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Occurrence and characteristics of rockglaciers in the Tien Shan (Central Asia)

T. Bolch

Institute for Cartography, Technische Universität Dresden, Germany

Many parts of the overall continental Tien Shan are characterized by a distinctive periglacial belt with the occurrence of many large rockglaciers. Besides their importance for the sediment transport system, the permafrost bodies have an essential function as water storage and water supplier for the (semi-)arid surroundings with irrigated farmland. During Soviet time especially the rockglaciers of northern Tien Shan, situated close to settlements, were well mapped and described (e.g. Gorbunov & Titkov 1989). Nowadays satellite data, Google Earth and GIS facilitates spatial mapping and analysis also for remote areas such as the Inner Tien Shan. First analyses show - as expected - differences in distribution and origin in the different mountain regions. The rockglacier density varies highly with, but also within, the different mountain ranges. The ratio of the rockglaicer/glacier area varies from about 1:100 up to 1:5, mainly due to climate and the altitude and shape of the mountain ridges. The rockglaciers can be devided into two types according to their origin: The "talus type" occur on non-glacierized talus slopes, the "debris type" or "moraine type" originate from terminal moraines and cover valley beds, but are not debris-covered glaciers. In the study area, talus rockglaciers prevail in number, while debris rockglaciers cover a much larger area. A latter one could cover an area of more than 2 km2, which is much larger than in the Alps. The development of these large rockglaciers is predominantly found in granite and most of them can be considered as "bouldery" rockglaciers. Measurements of the surface movement of the rockglaciers indicate rates of partially much more than one meter per year. This depends mainly on the slope conditions. Front measurements of the Gorodetzkij rockglacier show an increase since the 1950s which became pronounced since the 1980s (Bolch & Marchenko 2006). This is similar to the Alps and might be a result of climate warming. The lower limit of the occurrence of rockglaciers increases with continentality, from about 3100 to more than 3500 m asl.

The zero degree isothermal line is situated between 2900 and 2950 m asl. However, some debris rockglaciers move downwards into the forest areas to an altitude of lower than 2700 m asl, and pine trees are found to grow on their surface. It is assumed that the main reason for the occurrence of these huge rockglaciers in Tien Shan are intensive weathering and rock avalanches triggered by seismic activities. The favorable thermal condition within these ’bouldery’ rockglaciers prevents their tongues from melting.

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