Thresholds in karst catchments: the example of the Lurbach karst system

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Threshold behavior in hydrological systems generally involves a qualitative change of either a single process (process threshold), the response of the system (response threshold), or the functioning of the system (functional threshold) (ZEHE & SIVAPALAN, 2009). The transition from laminar to turbulent flow provides an example of threshold behavior at the process level, which occurs when the ratio of inertial forces to viscous forces (represented by the Reynolds number) exceeds an empirical threshold value. This transition, for instance, occurs in karst aquifers where water flows rapidly through solution conduits, and it is known that it may strongly influence the hydrological response of the springs draining these aquifers. Assessing if and under which conditions this leads to threshold behavior at the response level, however, is not straightforward, as the spring response is governed by the interaction of several processes and flow components. One example of a response threshold is provided by the Lurbach System (Austria) where the sinking stream Lurbach, which under low-flow conditions only resurges at the Hammerbach spring, additionally supplies a second spring, the Schmelzbach outlet, once a given threshold discharge is exceeded. Interestingly, this threshold appears to have changed after a flood event in 2005, presumably because of the plugging of flow paths with sediments or collapse material. Flow duration curves, master recession curves, and the thermal response of the Hammerbach spring have markedly changed since then, suggesting that a sudden qualitative change in the hydrological functioning was triggered by this flood event (functional threshold). This example demonstrates that thresholds in karst catchments are closely connected to geomorphologic processes, such as sediment transport, and climatic factors, such as the occurrence of extreme events.

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ZEHE, E. & SIVAPALAN, M. (2009): Threshold Behaviour in Hydrological Systems as (Human) Geo-Ecosystems: Manifestations, Controls, Implications. Hydrology and Earth System Sciences 13 (7): 1273–1297.

Serpentinite slices within a tectonic zone at the base of the Juvavic nappe systems (Eastern Alps, Austria): petrography and geochemistry

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Near to Unterhöflein (Lower Austria/Austria) at the eastern margin of the Eastern Alps several tectonic slices of serpentinites occur within a highly tectonised zone composed of schist of the Werfen Formation and different Triassic limestones and dolomites. The tectonic zone is situated at the base of the Juvavic nappe system of the Austroalpine unit. In a similar position basic magmatic rocks are known from several other localities, mostly occuring within evaporitic sediments of the Permian Haselgebirge (GRUBER et al., 1992; SCHORN et al., 2013). Further between the Juvavic nappe system and the underlying Tirolic nappe system tectonic slices of the Meliata unit occur, which represents remnants of the Neotethys oceanic domain (MANDL & ONDREJIKOVA, 1993).

The largest serpentinite body, 400 to 100 meters in size, was investigated by petrological (X-ray diffraction) and geochemical (X-ray fluorescence) methods. The primary mineral composition was olivine + orthopyroxene + clinopyroxene + chromite. Olivine is completely replaced by chrysotile which shows the typical mesh-structures. Some grains of clinopyroxene are preserved, whereas the main part and the orthopyroxene were transformed into lizardite. Within some pseudomorphs after orthopyroxene the former cleavage and twin lamella are visible. Chrome spinel is mostly transformed into magnetite. Further Mg-rich chlorite, talc and hydrogrossular appear.

The mineral compositions of the former peridotites were recalculated by an interative method using a dataset of typical chemical compositions for fresh harzburgite and lherzolite and geochemical analyses of the serpentinites. The results indicate harzburgites as precursor rocks of the serpentinites.

According to SCHORN et al. (2013) the basic rocks from the Haselgebirge represent remnants of the Permian to Lower Triassic rift of the Meliata ocean. However, it is difficult to exhume mantle rocks to the surface with the proposed mechanism without creating a deep marine basin. However, the latter is not indicated by the evaprites and the overlying Triassic shelf sediments of the Juvavic nappes. In any case a relation of the harzburgites to westward propagation of initial rifting of the Neotethys ocean seems to be the most convenient explanation for the investigated rocks.

GRUBER, P., FAUPL, P. & KOLLER, F. (1992): Zur Kenntnis basischer Vulkanitgerölle aus Gosaukonglomeraten der östlichen Kalkalpen - ein Vergleich mit Vulkaniten aus dem Haselgebirge. - Mitt. Österr. Geol. Ges., 84: 77-100.

MANDL, G.W. & ONDREJIKOVA, A. (1993): Radiolarien und Conodonten aus dem Meliatikum im Ostabschnitt der Nördlichen Kalkalpen (Österreich), Jahrbuch der Geologischen Bundesanstalt, Wien, Band 136/ 4, 1993: 841-871.

SCHORN, A., NEUBAUER, F., GENSER, J. & BERNROIDER, M. (2013): The Haselgebirge evaporitic mélange in central Northern Calcareous Alps (Austria): Part of the Permian to Lower Triassic rift of the Meliata ocean? - Tectonophysics, 583: 28–48.

Large-Scale Deformation of the Eastern Alps from Seismic Anisotropy

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Internal deformation in the Eastern Alps is documented by seismic anisotropy, and we report here observations from SKS shear-wave splitting. Together with earlier observations from the Western Alps, these observations present one of the clearest examples yet of “mountain chain parallel fast orientations” worldwide, with a stunningly simple pattern of fast orientations, nearly parallel to the trend of the mountain chain. This simple pattern (of deformation) appears to be in contrast with the complex surface geology of the Alps. Regarding the pattern, we make a number of important observations: there are rapid spatial variations of fast orientation in certain parts of the Alps while there is little variation in others. Where fast orientations vary (Western Alps and the Tauern-Window region), they do so with nearly constant spatial rotation rate. In the Eastern Alps, the fast orientations do not “connect” with neighboring mountain chains, neither the present-day Carpathians, nor the present-day Dinarides, but rather with an intermediate orientation.

There is a clear jump of fast orientations across the Tauern Window, by about 45 degrees, somewhat similar to the geometry of the Adriatic indenter. In the very east, where lithosphere is thin, and where we most likely observe asthenospheric anisotropy, the anisotropy is consistent with eastward extrusion toward the Pannonian basin, if we assume that the anisotropy recorded relative motion of the surface with respect to the deeper Earth moving coherently with the Central Alps. An eastward extrusion has been suggested before, based