Geophysical Research Abstracts
Vol. 19, EGU2017-7814, 2017
EGU General Assembly 2017

Impact of periglacial and paraglacial processes on rocky coast geomorphology in Arctic and Antarctic

Matt Strzelecki (1), Michael Lim (2), Marek Kasprzak (1), Zuzanna Swirad (3), Grzegorz Rachlewicz (4), Lukasz Pawlowski (1), Marek Jaskolski (1), and Piotr Migon (1)

(1) Institute of Geography and Regional Development, University of Wrocław, Wrocław, Poland (mat.strzelecki@gmail.com), (2) School of Built Environment, Northumbria University, Newcastel upon Tyne, United Kingdom, (3) Department of Geography, Durham University, Durham, United Kingdom, (4) Cryosphere Research Department, Adam Mickiewicz University, Poznan, Poland

In contrast to mid and low latitude coasts, relatively little is known regarding the potential impacts of climate and sea-level change on polar coastal margins. Indeed, many of the existing intellectual paradigms regarding the functioning of polar coasts are now out-dated, based on descriptive geomorphology and a limited process-based understanding.
Our work aims to address this deficiency in understanding by quantifying the processes controlling the evolution and behaviour of rock coasts in polar climates, based on representative examples from South Shetland Islands (Antarctic) and Svalbard (Arctic).

The pristine coasts of South Shetland Islands and Svalbard provide a superb opportunity to quantify how polar rock coasts are responding to sea-level changes and intensification of periglacial and paraglacial processes associated with climate warming. The selected coastline forms part of the South Shetland and Svalbard strandflat, which is characterized by diverse range of coastal landforms. The rock cliffs and shore platforms in selected study sites are formed in volcanic rocks (Antarctic) and divers mixture of sedimentary and crystalline formations (Svalbard).

In our project we utilise a rigorous, coherent and novel suite of techniques to analyse the spatially and temporally diverse range of processes and responses controlling the polar rock coast environments:
-Schmidt Hammer and Equotip tests of rock surface resistance
-micro-erosion meter measurements of rock surface downwearing rates
-observations of seasonal changes in the state of permafrost developed in solid rocks using electrical resistivity tomography (ERT)
-monitoring of thermal state of the rocky cliffs and platforms using network of thermistors
-photogrammetric analysis of digital images of scanned cliffs and platforms and GIS processing of obtained data

In this paper we present the results of field campaigns of the project carried out in years 2014-2016 in Admiralty Bay (South Shetland) and Hornsund and Billefjorden (Svalbard) that focused on:
- rock resistance surveys using Schmidt Hammer Rock Tests (SHRT) and Equotip (EQ) across the modern and uplifted shore platforms formed in various volcanic rocks
- measurements of shore platform downwearing rates using the Traverse Micro-Erosion Meter (TMEM) stations
- mapping rock coast permafrost distribution using geophysical techniques (ERT)

This lithological variability provided an excellent opportunity to examine the influence of rock resistance on the development of various coastal landforms in periglacial climate. SHRT, EQ and TMEM surveys along several morphologically different coast types demonstrated broad variety of interrelations between rock surface resistance and distance from present-day shoreline as well as thickness of sediment and snow covers. In general, rock cliff surfaces were the most resistant in their lower and middle zones which are thermally insulated by thick winter snowdrifts. Whereas the more exposed cliff tops were heavily fractured and weathered. The differences in rock resistance and downwearing rates observed along the shore platforms were highly dependent on thickness of sediment cover and shoreline configuration. These characteristics favoured stronger rock surfaces in areas exposed to the longest wave fetch, but also washing by meltwaters from decaying ice-foot. The results of ERT survey suggest that most of the rocky capes and platforms are free of continuous permafrost and frozen ground conditions

develop further inland along mountain slopes and plateaux. The results presented in this paper emphasize the richness of microrelief features and processes operating in polar rock coastal environments.

This paper is a contribution to the National Science Centre in Poland OPUS project UMO$_2$013/11/B/ST10/00283:‘POROCO – Mechanisms controlling the evolution and geomorphology of rock coasts in polar climates’.