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A short-lived aeolian event during the Early Holocene in southern Norway

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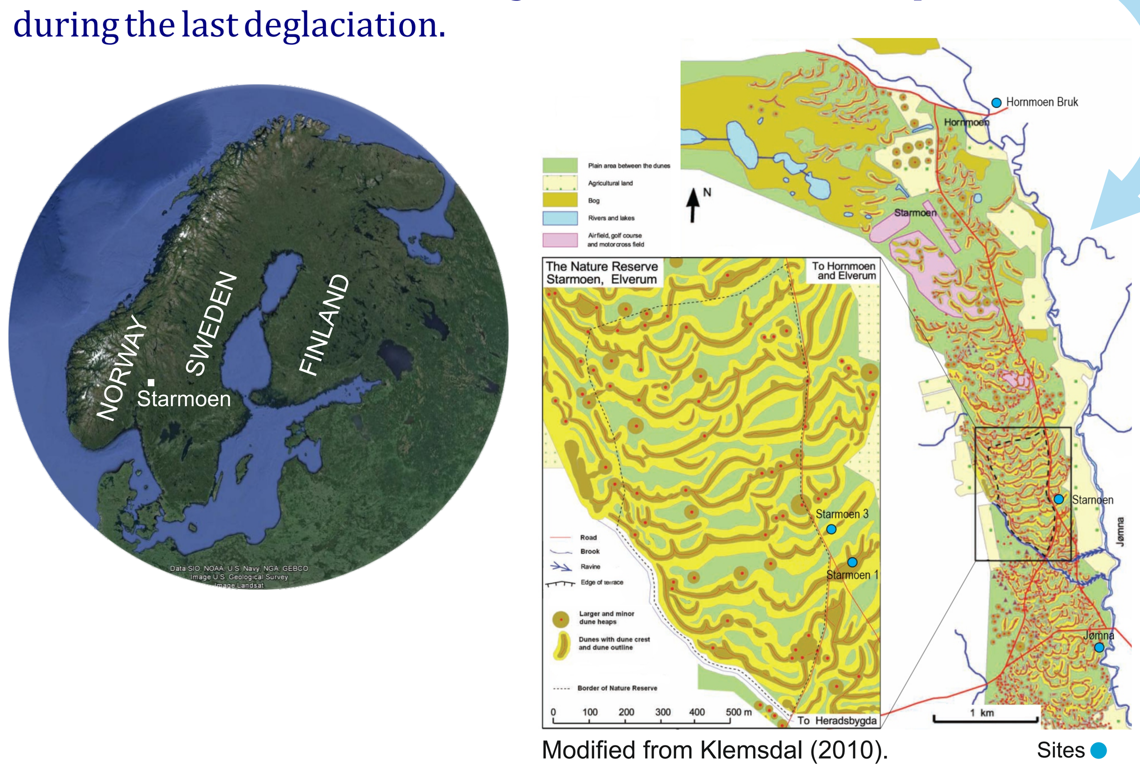
The Starmoen dune field in southern Norway was formed during a single, brief phase of aeolian activity right after the last deglaciation, 11-10 ka ago, as shown by tightly clustered quartz OSL ages and non-migrating dunes with few discordances. Luminescence characteristics depend on sediment type, and incomplete bleaching causes age overestimation for glacifluvial deposits.

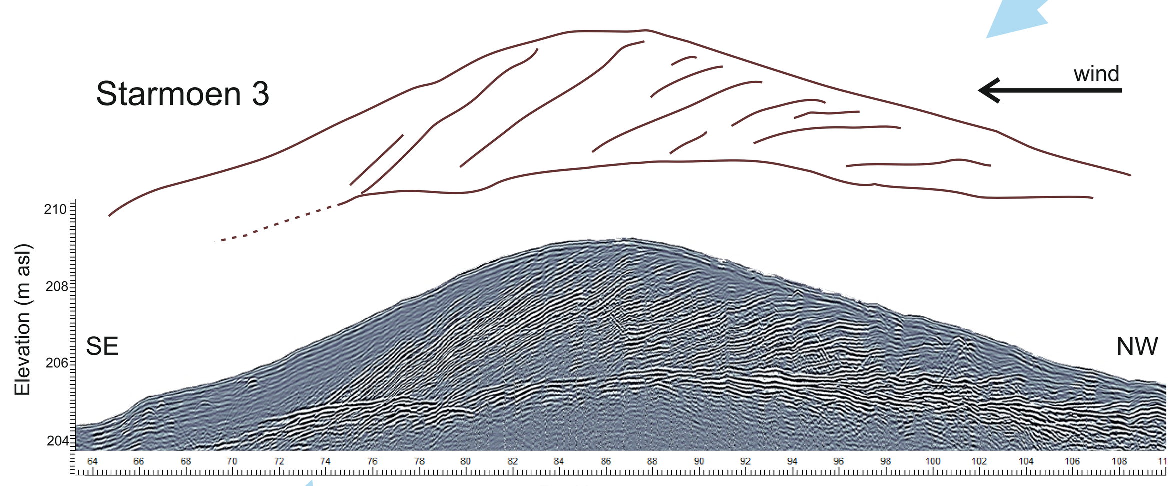
Geology

Crescentic dunes and dune heaps at Starmoen in the Jømna valley form part of one of Norway's largest dune fields. The dunes overlie glacifluvial sediments, deposited during the last deglaciation.



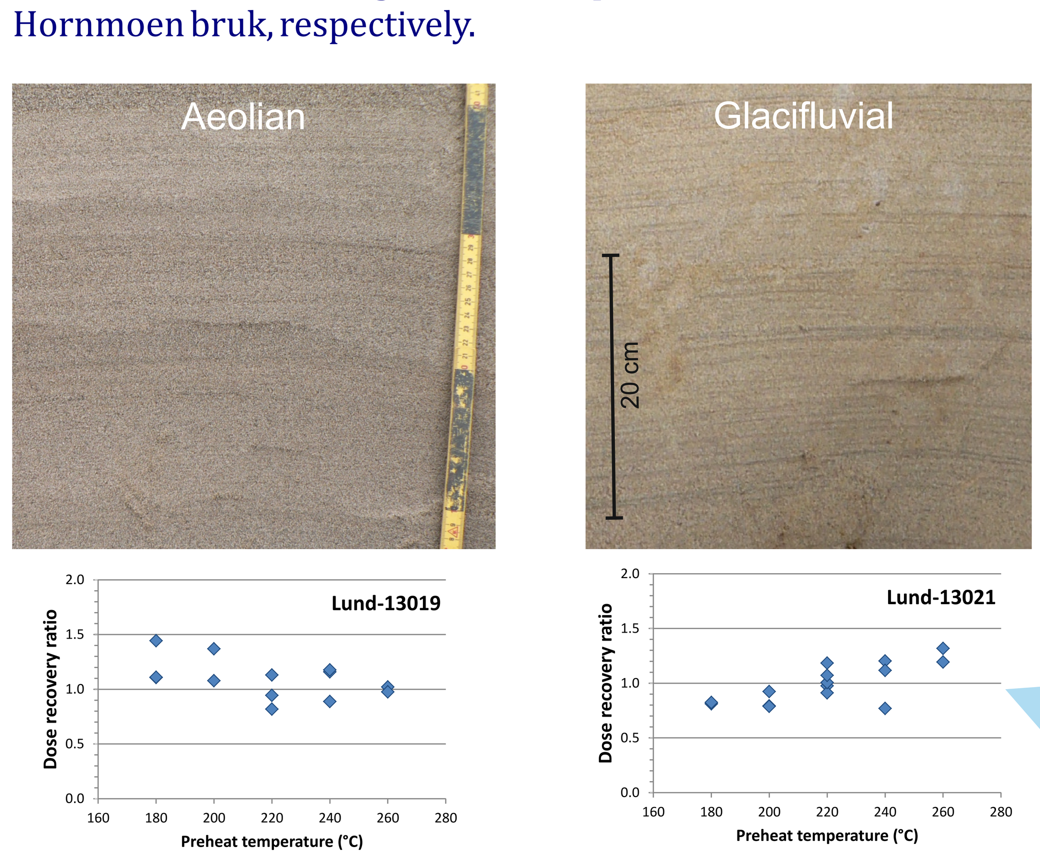
Modified from Klemsdal (2010).

Successively steeper beds indicates in-place build-up from a low heap to a dune, rather than a dune that has migrated to its present position, as seen in this example of a ground-penetrating radar (GPR) profile across a dune at Starmoen 3. This suggests that the dune-forming phase was short and did not allow for much migration.

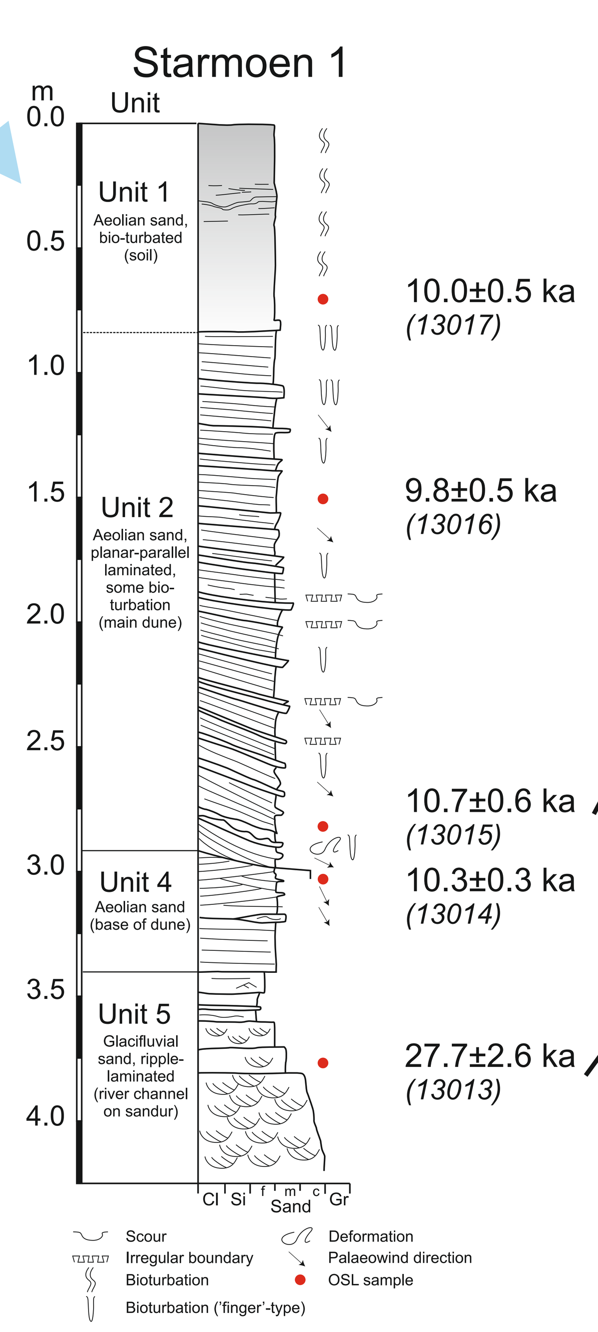


Few discordances are found in both GPR profiles and open sections, as shown above and right. This supports a single aeolian episode with minor reworking.

Aeolian and glacifluvial sediments may be sedimentologically very similar, but are distinctly different in their luminescence characteristics. Below are examples of thinly laminated aeolian and glacifluvial deposits from Starmoen 3 and Hornmoen bruk, respectively.



IR-tests and preheat plateau tests show that the aeolian samples have no feldspar contamination (mean IR/Blue ratio 2%) and could be analysed with preheat/cutheat at 260°/240°, while most glacifluvial samples suffered from feldspar contamination (IR/B 10-34%) and needed preheat/cutheat at 220°/200° or 180°/160°.

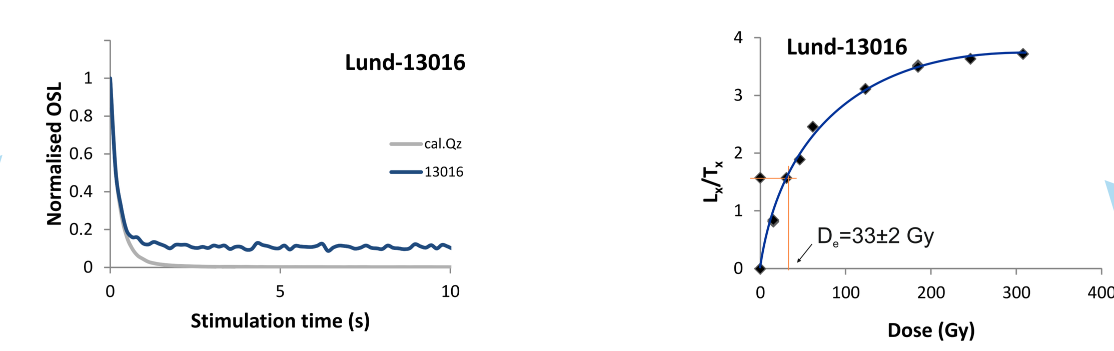


Chronology

Quartz OSL ages were determined from the 180-250 μm fraction of 14 samples at the Lund Luminescence Laboratory, Sweden. Both large and small aliquots were measured, using sample-adapted SAR-protocols on a Risø TL/OSL reader DA-20.

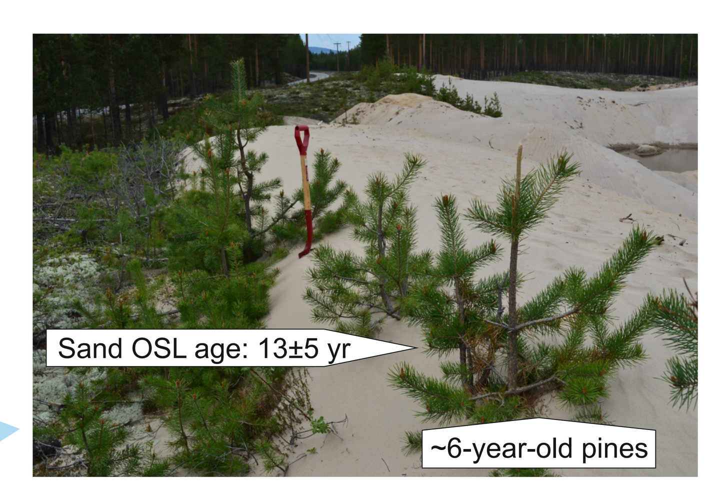
Table 1. OSL data from Starmoen

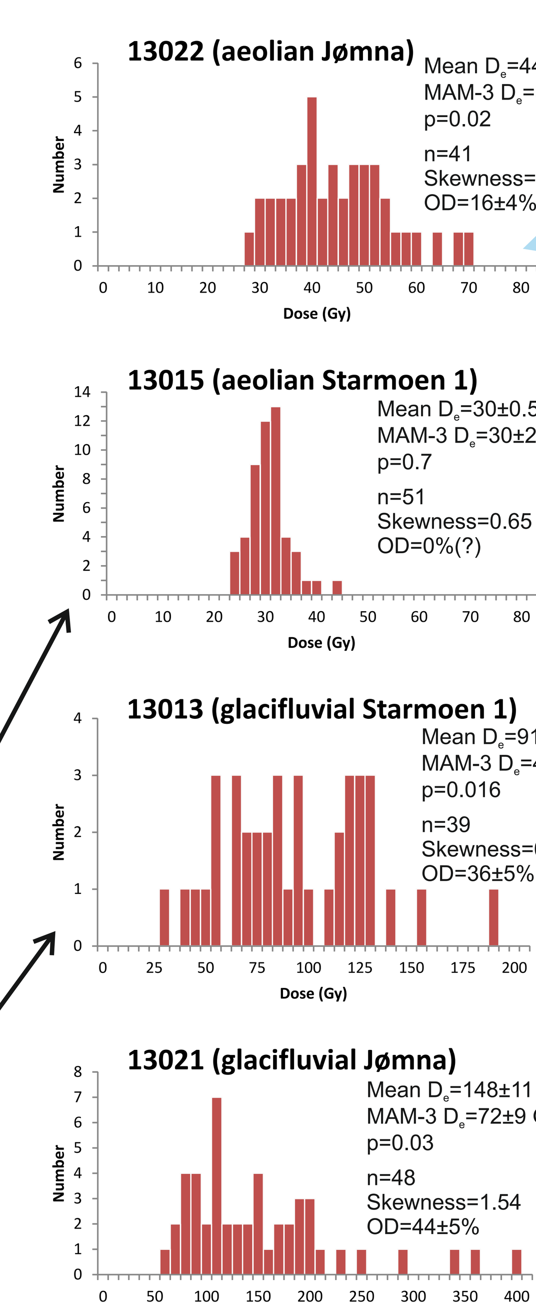
Lund sample no.	Sediment	Site	Depth (cm)	Age (ka)	Dose (Gy)	n/tot	Dose rate (Gy/ka)	w.c. (%)	MAM-3 age (ka)
Large aliquots									
13013	glacifluvial	Starmoen 1	370	27.7 ± 2.6	85.92 ± 6.94	22/27	3.10 ± 0.13	13	
13014	aeolian	Starmoen 1	300	10.3 ± 0.7	33.67 ± 1.57	20/27	3.26 ± 0.15	5	
13015	aeolian	Starmoen 1	280	10.7 ± 0.6	33.30 ± 0.75	26/27	3.11 ± 0.15	3	
13016	aeolian	Starmoen 1	130	9.8 ± 0.5	33.45 ± 0.77	28/30	3.40 ± 0.15	5	
13017	aeolian	Starmoen 1	70	10.0 ± 0.5	33.53 ± 0.68	26/27	3.36 ± 0.16	4	
13018	recent aeolian	Starmoen 2	25	0.013 ± 0.005	0.05 ± 0.02	18/24	3.62 ± 0.17	6	
13019	aeolian	Starmoen 3	420	9.9 ± 0.5	29.18 ± 0.75	29/42	2.95 ± 0.13	11	
13020	aeolian	Starmoen 3	120	9.8 ± 0.6	32.67 ± 1.10	26/27	3.33 ± 0.15	6	
13021	glacifluvial	Jømna	300	44.2 ± 4.2	139.32 ± 11.09	37/39	3.15 ± 0.15	4	
13022	aeolian	Jømna	190	13.2 ± 0.8	39.76 ± 1.26	26/33	3.01 ± 0.14	7	
13023	aeolian	Jømna	95	11.8 ± 0.8	35.87 ± 1.81	23/26	3.03 ± 0.14	6	
13024	glacifluvial	Hornmoen bruk	200	66 ± 6	199.61 ± 16.17	23/30	3.03 ± 0.13	11	
13025	glacifluvial	Hornmoen bruk	120	54 ± 5	171.93 ± 12.83	23/33	3.21 ± 0.14	8	
13026	recent aeolian	WP86	5	0.60 ± 0.08	1.66 ± 0.21	27/27	2.76 ± 0.13	10	
Small aliquots									
13013	glacifluvial	Starmoen 1	370	29.4 ± 2.3	91.23 ± 5.55	39/93	3.10 ± 0.13	13	14.2 ± 1.5
13015	aeolian	Starmoen 1	280	9.6 ± 0.5	29.75 ± 0.53	51/96	3.11 ± 0.15	3	9.8 ± 0.8
13021	glacifluvial	Jømna	300	46.8 ± 4.2	147.51 ± 10.93	48/96	3.15 ± 0.15	4	23 ± 3
13022	aeolian	Jømna	190	14.7 ± 0.9	44.12 ± 1.61	41/96	3.01 ± 0.14	7	11.5 ± 1.2



A fast component dominates the signal, as shown above in comparison with Risø calibration quartz, although the Starmoen quartz is not very bright. The luminescence response to dose continues to grow until ~200 Gy (D_0~55 Gy).

A modern analogue, a small dune forming at a sand pit, shows that the aeolian sand is bleached and can give accurate ages.





Small aliquots show that aeolian samples from Jømna have broad dose distributions and apparent age over-estimations, while samples from Starmoen have the expected narrow dose distributions and stratigraphically consistent ages.

Incomplete bleaching of glacifluvial sediments is suggested by broad and skewed small-aliquot dose distributions. Minimum age model (MAM-3) ages yield younger ages than the mean, but still older than expected from the regional deglaciation history and are based on very few aliquots (low p-values).

Acknowledgements & references
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Klemsdal, T. (2010). The eolian landforms and sediment in the valley of River Jømna, east of Elverum, south-east Norway. *Norsk Geografisk Tidsskrift 64(2)*: 94-104.