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# Thermoluminescence Dating of Loess Deposition in Normandy

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At the Fourth International Seminar on TL and ESR Dating held in September 1984, Debenham (1985a) reported that he had been unable to obtain a TL date of more than 140 ka for any sediment, although his samples of loess from N.W. Europe included about ten for which there were geological age estimates in excess of this up to 700 ka. His plot of TL age versus geologically estimated age reproduced above (1985b) shows a deviation for samples as young as 50 ka and he suggested that this might be caused by a time-dependent loss of luminescence centres such that the TL age, T, is given by

$$T = \tau ( 1 - e^{-t/\tau} ) \qquad \text{...............(1)}$$

where $\tau$ is the lifetime of the decay process and t is the real age of the sample. At the same meeting Strickertsson (1985) demonstrated that the electron trap in potassium feldspar responsible for the TL signal observed by Debenham and Wintle et al. (1984) has sufficient thermal stability that it should in principle be useful for dating samples with ages up to about 1 Ma. However, no laboratory TL experiment can test a sample for a time-dependent loss of luminescence centres such as has been proposed by Debenham.

Using the apparent TL ages for geologically older samples and the assumption that $T \rightarrow \tau$, Debenham estimated $\tau$ as 100±10 ka. It is possible to invert equation 1 so as to estimate the real age of the sample. I show these estimates in column 3 of Table 1 after I have taken account of the effect of different growth forms for the TL due to alpha particles and to beta and gamma radiation. Until the effect discovered by Debenham is better understood, I do not recommend that the values in column 3 be regarded as definitive. A clear understanding of the parameter $\tau$ in equation (1) and an estimate of its value with well-constrained confidence limits is an absolute requirement before this stage can be reached. The fact that the measured TL in the samples listed in Table 1 increases measurably with geological age, strongly suggests that they are, in principal, datable by the TL method; the very large confidence limits given for the older samples in column 3 reflect uncertainty in the parameter $\tau$ in equation (1), and not our uncertainty in the differences between the samples.

Table 1. Fine-grain feldspar age estimates (ka) for samples from Saint Romain

| Sample No. | from ref. 4 | col. 1 recalc. by Debenham | col. 2 corrected for fading $\tau$=100±10ka |
|---|---|---|---|
| QTL20 h | 80 ± 7 | 74 ± 12 | $135^{+160}_{-45}$ |
| QTL20 i | 88 ± 8 | 77 ± 10 | $150^{+150}_{-45}$ |
| QTL20 n | 114 ± 10 | 101 ± 12 | >180 |
| | | | |
| QTL20 a | 12.6 ± 1.3 | | 13.5 ± 1.6 |
| QTL20 b | 14.4 ± 1.3 | | $15.5^{+1.7}_{-1.6}$ |
| QTL20 c | 13.7 ± 1.2 | | $14.7^{+1.6}_{-1.4}$ |
| QTL20 d | 14.2 ± 1.3 | | $15.3^{+1.7}_{-1.6}$ |
| QTL20 e | 11.1 ± 1.0 | | 11.8 ± 1.2 |
| QTL20 f | 16.4 ± 1.5 | | $17.9^{+2.0}_{-1.9}$ |

It will be crucial to the further development of the method to obtain TL results for more samples that can be unequivocably correlated with the 120 ka-old interglacial that is confidently dated in the deep-sea, in Britain, and in raised beach deposits around the world. If the soil that we believed we had dated at this stage at Saint Romain is in fact significantly older, then the same may be true for Debenham's samples which have been assigned similar ages. In this case the value of $\tau$ becomes less well constrained than is shown in Debenham's figure 1.

In the meantime we can conclude, with respect to the results given in Wintle et al. (1984) that the section encompassing samples a-f was deposited very rapidly about 15 ka ago, that a hiatus of at least 50 ka intervened between samples g and f, and that the sequence from g-o probably represents an orderly record whose real age range should be determinable once there is a better understanding of the effect discovered by Debenham.

## References

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