136th MSS-Seminar
Wednesday, March 4th,
15:30 hrs, Seminarraum (00.156),
Cauerstraße 3, Erlangen.

Zebra stripes in the Atacama revisited – seismicity-induced granular fingering as a mechanism for zebra stripe formation?

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The hyperarid parts of the Atacama Desert, N Chile, are among the driest places on Earth, and a number of studies have emphasized the remarkable slowness of Earth surface processes since the late Tertiary. Nevertheless, geomorphic processes such as overland flow or flash flood activity, salt-driven shrink-swell processes, dust deposition, or seismic shaking have significantly contributed to the landscape formation in the Atacama, depending on the significance of rainfall and/or fog occurrence. In areas of low fog frequency, the Atacama-specific and enigmatic zebra stripes characterize numerous hillslopes in the central Atacama. Zebra stripes are contour-parallel, thin lateral bands of rather angular gravels on hillslopes, characterized by grain sorting and a specific wavelength. Hitherto, the study of Owen et al. (2013) represents the only study with detailed investigations on zebra stripes. While these authors suggest that zebra stripes represent fossil evidence of overland flow, recent investigations on the formation of the Atacama boulder fields emphasized the significance of seismicity in shaping Atacama landscapes, thereby challenging the water-related evolution of zebra stripes.

Based on UAV-derived high-resolution aerial photos, geomorphological surveys, sediment sampling and OSL- as well as cosmogenic nuclide-based chronological data, we present new and contrary data on zebra stripe patterns, which may be conducive in their better understanding. We document a wider distribution of zebra-type stone stripes than previously published, and a rather high variability of zebra stripe characteristics with regard to stripe orientation, sorting-patterns and bedding properties. At most locations, stripe orientation seems to be oblique rather than parallel to contour lines. In addition, stripe fronts at numerous locations consist of multiple bulges of 0.5-2 m width showing lateral and downslope coarsening patterns. Based on the form-concordance between these zebra stripes and experiments on segregation-induced granular fingering, we propose a combination of seismic shaking and dry granular free surface flows as the most likely mechanism for the formation of zebra stripes, rather than (palaeo-) overland flow. Finally, the talk gives a general overview of the specific geomorphological conditions in the central Atacama, which seem to be mainly influenced by seismicity, fog-induced soil moisture, and the long-term accumulation of thick layers of atmospheric dust.