompanied by dextral shear along NW-striking high-angle faults. Deposition of deep water sediments started before and outlasted Late Cretaceous thrust activity.

Deposition on thrust-sheet-tops was controlled by internal thrust-sheet deformation during transport. Upper Cretaceous thrust-sheet-top sediments of the Northern Calcareous Alps are locally characterized by very coarse clastic facies and syndepositional growth of WSW-trending folds resulting in the development of progressive unconformities.

In well-studied continental growth strata of the southern Pyrenees (e.g. at the classic locality of Sant Lorenc de Morunys), folds are more or less cylindrical and the characteristics of unconformities do not change significantly in different cross sections. The Gosau Group at Muttekopf is preserved in the core of the Muttekopf syncline and on top of the southerly adjacent anticline. Three sections across successive parts of the Muttekopf syncline are fundamentally different and show, from W to E, (1) combined rotational offlap-onlap, (2) combined rotational offlap-onlap-overlap and (3) rotational overlap in the growth strata. Section (2) crosses a high-angle fault with 1 km offset associated with a change from a fold domain in the west, where the Gosau Group is restricted to the core of a kilometric syncline, and a fault domain in the east, where the Gosau Group overlaps a hectometric system of thrust-related anticlines and synclines along the southern basin margin.

A detailed study of the main unconformity in cross section (2) which displays combined rotational offlap-onlap-overlap revealed that the offlap-onlap pattern is mainly produced by changes in strike instead of changes in dip as seen in the classic examples. The geological map of the area shows that the cross sections displaying rotational offlap-onlap (1) and rotational overlap (3) are located between high-angle faults, whereas the main unconformity in cross section (2) is located above a high-angle faults crossing the basin.

We imagine a basin in which dextral shearing and folding in the bedrock of the growth strata were contemporaneously active. This would cause both tilting of fold limbs and offset across the high-angle faults. Given some surface topography of the depositional system, lateral offset would create topography which would be onlapped by younger sediments. At the transition from the slope related to fold growth to the slope related to high-angle faults strike changes across angular unconformities. Therefore the apparent offlap-onlap-overlap pattern produced by changes of strike rather documents the activity of high-angle faults than folding.

Geometry and sequence of thrusting in the Subalpine Molasse of western Austria and Bavaria

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Paleomagnetic data from all main external tectonic units of the Western part of the Eastern Alps indicate large differential vertical axis rotations between the foreland and the Subalpine Molasse, and between the Helvetic nappes and the Subalpine Molasse.