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Edited by Wim Hoek & Jakob Wallinga
Luminescence dating - applications and research
October 6, 2006

Universiteit Utrecht
Faculty of Geosciences

Netherlands Centre for Luminescence dating

The Netherlands Centre for Luminescnence dating was founded in 2003. The centre is a collaboration of the Universities of Utrecht, Delft, Groningen, Wageningen, the Vrije Universiteit Amsterdam and TNO.

The main aims of the NCL are to make luminescence dating widely available to Netherlands research and to develop new and improved luminescence dating methods. The NCL received an equipment grant from NWO-ALW (834.03.003) to establish a dating lab at the Reactor Institute Delft of the TU Delft.

The NCL Symposium Series publishes abstracts of talks presented at the yearly NCL symposium. The NCL year report of the previous year is also published in the booklet.

More information on the NCL is available at www.ncl-lumdat.nl

SYMPOSIUM NETHERLANDS CENTRE FOR LUMINESCENCE DATING

Date: **Friday October 6, 2006**
Theme: **Luminescence dating - applications and research**
Venue: **Utrecht University, Faculty of Geosciences**
Budapestlaan 4, Kleine Collegezaal

PROGRAMME:

13.30 Welcome

LumiD: the NCL luminescence datingbase

DAVIDS F., WALLINGA J., JOHNS C.A. & NCL PARTNERS

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Luminescence dating determines the timing of deposition and burial of sediments in the age range of years to over 100.000 years. Optically stimulated luminescence dating techniques using quartz minerals have been greatly improved over the last decades, and are now widely used for earth science and archaeological research. Besides sediments, the technique can also be used to date archaeological artifacts.

To further develop and improve luminescence dating methods and to make luminescence dating widely available to the Netherlands' research community the Netherlands Centre for Luminescence dating (NCL) was founded in 2003. All national expertise with respect to luminescence dating techniques and applications is combined in the NCL. In recent years a cutting edge luminescence dating facility is established at the Reactor Institute Delft of the Delft University of Technology. This facility now processes about 150 samples per year and is expecting further growth in coming years.

At the NCL we have developed a Luminescence Datingbase (LumiD) that contains information on luminescence properties and dating results for all samples processed at the NCL and for samples from the Netherlands dated at other luminescence dating facilities. Goals of LumiD are: 1) to make luminescence dating results widely available to the research community; 2) to facilitate communication with NCL customers; and 3) to improve visibility of the NCL to (potential) users. We are proud to launch our searchable database LumiD at the 2006 NCL symposium; the database is now available on internet through www.lumid.nl.

LumiD provides a number of features for the benefit of NCL customers and other researchers. Clients can submit sample information for new orders. After submission they receive a password which they can use to monitor the progress of their project(s) and download (preliminary) results. If allowed by the client, the project information and the dating results will also be available publicly through LumiD after an embargo period.

Publicly accessible information in LumiD can be searched using a wide range of search options including the location, the age range, the depositional environment and the mineral used for analysis. LumiD is coupled to Google Earth to visualize sample locations and aid searching for dating sites in specific areas. In addition, luminescence dating results for Netherlands sediments will be included in DINO, the TNO BenO / National Geological Survey database on the Netherlands subsurface.

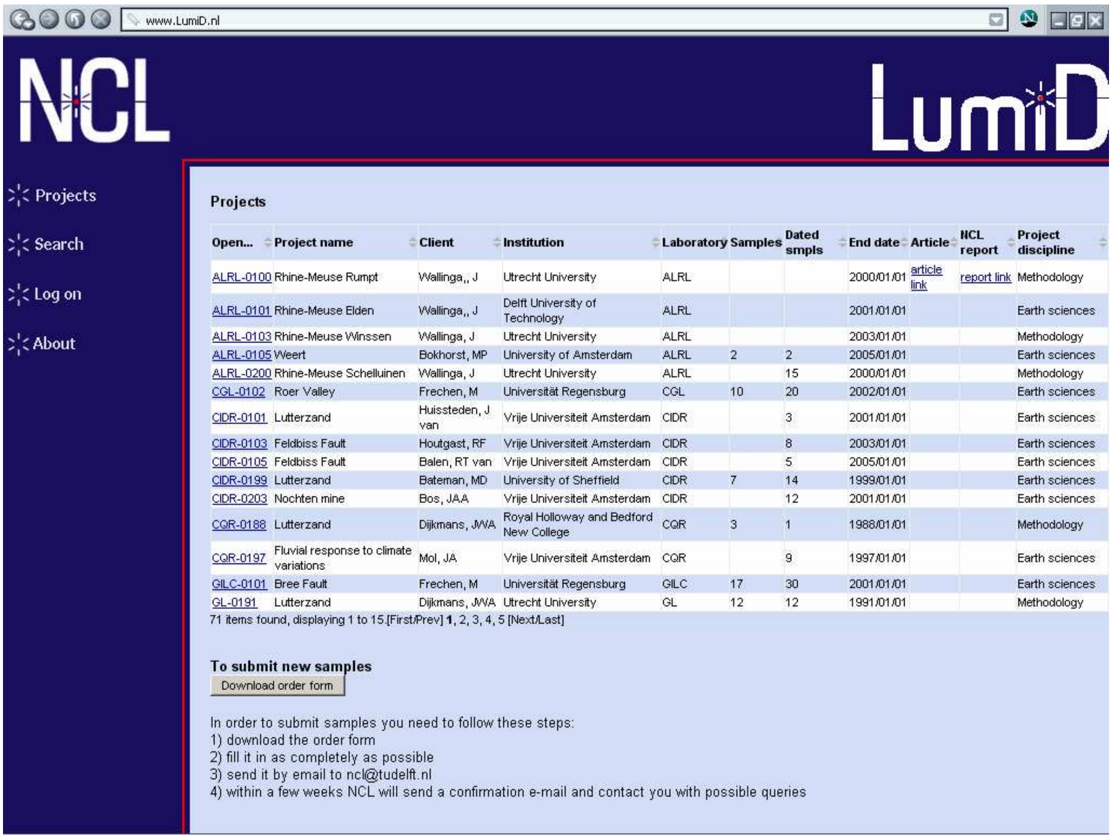

Fig. 1: *The LumiD start page available through* www.LumiD.nl

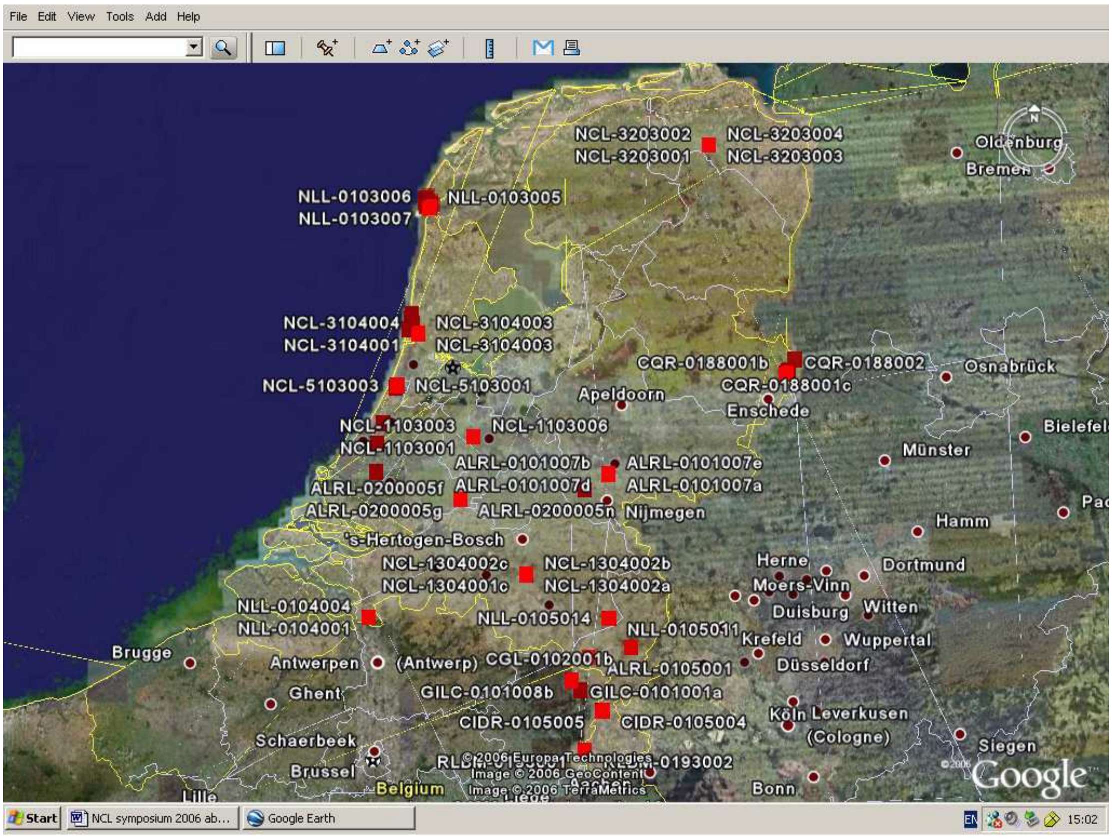

Fig 2: *Visualisation of sample locations contained in LumiD with Google Earth.*

Reconstruction of the former IJ estuary using radiocarbon and optical dating
(OSL onderzoek in het PWN duingebied bij Castricum)

VOS, P.C.

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In de periode tussen februari 2001 en maart 2002 heeft het Provinciaal Waterleidingbedrijf Noord-Holland (PWN) een deel van de oude en overbodig geworden waterwinsystemen (pompstations en secundairs) verwijderd uit het duingebied bij Castricum. Bij het opruimen van de gebouwen zijn op 8 locaties diepe ontsluitingen gegraven in het duingebied tot ca. 6-7 m –NAP (ca. 1-2 m –NAP). Het betrof de ontsluitingen Pompstation (Po), Waterverdeelstation (WRK), en de secumdairs 3, 5, G, D, E, en L (zie figuur 1). De ontsluitingen waren zowel om archeologische als om geologische redenen interessant. In het duinprofiel komen oude bodems voor uit de IJzertijd tot en met de Vroege Middeleeuwen en in deze horizonten komen archeologische resten voor. De ontsluitingen vormde een unieke gelegenheid om de archeologische sporen, zoals ploegkrassen, in een putwand te onderzoeken. Geologisch waren de putten belangwekkend omdat zij precies over het mondingsgebied van het voormalige Oer-IJ estuarium lagen (getijde systeem dat actief was tussen 5000 en 2000 voor heden in het gebied tussen Castricum en Amsterdam). Omdat de putdiepten tot 1 à 2 m –NAP reikten, kon de verlandingsgeschiedenis van het Oer-IJ in het duingebied van PWN in de profielwanden bestudeerd worden. Om ook de dieper liggende lagen van de Oer-IJ mondingafzettingen te kunnen onderzoeken (met name dateren) zijn aanvullend bij de onderzoekslocaties 8 steekboringen tot 35 m diep gezet door TNO.

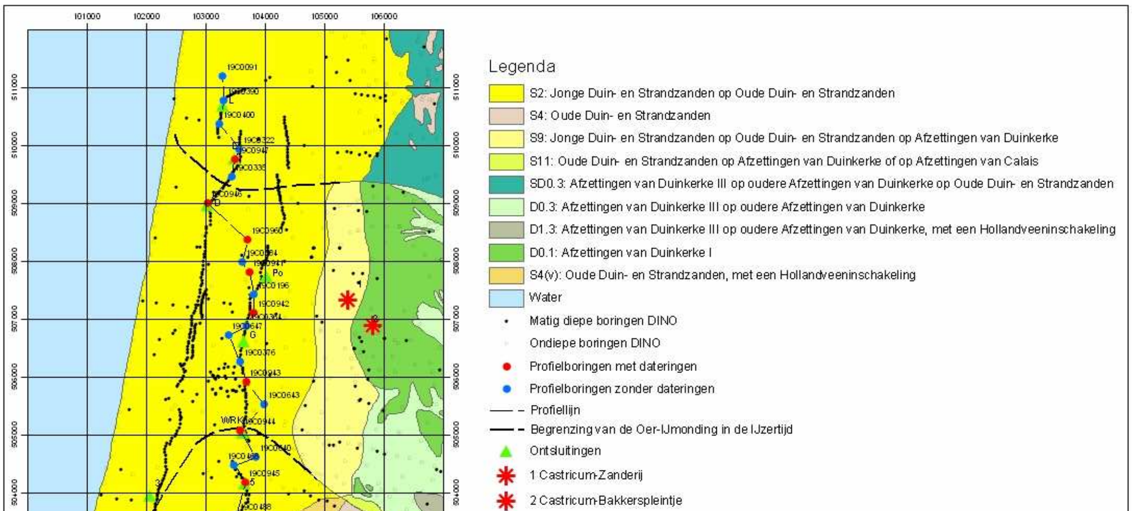

Fig. 1*: Locatiekaart van het onderzoeksgebied. Als ondergrond is de geologische kaart van het kaartblad Alkmaar (19W) gebruikt.*

Fig. 1: *Map of the research area.*

Door de lithologische lagen op de onderzoekslocaties te dateren kon de verlandingsgeschiedenis van de Oer-IJ monding van de laatste 5000 jaar in beeld worden gebracht. Gedateerd zijn de schone duinzanden (OSL), de organische lagen in het duinprofiel (^{14}C) en de mariene schelpen (meest juviniele Spisula's) uit de strand- en diepe liggende mondingsafzettingen (zie voorbeeld WRK gebouw / boring 19C944). Doordat verschillende dateringstechnieken zijn gebruikt (OSL, ^{14}C-methode en archeologische dateringen) konden de dateringsresultaten - in de stratigrafische sequentie - met elkaar vergeleken worden en konden de resultaten van de OSL bepalingen geijkt worden met deze andere dateringstechnieken

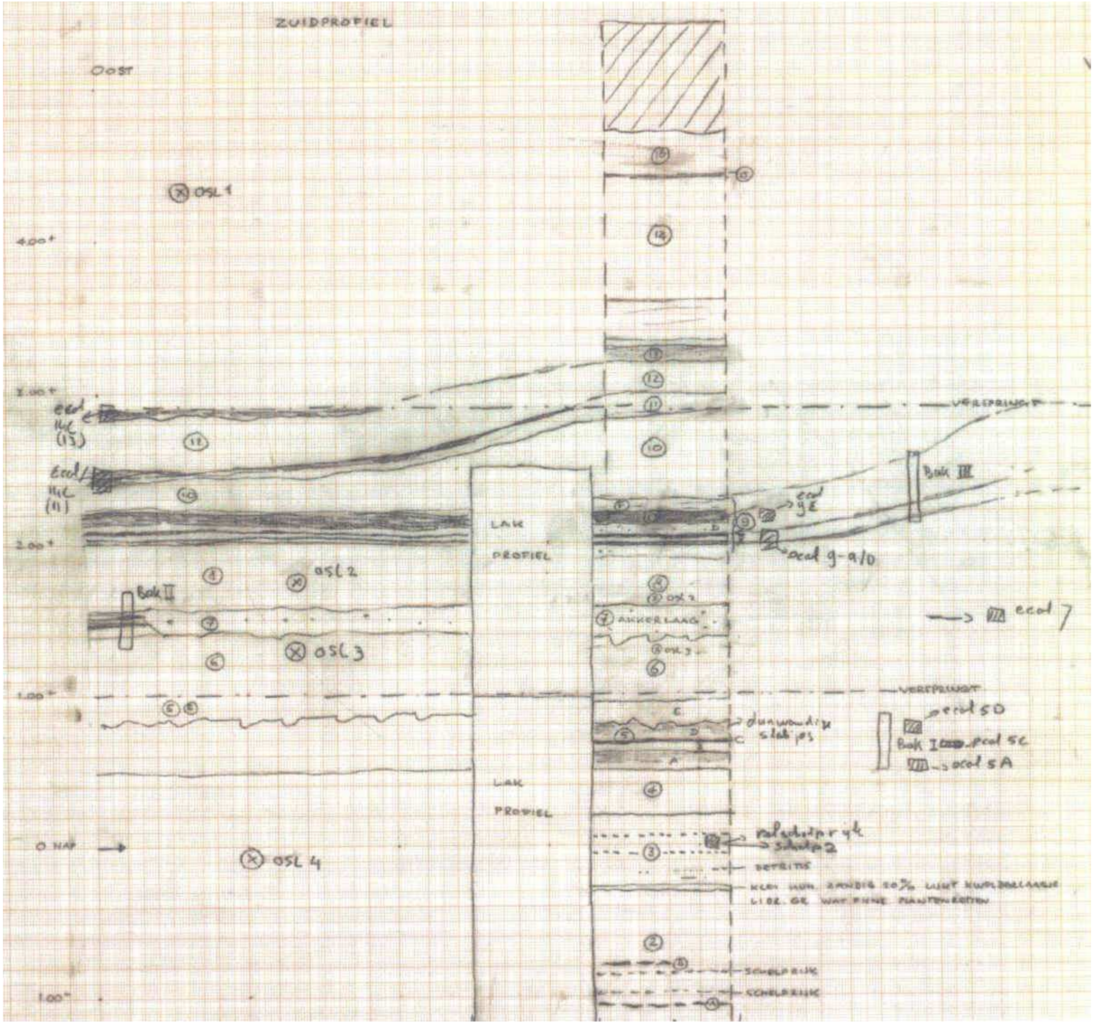

Fig. 2: *Veldtekening van de opgenomen zuidelijke profielwand van het WRK gebouw. In totaal zijn van de duinzanden 4 OSL monsters genomen (aangegeven links op de tekening). Drie daarvan zijn daadwerkelijk gedateerd, de resultaten staan in tabel 1.*

Fig. 2: *Field drawing of the southern wall of the WRK building excavation. Four OSL samples were taken (indicated on the left). Three samples were dated: results are presented in table 1.*

De belangrijkste conclusies van het onderzoek waren:

- De OSL dateringen passen goed binnen het chrono-stratigrafisch raamwerk van ^{14}C- en archeologische dateringen
- Net als bij de ^{14}C methode is de foutenrange met de OSL techniek (1 - sigma) groot (100 – 300 jaar, voor wat betreft de onderzochte periode). Exacte absolute dateringen, zoals met dendrologisch onderzoek, kunnen met de OSL techniek niet verkregen worden. De OSL techniek is wel zeer bruikbaar om de vorming van zandige afzettingen te dateren op het niveau van de archeologische perioden (bijvoorbeeld Vroege- , Midden- en Late-IJzertijd).
- Het litho- en chronostratigrafisch onderzoek wijst uit dat de Oer-IJ mondinafzettingen gevormd zijn binnen (= relict van) het grote mariene getijde bekken van het Vecht/IJsseldal dat zich bevind in de ondergrond van centraal Noord-Holland.
- De dateringen van de PWN onderzoekslocaties geven een goed inzicht in de opvullingsgeschiedenis van de Oer-IJ monding. Rond het jaar 0 is de Oer-IJ monding totaal verland. Deze constatering wordt ook bevestigd door het archeologisch onderzoek in de regio. Vanaf het jaar 0 (Romeinse Tijd) wordt op grote schaal gewoond en gewerkt op de (voormalige) getijde afzettingen van het Oer-IJ. Een rechtstreekse (Romeinse) scheepsverbinding (o.a. castellum Flevum, bij Velsen) naar de Noordzee is daarom zeer onwaarschijnlijk. Een verbinding tussen Oer-IJ achterland en de Noordzee was er wel, maar deze liep via het IJ naar de Flevomeren en de Waddenzee.

Tabel 1: *Voorbeeld van dateringsonderzoek bij één van de locaties (WRK) in het PWN duingebied (zie ook Fig. 1).*
Table 1: *Example of dating research at location WRK of the PWN dune area (see Fig. 1)*

Monster nr.	Lab. Code	Diepte NAP	Datering	Foutmarge	Richtgetal
WRK / OSL-1	NCL 303004	+ 4.35 m	1275 ± 44 AD	1-S: 1231-1319 AD	1275 AD
WRK / ^{14}C-O9	UtC 11896	+ 2.85 m	1046 ± 39 BP	2-S: 890 -1040 AD	1000 AD
WRK / ^{14}C-O8	UtC 11897	+ 2.40 m	1226 ± 36 BP	2-S: 680-900 AD	850 AD
WRK / ^{14}C-O6	UtC 11898	+ 2.10 m	1454 ± 35 BP	2-S: 540-660 AD	610 AD
WRK / OSL-2	NCL 303005	+ 1.70 m	146 ± 128 AD	1-S: 18-274 AD	146 AD
WRK / ^{14}C-O2	UtC 11899	+ 0.70 m	2243 ± 43 BP	2-S: 400-200 BC	275 BC
WRK / ^{14}C-S2	UtC 11895	0 m	3458 ± 36 BP*	2-S: 1880-1680 BC	--
WRK / OSL-4	NCL 303006	- 0.10 m	250 ± 146 BC	1-S: 396-104 BC	300 BC
B 944 / ^{14}C-S1	UtC 12014	- 0. 77 m	3089 ± 35 BP*	2-S: 1440-1260 BC	--
WRK / ^{14}C-S1	UtC 11894	- 1.30 m	2658 ± 38 BP*	2-S: 900-790 BC	800 BC
B 944 / ^{14}C-S2	UtC 12015	- 2.82 m	2614 ± 40 BP*	2-S: 900-550 BC	800 BC
B 944 / ^{14}C-S3	UtC 12016	- 5.40 m	2944 ± 35 BP*	2-S: 1270-1010 BC	1150 BC
B 944 / ^{14}C-S4	UtC 12017	-10.87 m	3194 ± 37 BP*	2-S: 1530-1390 BC	1450 BC
B 944 / ^{14}C-S5	UtC 12018	- 14.87 m	4424 ± 38 BP*	2-S: 3380-2910 BC	3050 BC
B 944 / ^{14}C-S6	UtC 12019	- 15.35 m	4687 ± 39 BP*	2-S: 3350-3030 BC	3250 BC
B 944 / ^{14}C-S7	UtC 12020	- 15.87 m	4698 ± 36 BP*	2-S: 3630-3360	3500 BC

*: AMS datering mariene schelp, gecorrigeerd met 402 jaar reservoir ouderdom

Fig. 3: *Foto van de geoarcheologische opname van het WRK gebouw (vergelijk de profieltekening van Fig. 2).*

Fig. 3: *Photo of the excavation of the WRK building (see drawing of Fig. 2).*

OSL and radiocarbon dating of Late-Holocene drift-sand deposits in the southern Netherlands

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Introduction

In this research we apply OSL dating of sand-sized quartz to Late-Holocene drift-sand deposits from the southern Netherlands (Weerterbergen). Aim is to improve the chronological framework of Late-Holocene periods of sand drifting and soil formation. Knowledge of the past will gain insight for the future management of these landscapes.

Alternation of periods of sand drifting and periods of landscape stability results in an intercalation of aeolian sediments and humic soil horizons. We dated sediments just above and just below embedded layers of soil organic matter at six sites, using optical dating. This humic layer is expected to be a micropodzol that was formed in Medieval times. Of the humic layer itself, radiocarbon ages were determined by using the humic acid fraction. The aim of our research is 1) to determine whether all micropodzols were formed (in-situ) within a single period of landscape stability, and 2) to gain insight in the duration of landscape stability phases. OSL ages are compared with radiocarbon ages of the soil organic matter from the soil horizons.

Results

We used a standard quartz SAR procedure with a preheat of 180°C and a test dose of 0.5 Gy. We determined that our samples were suitable for optical dating with respect to the absence of thermal transfer effects, the ability to recover a known laboratory dose (average recovery ratio 1.024 ± 0.016) and the completeness of resetting the quartz OSL signal upon burial (see equivalent dose distributions below). In general, all samples behaved extremely well in the SAR protocol (average recycling ratio 0.996 ± 0.004). An iterative procedure was used to remove outliers.

All samples show tight, normal distributions and the equivalent dose (D_e) is very low for all samples. Preliminary dating results indicate that all sampled sediments were deposited between 1802 and 1993 AD (see table 1). These results differ greatly from the radiocarbon ages on the humic layers (see table 1 and figure 1).

Table 1: *OSL and radiocarbon results for the six sampled profiles in "Weerterbergen". OSL ages in y AD with 1σ (NCL, Delft) and radiocarbon ages in y BP with 2σ (CIO, Groningen) and in cal y AD (all samples except *MIES: CALIB REV 5.0; MIES*: CALIBOMB)*

Profile	Sample	Depth (m)	Dose rate (Gy/ka)	D_e (Gy)	Age OSL (y AD)	Age Radiocarbon (y BP)	(cal y AD)
BOS-1	5106010	0.63	1.065 ± 0.045	0.047 ± 0.001	1961 ± 2	-	-
BOS-1	GrN-29960	0.67	-	-	-	225 ± 35	1442 - 1624
BOS-1	5106011	0.72	0.943 ± 0.041	0.167 ± 0.005	1828 ± 9	-	-
AAP	5106012	0.38	1.063 ± 0.044	0.086 ± 0.003	1924 ± 4	-	-
AAP	GrN-29959	0.42	-	-	-	950 ± 70	971 - 1225
AAP	5106013	0.47	1.247 ± 0.046	0.132 ± 0.004	1899 ± 5	-	-
NOOT	5106014	0.34	0.965 ± 0.042	0.023 ± 0.001	1981 ± 1	-	-
NOOT	GrN-29961	0.39	-	-	-	700 ± 50	1222 - 1395
NOOT	5106015	0.43	0.963 ± 0.042	0.107 ± 0.003	1894 ± 6	-	-
MIES	5106016	0.35	0.983 ± 0.044	0.012 ± 0.001	1993 ± 1	-	-
MIES*	GrN-29962	0.38	-	-	-	104.3 ± 5%*	1955 - 1956
MIES	5106017	0.42	0.947 ± 0.045	0.015 ± 0.001	1989 ± 1	-	-
VIS	5106018	0.39	0.993 ± 0.044	0.060 ± 0.002	1945 ± 3	-	-
VIS	GrN-29964	0.42	-	-	-	555± 55	1297 - 1440
VIS	5106019	0.47	1.138 ± 0.044	0.140 ± 0.003	1882 ± 6	-	-
ROOS	5106020	0.40	0.913 ± 0.040	0.185 ± 0.005	1802 ± 10	-	-
ROOS	GrN-29963	0.43	-	-	-	1490 ± 100	340 - 766
ROOS	5106021	0.48	0.919 ± 0.042	0.180 ± 0.005	1809 ± 10	-	-

Fig.1: *Schematic overview of the six sampled profiles with calibrated radiocarbon dates in cal y AD (CIO, Groningen; CALIB REV 5.02 and CALIBOMB used for calibrating) and OSL dates in y AD (1σ).*

Conclusions

We observe a large discrepancy between radiocarbon and OSL ages (figure 1), and interpret this to be caused by the sedimentation of wind-blown soil organic matter. We conclude that the humic layers may not be palaeosoils and are therefore not necessarily indicators of landscape stability. Our study demonstrates that optical dating is an essential tool for reading Late-Holocene drift-sand deposits; the use of radiocarbon dating alone would lead to erroneous interpretation.

Late Weichselian and Holocene earthquake events along the Geleen fault in NE Belgium: OSL and ^{14}C age constraints

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In 2005, a trench was opened for palaeoseismological analysis near the village of Rotem (Maas valley, NE Belgium). The trench exposed the Geleen fault, a branch of the Feldbiss fault zone of the Lower Rhine graben system, one of the most active tectonic structures in NW Europe. The sedimentary record in the trench consists of a sequence of aeolian and fluvio-aeolian sands, originally interpreted as Late Weichselian coversands. A pebbly deflation horizon (correlated with the Beuningen Gravel Bed in the Netherlands) separates medium to coarse-grained partly cross-stratified sands below from medium to fine-grained sands with interbedded silts above. The upper sediments are overprinted by soil formation processes (eluvial and illuvial horizons). The entire succession of coversands and soils has been vertically displaced by the fault. The uppermost stratigraphic unit in the hanging wall is interpreted as a colluvial deposit. This deposit is not present in the footwall and post-dates the last surface-rupturing earthquake, which is thought to be of Holocene age. Additional displacement of layers below the pebbly bed and truncated soft-sediment deformation are attributed to a second palaeoearthquake just before the deposition of this bed.
We report on the application of quartz-based optical dating to establish a chronological framework for the sediments exposed in the trench and to constrain the timing of the two palaeoearthquakes. Radiocarbon dating of charcoal and root samples found within the deposits provided independent age information.
Dosimetric information was obtained through gamma-ray spectrometry (both in the field and in the lab), while equivalent doses were determined using the SAR protocol. We tested the performance of the SAR protocol through dose recovery tests. The overall (20 samples) average measured to given dose ratio is 1.00±0.01. We conclude that we can accurately recover a known dose given prior to heating. The results from small single-aliquot analyses indicate that the samples are mainly composed of well-bleached material; a small proportion of incompletely bleached grains is probably present, but does not bias the dating results towards significant age overestimations.
Fig. 1 summarises the dating results. The optical ages for the samples overlying the pebbly deflation bed are consistent with the stratigraphic position of the samples. They are also in good agreement with the radiocarbon ages. The upper part of the fluvio-aeolian sands, situated in the eluvial horizon, was dated at ~6.0 ka. Previously, the entire unit had been ascribed to the Late Glacial. The very top of this unit, which is thought to have been at or near the surface before the most recent surface rupture, was dated at 3.1±0.3 ka. An age of 2.5±0.3

ka was obtained for the base of the overlying colluvial deposit. We conclude that the last earthquake occurred about 3 ka ago. The optical ages obtained for the coversand unit immediately underlying the pebbly deflation bed show a larger spread and only a limited degree of internal consistency. The optical age of 18.3±1.4 ka for the lowermost aeolian sand unit is also slightly younger than the radiocarbon age of 21.5-22.4 ka CalBP. The spread in ages for samples from the same stratigraphic unit reflects dose rate variations, but at present, the cause of these variations is not understood. Therefore, averaging appeared to us the most sensible course of action. In this way, the age of the deflation bed, and thus of the penultimate large earthquake, is bracketed between 15.8±1.1 ka and 17.5±1.2 ka. These age constraints indicate that the fine gravel horizon formed synchronously with the Beuningen Gravel Bed in the type locality of the Late Weichselian coversand stratigraphy in the S-Netherlands (Grubbenvorst).

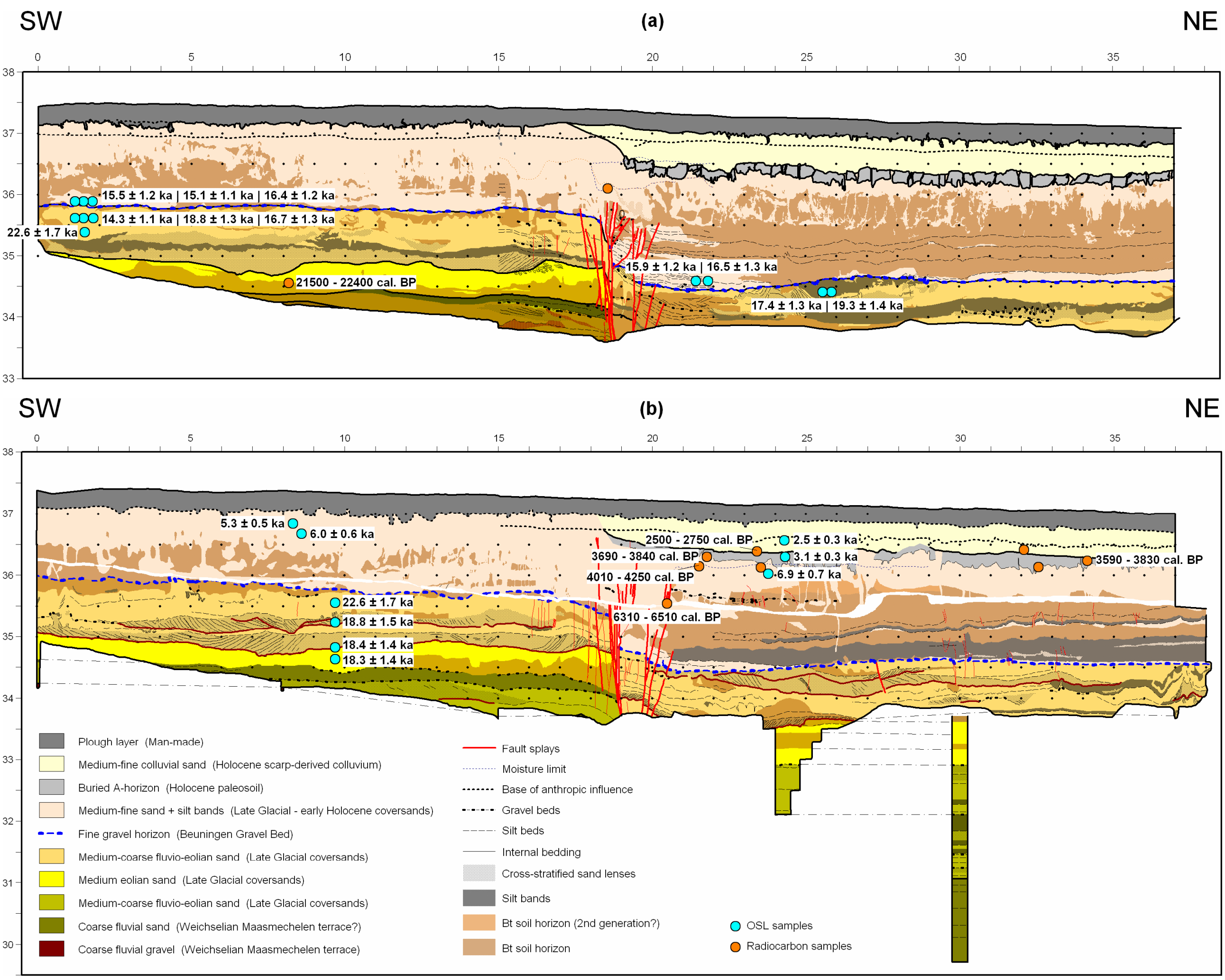

Fig. 1: *Summary of dating results [a: SE-Wall; b: NW-wall]*

Late Weichselian fluvial evolution of the Niers-Rhine: a multiple dating strategy

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Aim & approach

The aim of this research is to reconstruct the fluvial evolution of the Niers-Rhine (Germany) during the Late Weichselian (ca. 16-12 ka BP) in order to better understand fluvial response to climate change. The Niers-Rhine valley was part of the Lower Rhine system. It came into existence during the maximum of the Saalian glaciation and was abandoned shortly after the transition to the Holocene. The Niers-Rhine fluvial evolution is characterised by changing river patterns that have been related to climate and vegetation changes (Kasse *et al*. 2005).

The palaeo Niers-Rhine valley shows very well-preserved point bar series and meander cut-offs, directly found at the present-day surface (*Figure 1*). However, little is known about the exact timing of fluvial deposition during the Lateglacial. Together, this makes the Niers-Rhine valley an excellent research location to test different dating methods and to compare results.

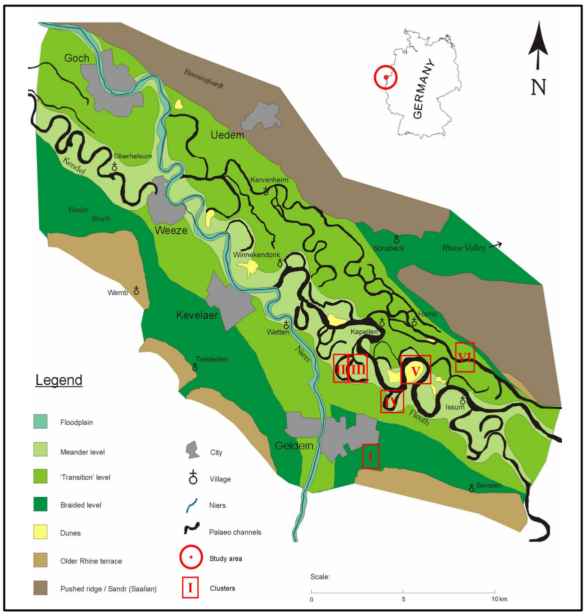

Fig. 1: Niers-Rhine valley research locations.

Multiple dating strategy

We used a combination of dating methods to investigate their applicability and to obtain insight in the chronology of the fluvial series (*Figure 2*). Point bar deposits and clastic channel infills were optically dated. Organic channel infills were palynologically analysed and biostratigraphically correlated to ^{14}C-dated sequences in the direct vicinity. ^{14}C-dating on charcoal embedded in the overbank deposits, and the presence of Laacher See Tephra in point bar deposits provide additional chronological control (*Figure 2*).

Optical dating

A Single-Aliquot-Regenerative-dose (SAR) procedure was applied to sand-sized quartz. The use of the post-IR blue OSL signal was necessary to eliminate contributions from contaminating feldspar grains, even after the second HF treatment of the sediment.

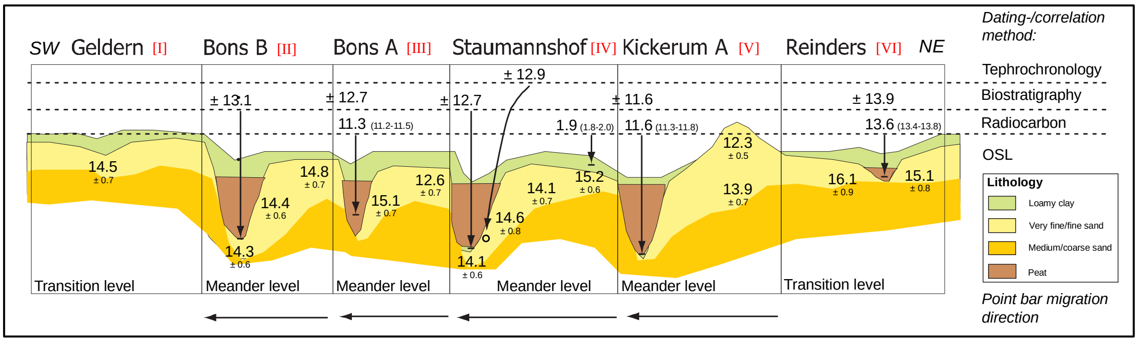

Fig. 2: Schematic cross-section of the Niers-Rhine valley. ^{14}C-ages are cal ka BP with 2σ range limits

To avoid bias in the dating results due to the presence of grains for which the quartz OSL signal was not completely reset upon deposition, single-aliquot equivalent doses, separated more than 2 SD from the sample mean, were iteratively removed from the distribution. This lead to the removal of one or more data points for 90% of the samples.

Conclusions

- The multiple dating strategy has shown that OSL is a powerful tool in dating sandy fluvial systems, although single-grain dating may be necessary to improve the ages of heterogeneously bleached sediments.
- Point bar aggradational velocities can already be derived with only a few OSL datings per point bar since the OSL datings are internally consistent. However, an age offset of ca. 1 ka between the OSL datings and the ^{14}C and biostratigraphical results from organic channel infills is found.
- It is not possible to accurately date the moment of channel abandonment by use of OSL dating of the clastic channel infill.
- The multiple dating strategy results indicate that the meandering system operated during the Allerød and Younger Dryas period (*Figure 3*). Implying that during the Younger Dryas the threshold towards braiding was not crossed in the Niers-Rhine which may be due to a regular discharge and limited sediment supply.

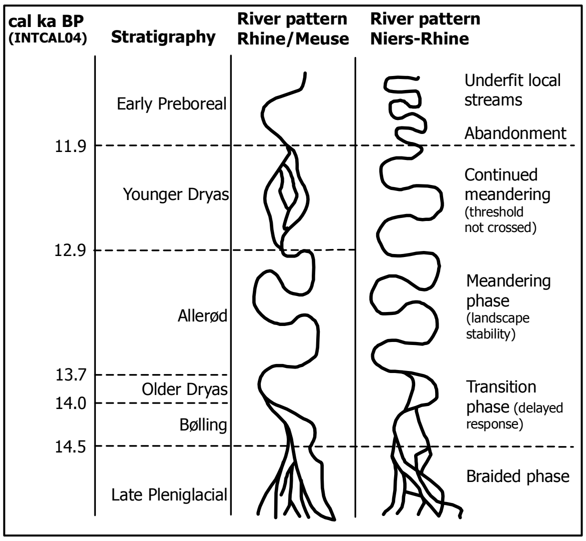

Fig. 3: *Synthesis of the Late Weichselian to Early Holocene fluvial evolution.*

Reference

Kasse, C., W.Z. Hoek, S.J.P. Bohncke, M. Konert, J.W.H. Weijers, M.L. Cassee & R.M. Van der Zee (2005). Late Glacial fluvial response of the Niers-Rhine (western Germany) to climate and vegetation change. *Journal of Quaternary Science* 20(4), 377-394.

OSL-dating of three classic Younger Dryas sites in New Zealand

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The Younger Dryas Stadial (YD) was a brief but intense climatic deterioration that occurred during the last deglaciation of the North Atlantic region. Although the YD is widely recognized in magnitude, timing and geographic extent throughout the North Atlantic, the mechanism behind the temporarily reversion is still poorly understood. The question remains whether the Younger Dryas was a global, synchronous, phenomenon or a result of the so-called bipolar seesaw and, hence, by definition asynchronous on both hemispheres. The presence of the Antarctic Cold Reversal (ACR) in particularly Austral-Asia, which is more or less synchronous to the North Atlantic Bølling-Allerød interstadial seems to support the latter hypothesis. To get a better understanding of global climatic change more precise records of mid-latitude palaeoclimatic changes in the Southern Hemisphere are needed. An ideal location to record climatic changes on the Southern Hemisphere is New Zealand. This country has a high potential sensitivity to climate change due to the high mountains that support glaciers and the prevailing westerly airflow, which generates abrupt environmental and climatic gradients.

This study is aimed at answering one of the key questions in global climate change: "Was the last deglaciation synchronous or asynchronous on both hemispheres". In order to answer this question an alternative approach is used focussing in particular on the anomalous North Atlantic YD event. Optically stimulated luminescence (OSL) properties of quartz and feldspar sediments are used to date glacial moraine deposits of three classic YD sites on the South Island, New Zealand: the Birch Hill Moraines (Burrows et al., 1976), the Waiho Loop terminal moraine (Denton & Hendy, 1994; Mercer, 1988) and Cropp River (Basher & McSaveney, 1989). Relatively high precision ages are obtained for these glacial advances in order to test for an interhemispheric synchroneity. It can be concluded, preliminarily, that:

- The Waiho Loop terminal moraine most likely formed during the ACR.
- The Birch Hill moraines clearly predate the North Atlantic YD event. The Birch Hill advance occurred close to the onset of the Antarctic Cold Reversal (ACR) or North Atlantic Bølling-Allerød interstadial (GI-1). It can thus be concluded that the Birch Hill moraines are no indication of an Interhemispheric synchroneity of the last deglaciation.
- Although no OSL date has yet been obtained for the Cropp River site, the radiocarbon age of 10,120 ± 40 14C yr BP is consistent with the radiocarbon age of 10,250 ± 150 14C yr BP as found by Basher & McSaveney (1989). This suggests a glacial advance synchronous with the North Atlantic YD. A possible mechanism for this contradicting evidence will be discussed.

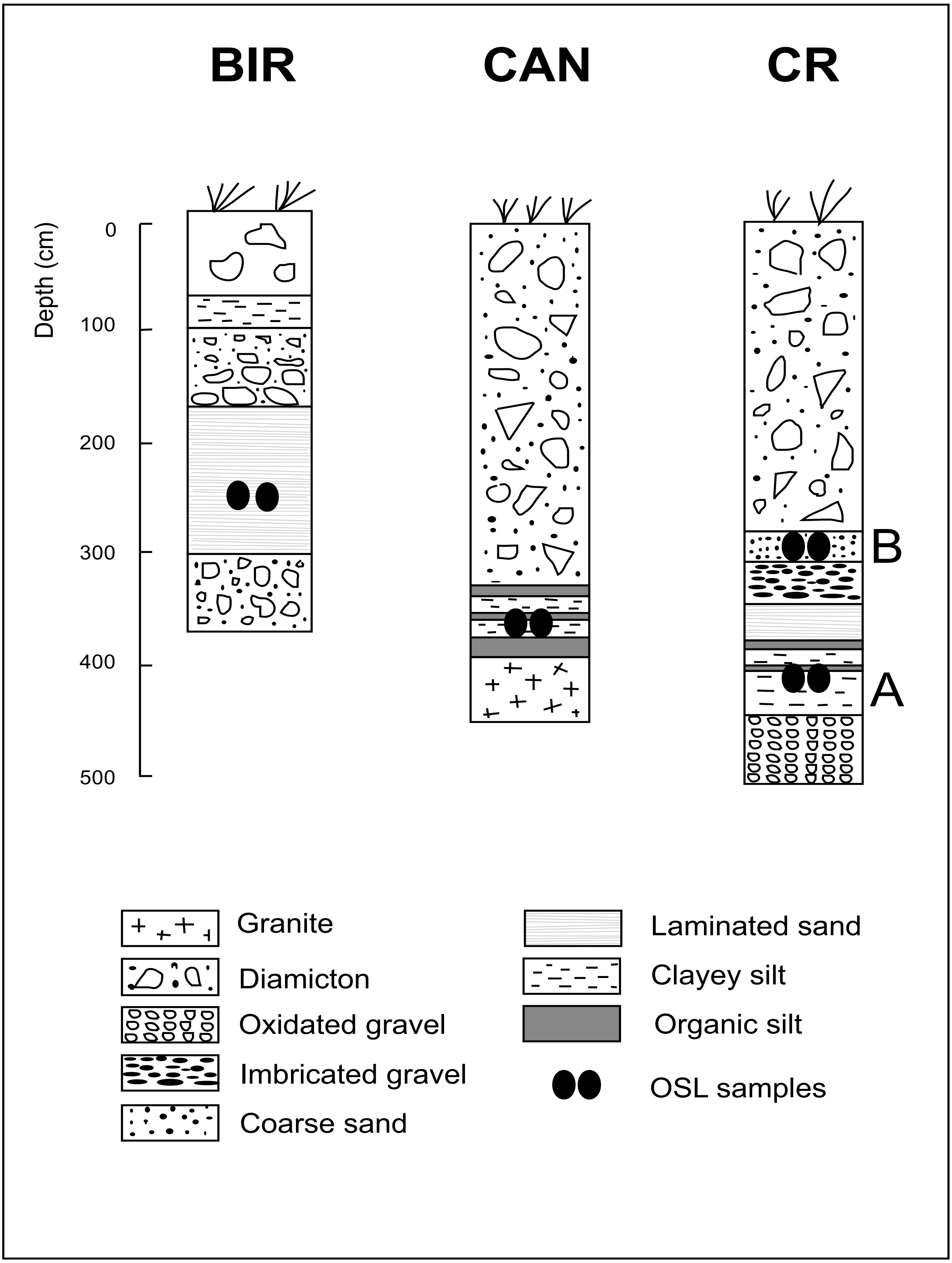

Fig. 1: *Schematic sketches of the three site locations on the south Island in New Zealand; Birch Hill (BIR), Waiho Loop moraine at Canavans Knob (CAN) and Cropp River (CR).*

Establishing a chronological framework for loess: wiggle matching versus absolute dating

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The Chinese Loess Plateau represents an important terrestrial archive to study Late Quaternary climate changes. During the late Pleistocene over 40 metres of eolian sediments were deposited at Tuxiangdao, north-western China. The high loess accumulation rate in this area theoretically provides the possibility for a high-resolution paleoclimatic study. However, to interpret the Tuxiangdao data set in terms of high-resolution climate changes, a reliable chronology for the record is necessary.

Several methods are developed to date loess sequences. These dating methods can be roughly subdivided in two groups: the wiggle match methods and the absolute dating methods. The wiggle match methods often use a well-dated marine oxygen isotope record like the SPECMAP to establish a chronological framework. Alternating loess and paleosol units (stratigraphy), or proxy records (grain-size, magnetic susceptibility) are visually linked to the marine oxygen isotope record. After visually linking, a linear or sedimentation-rate based interpolation will provide an age for every single point in the loess record.
Absolute dating techniques which normally used to date loess are radiocarbon dating and luminescence dating. Radiocarbon dating only covers a limited (~40 ka) time span and suitable organic mater is often scarce. Luminescence dating therefore provides a better alternative. Because of the eolian transport prior to deposition, the latent luminescence signal is completely reset. However, OSL dates (quartz, single-aliquot regenerative dose) appear to underestimate the age of deposition for samples older than 50 ka.

In this presentation, the application of the wiggle match and absolute dating techniques in loess sequences will be discussed. It will be shown that both techniques are useful to end up with a reliable chronological framework for loess.

ESR dating of aeolian sediments – a case study from a Pleistocene dune in SE Australia

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Electron spin resonance (ESR) spectroscopy detects paramagnetic centres in defects of the crystal lattice. For natural quartz, geological events such as the zeroing of traps by pressure, by mineralization and by optical bleaching can be dated. While fault gouge and volcanic events have already been successfully analysed with ESR, a systematic study for sedimentary quartz has not yet been established. In regard to the fact that sedimentary quartz is an ubiquitous mineral and that it is - as an unconsolidated sediment - widespread in the Quaternary period, the prime motivation for this study is to extend the dating range beyond the limits of other techniques (e.g. luminescence).

In recent investigations, the use of Ti-related impurity defects in aeolian quartz has revealed a high potential for electron spin resonance (ESR) dating. This is true especially for sediments from desert environments as these are most likely to be fully bleached. Accordingly, this project started off with the investigation of Ti-related centres in ESR dating of sedimentary quartz. The samples were taken from a Pleistocene dune in south-eastern Australia (Murray Basin). Depositional ages for this site are constrained by OSL data covering the last 500 ka . In the talk, first results shall be presented.

The ESR spectra of the Ti centre, with its two relevant subcentres Ti-Li and Ti-H, were analysed with respect to their suitability as potential dating signals. The multiple aliquot regenerative and additive dose methods were applied to estimate the palaeodoses for various Ti-related ESR signals. All resulting palaeodoses were compared to optically stimulated luminescence (OSL) data.

Overall, the outcome of this study is very promising and several tendencies can be observed. Palaeodoses based on various Ti signals appear to be in fair agreement with the luminescence data, except for two samples. The thus far obtained ESR data seem to confirm the presence of very old (Middle Pleistocene) dunes in the Murray Basin.

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Realisatie luminescentiedateringsfaciliteiten Delft

Het NCL luminescentiedateringslaboratorium bij het RID in Delft is geheel operationeel.

Apparatuur **-** Op dit moment is een extra Risoe TL/OSL reader in bestelling om de capaciteit van het NCL te vergroten. De reader wordt zeer binnenkort geleverd en wordt half gefinancierd uit de NWO apparatuursubsidie, en half uit de opgebouwde NCL reserves.

Ondersteuning **-** Candice Johns heeft een 0.8 fte aanstelling, waarvan 0.6 fte gefinancierd uit middelen van het NCL. De aanstelling van Candice is inmiddels omgezet in een vaste aanstelling. In de periode van 1 nov 2004 tot 1 juli 2005 heeft Femke Davids als student assistent geassisteerd in het lab (parttime, 0.2 – 0.4 fte). Sinds half september 2005 wordt Candice voor laboratorium werkzaamheden ondersteund door Ula Woroniecka (0.5 fte). Gemiddeld was in 2005 1.2 fte analist werkzaam voor luminescentiedatering, waarvan 1 fte betaald is vanuit het NCL budget.

Opdrachten

In 2005 zijn door NCL partners 94 monsters ingediend voor datering en door externen nog eens 18 monsters. Daarnaast zijn voor intern onderzoek van het NCL in Delft metingen aan 16 monsters verricht. De doorlooptijd van een monster is nu ongeveer een jaar; voor grote opdrachten is de periode wat langer.

Onderzoeksactiviteiten Delft

Mirko Ballarini heeft methoden voor datering van individuele korrels van jonge afzettingen verbeterd. Zijn resultaten zijn verwerkt in een proefschrift en een aantal publicaties. Mirko's promotie staat gepland voor 1 mei 2006.

Adrie Bos heeft een nieuwe methode ontwikkeld voor calibratie van de betabronnen in the OSL readers en doet onderzoek naar niet-constante stimulatie tbv optische datering.

Femke Davids is een gast student van de Universiteit Utrecht. Zij heeft veldspaat IRSL methoden gebruikt om monsters uit Zuid-Zweden te dateren.

Jakob Wallinga werkt aan:

- Onderzoek op oude monsters om methoden voor datering van oude afzettingen (> 100.000 jaar) te verbeteren.
- Toepassing van OSL datering op Rijn-Maas afzettingen om inzicht in de respons van dit riviersysteem op zeespiegel, klimaat en vergletsjering te vergroten (samenwerking met Freek Busschers, VU).
- Onderzoeksvoorstel voor datering van stormvloedafzettingen (VIDI voorstel)

Onderzoeksactiviteiten in Groningen

Het onderzoek naar luminescentieprocessen in zircoon is voortgezet in samenwerking met buitenlandse gastonderzoekers. ***M. Secu*** uit Roemenie heeft een aantal monsters van de Texelse duinsequentie gedateerd. Er bleek onvoldoende zircoon in het verzamelde materiaal te zitten om tot een nauwkeurige datering te komen. Het onderzoek wordt in 2006 voortgezet. Het promotieonderzoek van ***Harriet van Es*** bevindt zich in de afrondingsfase. De verwachting is dat zij in 2006 zal promoveren.

NCL Symposium

Op 23 september 2005 werd het NCL symposium ‘Luminescence dating applications and research’ gehouden bij het RID in Delft. Het was een geslaagd symposium met ongeveer 40 deelnemers. Er werden presentaties verzorgd door Jakob Wallinga (NCL), Jan van Mourik (UvA), Femke Davids (UU / NCL), Anni Madsen (Kopenhagen), Mirko Ballarini (TUDelft), Freek Busschers (VU), en Jan-Pieter Buylaert (Gent). Door technische problemen kon een presentatie van Peter Vos (TNO) niet doorgaan. Ward Koster werd tijdens het symposium bedankt voor zijn inspanningen om het NCL op te richten.

LumiD – de NCL daterings database

Er wordt hard gewerkt om NCL dateringen, en luminescentiedateringen aan Nederlandse monsters die elders zijn uitgevoerd, beschikbaar te maken in een database. Femke Davids heeft tijdens een tijdelijke aanstelling de informatie verzameld van eerder onderzoek, en een structuur voor de database ontwikkeld. De bouw van de Oracle database is uitbesteed aan de ICT afdeling van de TUDelft; het bleek te ingewikkeld om dit in eigen beheer te doen. Investeringen worden betaald uit de NWO apparatuursubsidie.

Voor gebruikers zal het mogelijk zijn om gegevens over in te dienen monsters te ‘uploaden’ in de database, en om voortgang en resultaten te bekijken. De gebruiker kan aangeven of zijn/haar informatie algemeen beschikbaar komt, eventueel na een embargo periode.

De database zal het mogelijk maken om naar dateringen in bepaalde gebieden, perioden en/of aan monsters van een bepaald afzettingsmilieu te zoeken. Weergave van monsterlocaties wordt gekoppeld aan Google Earth.

NCL publicaties 2005

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Populair wetenschappelijke publicaties

Schut, P.A.C (met een bijdrage van J. Wallinga). 2005. De aardwerken van Groesbeek: een aquaduct voor de Romeinse legioensvesting van Nijmegen? Rapportage Archeologische Monumentenzorg 119, 85p.

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Wallinga, J. 2005. Optische datering: klok in het zand. Grondboor & Hamer 59, 55.

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Wallinga, J. & Van Heteren, S. 2005. Duinen laten Texel Groeien. Grondboor & Hamer 59, 56-58.