Mapping of microglacial landforms using the UAV-SfM method on the Sôya Coast, East Antarctica

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Abstract

Glacial landforms in Antarctica provide fundamental information on past ice sheet flow direction, subglacial environment, and ice sheet expansion/retreat history. These information is important for reconstructing past ice sheet change, which is essential to evaluate the stability of ice sheet and to anticipate their contribution to future sea level rise. Previous researches reported different timings of the deglaciation between the northern and southern parts of the Sôya Coast, East Antarctica, based on ^{14}C ages of fossil shells in raised beaches (Miura et al., 1998a, b). They also showed consistent results from differences in relative degrees of weathering of surface rocks on these areas. Because the relative degrees of surface rocks weathering consider to reflect a length of time after the retreat of ice sheet, it is an useful index to reconstruct the ice sheet expansion/retreat history on the Sôya Coast. In addition, Sawagaki and Hirakawa (1997) described the streamlined bedforms and small erosional marks (s-form) in the southern part of the Sôya Coast. They suggested that these subglacial bedforms on the basement rock is thought to be formed by erosion due to large-scale subglacial water flow with high-velocity. This large water flow may have influenced past ice sheet stability. Therefore, it is important to obtain a detailed geomorphological data from a wider area for understanding landform evolution processes, including the glacial landforms and weathering after the ice sheet retreat. However, the detailed description of glacial landforms is very limited, because of the restricted period for the fieldwork and study areas are vast in Antarctica. In order to solve these problems, we carried out an Unmanned Aerial Vehicle (UAV) - Structure from Motion (SfM) analysis, which enable us to obtain high resolution Digital Elevation Model (DEM) from a wider area. The UAV survey was carried out in three areas (the West Ongul Island, Telen, and Skallen) on the Sôya Coast during a December 2015 - March 2016 and succeeded in obtaining very detailed and extensive DEMs and orthoimages. A hairpin-like smooth erosion marks (Transverse s-form) and small scale grooves extending parallel to glacial striations (Longitudinal s-form) are observed in Telen and Skallen in the southern parts of the Sôya Coast. On the other hand, s-forms and glacier striations can not be observed in the West Ongul Island in the northern parts of the Sôya Coast. Topographic roughness in this area is thought to be controlled by the original geological structure through the longer time of weathering after the ice sheet retreat in this area. These differences in microglacial landforms support that the retreat of the East Antarctic Ice Sheet in this area was earlier in the northern part of than that of the southern part of the Sôya Coast.

Keywords: UAV-SfM, subglacial bedforms, relative weathering

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