### Challenges in the interpretation of quartz luminescence ages in the Kalahari environment

### Andy Moore

#### Pristine modern dune

M.D. Bateman et al. / Sedimentary Geology 195 (2007) 5-19



 Degraded linear dunes are widespread in the Kalahari

## 70-130mmAnnual Rainfall





Figure 24.44. Orientation of the main, fixed, linear dunes in the Kalahari Basin (after Lancaster, 1981, 1987).

### Tsodilo linear dunes – NW Botswana



g. 4. Examples of multiple OSL D<sub>e</sub> replicates from (a) typical pristine dune samples (b) linear dunes at the Tsodilo Hills, Botswana (Thomas et al., 003). D<sub>e</sub> measurements and associated errors (closed squares) and samples during samples mean and error (open squares) are shown.



Figure 24.44. Orientation of the main, fixed, linear dunes in the Kalahari Basin (after Lancaster, 1981, 1987).

#### Auob River – SE Namibia

![](_page_7_Picture_1.jpeg)

#### Auob River – SW Namibia

![](_page_8_Picture_1.jpeg)

• Upper Auob incised 45m

 5m terrace has water-worn Early Stone Age (ESA) lithic artefacts (>500 ka)

 2m terrace has Middle Stone Age (MSA) tools (> ~30 ka)

Implies Auob older than the dunes it cuts!

# Auob River - Calcretized cliffs of pebbly Kalahari sand

![](_page_10_Picture_1.jpeg)

#### Auob – Location of MSA artefacts

![](_page_11_Picture_1.jpeg)

### 10 - 150 Ka dunes – Victoria Falls

![](_page_12_Picture_1.jpeg)

![](_page_13_Figure_0.jpeg)

![](_page_14_Figure_0.jpeg)

![](_page_15_Picture_0.jpeg)

![](_page_16_Figure_0.jpeg)

### **FOSSIL LAKE SHORES**

~995m above msl

945m

936m

922m

912m

![](_page_18_Picture_0.jpeg)

![](_page_19_Picture_0.jpeg)

![](_page_20_Picture_0.jpeg)

![](_page_21_Picture_0.jpeg)

![](_page_22_Figure_0.jpeg)

### 945m Highs = elevated rainfall?

![](_page_23_Figure_1.jpeg)

### Makgadikgadi 945m shorline Luminescence ages with error bars

![](_page_24_Figure_1.jpeg)

![](_page_25_Figure_0.jpeg)

![](_page_26_Figure_0.jpeg)

![](_page_27_Figure_0.jpeg)

### RELATIVE LANDFORM AGES

- Linear Dunes > 995m shoreline
- Linear Dunes > fossil Rivers
- Linear Dunes >Transverse Dunes
- Transverse Dunes = 945m lake
- Rivers = 995m lake
- Rivers =/< 945m lake
- Thus Linear dunes not coeval with 945m shoreline

### **INITIATION OF RIVERS?**

- Rivers active at the time of 995m and 945m shorelines
- Reflects locally higher rainfall in vicinity of the Makgadikgadi palaeo-lake system - ie rivers initiated by the palaeo-lake system???
- If so, dune formation unlikely while the palaeo-lake was extant

#### WHAT CAUSES APPARENTLY

#### **ABBERRENT QUARTZ LIMINESCENCE**

AGES?

### LUMINESCENCE DATING ASSUMPTIONS

#### 1. QUARTZ GRAINS REMAIN *IN-SITU* FOLLOWING BURIAL

#### 2 Thus, YOUNGER GRAINS SHOULD OVERLIE OLDER GRAINS

3. APPARENTLY SUPPORTED BY OLDER LUMINESCENCE AGES WITH DEPTH. BUT SOME INVERTED AGE SEQUENCES

![](_page_32_Picture_0.jpeg)

![](_page_33_Picture_0.jpeg)

![](_page_34_Picture_0.jpeg)

![](_page_35_Figure_0.jpeg)

#### Ilmenite "fingerprints" in kimberlites

![](_page_36_Figure_1.jpeg)

![](_page_37_Figure_0.jpeg)

![](_page_38_Figure_0.jpeg)

![](_page_39_Figure_0.jpeg)

![](_page_40_Picture_0.jpeg)

![](_page_41_Picture_0.jpeg)

### CONCLUSIONS

- 1. Bioturbation has resulted in continuous vertical (up and down) translocation of Kalahari sand grains
- 2. Neogene (past 20Ma) expansion of C4 grasslands and associated termite radiations increased bioturbation rates
- 3 Luminescence ages of resultant mixed Kalahari samples do not reflect age of formation of landforms.

### WHAT COULD KALAHARI LUMINESCENCE AGES REFLECT

### POST LANDFORM REWORKING?

![](_page_44_Figure_1.jpeg)

# Multiple reworking or simply bioturbation?

![](_page_45_Figure_1.jpeg)

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## Thank you

![](_page_49_Figure_0.jpeg)