Exploring the potential for OSL in the rise and fall in transhumance in Iceland, 800–1800 project

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EXPLORING THE POTENTIAL FOR OSL IN THE RISE AND FALL IN TRANSHUMANCE IN ICELAND, 800-1800 PROJECT

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The cover photo is taken at Baðsvellir (site 3) during sampling for OSL profiling measuring, looking northwest.

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Samantekt

Þessi skýrsla greinir frá niðurstöðum úr verkefninu *Sel á Reykjanesi: Ný aðferð til aldursgreiningar fornleifa (optically stimulated luminescence – OSL*) sem hlaut styrk frá Fornminjasjóði 2023. Markmið verkefnisins var að kanna hvort hægt væri að beita OSL- aldursgreiningu á fornminjum á Íslandi til þess að hjálpa okkur að skilja betur þróun seljabúskapar á Íslandi. Eitt það helsta sem hamlað hefur fyrri seljarannsóknum er skortur á traustri tímasetningu seljanna. Fornminjasjóðsverkefnið er hluti af stærra verkefni um seljabúskap á Íslandi frá 800-1800 e.Kr. sem styrkt var af Rannsóknarsjóði Íslands. Undanfarin ár hafa orðið gríðarlega miklar framfarir í OSL-greiningu jarðvegssýna sem hafa reynst vel í fornleifafræði Norður-Evrópu. OSL- greiningar búa yfir þeim kosti að ekki er þörf á gripum eða vistleifum, heldur er notast við jarðveg.

Tekin voru sýni frá sex seljum: Selsvöllum og Sogaseli á Reykjanesi, Baðsvöllum við Þorbjörn í Grindavík, Vífilsstaðaseli, Helguseli í Mosfellsdal og Mosfellsseli. Niðurstaðan var að ekki reyndist unnt að nota OSL-greiningu til að aldursgreina seljarústir á Suðvesturlandi. Það útilokar hins vegar ekki að aðferðin geti hentað annars staðar, og gefa sýnin frá Helguseli og Mosfellsseli von um slíkt kunni að vera gerlegt á öðrum stöðum.

Efnisorð
Fornminjasjóður, aldursgreining, OSL-greining, seljabúskapur, Reykjanes, Mosfelldalur

Summary

This report presents the results from the project '*Sel á Reykjanesi Ný aðferð til aldursgreiningar fornleifa (optically)'*, which was awarded a grant in 2023 from Fornminjasjóður. The aim of the project was to test the applicability of the optically stimulated luminescence profiling and dating (OSL P-D) methodology to the Icelandic soils in order to advance our knowledge regarding transhumance in Iceland. The project sits within the larger remit of *The Rise and Fall in Transhumance in Iceland, 800-1800,* awarded by Rannsóknasjóður Íslands. There have been great advantages in applying OSL to date younger archaeological remains in North-Europe. One of the main benefits of OSL is that it dates quartz or feldspar in the soil, so archaeologists do not need ecofacts or artefacts to be able to date sites.

Samples were taken from six sheiling sites: Selsvelli og Sogasel at Reykjanes, Baðsvellir near Þorbjörn in Grindavík, Vífilsstaðasel, Helguseli in Mosfellsdalur og Mosfellssel. Overall, the results were unsatisfactory, but samples from Helgusel and Mosfellsel were marginally better and do not rule out the application of OSL to other localities in Iceland; the screening results from Helgusel show that the bulk sediment does contain a dosimeter that registers an age-signature, although not in the quantity required for more formal quantitative dating.

Keywords

Fornminjasjóður, dating, OSL method, transhumance, Reykjanes, Mosfellsdalur

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1 Introduction

This short report explores the potential for OSL dating in Southwest-Iceland. This fulfils a condition in grant for Fornminjasjóður, *Sel á Reykjanesi Ný aðferð til aldursgreiningar fornleifa (optically optically stimulated luminescence - OSL)*, which sits within the larger remit of *The Rise and Fall in Transhumance in Iceland, 800-1800* project (TransIce: Rannís Grant no 228883). The aim of the Fornminjasjóður's project was to test the applicability of the optically stimulated luminescence profiling and dating (OSL P-D) methodology to the Icelandic soils in Southwest-Iceland. A prerequisite for the luminescence dating is that the soil contains quartz and feldspar, and that these minerals have sufficient luminescence sensitivity to register archaeological meaningful doses.

Tim Kinnaird along with members of the TransIce team visited several sites across in Southwest-Iceland between the 1st and 4th of July 2023, to collect samples for OSL P-D and dating: Sogasel, Selsvellir, Baðsvellir, Vífilsstaðasel, Helgusel and Mosfellssel (**Fig** 1)

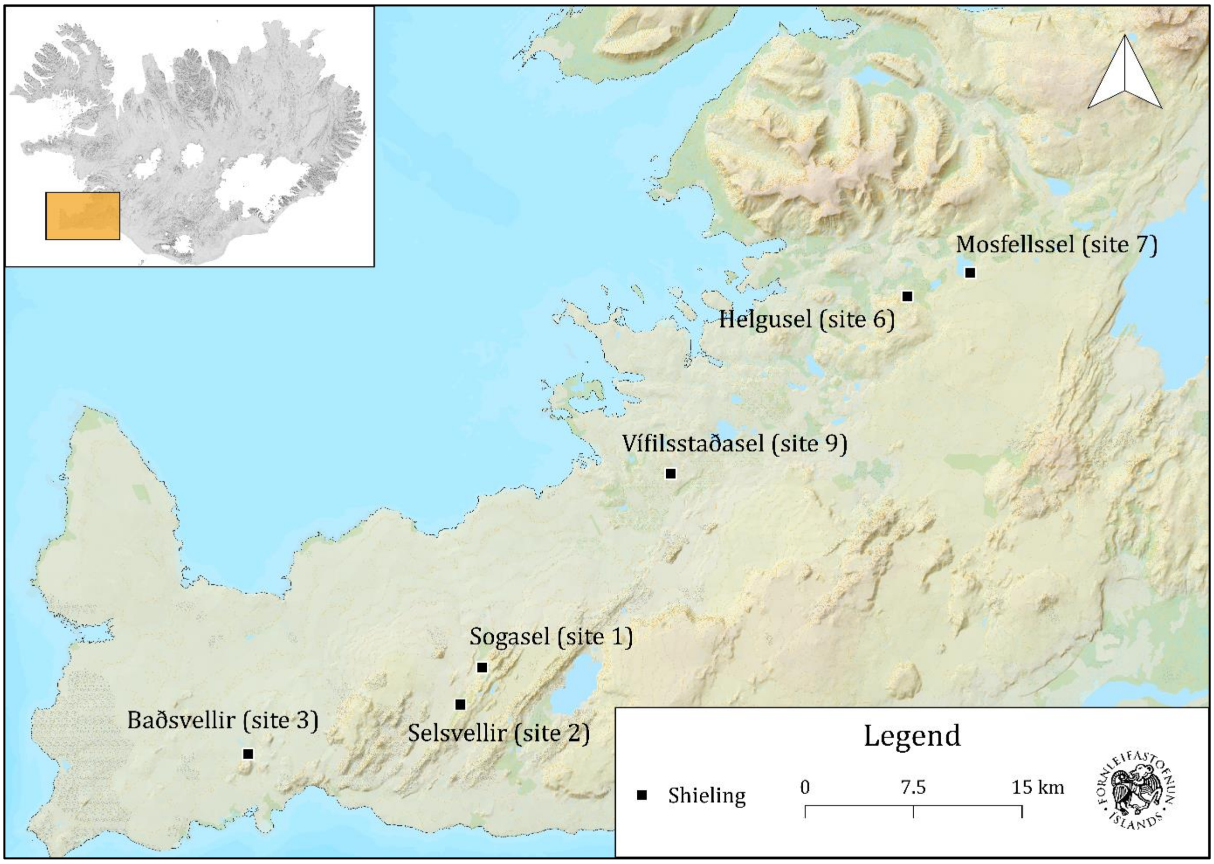


***Fig** 1. Map detailing the locations mentioned in the text. Background: Landmælingar Íslands.*

2 Methodology

The OSL P-D methodology tested here, is described in a number of recent publications, Srivastava *et al.* (2023), Kinnaird *et al.* (2022), Turner *et al.* (2021). It utilises a three-stage approach to luminescence investigations. The first stage concerns sample collection and OSL profiling undertaken alongside excavation. The second and third stages concern more targeted analyses undertaken in the laboratory, to characterise the luminescence properties of prepared quartz and feldspar, to obtain the first approximations of apparent dose, then, determine luminescence depositional ages.

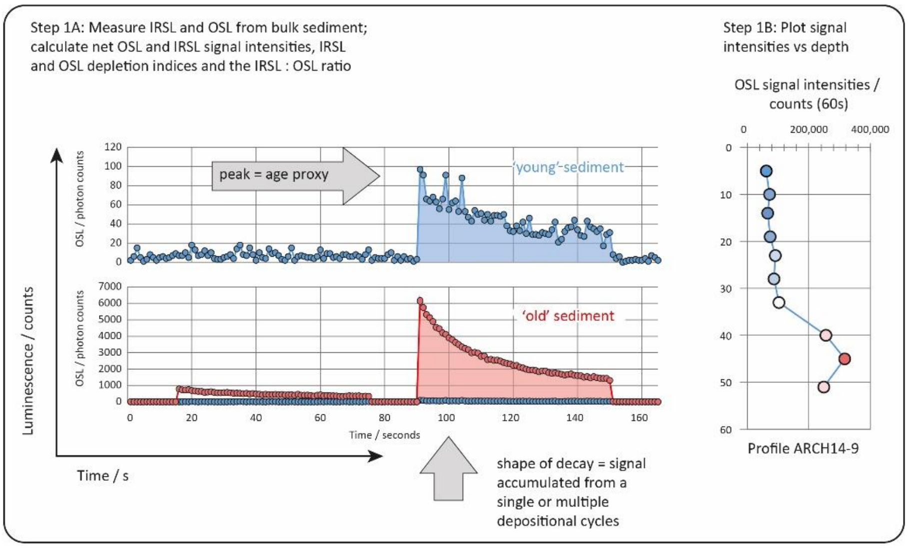


***Fig** 2: The methodological approach:*

step 1a, IRSL and OSL measured, and used to calculate IRSL and OSL signal intensities, IRSL and OSL depletion indices and the IRSL : OSL ratio

step 1b, signal intensites are considered in light of the stratigraphy, assesssing down-profile trends

OSL profiling was trialled at six localities (**Fig** 1). During this stage, portable OSL equipment (Munyikwa *et al.* 2020) was used to investigate the luminescence characteristics of bulk sediment. This approach is illustrated in figure 2. Bulk sediment is subjected to an interleaved sequence of system dark count (background), infra-red stimulated luminescence (IRSL) and OSL. These readings are used to calculate IRSL and OSL net signal intensities, IRSL and OSL depletion indices and IRSL:OSL ratios. In well bleached sediments, signal intensities may act as a proxy for age: lower signal intensities reflect more recent zeroing and deposition (*eg* **Fig** 2, step 1A, the blue luminescence response), while higher intensities indicate sediments that were zeroed and deposited longer ago (**Fig** 2, step 1A, the red response). The down-profile trends in signal intensities should respond to temporal breaks and/or stratigraphic progressions.

100 samples were retrieved for preliminary screening from across the 6 sites, as follows, 17 from site 1, 29 from site 2, 16 from site 3, 14 from site 9, 17 from site 6 and 9 from site 7.

3 Results

In short, the results were mixed (Table 1). Not one sample from sites 1, 2, 3 and 9 returned IRSL net signal intensities above the limit of detection; and OSL net signal intensities ranged from ~100 to 740 counts, with little stratigraphic progression. (To provide perspective, in a recent study in Norfolk, England, equivalent aged soils to those studied here returned values in the range 3.32 x 10^4 to 1.87 x 10^6 counts, with stratigraphic progression).

The results from sites 6 and 7 showed slightly more promise: ~ 50 % of these samples had measurable IRSL, with IRSL intensities in the range ~110 to 6290 counts; OSL net signal intensities ranged from 430 to 4.12 x10^4 counts (which in the Norfolk study, would be equivalent to the luminescence that grew in situ in the top 10cm of topsoil).

Table 1: Preliminary OSL screening results from the study sites

Field ID	Context	Depth	IRSL		OSL		IRSL : OSL
			Signal intensities / counts	Depletion ratio	Signal intensities / counts	Depletion ratio	
Site 1,							
s23-1-1/1	1	12	-	-	430 ± 40	0.84 ± 0.09	-
s23-1-1/2	2	20	-	-	240 ± 40	0.71 ± 0.09	-
s23-1-1/3	2	28	-	-	280 ± 40	1.04 ± 0.14	-
s23-1-1/4	12	34	-	-	240 ± 40	1.46 ± 0.23	-
s23-1-1/5	12	40	-	-	130 ± 40	0.98 ± 0.18	-
s23-1-1/6	12	45	-	-	240 ± 40	1.04 ± 0.12	-
s23-1-1/7	6	50	-	-	440 ± 40	1.19 ± 0.16	-
s23-1-1/8	6	55	-	-	120 ± 30	1.42 ± 0.23	-
s23-1-1/9	6	62	-	-	200 ± 40	0.78 ± 0.13	-
s23-1-1/10	6	68	-	-	120 ± 40	0.78 ± 0.11	-
s23-1-1/11	7	74	-	-	230 ± 40	0.82 ± 0.11	-
s23-1-1/12	7	82	-	-	400 ± 40	0.84 ± 0.12	-
s23-1-1/13	15	95	-	-	300 ± 40	0.94 ± 0.15	-
s23-1-1/14	15	102	-	-	-	-	-
s23-1-1/15	16	108	-	-	200 ± 40	0.9 ± 0.12	-
s23-1-1/16	nat	114	-	-	-	-	-
s23-1-1/17	nat	120	-	-	740 ± 40	1.26 ± 0.1	-
s23-2-1/1	7	1	-	-	300 ± 40	1.41 ± 0.19	-
s23-2-1/2	7	2	-	-	670 ± 40	1.73 ± 0.16	-
s23-2-1/3	8	3	-	-	570 ± 40	1.28 ± 0.13	-

s23-2-1/4	9	4	-	-	370 ± 40	0.88 ± 0.1	-
s23-2-1/6	9	6	-	-	280 ± 40	1.04 ± 0.14	-
s23-2-1/7	9	7	-	-	330 ± 40	0.87 ± 0.11	-
s23-2-1/8	9	8	-	-	320 ± 40	1.1 ± 0.14	-
s23-2-1/9	9	9	-	-	310 ± 40	1.24 ± 0.15	-
s23-2-1/10	9	10	-	-	440 ± 40	0.9 ± 0.1	-
s23-2-1/11	12	11	-	-	260 ± 40	1.58 ± 0.21	-
s23-2-1/12	12	12	-	-	380 ± 40	1.22 ± 0.15	-
s23-2-1/13	12	14	-	-	280 ± 40	0.94 ± 0.13	-
s23-2-1/14	12	14	-	-	310 ± 40	1.33 ± 0.19	-
s23-2-1/15	12	15	-	-	460 ± 40	1.23 ± 0.13	-
s23-2-1/16	12	16	-	-	510 ± 50	1.18 ± 0.1	-
s23-2-1/17	12	17	-	-	150 ± 40	0.53 ± 0.07	-
s23-2-1/18	nat	18	-	-	320 ± 40	0.92 ± 0.12	-
s23-2-1/19	1	19	-	-	100 ± 40	5.19 ± 0.77	-
s23-2-1/20	5	20	-	-	610 ± 40	1.03 ± 0.1	-
s23-2-1/21	5	21	-	-	330 ± 40	1.06 ± 0.13	-
s23-2-1/22	5	22	-	-	210 ± 40	0.93 ± 0.13	-
s23-2-1/23	6	23	-	-	200 ± 40	0.66 ± 0.09	-
s23-2-1/24	7	24	-	-	220 ± 40	0.93 ± 0.12	-
s23-2-1/25	9	25	-	-	320 ± 40	1.42 ± 0.18	-
s23-2-1/26	10	26	-	-	-	-	-
s23-2-1/27	10	27	-	-	290 ± 40	0.75 ± 0.09	-
s23-2-1/28	10	28	-	-	370 ± 40	1.2 ± 0.14	-
s23-2-1/29	nat	29	-	-	340 ± 40	0.81 ± 0.1	-
s23-3-2/1			-	-	-	-	-
s23-3-2/2			-	-	-	-	-
s23-3-2/3			-	-	-	-	-
s23-3-2/4			-	-	-	-	-
s23-3-2/5			-	-	-	-	-
s23-3-2/6	1	19	-	-	370 ± 40	1.02 ± 0.14	-
s23-3-2/7	4	25	-	-	510 ± 40	0.97 ± 0.11	-
s23-3-2/8	5	31	-	-	270 ± 40	1.18 ± 0.16	-
s23-3-2/9	5	37	-	-	280 ± 40	1.36 ± 0.2	-
s23-3-2/10	8	43	-	-	120 ± 40	0.38 ± 0.07	-
s23-3-2/11	8	48	-	-	300 ± 40	1.43 ± 0.2	-
s23-3-2/12	8	53	-	-	-	-	-
s23-3-2/13	8	59	-	-	160 ± 40	1.5 ± 0.26	-
s23-3-2/14	8	67	-	-	200 ± 40	0.93 ± 0.15	-
s23-3-2/15	8	73	-	-	200 ± 40	0.75 ± 0.12	-
s23-3-2/16	0	81	-	-	-	-	-
s23-9-2/1	2	14	-	-	250 ± 40	0.96 ± 0.14	-
s23-9-2/2	2	19	-	-	240 ± 40	1.48 ± 0.21	-
s23-9-2/3	4	27	-	-	270 ± 40	1.42 ± 0.2	-
s23-9-2/4	4	34	-	-	-	-	-
s23-9-2/5	5	60	-	-	150 ± 40	1.69 ± 0.27	-
s23-9-2/6	5	68	-	-	210 ± 40	0.78 ± 0.12	-

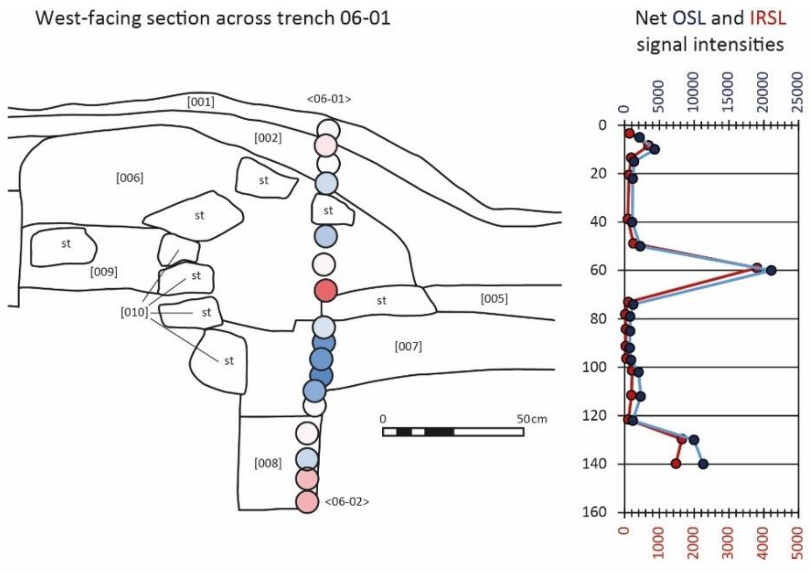
s23-9-2/7	5	74	-	-	250 ± 40	1.21 ± 0.17	-
s23-9-2/8	7	80	-	-	140 ± 40	0.43 ± 0.07	-
s23-9-2/9	7	85	-	-	370 ± 40	0.82 ± 0.11	-
s23-9-2/10	7	90	-	-	290 ± 40	1.24 ± 0.17	-
s23-9-2/11	.9/1	95	-	-	320 ± 40	1.32 ± 0.17	-
s23-9-2/12	.9/2	100	-	-	170 ± 40	2.11 ± 0.35	-
s23-9-2/13	.9/3	105	-	-	220 ± 40	1.02 ± 0.15	-
s23-9-2/14	nat	112	-	-	-	-	-
s23-6-4/1	1	5	150 ± 40	1.79 ± 0.27	2140 ± 60	1.44 ± 0.07	0.0677 ± 0.0194
s23-6-4/2	2	10	700 ± 50	1.21 ± 0.11	4320 ± 70	1.55 ± 0.05	0.1609 ± 0.0108
s23-6-4/3	2	15	200 ± 40	2.2 ± 0.34	1340 ± 50	1.16 ± 0.07	0.1457 ± 0.0301
s23-6-4/4	2	22	-	-	1170 ± 50	1.13 ± 0.07	0.1099 ± 0.0354
s23-6-4/5	6	40	-	-	1060 ± 50	1.28 ± 0.09	0.0903 ± 0.0359
s23-6-4/6	6	50	260 ± 40	0.9 ± 0.11	2240 ± 60	1.4 ± 0.06	0.1147 ± 0.02
s23-6-4/7	6	60	3810 ± 70	1.36 ± 0.05	21090 ± 150	1.91 ± 0.03	0.1807 ± 0.0037
s23-6-4/8	7	74	110 ± 40	1.37 ± 0.25	1210 ± 50	1.15 ± 0.08	0.0899 ± 0.0319
s23-6-4/9	7	79	-	-	780 ± 50	1.2 ± 0.1	0.0296 ± 0.0482
s23-6-4/10	7	85	-	-	780 ± 50	1.1 ± 0.09	0.0526 ± 0.0503
s23-6-4/11	7	92	-	-	700 ± 50	1.09 ± 0.09	0.0515 ± 0.0536
s23-6-4/12	7	97	-	-	900 ± 50	1.1 ± 0.08	0.0598 ± 0.0429
s23-6-4/13	7	102	220 ± 40	1.44 ± 0.21	1990 ± 60	1.36 ± 0.07	0.1106 ± 0.0207
s23-6-4/14	8	112	200 ± 40	1.34 ± 0.19	2300 ± 60	1.28 ± 0.06	0.0873 ± 0.0183
s23-6-4/15	8	122	110 ± 40	1.67 ± 0.27	1140 ± 50	1.28 ± 0.09	0.0983 ± 0.0351
s23-6-4/16	8	130	1650 ± 60	1.41 ± 0.08	9970 ± 110	1.99 ± 0.04	0.1658 ± 0.006
s23-6-4/17	8	140	1480 ± 50	1.31 ± 0.08	11290 ± 110	1.99 ± 0.04	0.131 ± 0.0049
s23-7-4/1	1	10	6290 ± 90	1.45 ± 0.04	41240 ± 210	3 ± 0.03	0.1526 ± 0.0023
s23-7-4/2	1	16	-	-	770 ± 50	1.05 ± 0.09	0.0456 ± 0.0498
s23-7-4/3	3	23	330 ± 40	1.19 ± 0.15	1930 ± 60	1.33 ± 0.07	0.1702 ± 0.0219
s23-7-4/4	3	29	-	-	630 ± 50	1.06 ± 0.1	0.0711 ± 0.0593
s23-7-4/5	3	34	2400 ± 60	1.4 ± 0.06	16500 ± 140	1.66 ± 0.03	0.1451 ± 0.004
s23-7-4/6	4	39	-	-	430 ± 40	1.15 ± 0.13	0.1088 ± 0.0845
s23-7-4/7	6	45	-	-	440 ± 40	1.26 ± 0.13	0.0677 ± 0.0848
s23-7-4/8	8	51	-	-	840 ± 50	1.56 ± 0.13	0.0203 ± 0.0461
s23-7-4/9	nat	57	-	-	670 ± 50	1.08 ± 0.1	-

The sites at Helgusel (site 6) and Mosfellssel (site 7) showed the most promise, as although IRSL and OSL counts were low, there was some variation with luminescence with stratigraphy / depth (**Fig** 3). The profile through the west-facing section of the excavation of the shieling at Helgusel, encompasses the topsoil [001, 002], the upcast/earth wall of the shieling [006], and the underlying floor layers of peat ash, wood ash and charcoal [007, 008]. In contrast to expectations, the IRSL and OSL signal intensities do not show a stratigraphic progression down-profile; instead, the top soil –

[001]/(s23-6/1) and [002]/(s23-6/2 and 3) – and turf bank [006]/(s23-6/4 through 7) are characterised by higher intensities, than the floor layers at depth – [007]/(s23-6/9 through 12). This inversion in IRSL and OSL signal intensities is consistent with the turf bank being upcast, without the luminescence signals being reset. The lower signal intensities characterising the floor layers [007] and [008] might imply some disturbance to these layers at the time they were laid down. At the very base of the profile, the IRSL and OSL intensities show a progression to higher values, consistent with a normal age-depth progression. This profile was used to select the most promising position for the dating sample in this stratigraphy (Table 2).

Table 2: Sample details

Site	Equivalent to	Depth /cm	Context / significance
Site 1, Sogasel	S23-1-1/5 to 6	44	between tephra layers ~AD1500-AD1226?
	S23-1-1/7 to 8	56	beneath prominent tephra ~ AD1226?
	S23-1-1/13	94	beneath charcoal layer, < AD1226?; above substrate
Site 2, Sogasel	S23-2-1/16 to 17		base of accumulation [012], behind large stone
Site 3, Baðsvellir	S23-3-2/5	53	base of [007], in turf wall
	S23-3-2/11	48	in [008], beneath wall, should provide TPQ
Site 6, Helgusel	S23-6-4/17	140	in [008], base of floor layers as excavated
Site 7, Mosfellssel	S23-7-4/8	51	in [008], floor layer; lies on tephra ~ AD 1500?
Site 9, Vifilsstaðasel	S23-9-2/13	105	in floor [009/3]



Field ID	context	Depth/cm	IRSL net signal intensities / counts	IRSL depletion indices	OSL net signal intensities / counts	OSL depletion indices
s23-6-4/1	1	5	150 ± 40	1.79 ± 0.27	2140 ± 60	1.44 ± 0.07
s23-6-4/2	2	10	700 ± 50	1.21 ± 0.11	4320 ± 70	1.55 ± 0.05
s23-6-4/3	2	15	200 ± 40	2.20 ± 0.34	1340 ± 50	1.16 ± 0.07
s23-6-4/4	2	22	-	-	1170 ± 50	1.13 ± 0.07
s23-6-4/5	6	40	-	-	1060 ± 50	1.28 ± 0.09
s23-6-4/6	6	50	260 ± 40	0.90 ± 0.11	2240 ± 60	1.40 ± 0.06
s23-6-4/7	6	60	3810 ± 70	1.36 ± 0.05	21090 ± 150	1.91 ± 0.03
s23-6-4/8	7	74	110 ± 40	1.37 ± 0.25	1210 ± 50	1.15 ± 0.08
s23-6-4/9	7	79	-	-	780 ± 50	1.20 ± 0.10
s23-6-4/10	7	85	-	-	780 ± 50	1.10 ± 0.09
s23-6-4/11	7	92	-	-	700 ± 50	1.09 ± 0.09
s23-6-4/12	7	97	-	-	900 ± 50	1.10 ± 0.08
s23-6-4/13	7	102	220 ± 40	1.44 ± 0.21	1990 ± 60	1.36 ± 0.07
s23-6-4/14	8	112	200 ± 40	1.34 ± 0.19	2300 ± 60	1.28 ± 0.06
s23-6-4/15	8	122	110 ± 40	1.67 ± 0.27	1140 ± 50	1.28 ± 0.09
s23-6-4/16	8	130	1650 ± 60	1.41 ± 0.08	9970 ± 110	1.99 ± 0.04
s23-6-4/17	8	140	1480 ± 50	1.31 ± 0.08	11290 ± 110	1.99 ± 0.04

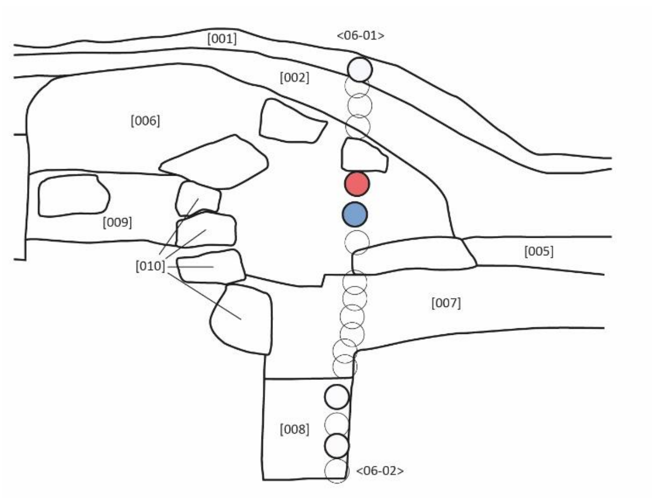


***Fig** 3: Results from preliminary screening of the soils at Helgusel (site 6):*

(top) IRSL and OSL net signal intensities from bulk sediment collected through the west-facing section of the trench. The middle plot shows the variation in OSL intensities with depth, illustrating some stratigraphic variation. OSL intensities are overlain on the section drawing, coloured by intensity, with the cooler colours representing the lower intensities, the warmer colours the higher intensities;

(bottom) OSL apparent doses (the samples did not respond to IRSL) for the few samples that yielded feldspar

The extremely low IRSL and OSL count for the Reykjanes soils suggest that the application of OSL P-D to the sediment stratigraphies at Sogasel, Selsvellir, Baðsvellir and Vífilsstaðasel might be problematic. However, the results from Helgusel were more promising, suggesting that there might be merit in more targeted investigations in specific localities.

The test of this, is in the next stage of the OSL P-D methodology, in which minerals responsive to luminescence are extracted from the bulk sediment and subjected to more formal laboratory analyses. The first task is to isolate the minerals that act as dosimeters for luminescence dating, K feldspar and quartz. Given the bedrock geology, expectations of quartz were low (any quartz present must be allochthonous) and mineral preparation protocols were implemented to concentrate the feldspar fractions. 34 samples were progressed to formal laboratory analysis: 17 from Helgusel (with the more promising luminescence behaviour) and 17 from Sogasel (with the poorer behaviour). The samples were wet sieved to obtain the 90 to 250 μm fraction, which were then treated in 1M hydrochloric acid (HCl) for 10 minutes, 15% hydrofluoric acid (HF) for 15 minutes, and then, a further 1M HCl for 10minutes. This fraction was then density separated in LST fastfloat solutions of 2.51 gcm^{-3}, 2.58 gcm^{-3} and 2.62 gcm^{-3}, to concentrate potassium-rich feldspar (2.51-2.58 gcm^{-3}) and sodium-rich feldspar (2.58-2.62 gcm^{-3}) (any quartz present would have been present in the >2.62 gcm^{-3}; quartz was absent). The feldspar yields were very low, and only one to two aliquots could be dispensed from each sub-sample: 34 from the 17 samples from Helgusel and 17 from Sogasel.

Luminescence sensitivities (Photon Counts per Gy) and stored doses (Gy) were evaluated from paired aliquots of the HF-etched quartz and polymineral fractions, using Risø DA-20 automatic readers (following procedures outlined in Burbidge *et al.* (2007), Turner *et al.* (2022) and Srivastava *et al.* (2023). The Risø DA-20 automatic readers are equipped with $^{90}Sr/^{90}Y$ β-sources for irradiation, blue LEDs emitting around 470 nm and infrared diodes emitting around 830 nm for optical stimulation. The readout cycles comprised a natural readout, followed by a 2.8 Gy test dose, then regenerative doses of 2.8 Gy, 5.5 Gy, 11.0 Gy and 33.0 Gy, each with a 2.8 Gy test dose. A repeat dose point, 2.8 Gy, was included to check the ability of the SAR procedure to correct for laboratory-induced sensitivity changes (the 'recycling test'), and a zero-dose point (0 Gy), late in the sequence, to check for thermally induced charge transfer during the irradiation and preheating cycle (‘recuperation’). A preheat of 220°C preheat was followed by 60s OSL measurements using the IR LEDs at 50°C (the IRSL signal), then the blue LEDs at 125°C (the OSL signal).

The results were disappointing. No samples from Sogasel yielded measurable IRSL or OSL. The results from Helgusel were marginally better: again, no samples yielded measurable IRSL; but, 5 samples had measurable OSL (**Fig** 4; table 3). These five samples all had extremely low sensitivities (< 300 counts Gy^{-1}). The low sensitivities, poor dose recyclability, and variable recuperation, mean that the apparent doses are only poorly resolved. The apparent doses obtained for these 5 samples are provided in table 3.

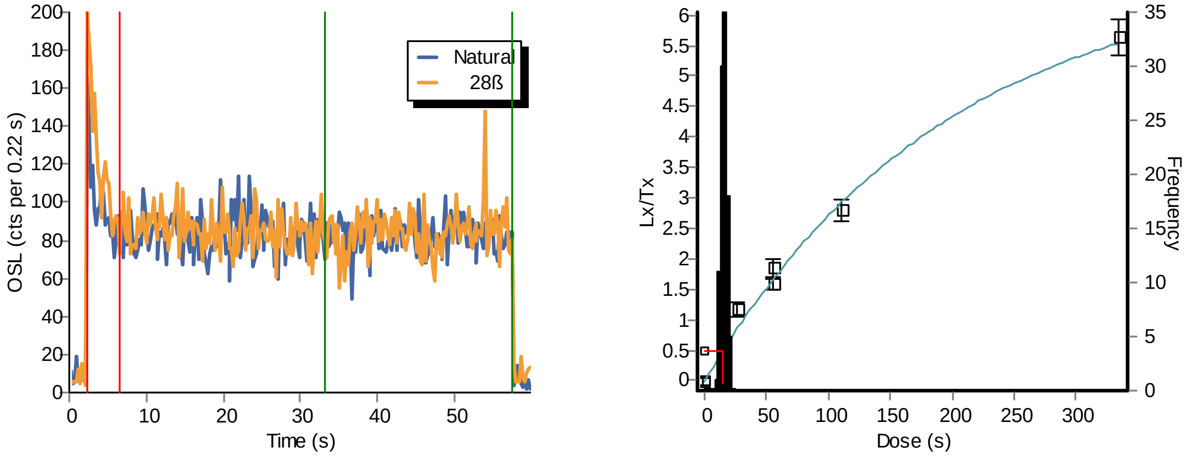


***Fig** 4: only a few aliquots from CERSA1333 returned OSL, aliquot #12: (left) its OSL decay and (right) dose response curve.*

These results preclude the application of IRSL / OSL dating to the Reykjanes soils at the sites of Sogasel, Selsvellir, Baðsvellir and Vífilsstaðasel. This does not rule out the application of OSL to other localities in Iceland; the screening results from Helgusel show that the bulk sediment does contain a dosimeter that registers an age-signature, although not in the quantity required for more formal quantitative dating.

Table 3: results from calibrated OSL screening of the Helgusel quartz

Lab ID	Field ID	Depth/ context	Equivalent dose / Gy	Sensitivity / counts Gy^{-1}
CERSA1333/1	S23-6-4/1	5 cm [001]	3.43 ± 2.60	120 ± 10
CERSA1333/5	S23-6-4/5	40 cm [006]	33.04 ± 13.40	140 ± 10
CERSA1333/6	S23-6-4/6	50 cm [006]	1.45 ± 0.22	870 ± 30

CERSA1333/14	S23-6-4/14	112 cm [008]	3.57 ± 1.82	140 ± 10
CERSA1333/14	S23-6-4/14	112 cm [008]	0.88 ± 0.56	330 ± 20
CERSA1333/16	S23-6-4/16	130 cm [008]	3.91 ± 2.04	200 ± 10

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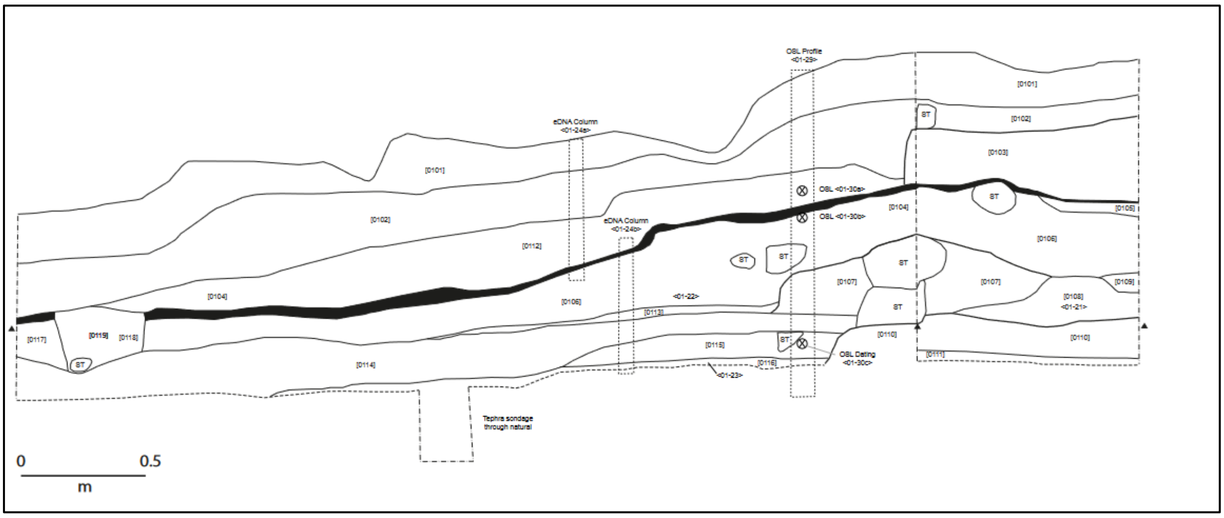
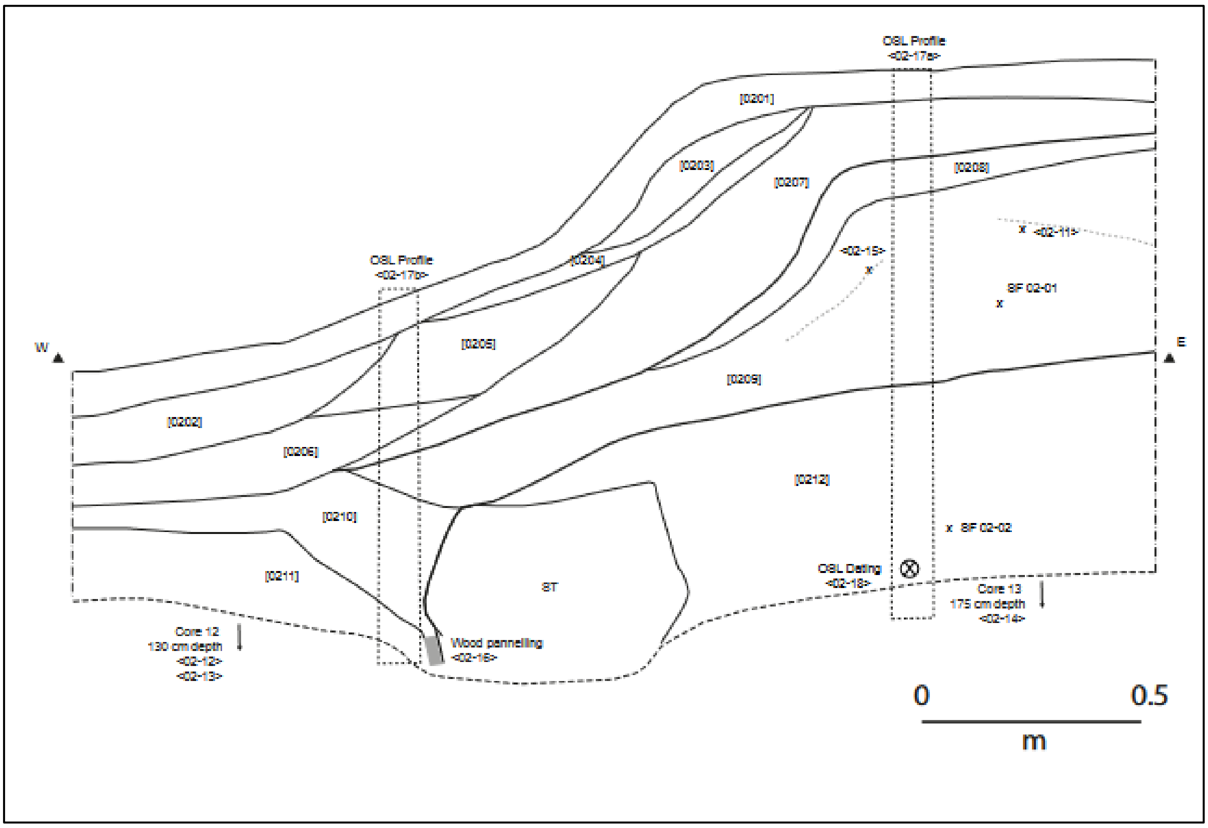
Appendix A – Section drawings

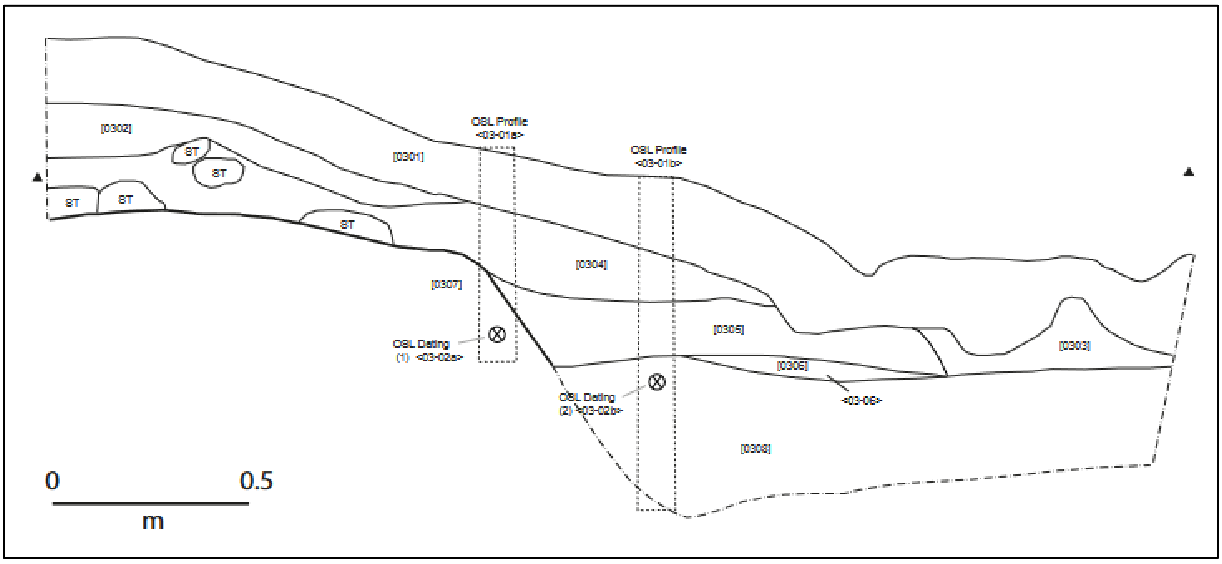
Sogasel – Site 1



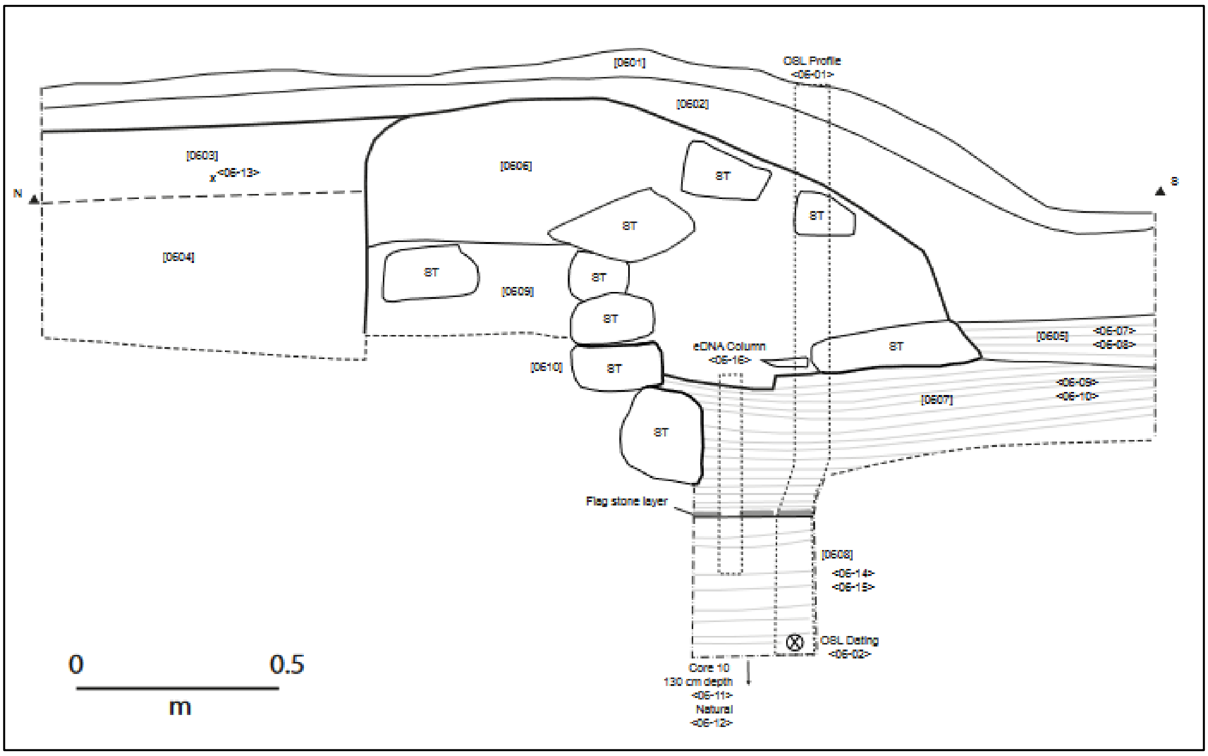
Selsvellir – Site 2



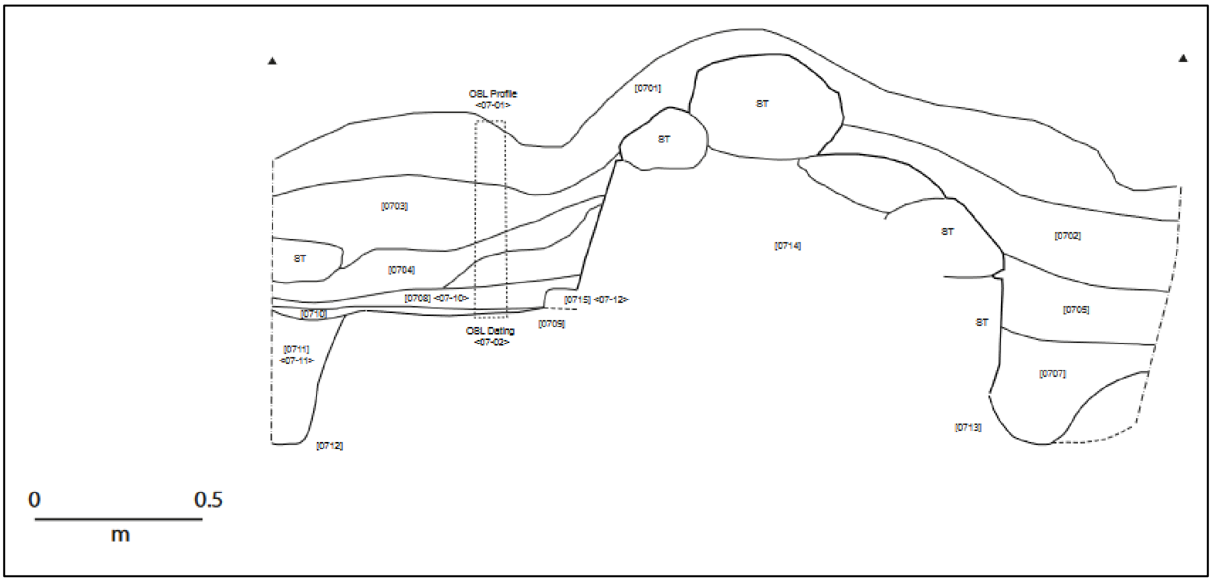
Baðsvellir – Site 3



Helgusel – Site 6



Mosfellssel - Site 7



Vífilsstaðasel – Site 9