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Terrestrial laser scanning in geoarchaeology – capturing one of the oldest settlement places in the high Andes of southern Peru

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Terrestrial Laser Scanning (TLS) is increasingly attracting archaeological interest because of its manifold application possibilities, such as digital and non-destructive analysis of cultural heritage and documentation of excavation activities. In this context, the high mountain areas of the Peruvian Andes along with their unique ecotopes of cushion peatlands, are of special interest for palaeoenvironmental reconstructions and geoarchaeology, since they represent important locations for permanent water supply in the context of transhumance in this arid to semiarid environment. Even though the region shares a long term settlement history, only few studies have been conducted here so far due to the remoteness of the study site. According to first archaeological investigations, the abris below Cerro Llamoca, 4.450 m a.s.l. (southern Peru, province Lucanas, 14° S) in the uppermost ranges of the Llamoca peatland catchment area reveals an occupation history over the last 10.000 years. Stone settings and lithic artefacts even predate these findings. The main objective of the study at hand is the capture and documentation of the complete abris along with its surroundings in order to visualize the archaeological site in 3D. The study is embedded in the framework of the BMBF-funded project 'Andean Transect – Climate Sensitivity of pre-Columbian Man-Environment-Systems'. All investigations are based on one of the latest 'time-of-flight'-scanners (Riegl VZ-400). In contrast to conventional scanners, TLS with full-waveform capability provides a larger amount of terrain information, as a higher number of reflections can be recorded for each laser shot. Shadowing effects caused by vegetation cover were eliminated by postprocessing. By combining high-resolution 3D-data with RGB-values, a highly accurate and textured map of the abris is provided, which serves as a base for further digital analysis (e.g. regarding volume, extent, construction, setup). Subsequent desktop studies allow detailed postprocessing, refinement and analysis of 3D data sets, such as filtering (i.e. removal of distorting features such as vegetation). As a consequence, stone settings and microscale features can be highlighted and, thus, appear more clearly in the digital terrain model than on-site or even become visible for the first time. The outcomes demonstrate the great suitability of terrestrial laser scanning for fast and high-precision mapping of archaeological remains, particularly in isolated terrains at high altitudes like the Peruvian Altiplano. Future investigations will focus on the archaeological interpretation of results and the assessment of socioculturally relevant implications for the reconstruction of the settlement history.