Geophysical Research Abstracts
Vol. 20, EGU2018-1689-1, 2018
EGU General Assembly 2018

Genetic and process geomorphology – apples and oranges or two sides of the same coin? (From natural heritage to future). In honour of Frank Ahnert

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Geomorphology knows several sub-disciplines. A traditional, though not the only, subdivision is (historic) genetic geomorphology and process geomorphology. Genetic interpretation of landforms implies the knowledge of processes having created these landforms over time. A problem arises, however, if processes acted only over a certain episode of time and then ceased, giving way to other processes, thus leading to inherited relief generations. Hence, the timing of processes becomes ambiguous and, vice versa, the use of the term “time”.

Time is inherent to processes acting over a certain time at a certain process rate to create a landform. This landform, according to a functional approach, ideally reaches steady state equilibrium with the acting processes. Assuming a constant process rate a landform as the outcome of geomorphological work is the product of process rate and time of action (“physical time” sensu Ahnert). On the other hand, the timing of a past geomorphological or geological event (e.g., an earthquake rupture or a volcanic eruption) or of the onset and the termination of past processes places inherited landforms, weathering residuals, or sedimentary archives in the geological timescale (“historic time” sensu Ahnert). Most dating methods determine historic time, and long-lasting or past process rates are – apart from a few exceptions – estimated via historic time and interpolation between points in time.

Deriving process rates from interpolation may, however, introduce large errors due to the law of error propagation. An age-depth model of sediments, e.g., containing a considerable number of data points and fitted to a regression function may reduce the errors of mean process rates over a longer time span. However, hiatuses and discordances of secondary importance but associated with time lapse may be overlooked as well as shorter wiggles of geomorphodynamics, and, thus, may appear to show non-existent longer term stability of the process rate. A time gap easily entails a gap between genetic and process geomorphology.

Are there perspectives for bridging the gap(s)? Possible and complementary approaches include i), high density sampling, ii), improving reliability and accuracy of dating methods, and, iii), exemplarily reducing the order of dated “historical time” to the order of experimentally observable “physical time”, i.e. to a or few decades or even to a year. If the latter approach can be successfully achieved process geomorphology merges with genetic geomorphology on a short time axis but will allow for much better understanding of process variability and, thus, of historic landscape development in the past (including human impact) and in the future.

Geomorphosites are remnants of one or more relief generations, but they normally do not illustrate the original landform. Their present appearance rather depicts posterior processes and resultant developments known, e.g., as “site formation processes” in geoarchaeology. They may include both, natural and cultural transformations. Deciphering those different processes and the durations of their activity demands great skill in both, process geomorphology and genetic geomorphology, and the timing of the transformations is a challenge for geomorphology and geochronology.