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Debris Supply as a Control on the Development of Rock Glaciers in the Central Brooks Range, Alaska

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The relationship between debris supply and the size of rock glaciers is discussed through a topographical analysis of a number of rock glaciers and their debris sources (i.e. rockwalls) in the central Brooks Range, Alaska, an area characterised by simple geology and continuous permafrost. The measured topographical parameters, such as lengths, areas and slope angles for the rock glaciers and their source rockwalls, were analysed in terms of the following concepts. The deformation of a rock glacier can be represented by the shear stress in the creeping permafrost, using a pseudoplastic flow law for glacier ice. In addition, the long-term (i.e. more than several hundred years) deformation has been assumed to result in a steady state of the thickness of the rock glacier balancing with debris supply. Here, the size of the source rockwalls was assumed to mainly control the rate of debris supply. To satisfy these concepts and assumptions, parameters combined the sine of the average slope angle for a rock glacier with the normalised length of the source rockwall were prepared as values proportional to the velocity of the rock glacier. Then, these parameters for each rock glacier were compared with the normalised length of the rock glacier. A positive correlation between the parameters and length was found in the case of the active talus-derived rock glaciers, which implies that the debris supply from the rockwalls at least partly controls the size of the rock glaciers. In contrast, the combined parameters cannot explain the large size of glacier-derived and some inactive talus-derived rock glaciers. The location of these rock glaciers, however, indicates that glacial processes or catastrophic landslide effectively enlarged rock glaciers. Such an analysis focused on size variation of relict rock glaciers will be useful for discussing the glacial interaction and short-term (e.g. paraglacial) debris supply in paleo-permafrost environment.