

Using OSL to Date Fine-Grained Ceramics

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Research funded by the National Science Foundation

Presentation Summary

- I. Project Justification
- II. Analytical Procedures
- III. Evaluation of SAR Method
- IV. Determination of b-values for OSL
- V. Impact on Archaeological Dating

Project Justification

Project Justification

- Two aspects of TL dating can be addressed by OSL:
 - 1. Sherd size requirement
 - 2. Problems inherent with TL signal:
 - 1. Scatter
 - 2. Poorly defined plateau regions
 - 3. Anomalous fading
 - 4. Poor precision

Analytical Procedures

Analytical Procedures

- Analysis of fine-grained fraction (1-8 μm)
- Use of TL-slide technique
- Use of Double SAR
- Alpha efficiency for OSL
- Fading tests for TL and OSL

TL parameters

- Daybreak 1100 reader
- Preheat: 240° C, no hold time
- Corning 759 (blue) filter
- At least 1 week storage time between irradiation and glow out
- Slide procedure used program written by David Huntley, with adjustable scale factor for 2nd glow sensitivity change
- Plateau test to isolate stable signal

OSL parameters

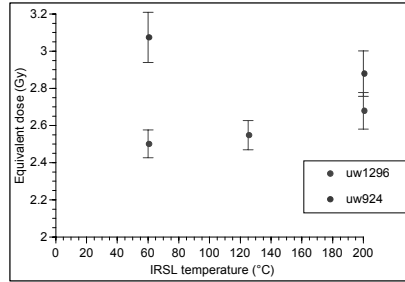
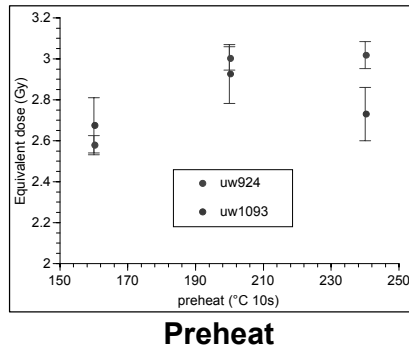
- Risø TL-DA-15 reader
- IRSL: 880 nm diodes
- OSL: 470 nm diodes
- Hoya U340 (ultraviolet) filter
- Analysis uses first 1.2 seconds of illumination, with last 10 seconds subtracted as background
- # of aliquots ranged from 1-11 per sample

SAR sequence

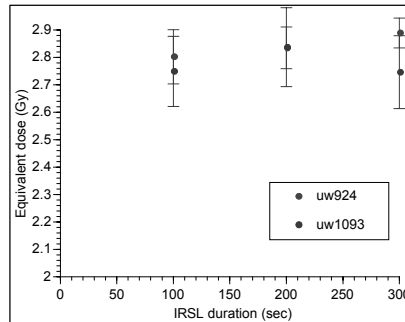
- Dose
- Preheat (200°C 5-min or 240°C 10-sec)
- IRSL (100 sec at variable temperature)
- OSL (100 sec at 125°C)
- Test Dose (1.8 Gy)
- Preheat: 160°C
- IRSL/OSL as above
- Natural plus 7 regeneration cycles including one repeat (recycle test) and one zero dose

Evaluation of SAR Method

EVALUATION OF SAR: Varying Preheat and Irradiation Parameters

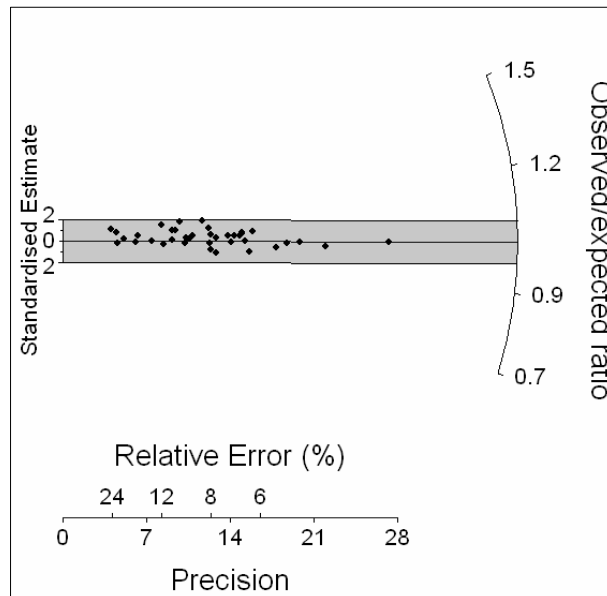


IRSL Temp

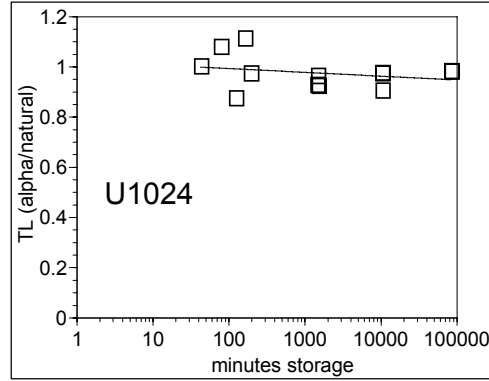
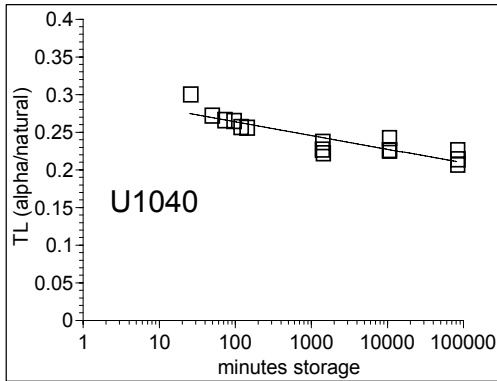


IRSL Duration

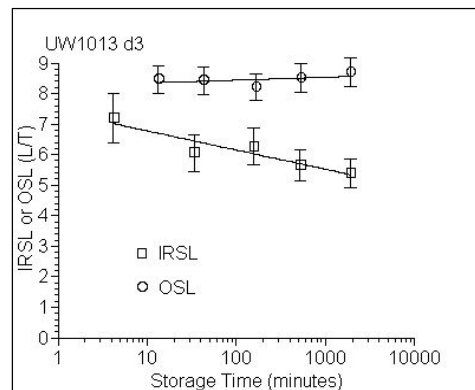
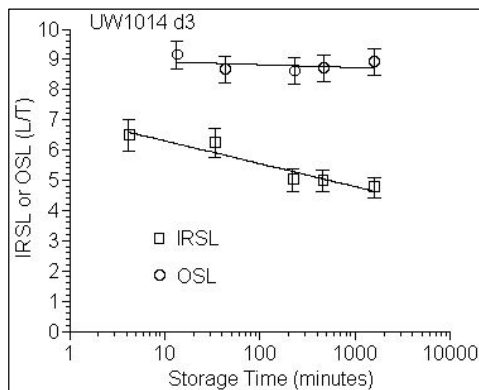
Evaluation of SAR: Dose Recovery, β 's



Evaluation of Fading: TL



Evaluation of Fading: OSL



Determination of b-values for OSL

Alpha Efficiency: b-value

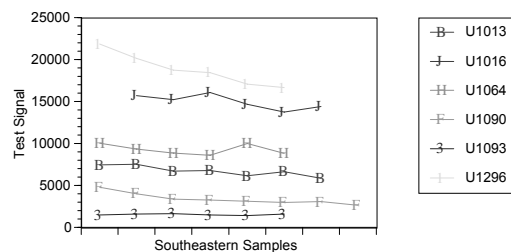
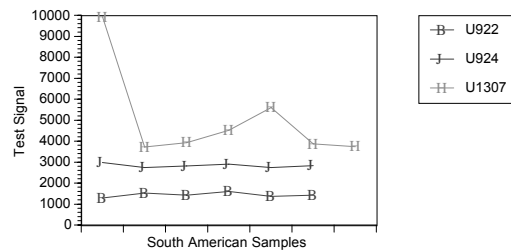
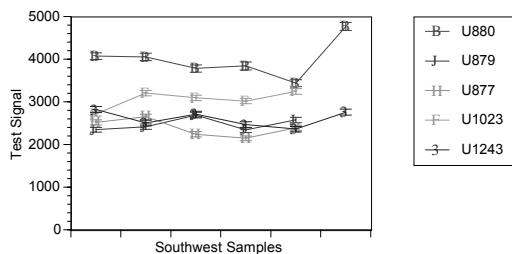
- b-value =
$$\frac{\text{TL}/\alpha \text{ track length/volume}}{(\text{TL}/\text{unit absorbed } \beta \text{ dose})}$$
- For linear growth curve this is equivalent to:
$$\frac{\text{single aliquot } D_e \text{ in terms of } \beta \text{ dose}}{\text{single aliquot } D_e \text{ in terms of } \alpha \text{ dose}}$$

b-value: Three Methods

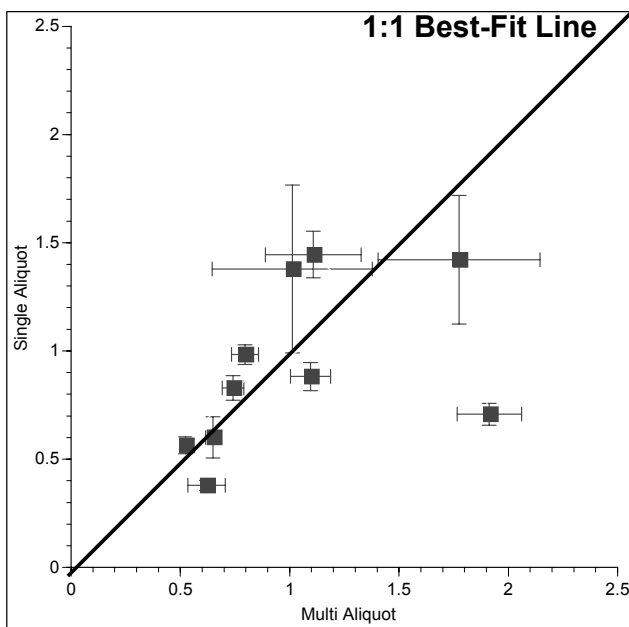
- **Multi-aliquot:** Separate growth curves using α and β radiation
- **'Separate Discs':** Using SAR, determine αD_e on separate disk from that used for determining βD_e
 - Test doses used α radiation
- **'Same Discs':** Add α regeneration doses on same disk used for βD_e
 - Test doses used β radiation

b-value: Sensitivity Change

Sorted by Region

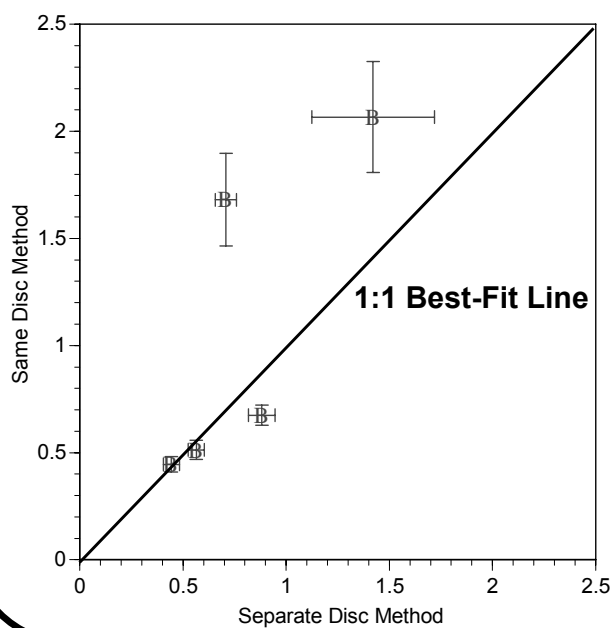


b-value: Multi Aliquot vs. SAR

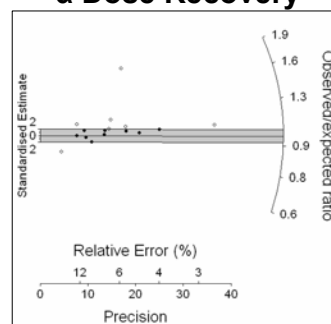


OSL Data

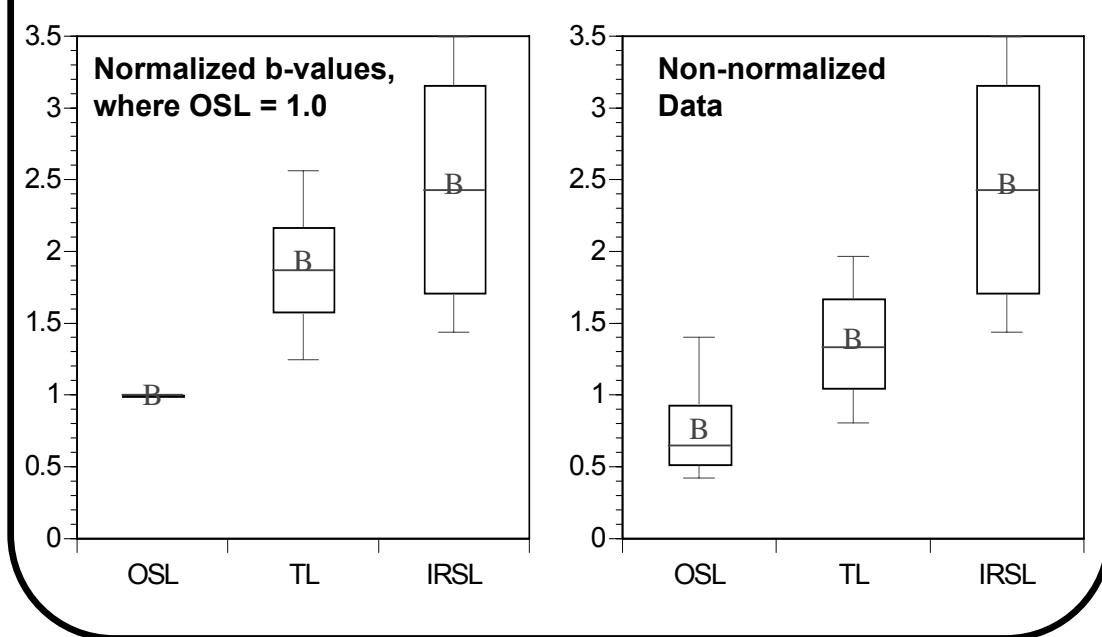
b-value: Separate Disc vs. Single Disc Methods



α Dose Recovery



b-value: Results of TL, OSL, IRSL



Impact on Archaeological Dating

Comparison of Ages

	<u>Total # of Sherds</u>	<u>OSL and TL Agreement</u>	<u>Discrepancy Explainable by TL Fading</u>	<u># of 'Problematic' Sherds</u>
Shiloh	17	11	4	2
SW	5	4	1	0
SE	5	2	2	1
SAmer	3	1	1	1*
* Multi-Aliquot Data Provides Better Agreement				

The Shiloh Case Study

- Radiocarbon dates the construction of the mound to between AD 1020 and 1160, in agreement with the majority of the luminescence dates.
- **Luminescence Calendar Ages:**

Sample	TL	Error	OSL	Error	Wgtd Avg	Error
U1219	1635	59 AD	978	186 AD	TL Fades	
U1220	1202	96 AD	874	64 AD	TL Fades	
U1221	215	580 AD	870	159 AD	TL Too Old	
u1222	1094	120 AD	929	96 AD	994	75
U1223	942	233 AD	982	63 AD	980	61
U1224	935	203 AD	831	198 AD	883	142
U1225	869	184 AD	2206	567 AD	OSL Too Old	
U1226	703	414 AD	599	179 AD	616	164
U1227	1300	84 AD	1194	109 AD	1261	67
U1228	881	386 AD	1100	57 AD	1096	56
U1229	573	212 AD	321	238 AD	463	158
U1230	1068	128 AD	1067	92 AD	1069	75
U1231	755	242 AD	1020	59 AD	946	58
U1232	1565	84 AD	837	153 AD	TL Fades	
U1233	1015	80 AD	972	108 AD	1001	65
U1234	589	142 AD	309	214 AD	504	118
U1235	1288	105 AD	965	43 AD	TL Fades	

Change in % Error

	<u>TL %</u> <u>Error</u>	<u>OSL %</u> <u>Error</u>	<u>Weighted</u> <u>Average %</u> <u>Error</u>	<u>Improved</u> <u>Precision (%)</u>
SE Samples	15.59	7.95	7.08	8.50
SW Samples	13.41	9.03	7.13	6.28
Shiloh	16.37	11.11	8.48	7.89
Samer	7.53	7.58	5.34	2.19