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1 Differentiated Denudation in the High Mountains of Taiwan

M. Böse, C. Klose, R. Hebenstreit

Freie Universität Berlin, Department of Earth Sciences, Physical Geography

(mboese@geog.fu-berlin.de / Phone: ++49-30-83870373)

A complex subduction situation between the converging Philippine and Eurasian Plates, and the arc-collision zone of the Luzon arc are responsible for the high seismicity and the formation of the compressive high mountains of Taiwan. Altitudes above 3000 m are quite common, the highest peak being the Yu Shan at 3952 m. The mean uplift of Taiwan is calculated to 5.5 mm/a or 5 to 10 mm/a in the last million-year timescale. The high seismicity prepares the rock for erosion by loosening the near-surface material and triggers differently scaled mass movements and consequently erosion. In addition, the monsoon-driven precipitation regime, reinforced by seasonal typhoon events, generates high surface dynamics and denudation rates. The recent values for erosion are estimated at 2 - 8.6 mm/a on Taiwan, but with some considerable spatial differences. Two major factors are responsible for relief formation in the high mountains of Taiwan: tectonic activity and the climate of the past and present. Geomorphology mainly studies the surface uplift rate and the processes shaping the surface, whereas the bedrock uplift rate provides the background.

During the last glacial cycle the upper parts of Taiwan's mountains were glaciated; calculations indicate that the largest valley glaciers extended down to about 2200 m asl. Thus the uppermost parts of the valleys were cleared of debris by glacial processes and the formation of a typical high mountain relief began at that time. There is a direct correlation between denudation and slope inclination: if relief increases, slope inclination becomes steeper; therefore denudation, itself depending on gravity, also

increases.

Greatly reduced sediment transport in the study areas above 3000 m is obvious, as slopes and debris cones of Holocene age are well preserved and reshape the trough valleys. Holocene periglacial activity is documented but was probably more vigorous about 3000 years BP. The present-day critical lower limit for debris production is near 3,600 m in Nanhuta Shan and near 3,700 m in Yushan, as indicated by the presence of vegetation. Periglacial smooth slopes are the only active landforms. The mean annual air temperature (MAAT) in Nanhuta Shan at 3560 m asl.is roughly 4.0˚C, January being the coldest and July the warmest month

(-2.6˚C and 8.2˚C, respectively). The upper limit of the periglacial belt is not met, as the climatic snowline is above or near the highest peaks.

This differentiated denudation pattern is partly the result of the delayed reaction of the surface to climatic changes but it cannot be excluded that it is also steered by a reduction of precipitation in the top areas of the mountains, which reach above the shallow monsoon circulation and are mainly influenced by the westerlies. In the mountains only two stations have long-term measurements indicating about 3000 mm in 3850 m a.s.l. (Yu Shan North Peak) and 3900 mm at about 2300m a.s.l. (Alishan). The main precipitation here also is related to typhoon events in summer. These observations imply that uplift and denudation are not in steady-state and that the high erosion rates have not yet reached the highest peaks and crests.

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