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Aeolian screecone formation in Torfajökull, Iceland

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The role of aeolian erosion processes on hill slopes remains underestimated. Although the role of physical weathering and the influence of vegetation are well understood in the formation of screecones in mountainous areas, the role of aeolian processes in the formation of scree cones has to date not yet been documented. This study endeavours to show that aeolian processes play an important role in the formation of scree cones and scree slopes in cold desert environments. The focus will be on the mechanisms that underlie these processes by using a case study from the central highlands of Iceland, within the Torfajökull area. Evidence for this aeolian influence was observed during a period with strong winds within this area. The parent material of the slopes of the area of interest is composed of subglacially deposited rhyolitic hyaloclastites (compacted ashes) that are superimposed on the older pre-glacial topography.
A field campaign was carried out to obtain field data to ascertain an overview of the landscape evolution and geomorphology of the area. The morphometric characteristics of the scree cones were measured and recorded for seven individual, clearly distinguishable scree cones. One scree cone was sampled along three transects at various heights to obtain insight into the particle distribution of the deposited material. Ten additional samples were taken in-situ from the parent material from which the scree cones are derived. Grain size distributions of the samples were analyzed, as well as the morphometric parameters of the screecones. Windtunnel experiments have been carried out to determine the static threshold conditions for entrainment of various grain size fractions. The conditions at which material is entrained and deposited have been compared to the meteorological conditions found in this area of Iceland.
A strong difference was found between the distribution of the screecone deposits and the parent material. The parent material is classified as poorly sorted medium sand whereas the screecones deposits are classified as poorly sorted very coarse sand. The distribution of both samples indicates a depletion of finer silty material and an enrichment of coarser material in the scree cone sediment. These differences will be put into perspective by the results of windtunnel experiments where static threshold conditions are compared to the meteorological conditions common to these areas.
The differences in grain size distribution, the windtunnel data and the meteorological conditions are indicative for a mechanism where fine particles are entrained by gusts of wind, carried aloft and deposited elsewhere, while particles too large to be entrained are liberated by the ongoing aeolian erosion until the point where gravity takes over and coarser particles are falling down slope. These processes facilitate the wind induced formation of scree cones and -slopes which are deposited at steep, river undercut slopes. The proposed mechanisms for aeolian screecone formation are tested against a rockfall model that also incorporates aeolian processes. Finally, possible geological and geomorphological analogies on Mars will be explored.