Rapid age assessment: testing a portable luminescence reader

In Full: Rapid age assessment of Namib Sand Sea sediment chronologies?
Testing a portable luminescence reader against full dating.

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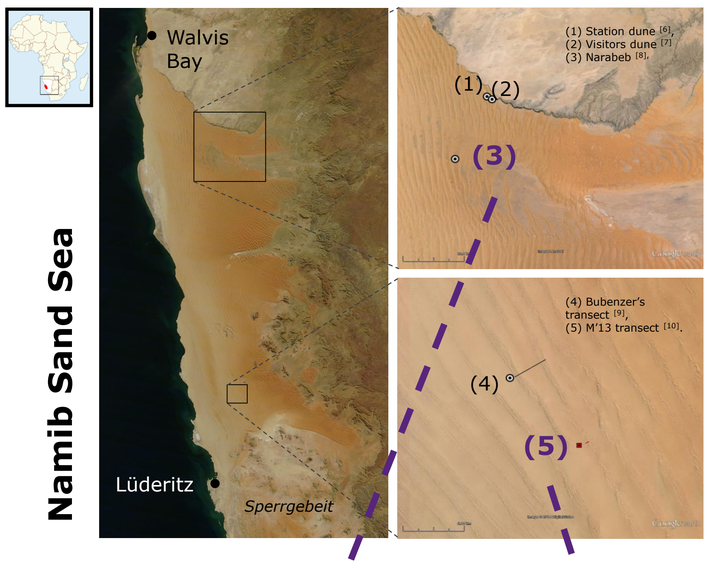
Context Dating dunefields

- The dunes of the 34,000 km^2 Namib Sand Sea have very little chronological control [1,2,3]
- Small numbers of ages produce falsely simple palaeoenvironmental reconstructions. e.g. the Kalahari

1997: < 50 ages, 'discrete age signals', 115-95, 46-41, 26-20, 16-9 ka 'episodic aridity' [4]
2014: ~350 ages. 'near continuum of ages since120 ka', 'complex spatial differences' [5]



- Further data is greatly needed to understand sand sea dynamics

OSL dating is a time consuming, complex process

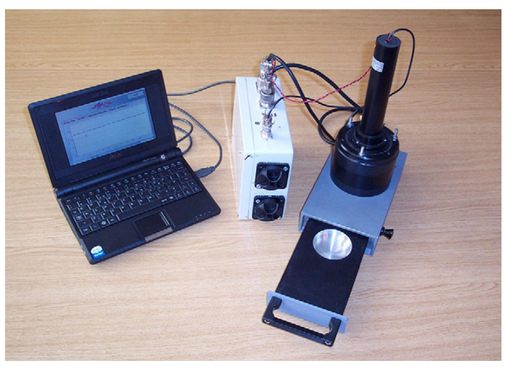
Approaches developed for rapid age assessment include:

(i) Streamlined chemical pre-treatment [11]
(ii) Luminescence 'profiling' [12,13,14,15]
(iii) Standardised growth curves for equivalent dose estimation with fully-prepped sample [16,17]
(iv) Portable readers [18-23]

Portable reader

WHAT? A portable reader measures bulk (as found in field) sediment in a 5 cm petri dish

- 60s IRSL (infra-red stimulated luminescence) & 60s post-IR BLSL (blue light stimulated luminescence)

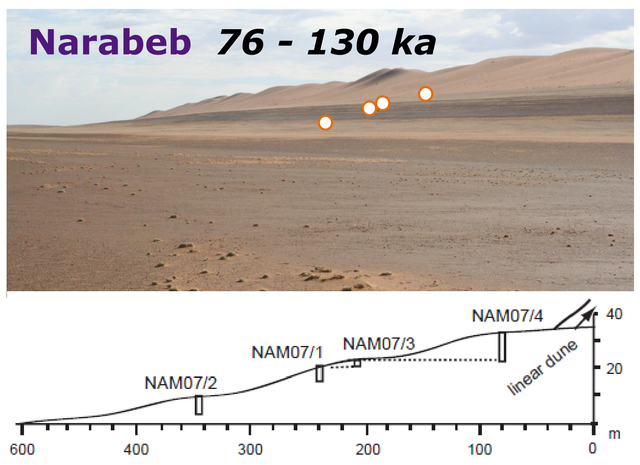


SUERC portable reader

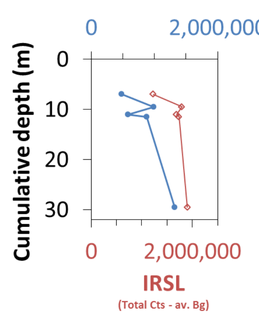
WHY? The portable reader can provide *in-situ* information to:

➔ Assess relative age of samples at individual sites.
➔ Facilitate targeted sampling strategies, e.g. to identify sediments in geoproxies that record Holocene or LGM landscape dynamics.
➔ Assess geomorphology and stratigraphic structures in the field

Assessing geomorphology

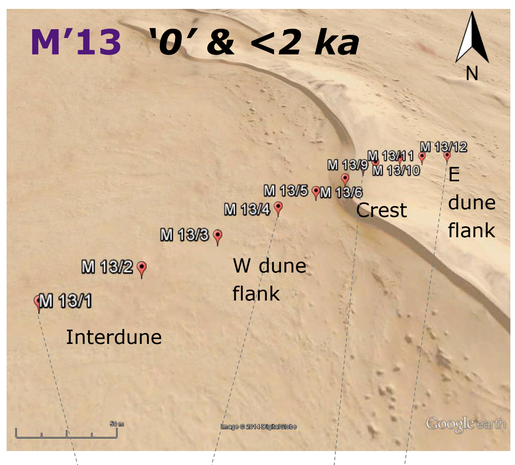


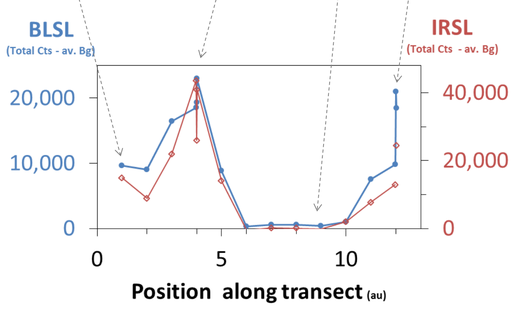
- Signals broadly increase with depth at Narabeb



- Signals an order of magnitude higher for Narabeb than M'13 samples.

Relative age



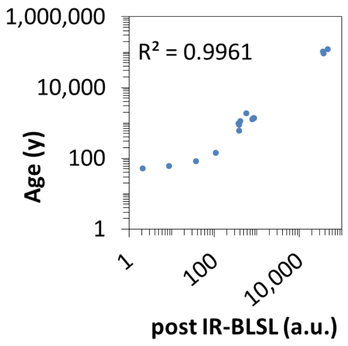


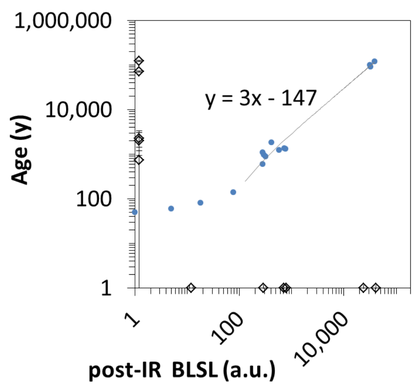
- Signals reflect geomorphology of dune transect.

and doing even better?

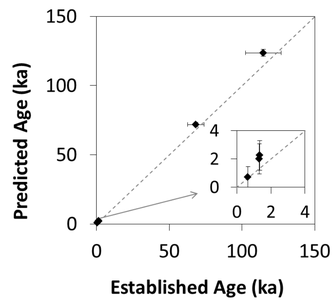
Rapid age assessment Simple calibration

- 2 sample sites with established OSL age estimates using fully-prepped quartz and SAR protocol spanning wide range of ages.
- Strong correlation between portable reader signal & established OSL age.
- Regression of subset of samples (15 of 20) portable reader signals against OSL age, and predict ages of remaining 6.





- Predicted ages for the 6 samples match established ages well.



The portable reader is no substitute for full OSL dating protocols, but this simple calibration of 'rough-and-ready' rapid age estimates along with the portable reader is an extremely powerful tool on the laptop in the field!

References and acknowledgements

[1] Livingstone, I., Bristow, C., Bryant, R.G., Bullard, J., White, K., Wiggs, G.F.S., Baas, A.C.W., Bateman, M.D., Thomas, D.S.G. *Aeolian Res* **2**, 93– 104 (2010)
[2] Stone, . E. C., Thomas, D. S. G. 2013. *J of Arid Env* **93**, 40-58 (2013)
[3] Stone, A. E. C., *J Afr Earth Sci* **82**, 70–87 (2013)
[4] Stokes, S., Thomas, D. S. G., Washington, *R., Nature* **388**, 154-158 (1997)
[5] Thomas, D. S. G., Burrough, S. L., *Quaternary International* (in press) (2013)
[6] Bristow, C.S., Lancaster, N. &Duller, G.A.T., *J Geol Soc London* **162**, 315–321 (2005)
[7] Bristow, C.S., Duller, G.A.T. & Lancaster, N., *Geology* **35**, 555–558 (2007)
[8] Stone, A.E.C., Thomas, D.S.G., & Viles, H.A., *Palaeogeogr Palaeocl* **288**, 35–53 (2010)
[9] Bubenzer, O., Bodeker, O. & Besler, H., *ZBL Geol Pal* **1**, 7–23 (2007)
[10] Stone, A. E. C., Bateman, M. D., Thomas, D. S. G., *Quat Geochr* (in review)
[11] Roberts, H. M., Durcan, J., Duller, G. A. T. *Radiat Meas* **44**, 582-587 (2009)
[12] Sanderson, D. C. W., Bishop, P., Houston, I., Boonsener, M. *Quat Sci Rev* **20**, 893-900 (2001)
[13] Sanderson, D. C. W., Bishop, P., Stark, M. T., Spencer, J. Q. *Quat Sci Rev* **22**, 1111-1121 (2003)
[14] Sanderson, D. C. W., Bishop, P., Stark, M., Alexaner, S., Penny, D. *Quat Geochr* **2**, 322-329 (2007)
[15] Burbidge, C. I., Sanderson, D. C. W., Housley, R. A., Allsworth Jones, P., *Quat Geochr* **2**, 296-302 (2007)
[16] Roberts, H. M., Duller, G. A. T. *Radiat Meas* **38**, 241-252.
[17] Telfer, M. W., Bateman, M. D., Carr, A. S., Chase, B. M. *Quat Geochr* **3**, 137-142.
[18] Sanderson, D. W.. & Murphy, S., *Quat Geochr* **5**, 299-305 (2010)
[19] Kinnard, T. C., Sanderson, D. C. W., Woodward, N. L. *Earth and Env Science* **102**, 191-199 (2011)
[20] Stang, D. M., Rhodes, E. J., Heimsath, A. M. *Quat Geochr* **10**, 314-319 (2012)
[21] Muñoz-Salinas, E., Bishop, P., Sanderson, D. C. W., Zamorano, J-J, *ESPL* **36**, 651-660 (2011)
[22] Munyikwa, K., Brown, S., Kitabwalla, Z. *ESPL* **37**, 1603-1614 (2012)
[23] Muñoz-Salinas, E., Bishop, P., Sanderson, D. C. W. Kinnaird, T. *ESPL* DOI: 10.1002/esp.3452 (2014)
[24] Munyikwa, K., Brown, S., *Quat Geochronol* **22**, 116-125 (2014)

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Read more details here…

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Other applications and settings?

Please talk to us about ideas.

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