Geschichten, die man versteht, wenn man die Sprache der Steine beherrscht.
Geowissenschafter sind selten Pädagogen oder Didaktiker. Wie gelingt es also, unser umfangreiches, geowissenschaftliches Wissen das wir aus den spärlichen Archiven unserer Erde haben, spannend zu vermitteln und noch dazu Begeisterung zu wecken? Ist uns bewusst, dass räuberische Libellen mit einer Flügelspannweite wie Falken oder Tausendfüßer so lang wie Krokodile die Erde bevölkert haben, oder dass Teile von Europa eine Reise von 7.000 km hinter sich haben?
Nur was man begreift, versteht man. Um die Dimensionen der Erdgeschichte begreifen zu können ist es wichtig diese in geeigneter Form „begreifbar" zu machen.
Welche didaktische Methoden dafür entwickelt wurden und wie man sie umsetzten kann, soll Inhalt dieser Präsentation sein. – Ein Experiment unter Fachleuten.

Fritsche, E. & Sulzenbacher, G. (Hrsg.) (2003): Geo-Reise in die Alpen. - 43-96, (Folio Verlag) Wien/Bozen.

U/Pb isotopic dating of brittle deformation

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U/Pb isotopic dating of calcite has been successfully applied to constrain ages of speleothems, paleosols and calcite tufas (Cole et al. 2005, Woodhead et al. 2006). In this study, we attempt to apply the technique for the first time to gain insight in the dynamics of brittle deformation.
During brittle deformation, fibrous calcite grows abundantly as slickenfibres and tension gashes, recording not only the direction, but possibly also time and rates of deformation.
Under favourable conditions, calcite may contain high uranium concentrations in its crystal lattice (Kelly et al. 2003), and its Pb isotopic composition is sufficiently protected against secondary influences to make it suitable for dating. Our preliminary findings suggest that the main factor limiting uranium concentration in newly grown calcites is host rock composition, particularly organic content.
The study comprises samples from several areas along the Alpine orogen, to record a wide range of different lithologies, tectonic settings and deformation ages.
Initial trace element profiling of samples by Laser-Ablation Inductively-Coupled-Plasma Mass Spectrometry (LA-ICPMS) reveals element distribution and concentrations, allowing for a quick overview aiding in further planning of workflow for each individual sample. Uranium concentrations of 1 to >3ppm and low Pb contents (approximate $^{238}U/^{204}Pb$-ratios of up to ~9000, with variations spanning 3 orders of magnitude) are well comparable to published data of successfully dated calcites (Cole et al. 2005, Richards et al. 1998). Dating several points along a continuous calcite fibre may yield information on deformation rates and (minimum) durations.
Here, we present current results and preliminary interpretations of data from sampling localities in the Cretaceous Gosau basin, Salzburg, Austria.

Cole, J. M., Rasbury, E. T., Hanson, G. N., Montanez, I. P. & Pedone, V. A. (2005): Using U-Pb ages of Miocene tufa for correlation in a terrestrial succession, Barstow Formation, California. - Geol. Soc. Am. Bull., **117**: 276-287.

Kelly, S., Newville, M., Cheng, L., Kemner, K., Sutton, S., Fenter, P., Sturchio, N. & Spötl, C. (2003): Uranyl Incorporation in Natural Calcite. - Environ. Sci. Technol., **37**: 1284-1287.

Richards, D. A., Bottrell, S. H., Cliff, R. A., Ströhle, K. & Rowe, P. J. (1998): U-Pb dating of a speleothem of Quaternary age. - Geochimica et Cosmochimica Acta, **62**: 3683-3688.

Woodhead, J., Hellstrom, J., Maas, R., Drysdale, R., Zanchetta, G., Devine, P. & Taylor, E. (2006): U-Pb geochronology of speleothems by MC-ICPMS. - Quaternary Geochronology, **1**: 221.

Are the major structures of the Eastern Alps recorded in river profiles?

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The Eastern European Alps are known to be tectonically very active. This is in contrast to the Western Alps which appear to act tectonically in passive response to erosion. This difference in tectonic activity between Western and Eastern Alps is now being increasingly well documented, but differences in the morphological response between west and east have not been investigated. Here we study the morphology of the major rivers draining the Eastern Alps to test if the activity of major structures is reflected in channel profiles of the major rivers. Active tectonics of this part of the orogen is reflected in the shape of the channel profiles. In our approach we compare channel profiles measured from digital elevation models with numerically modeled channel profiles using a stream power approach. Interestingly, most knick points, wind gaps and other non-equilibrium features of the rivers may be correlated with features related to the last glacial maximum and appear unrelated to the young tectonic activity. Only a long wavelength uplift of the alps as a whole is reflected in a close correlation between stream power of rivers and geodetically measured uplift rates.

Textural, chemical and microstructural records during snowball garnets growth

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The growth history of two populations of snowball garnets from the Lukmanier Pass area (central Swiss Alps) was examined through a detailed analysis of chemical zoning, crystallographic orientation and 3D geometry. The first population was collected in the hinge of a chevron-type fold and shows an apparent rotation of 360°. Microstructural and chemical data reveal a modification of the stress field regime during garnet growth occuring after 270° of relative rotation and for XMn = 0.009. Crenulated inclusion trails indicate that the last 90° of the spiral curvature was formed under a non-rotational regime associated with flexural folding. Electron Backscattered diffraction (EBSD) maps reveal a crystallographic central domain exhibiting 270° of relative rotation and distinct smaller crystallographic domains at the end of the spirals. A second population collected on the limb of the folds exhibits a spiral geometry that does not exceed 270°. Here, the garnet microstructures do not record any evidence for a modification of the stress field regime during garnet growth, and a single crystallo-

graphic orientation is observed for the whole spiral. Local geological data and microstructural elements tend toward a simultaneous growth and rotation for the core region of the snowball garnet, whereas subsequent garnet growth occurs under a non rotational regime. The similarity in geometry between the central sector domains and the geometry acquired by the snowball garnets under the rotational regime strongly suggests that as long as the growth is accompanied by rotation, the primary core orientation is preserved, but once the rotation stops the crystallographic orientation may change.
EBSD data also indicate that the central domain displays a crystallographic orientation characterized by a [001] pole oriented sub-parallel to the symmetry axis of the snowball garnet. Moreover, in most crystallographic sectors, one of the two other [100] poles is (sub)parallel to the orientation of the internal foliation. This feature suggests that the crystallographic orientation across the garnet spiral is not random and that a relation between symmetry axis, internal foliation and crystallographic orientation does exist. Several arguments indicate that EBSD data can represent an indicator of the modification of the growth regime during the formation of the snowball garnet. In this view, EBSD data can potentially be used to distinguish between the rotational and non-rotational models.

Determination and interpretation of vertical pressure gradients throughout the Plattengneiss shear zone, Koralpe, Eastern Alps

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The Plattengneiss is one of the largest shear zones in the Eastern Alps. It is flat lying, about 500 m thick and crops out over almost 1000 km^2. It is characterised by a strong mylonitic foliation, a strictly north - south striking lineation, an absence of obvious shear sense indicators and it does not separate different tectonic units in the hanging- and the foot wall. Thus, main kinematic features during the development in the Eo-Alpine orogenic event are still unknown. In this project barometric gradients across the shear zone were measured in order to determine the vertical kinematics via petrological methods.
Samples from the hanging- and the foot wall of the Plattengneiss shear zone were collected. Based on published geometrical models of the shear zone the vertical distance of each sample from the shear zone margin was calculated. Formation pressure was then determined for each sample using THERMOCALC 3.30, paying careful attention to compare identical parageneses in all samples. Moreover, pressure differences were determined for selected hanging wall and foot wall pairs. For this, a new facility of THERMOCALC was employed. Pressure differences can be determined with much more precision than absolute pressures, as many of the errors cancel out.
Pressure differences throughout the whole outcrop area of the Plattengneiss show systematic trends. Typically, pressure differences between hanging wall - foot wall pairs are too high compared to the vertical distance between the two samples. For example, two samples with 2 km vertical separation record a pressure difference of approximately 2 to 4 kbars.
Being aware of that, all samples were listed in an order corresponding to the vertical distance from the shear zone contacts. Two possibilities of vertical pressure gradients are fit to the data. Both feature a more rapid increase of pressure with depth than can be explained by a lithostatic gradient. Both suggest that about 10 km of material in a vertical extension are missing. We suggest that this may be interpreted in terms of a strong component of flattening or as a loss of material during deformation. Moreover, it can be observed that the formation pressures in the Plattengneiss are higher than pressures in both the hanging- and the foot wall. Interpretations of this observation in terms of (a) tectonic overpressure, (b) the shear zone recording a different stage of the metamorphic evolution and (c) the Plattengneiss representing a low viscosity channel are discussed.

The Styrian Tectonic Phase - A series of events at the Early/Middle Miocene boundary (Styrian Basin, Central Paratethys)

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The *Styrian Phase* of Stille (1924) characterises multiple tectonic events at the Early/Middle Miocene, i.e., Karpatian/Badenian boundary. This phase is based on the observed Neogene tectonic history in the Styrian Basin, Austria. In a geologic setting, the Styrian Basin belongs to the western part of the Intra-Carpathian Pannonian Basin system. Basin formation started during the Early Miocene, probably during Ottnangian. On top of deeply eroded Austroalpine nappes, swamp and flood deposits are transgressed by the Paratethys Sea in Karpatian time.
Angular discordances and sedimentation gaps characterize the Early/Middle Miocene, the Karpatian/Badenian boundary. On top of the Karpatian, deep water sediments of the „Steirischer Schlier“ follow a series of marine ingressions of the Badenian Sea in the realm of Central Paratethys. During Badenian, tectonic activity is accompanied by extensive volcanism.
Changes in sedimentation, discordances, sedimentation gaps, as well as tectonic and volcanic activity demonstrate the *Styrian Phase* as a multiphase event around the Early/Middle Miocene boundary. New stratigraphic results in combination with paleomagnetic and micropaleontological investigations allow a timing of these events. A major event is present between the sedimentation of the Karpatian *Steirischer Schlier* and the lowermost Badenian silts, with tilting of the *Steirischer Schlier*, and a sedimentation gap between 16.5 and 16.1-16.2 my. The next gap occurred around the nannoplankton zone NN4/NN5 boundary (14.74 my) between chron C5Br and C5Bn.1n, ranging from about 15.4 to <14.8 my. A third discontinuity at the base of corallinacean limestones is too short to be dated in the Wagna section. The sedimentation gap is extended in the Retznei sections from the top of Karpatian *Steirischer Schlier* to the base of carbonate sedimentation (larger gap between NN4 and NN5). Only in a few places sandy-silty sediments of the Early Badenian are intercalated below the carbonates. Volcanic ash layers and tuffites are deposited within the marls of zone NN5, in the overlapping range of *Praeorbulina* and *Orbulina*, which belong to chron C5ADn (14.19-14.58 my).
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Stille, H. (1924): Grundfragen vergleichender Tektonik. - 1-443, Berlin (Borntraeger).