# A Note on the Temperature Dependence of Anomalous Fading

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Anomalous fading is generally attributed to the tunneling of electrons from traps to neighbouring sites. In the standard derivation of the probability of quantum-mechanical tunnelling there is no temperature dependence, yet the measurements of Wintle (1977) showed a significant temperature dependence. The purpose of this note is to suggest a simple explanation.

The barrier through which the electron tunnels may be itself temperature dependent due to the vibrations of the neighbouring atoms. This vibrating barrier model leads to the behaviour

$$\text{tunneling probability} \propto \exp(C.T.)$$

where T is the temperature and C a constant.

This relation has been independently derived by numerous authors in various disciplines but is not widely known or applied. Possibly the first derivation was by Tredgold (1962); a summary is given by McKinnon and Hurd (1983).

Testing the applicability of the relation to anomalous fading will not be easy since the time dependence is not a simple exponential, presumably the result of a distribution of tunneling barriers. On the other hand acceleration of anomalous fading by increasing the storage temperature should make its detection more convenient due to the use of shorter storage times. Similar considerations apply to the use of delayed TL measurements to reduce the effect of fading on TL dates as suggested by Huxtable et al (1972), Fleming (1976, p. 126), Wintle (1978), Berger (1984) and Lamothe (1984). Templer (1985) has shown the use of increased storage temperature to be highly promising for dating using zircon grains.

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## Reviewer's Comments (M. J. Aitken)

It is timely to be reminded that in her early work on anomalous fading Wintle noted a weak temperature dependence. Besides the mechanism now proposed there is also the possibility that thermally-assisted tunnelling arises because of increased occupancy, as the temperature is raised, of above-ground-state energy levels (see Figure 5 of Visocekas et al., 1976 for illustration). As regards dependence on time most reported data can be interpreted (Visocekas, 1979; Visocekas et al., 1983) as indicating that the amount of TL lost is proportional to log (time).

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