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Geophysical evidence for a large Holocene ice marginal moraine of Skeiðarárjökull, SE Iceland

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The sedimentary record of Icelandic ice-contact environments provides valuable information about glacier margin dynamics and position, relative sea-level and the geomorphic processes driving proglacial environments. This important archive has been little exploited, however, with most glacier and sea level reconstructions based on limited sedimentary exposures and surface geomorphic evidence. Although geophysical surveys of Icelandic sandur have been conducted, they have often been of limited spatial scale and focused on specific landforms. Here, we report an extensive (42 km of data) detailed low-frequency (40 and 100 MHz) ground-penetrating radar (GPR) survey of the Sandgigúr moraine complex, SE Iceland, which transforms our understanding of this landform, with implications for the Holocene history of Skeiðarársandur and SE Iceland.

The Sandgigúr moraines are located on Skeiðarársandur, SE Iceland, down-sandur of large Little Ice Age-moraines of Skeiðarárjökull. They have a relatively subtle surface geomorphic expression (typically 125 m wide and 7 m high), and knowledge of their formation is limited, with no dating control on their age or detailed geomorphic or sedimentological investigations. GPR investigations reveal a much larger (60 m high and 1200 m wide) and extensive buried moraine complex than that suggested by surface morphology, suggesting that the moraine was a major Holocene ice margin of Skeiðarárjökull.

GPR reflections interpreted as large progradational foresets (up to 20 m in height) beneath the morainic structure are consistent with a sub-aqueous depositional environment before moraine formation, providing potential controls on former sea-level. The GPR data also provide information on the internal structure of the moraine, with evidence for glacitectonism within the proximal side of the moraine, multiphase moraine formation, and possible buried ice at depth. A 30-40 m thick package of down-sandur dipping GPR reflections drape the leeside of the moraine, evidencing glaciofluvial deposition during and after moraine development. Potential moraine breaches, possibly caused by glaciofluvial (e.g. jökulhlaup) events, are also apparent within the GPR data and the surface geomorphology.

We combine GPR-derived subsurface architecture with the current surface morphology to develop a conceptual model detailing the geomorphic evolution of the moraines and surrounding region, from pre-moraine morphology, to their formation and breaching, resulting in the subsequent

present-day morphology. These results provide new insights into the Holocene to present-day evolution of Skeiðarársandur and Skeiðarárjökull, with implications for reconstructions of the Holocene environmental history of SE Iceland.