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Investigating the impact of fast ice flow on the proglacial fields of Sléttjökull and Öldufellsjökull, Mýrdalsjökull Ice Cap, southern Iceland

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Recent climatic warming has resulted in rapid retreat of glacier margins in the northern hemisphere exposing landforms which record changes in glacier extent and behaviour through their sedimentology and geomorphology. These modern glacial systems can be used as analogues for paleoglacial deposits, such as those found throughout Europe, Canada and the northern USA. Large ice sheets that covered land masses in the northern hemisphere during the Quaternary are known to have hosted fast-flowing ice streams that controlled ice dynamics and behaviour. However, the former positions of these ice steams are difficult to determine in paleoglacial deposits.
This study focuses on documentation of sedimentological and geomorphological characteristics of the proglacial fields of western Slettjökull and Öldufellsjökull, northern outlet glaciers of the Mýrdalsjökull Ice Cap in southern Iceland. These glaciers were selected as they have both experienced periodic episodes of fast ice flow and rapid marginal advance (surges) during the last century. It is believed that surging ice margins can be used as analogues for rapidly moving paleoice streams common within the Laurentide and Scandinavian Ice Sheets during the last glaciation. A combination of landsystem analysis, whereby landforms are classified into genetically related landform-sediment assemblages, and architectural element analysis (AEA), a hierarchal method of examining sedimentary deposits, is applied in this study. This methodology allows a detailed model of the process-form relationship of landforms and sediments exposed in front of the retreating glaciers to be created. Initial mapping of the proglacial fields of Sléttjökull and Öldufellsjökull was completed using high resolution digital elevation models (DEM) obtained from the Icelandic Meteorological Office to investigate the types, scale and distribution of glacial landforms. These maps were ground checked in the field using a portable geographic information systems (GIS) unit. Sedimentological data were collected from exposures along river banks and terraces to identify the sediment types associated with different landform types. An unmanned aerial vehicle (UAV) was also used to collect high resolution imagery of the proglacial fields, focusing in particular on areas impacted by the most recent surge events. Field and remotely sensed data were combined into a GIS to examine the spatial relationship between the various landforms and their associated sediments.
The proglacial fields of these two outlet glaciers show overall similarities in the distribution and morphology of landsystems tracts connected with end moraine development. However, the proglacial field of Sléttjökull has a larger sandur proximal to the glacier margin and a greater amount of glaciofluvial sediment compared with Öldufellsjökull. The areas of the proglacial fields impacted by surges that occurred in the 20th century show a distribution of landforms that is similar to that described from other surge-type glaciers, including hummocky terrain and kettle holes. However, these proglacial fields lack the prominent glaciotectonized end moraine frequently reported at surge-type glaciers. The model developed for these proglacial fields may be utilized to help identify areas affected by fast-flowing ice and the position of former ice streams in previously glaciated regions.