Reviewed research article

Seismic soundings of sediment thickness on Skeiðarársandur, SE-Iceland

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Abstract – *Seismic soundings on Skeiðarársandur show clear reflections from bedrock and inter-sedimentary layers. Ten seismic profiles were collected at scattered locations in 1997 and 1999. They indicate a sediment thickness of 80–100 m near the terminus of Skeiðarárjökull, increasing to about 250 m at the coast. The soundings suggest that a 100 m deep valley is present in the bedrock south of Skaftafell, probably eroded by a Pleistocene ice stream. Three seismic units are detected in the sediments. The uppermost unit and the most voluminous consists of unconsolidated glaciofluvial sediments with a seismic velocity of 1.4–1.8 km* s^{-1}*. A second unit with a slightly higher seismic velocity (1.9–2.2 km* s^{-1}*) is found inside the outermost moraines of Skeiðarárjökull and Svínafellsjökull. A comparison with studies on Breiðamerkursandur suggests that this unit may be glaciofluvial Holocene sediments compacted by loading of ice during the Little Ice Age and earlier Holocene advances. Alternatively, the higher velocities may be due to larger proportion of coarse-grained sediments in the vicinity of the glacier. A third unit, with seismic velocity of 2.5–2.7 km* s^{-1}*, is found in the southern and central parts of the sandur, buried under 100–150 m of sediments. The velocity is consistent with consolidated sedimentary rock of Pleistocene age. The total volume of sediments on Skeiðarársandur is 100–200* km^3*. The majority of this material has not been subjected to compaction under glaciers and must therefore date from the Holocene. There may have been large variations in sedimentation rates over the Holocene, but the average growth of the sandur body over the last 10,000 years has been about 1* km^3*/century.*

INTRODUCTION

The lowland areas in south and southeast Iceland are predominantly outwash plains or sandur, created by deposition of glaciofluvial jökulhlaup sediments (e.g. Hjulström *et al.*, 1954; Þórarinsson, 1974; Haraldsson, 1981; Maizels, 1991). The sandur contains large volumes of sediment; seismic depth soundings have revealed thicknesses of 100–200 m on Breiðamerkursandur (Bogadóttir *et al.*, 1987), the Markarfljót sandur (Haraldsson and Palm, 1980) and Mýrdalssandur (Björnsson, 1964; Þórarinsson and Guðmundsson, 1979). Since the sandur are major traps for glaciofluvial sediment, both from regular runoff and high magnitude jökulhlaups, their stratigraphy and sediment volume provide important information on erosion and sedimentation in Iceland. Studies of sandur thickness and stratigraphy are therefore important in quantifying rates of these processes. Until recently no data existed on the thickness and stratigraphy of Skeiðarársandur (∼1000 km^2), the largest of the active sandur in Iceland, located between the Atlantic Ocean and Skeiðarárjökull, an outlet glacier of Vatnajökull (Figures 1 and 2). In this paper the results of a small-scale reconnaissance seismic reflection survey are presented. The data consist of 10 soundings made at scattered locations on the sandur during field courses in exploration geophysics at the University of Iceland in May 1997 and 1999.

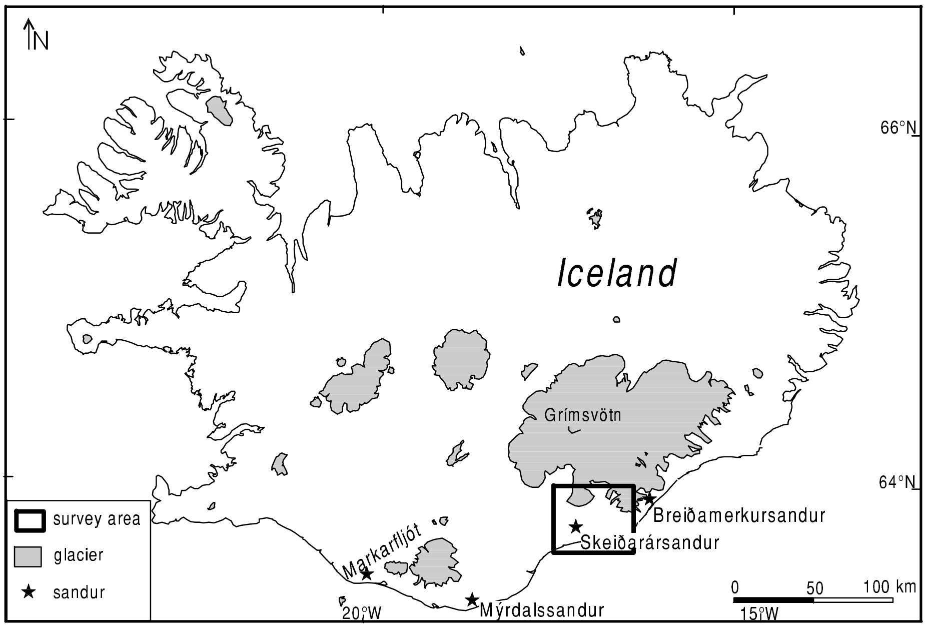

Figure 1. Iceland, the main sandur areas in South Iceland, glaciers and the survey area. The area shown on Figures 2 and 5 is framed. – *Helstu sandar á Suðurlandi. Kassinn afmarkar svæðið á 2. og 5. mynd.*

SURVEY AREA

Skeiðarársandur (Figures 1 and 2) lies between Lómagnúpur in the west and the district of Öræfi in the east. To the north is the broad lobe of Skeiðarárjökull, one of the largest outlets of Vatnajökull. Skeiðarárjökull has retreated 2–3 km from its Little Ice Age maximum extent, reached in the nineteenth century (Jóhannesson, 1984; Sigurðsson, 1995), leaving a moraine complex to the south of the present location of the terminus. Three main rivers drain from Skeiðarárjökull across the sandur. These are Núpsvötn-Súla in the west, Gígjukvísl on the central western part and Skeiðará in the east. Skeiðarársandur has over several centuries been swept by jökulhlaups from Grímsvötn in Vatnajökull that have occurred on average at 5 to 10 year intervals (Þórarinsson, 1974, Guðmundsson *et al.*, 1995). Some of these jökulhlaups have been very large, with peak discharges of 40–50$\times$10^3 m^{3}s^{-1}; inundating most of the sandur and bringing abundant sediments that have been deposited on the sandur and in the sea (Þórarinsson, 1974; Russell and Knudsen, 1999; Smith *et al.*, 2000; Maria *et al.*, 2000; Snorrason *et al.*, 2002). Thus Skeiðarársandur is, at least partly, built up of repeated large magnitude jökulhlaups (Maizels, 1991).

In 1991 a small outcrop of crystalline bedrock was observed close to the terminus of Skeiðarárjökull, near the water divide between the rivers Gígjukvísl and Sæluhúsavatn. This outcrop is now covered by sediments from the 1991 surge of Skeiðarárjökull and the 1996 jökulhlaup (Óskar Knudsen, *pers. comm.*, 2002).

SEISMIC MEASUREMENTS

In 1997 three seismic profiles were surveyed close to the glacier Svínafellsjökull. Svínafellsjökull has retreated several hundred metres from the moraine complex formed during the Little Ice Age (LIA) maximum. Two of the profiles were located on the alluvium plain west of the terminal moraines while the

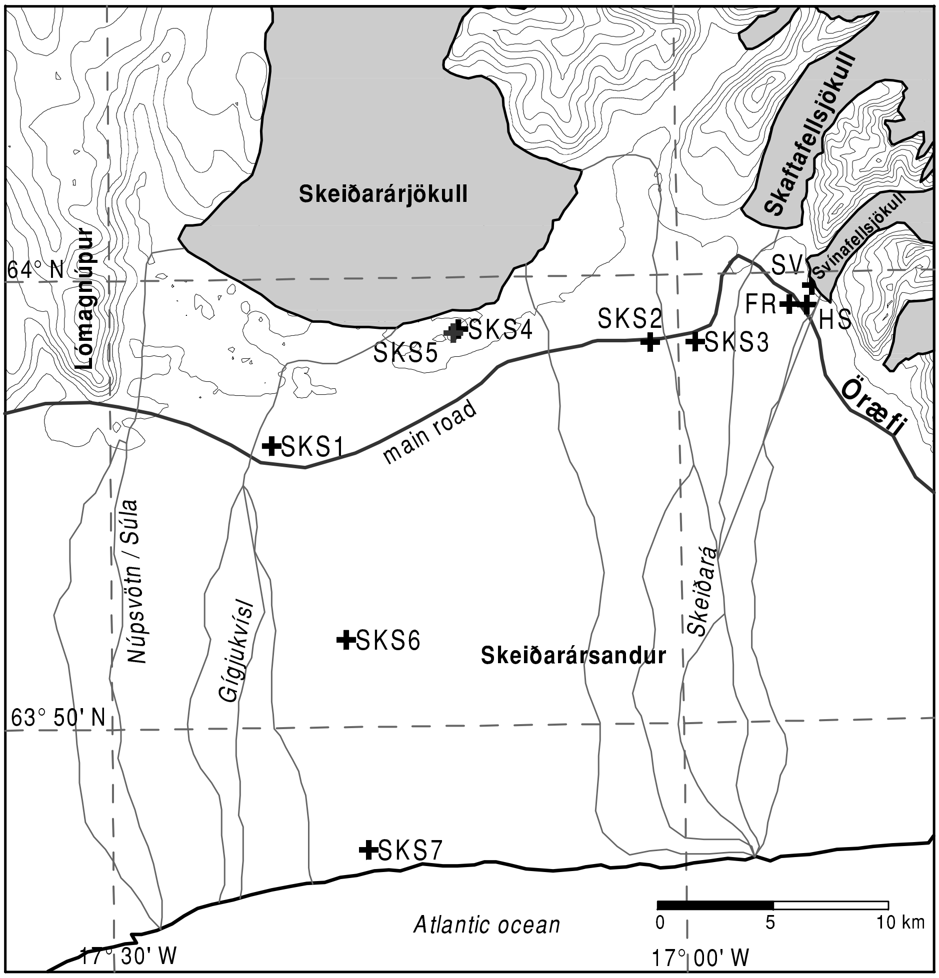

Figure 2. Skeiðarársandur, its main rivers and location of the seismic profiles. – *Skeiðarársandur, helstu ár og staðsetning endurkastsmælisniða.*

third was located inside the moraine complex. The second survey was carried out in 1999 when seven profiles (SKS1-SKS7) were surveyed. Profiles SKS4 and SKS5 were shot inside the terminal moraines near the snout of Skeiðarárjökull. The other profiles were at scattered locations on the sandur (Figure 2).

Seismic waves were generated through detonation of dynamite charges (100–500 g) in 0.3–0.5 m deep holes in the surface layer and recorded on a linear array of geophones. The recording system used was a 24-channel Geometrics seismograph. In 1997 the profiles had a spread of 230 m with 24 geophones placed at 10 m intervals. In 1999 the layout was different since the spread was 115 m long and had a geophone spacing of 5 m. At least two shots were fired on each profile, one at each end of the receiving spread. Before recording, the returning signal was fed through a 25–500 Hz bandpass filter in 1997 and 50–500 Hz bandpass in 1999. The sampling interval was 0.5 ms.

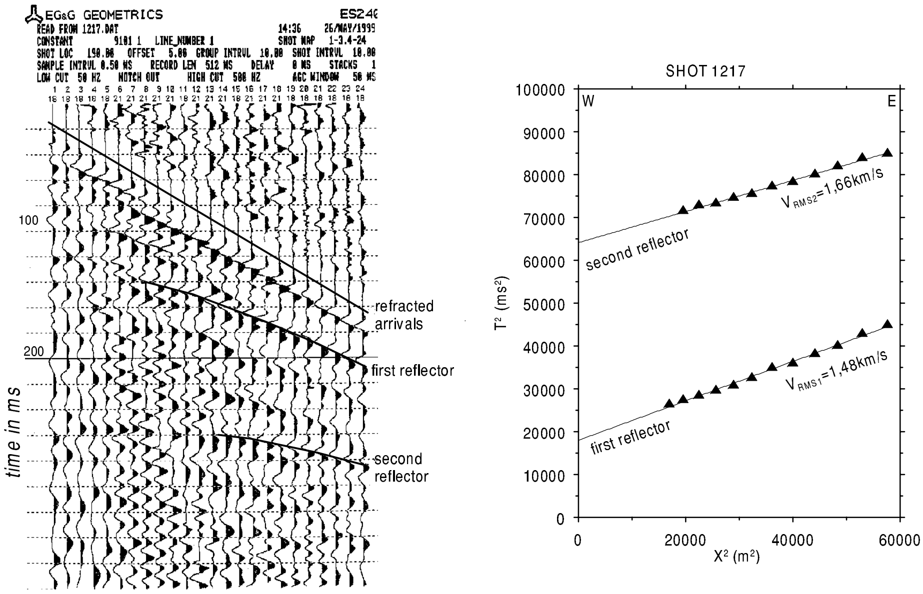

Figure 3. An example of a 24 channel seismic section from Skeiðarársandur (Profile SKS2). The spacing between geophones was 5 m. Two reflectors appear on the section; at small offset they are partly obscured by surface waves. b) X^2T^2 graph of the section shown to the left. – *Dæmi um niðurstöður úr 24 rása endurkastsmælingu á Skeiðarársandi (snið SKS2). Bil milli nema var 5 m. Tvö endurköst koma fram. Til hægri er X^2T^2 línurit af sniði SKS2. RMS-hraðar fyrir lögin eru ákvarðaðir út frá hallatölum á línuritinu.*

INTERPRETATION

Interpretation of the seismic records involved the determination of travel times of refracted and reflected waves. Clear reflections were picked and RMS- and interval velocities determined. The velocity of the uppermost layer was determined from the first arrivals and RMS-velocity of the first reflection (Figure 3a). Due to the limited length of the profiles, refracted waves were usually not detected from deeper layers. Velocities in the sediments were therefore determined using the X^2T^2 method (Dix, 1955). This method (Figure 3b) is based on the equation of the time-distance hyperbola

$$t^2 = {t_0}^2 + \frac{X^2}{V_{RMS}^2} \tag{1}$$

Here t is the travel time for a distance X between the shotpoint and the geophone and t_0 is the travel time for a vertical ray. V_{RMS} is the root mean square velocity of the layers overlying the nth reflector and is defined from

$$V_{RMS} = \left[\sum_{i=1}^{n} {\nu_i}^2 \tau_i / \sum_{i=1}^{n} \tau_i \right]^{1/2} \tag{2}$$

Here ν_i and τ_i are respectively the interval velocity and travel time through layer number i. Finally, the interval velocity of the layer above the nth reflector is given by the Dix formula:

$$\nu_n = \left[\frac{V_{RMS,n}^2 t_n - V_{RMS,n-1}^2 t_{n-1}}{t_n - t_{n-1}} \right]^{1/2} \tag{3}$$

where $V_{RMS,n}, t_n$ and $V_{RMS,n-1}, t_{n-1}$ are, respectively, the root mean square velocities and travel times from reflectors number n and $n-1$.

When possible, reflections were picked on reversed shots. The interval velocities are then the mean

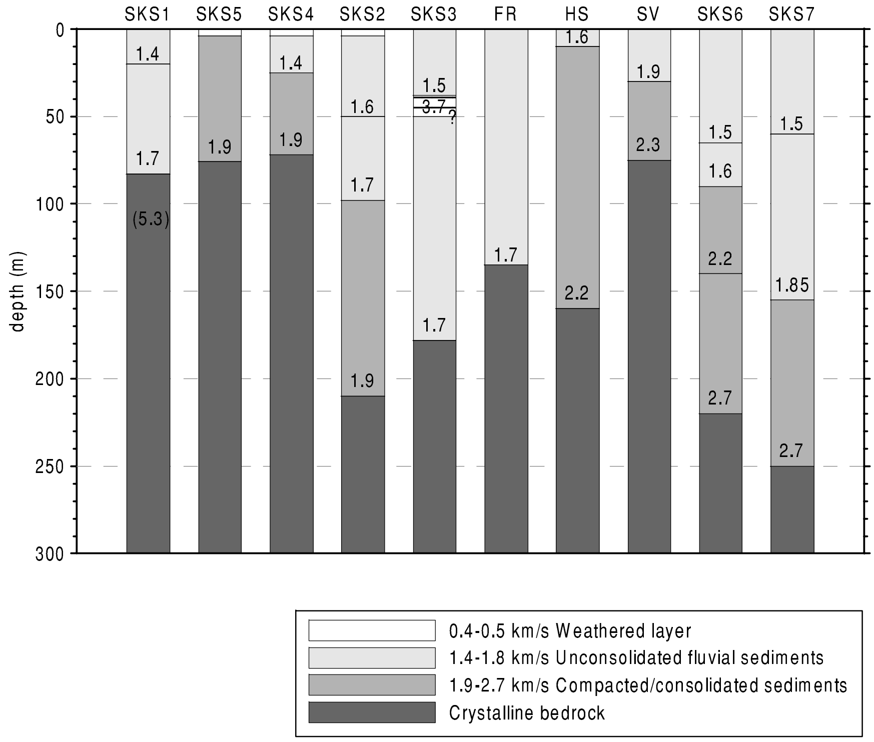

Figure 4. Stratigraphic columns for the profiles showing the layering obtained from the seismic soundings. The velocities in each layer are shown in km s^{-1}. The weathered layer detected in SKS2, SKS4 and SKS5 is 1–4 m thick. Its thickness marks the depth to the groundwater table in these profiles. The nature of the high-velocity layer in SKS3 at 40 m depth is unclear; it may be an altered sedimentary layer but the velocity is such that it does not rule out an intersedimentary lava flow. – *Lagskipting endurkastssniða á Skeiðarársandi. Tölurnar eru bylgjuhraðar í lögunum. Þykktin á yfirborðslaginu í sniðum SKS2, SKS4 og SKS5 (1–4 m) er dýpi niður á grunnvatnsborð. Háhraðalagið á 40 m dýpi í SKS3 gæti verið ummyndað setlag en ekki er hægt að útiloka að þar sé hraunlag grafið í setlögunum.*

of the results from the shots at each end. This applies to majority of profiles and in most cases the difference in calculated interval velocity is less than 0.15 km s^{-1}. However, the interval velocities for the deeper reflections must be regarded as very approximate since they are sensitive to dip of layers.

RESULTS

SEISMIC REFLECTIONS

Reflections were detected at all locations (Figures 3 and 4). The number of reflections ranged from one (FR) to four (SKS6). The lowermost reflection is considered to be from the igneous bedrock. This was confirmed at only one location (SKS1) where refracted waves with a velocity of 5.3 km s^{-1} from the lowermost reflector were recorded. This refractor was detected in one direction only. It may be from an upward dipping boundary and the velocity therefore too high. The expected bedrock velocity in this region is 4.0–4.5 km s^{-1}, that of Layer 1 of Pálmason (1971). However, since no velocity information exists for the assumed bedrock in most places, the

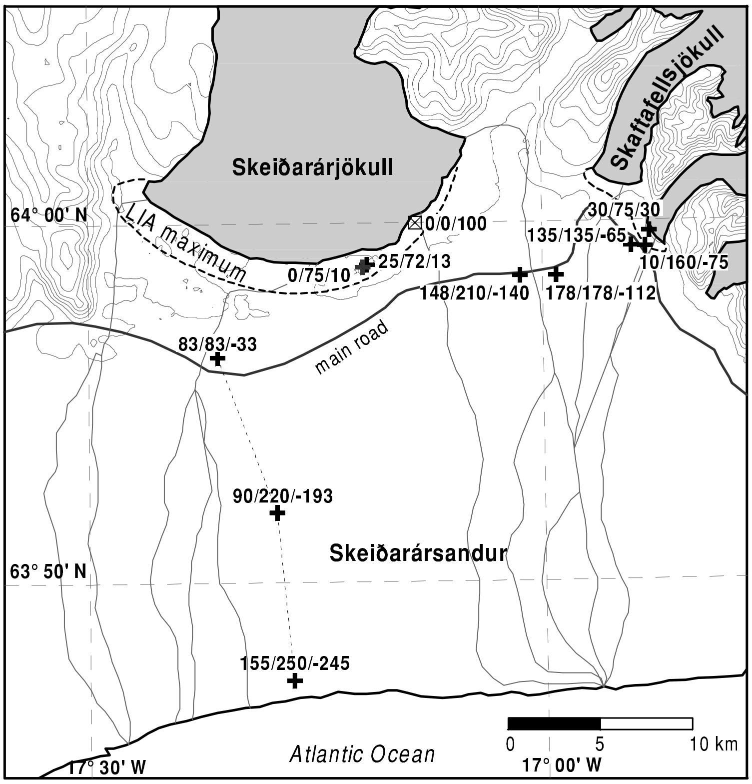

Figure 5. Map of Skeiðarársandur showing the sediment thickness; 90/220/-193 denotes the thickness of unconsolidated glaciofluvial sediments/total sediment thickness/height of bedrock above sea level. The thickness of the unconsolidated sediments (V<1.9 km s^{-1}) is small in the areas that have been under glacier cover during the Little Ice Age or in earlier advances during the Holocene. – *Setlagaþykkt á Skeiðarársandi; 90/220/-193, þykkt lausra setlaga/heildarþykkt setlaga/hæð berggrunns yfir sjó. Þykktin er lítil á þeim stöðum sem lágu undir jökli á litlu ísöldinni eða á fyrri skeiðum jökulframskriðs frá því síðasta jökulskeiði lauk. Þykkt lausa setsins (V<1.9 km s^{-1}) er mest neðan til á sandinum og austan til, nærri Skaftafelli.*

possibility of the deepest observed reflection being from the top of a layer of sedimentary rock cannot be ruled out. However, this is considered unlikely. Firstly, there are no indications of reflections deeper than the assumed bedrock. Secondly, the bedrock outcrop found about 2 km east of SKS4 (Óskar Knudsen, pers. comm. 2002) may be taken as evidence against considerably greater bedrock depths than found in this study. Thirdly, on Breiðamerkursandur at the other side of Öræfajökull, good agreement was obtained between bedrock depths from reflection and refraction (Bogadóttir *et al.*, 1987). The reflections from boundaries above the deepest reflection must arise from layering of the sediments. The deeper layers have higher velocities indicating progressively greater consolidation with increasing depth.

DEPTH TO BEDROCK

Although bedrock depth has been determined at only 10 points an interesting picture emerges from the soundings (Figures 4 and 5). Sediment thickness is smallest, 70–80 m, near Skeiðarárjökull, where the bedrock lies slightly above the present sea level. The same applies to profile SV near the terminus of Svínafellsjökull. Sediment thickness increases towards the sea and bedrock is 200–250 below sea level on the lower part of the sandur (Figure 5).

Compared to the upper central part, depth to bedrock is much greater on the eastern part of the sandur, near the bridge over Skeiðará (Figure 4). The two profiles located in its vicinity (SKS2 and SKS3) reveal a depth of 180–210 m. Thus an erosional channel may exist in the eastern part of the sandur. Depth to bedrock decreases again near Svínafellsjökull where it is 75 m in front of the glacier terminus.

LAYERING OF SEDIMENTS

While the interval velocities obtained through the Dix equation are very approximate and subject to considerable uncertainty, the determination of distinct layering above bedrock is robust. Moreover, there is a clear pattern of higher velocities in the deeper sedimentary layers. The uppermost layer (V = 1.4–1.8 km s^{-1}) has velocity characteristic of unconsolidated water-saturated fluvial sediments. It is therefore considered to consist of glaciofluvial sediments that have not been subjected to any appreciable compaction. This layer is thin or absent inside the outermost terminal moraines of Skeiðarárjökull and Svínafellsjökull. Its thickness increases rapidly outside the moraines reaching over 150 m in vicinity of the Skeiðará bridge and near the coast (Figures 4 and 5).

On the basis of sediment grain size, Boothroyd and Nummedal (1978) divided Skeiðarársandur into four areas, with coarseness of sediments gradually decreasing with increasing distance from Skeiðarárjökull. Proximal to the glacier are tills, grading to coarse gravel through to fine gravel, with the lower half of the sandur largely composed of sand-sized material. The velocities recorded in our profiles show little correlation with this classification apart from the significantly higher velocities in the till facies area.

The layers underneath the unconsolidated glaciofluvial sediments have velocities in the range 1.9–2.7 km s^{-1} (Figures 4 and 6). The lower values (1.9–2.2 km s^{-1}) may be due to coarse-grained sediments; Haraldsson and Palm (1980) obtained a good correlation between coarseness and seismic velocity in the Markarfljót sandur. An alternative explanation would be that these velocities represent somewhat compacted sediments of the same type as the top layer. On Breiðamerkursandur, Bogadóttir *et al.* (1987) recorded velocites of 1.5 km s^{-1} outside the Little Ice Age moraines but 1.9–2.0 km s^{-1} in the same type of sediments within the moraines. They suggested that the higher velocities arise because of compaction by ice loading. Boulton and Dobbie (1993) presented a model explaining how the flux of groundwater in sediments under a glacier may lead to such consolidation.

On Skeiðarársandur, the layer with velocity 1.9–2.2 km s^{-1} reaches almost to the surface within the Skeiðarárjökull Little Ice Age moraines while the thickness of the overlying unconsolidated sediments increases rapidly outside the moraines. Although increased coarseness undoubtedly plays a role in increasing seismic velocity in the proximal zone of Skeiðarárjökull, the close correlation between maximum extent of the Little Ice Age moraines and sediment velocity suggests that compaction by glacier load is an equally plausible mechanism. At Svínafellsjökull (Figures 7 and 8) the relationship between seismic velocity and Holocene glacial extent is particularly instructive. The profile HS coincides roughly with the maximum extent of the glacier in the Holocene, the Stóralda stage considered to date back to the onset of climatic deterioration 2500 years BP (Þórarinsson, 1956). This profile has a velocity of 2.2 km s^{-1} at about 10 m depth while no such layer is found in profile FR, only 0.8 km to the west.

The highest velocities found in the Skeiðarársandur sediments (2.5–2.7 km s^{-1}) indicate consolidated sedimentary rocks. The fact that the upper surface of this layer shows up as a reflection indicates that it is an unconformity; this lowermost layer may be sedimentary rock of Pleistocene age.

In profile SKS3 a layer with a velocity of 3.7 km s^{-1} showed up as a refraction (Figure 4) at about 40 m depth. The origin of this layer is unknown. The velocity is unusually high for a sedimentary layer and it seems to be underlain by more than 100 m of unconsolidated sediments. The likelihood of a buried lava flow at this location is small. This may be a thin fully consolidated layer within the sediments, perhaps due to palagonitization or some other alteration process.

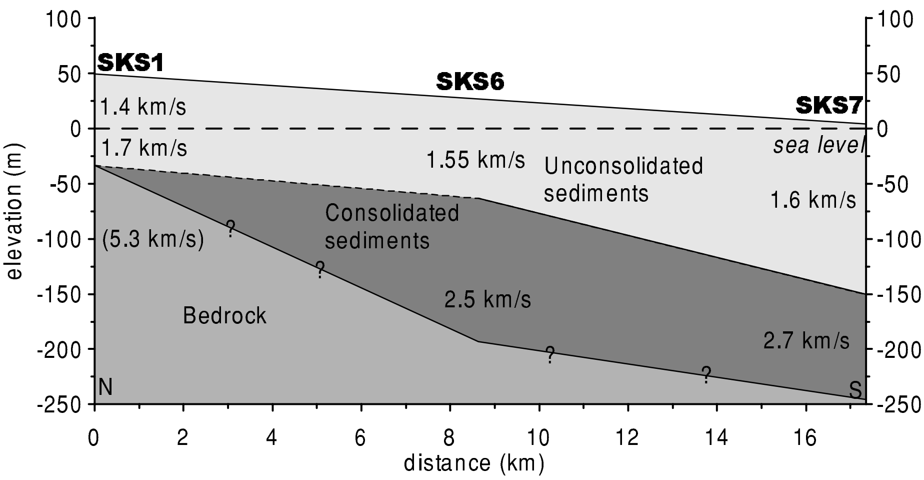

Figure 6. Cross section showing the stratification of the sediments across Skeiðarársandur from north to south (from SKS1 to SKS7). – *Þversnið milli SKS1 og SKS7: Lagskipting setlaga frá norðri til suðurs. Bylgjuhraðar á bilinu 1.4–1.7 km s^{-1} benda til lausra setlaga en 2.5–2.7 km s^{-1} benda til þéttra setlaga.*

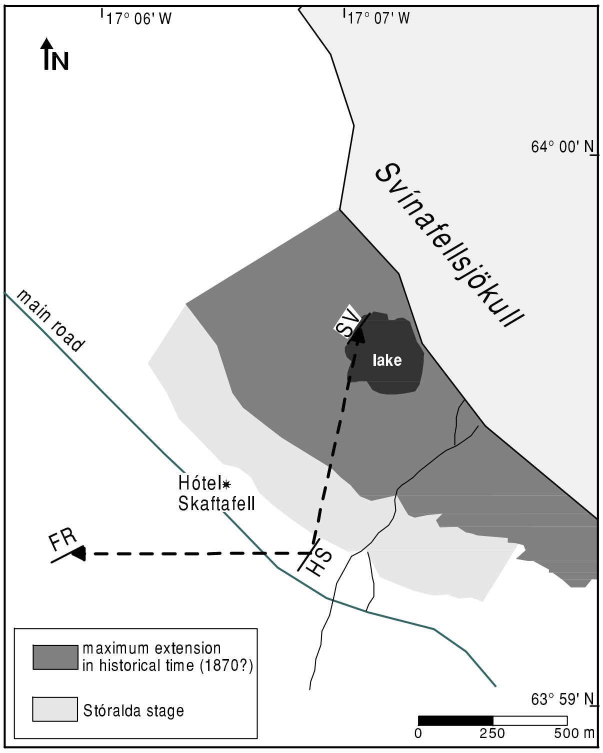

Figure 7. The survey area in front of Svínafellsjökull and the extent of the glacier during the Little Ice Age maximum and the Stóralda stage (Þórarinsson, 1956). The cross section on Figure 8 (SV-HS-FR) is indicated. – *Svæðið framan við Svínafellsjökul. Grái liturinn táknar svæði sem jökullinn gekk yfir á 19. öld en svæðið þar fyrir framan (Stóralda stage) var undir jökli við mestu framrás jökulsins á nútíma sem talin er hafa orðið fyrir um 2500 árum (Sigurður Þórarinsson, 1956). Sniðið SV-HS-FR er á 8. mynd.*

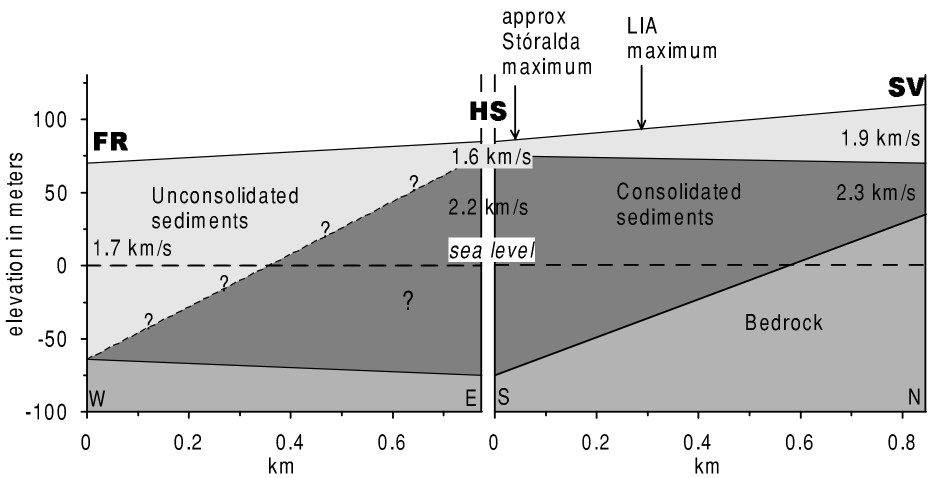

Figure 8. Seismic stratigraphy of the SV-HS-FR profile in front of Svínafellsjökull. The unconsolidated sediments are thin in the area that has been covered by ice during the Holocene but the compacted layer is absent outside that area. – *Lagskipting setsins framan við Svínafellsjökul. Bylgjuhraði í því seti sem legið hefur undir jökli er hærri en þar sem jökull hefur ekki gengið yfir á nútíma.*

SEDIMENT VOLUMES

The seismic soundings show sediment thicknesses in excess of 200 m for the lower reaches of the sandur and 70–180 m for the upper parts. Although the soundings are widely spaced and therefore cannot be used for detailed volume estimates, the results indicate a total volume of sediments above bedrock of 100–200 km^3 over the 1000 km^2 area of Skeiðarársandur. Unconsolidated and uncompacted glaciofluvial sediments (1.4–1.8 km s^{-1}) seem to make up one half to two-thirds of this volume. Material of intermediate seismic velocity (1.9–2.2 km s^{-1}) occurs mainly inside the moraines of Skeiðarárjökull and Svínafellsjökull. The volume of this formation inside the moraines is only a few km^3, but if it also occurs in appreciable thicknesses elsewhere, as indicated by SKS2, its volume may be greater. The third sedimentary unit, the consolidated sedimentary rocks (2.5–2.7 km s^{-1}), is about 100 m thick in the two profiles on the central and southern part of the sandur. If these profiles are characteristic for the lower reaches of the sandur this unit may well have a total volume of the order of 50 km^3. More detailed seismic work is required to test these estimates.

DISCUSSION

The bedrock depth observed on Skeiðarársandur is similar to that found on Breiðamerkursandur (Bogadóttir *et al.*, 1987) and the Markarfljót sandur (Haraldsson and Palm, 1980). In both Breiðamerkursandur and in the Markarfljót area buried bedrock troughs were found, considered eroded by Pleistocene ice streams (Haraldsson, 1981; Bogadóttir *et al.*, 1987; Björnsson, 1996). The valley southwest of Skaftafell may be of similar origin. It lines up with the Skeiðarárdjúp, a submarine gorge in the insular shelf off the coast south of Skeiðarársandur. The erosional valley may also connect to the overdeepening found in radio-echo soundings under the eastern part of Skeiðarárjökull (Björnsson, 1998; Björnsson *et al.*, 1999). During the height of recent Pleistocene glaciations most of Iceland was ice covered (e.g. Norðdahl, 1990) and glaciers probably calved into the sea off the southeast coast of Iceland. South of Skaftafell large ice streams/valley glaciers from Morsárdalur and Skaftafellsjökull must have merged with the main ice stream of Skeiðarárjökull in the area of this bedrock valley. Merging of ice streams may have caused enhanced erosion forming the valley.

The close correlation between past extent of glaciers during the Holocene and seismic velocities in glaciofluvial sediments on Breiðamerkursandur (Bogadóttir *et al.*, 1987; Boulton and Dobbie, 1993) and Skeiðarársandur may provide a tool to study the past extent of glaciers in areas like Skeiðarársandur where sedimentation rates are high. Moraines may quickly get buried in sediments or washed away in jökulhlaups. Seismic soundings can then be used to reveal the existence or absence of compacted and/or coarse-grained sediments in areas suspected of having been ice covered at some stage during the Holocene.

The unconsolidated glaciofluvial sediments that make up the bulk of Skeiðarársandur must have been formed since the end of the Weichselian glaciation ∼10,000 years ago. The compacted sedimentary rocks inferred at 100–150 m depth in the central and southern reaches of the sandur are in all likelihood older than the Holocene. They may be sediments deposited at the end of the Weichselian glaciation that were subsequently covered and compacted under glaciers during re-advances. Alternatively, these may be older sediment accumulations that survived the Weichselian glaciation.

If ∼100 km^3 of sediments have accumulated on Skeiðarársandur during the Holocene (10^4 years) as suggested by the seismic soundings, the average sedimentation rate has been $\sim 10^{-2}$ km^3/yr or ∼1 km^3/century. The sediment transport of the rivers on Skeiðarársandur, excluding large jökulhlaups, has been estimated as 9.5 million tonnes per year (Tómasson, 1990). If it is assumed that the dry density of the uncompacted sediments is 1500–1700 kg m^{-3}, the accumulated volume amounts to 0.6 km^3/century. A part of these sediments are deposited offshore, suggesting a maximum deposition rate on the sandur of 0.5 km^3/century. The most likely source for the remaining sediments is large jökulhlaups. Recent history shows several high-magnitude jökulhlaups per century (Þórarinsson, 1974). In the 1996 jökulhlaup a minimum of 180 million tonnes of sediments were carried with the floodwater and most of it was deposited on the sandur (Snorrason *et al.*, 2002; Maria *et al.*, 2000). Assuming the same density as before these sediments have a volume of ∼0.1 km^3. Thus, ∼5 events of similar magnitude per century over the last 10,000 years seem to be required to account for the formation of Skeiðarársandur. Since some material is probably removed by coastal erosion this estimate should be taken as a minimum value.

It is unlikely that the rate of sediment accumulation on the sandur has been constant during the Holocene. Firstly, sedimentation was probably very rapid while the Weichselian glacier was melting. Secondly, some jökulhlaups may have deposited considerably greater volume of sediments than did the 1996 jökulhlaup. Thirdly, increased sediment concentration due to surges of Skeiðarárjökull may have been a contributing factor, as suggested by Knudsen and Marren (2002) for the upper Jökuldalur valley in early Holocene. However, despite the contributions from surges and normal river flow, it seems that on average a few high magnitude jökulhlaups per century over the last 10,000 years are required to explain the accumulation of sediments on Skeiðarársandur. If large glaciers did not exist during the Holocene thermal optimum (Eyþórsson, 1951), the rate of sedimentation during relatively ice-free periods may have been considerably less than at present. However, this need not have been the case. The Grímsvötn area may have had a local ice cap during most of the Holocene and activity in Grímsvötn may have caused jökulhlaups similar to those from Katla in historical times. Volcanic eruptions in Grímsvötn may therefore have been a rich source of sediments even at times when Vatnajökull, in its present form, did not exist. Further work on the stratigraphy of Skeiðarársandur and the origins of the sediments underlying the sandur is required to resolve this question.

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ÁGRIP

ÞYKKT SKEIÐARÁRSANDS SAMKVÆMT ENDURKASTSMÆLINGUM

Láglendið við suðurströnd Íslands er að verulegu leyti sandar sem myndast hafa af framburði jökuláa. Jökulhlaup hafa átt stóran þátt í að leggja til efnið í sandana en nokkur setmyndun verður einnig í venjulegu rennsli jökulánna auk þess sem framhlaup jöklanna valda auknum aurburði og setmyndun. Sandarnir geyma því mikilsverða sögu um rof og setflutninga á Íslandi. Skeiðarársandur er stærsti jökulsandur á Íslandi, um 1000 km^2. Til að kanna þykkt hans og lagskiptingu voru gerðar endurkastsmælingar vorin 1997 og 1999. Þær voru unnar sem hluti námskeiðs í jarðeðlisfræðilegri könnun fyrir stúdenta í Háskóla Íslands og var þykkt og gerð setlaga könnuð á alls 10 stöðum. Í mælingunum komu fram skýrir endurkastsfletir og er sá dýpsti þeirra talinn vera berggrunnur á svæðinu. Þykkt setsins mældist minnst 70–80 m upp við jaðar Skeiðarárjökuls en hún fer vaxandi eftir því sem neðar kemur á sandinn. Sunnan við miðjan sand er þykktin 220–250 m. Einnig eru setlögin þykk undir farvegi Skeiðarár sunnan Skaftafells, eða 180–220 m. Þar virðist vera um 100 m djúpur setfylltur dalur í berggrunninn. Dalur þessi er í beinu framhaldi af Skeiðarárdjúpi og er líklegt að hann sé grafinn af ísaldarjöklum.

Nokkur innri endurköst koma fram í setinu og sýna þau að sandurinn er lagskiptur. Á þeim svæðum þar sem jökull hefur ekki legið yfir á nútíma er 80–170 m þykkt lag af óhörðnuðu seti með bylgjuhraða 1.4–1.8 km s^{-1}. Upp við jaðar Skeiðarárjökuls og Svínafellsjökuls er bylgjuhraði í setinu hins vegar 1.9–2.2 km s^{-1}. Til að skýra þessa skiptingu eru einkum tveir möguleikar. Í fyrsta lagi gæti setið við jökulinn verið grófara og þéttara og því haft hærri hraða. Í öðru lagi gæti setið sem jökull hefur legið yfir hafa þjappast vegna fargs jökulsins. Síðari túlkuninni var beitt til að skýra svipaða tvískiptingu bylgjuhraða lausra setlaga á Breiðamerkursandi (Halína Bogadóttir *og fl.*, 1987).

Þó svo mælipunktarnir séu fáir, má út frá þeim meta gróflega rúmmál setbunkans sem 100–200 km^3. Stærri hluti þessa sets hefur orðið til á síðustu 10.000 árum, þ.e. frá lokum síðasta jökulskeiðs. Setsöfnun hefur því numið um 1 km^3/öld að meðaltali. Þó svo hluti setsins hafi fallið til sem framburður jökulánna við venjulegt rennsli bendir flest til þess að meirihlutinn sé til kominn sem framburður jökulhlaupa. Til að skýra magnið virðist sem að meðaltali þurfi nokkur stórhlaup að hafa komið á hverri öld frá lokum síðasta jökulskeiðs. Viðteknar skoðanir um stærð jökla á Íslandi á nútíma gera ráð fyrir að Vatnajökull í núverandi mynd hafi orðið til fyrir um 2500 árum. Nú hljómar það sem mótsögn að Skeiðarársandur hafi að verulegum hluta hlaðist upp í jökulhlaupum áður en Vatnajökull varð til. Hugsanleg lausn á þessari mótsögn væri sú að jökulhetta hliðstæð Mýrdalsjökli hafi legið yfir Grímsvatnasvæðinu áður en Vatnajökull myndaðist. Ef svo var gætu jökulhlaup vegna tíðra gosa í Grímsvötnum hafa flutt verulegt magn gjósku og annars sets niður á láglendið sunnan Grímsvatna. Þörf er á frekari rannsóknum á lagskiptingu Skeiðarársands ef skera á úr um hvort þessi tilgáta á við rök að styðjast.

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