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General conclusions

(i) There do seem to be non-fading deep (500-700°) traps.

(ii) They are probably in significant numbers - around 10^8/mg at 100 rads.

(iii) Optical transfer is not the way to measure them. The residual is 3 orders of magnitude too large for the 'natural' method. This appears to be a fundamental limitation arising from the impurity of the crystals. The sensitivity is also low, though that may not be a fundamental limitation.

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REDUCTION OF SPURIOUS TL IN ATMOSPHERES

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It is well-known that the so-called "Spurious TL" component of a glow curve can be reduced by heating samples in inert atmospheres having very low oxygen and moisture concentrations. The exact reasons for this have so far defied detailed explanation but it is quite clear that the lower the oxygen content of the gas in the TL system, the less likely is spurious TL to occur (see e.g. Sutton and Zimmerman, 1977). This suggests that some further improvement might be achieved with the use of chemically reducing atmospheres. Additionally, as an economic factor, the need for the use of high-purity gases might be avoided, or at least one might be able to tolerate a somewhat greater oxygen content in the gas used. A range of samples of archaeological and geological interest has been tested in a mixture of 5% hydrogen plus 95% nitrogen. (Manufacturer's specifications state: less than 10 ppm oxygen, less than 25 ppm moisture). Comparison was made with commercial high purity argon (less than 6 ppm oxygen, 12 ppm water). The samples tested included aboriginal hearthstones, baked clay, apatite, calcite, fluorite, zircon, pottery samples, various quartzes, as well as a variety of TLD phosphors. No great improvement was noted but in no case was the result worse than that obtained with the high purity argon. A mixture of 10% methane plus 90% argon, called P-10 and commonly used for filling gas counters (15 ppm oxygen 25 ppm moisture) did not give improved performance for any sample.

Fig. 1 shows glow curves obtained on a sample of powdered quartz using the above-mentioned heating atmospheres. This example was chosen as showing "average" behaviour rather than "typical" behaviour, since there were differences from sample to sample. In this particular case the hydrogen/nitrogen mixture is slightly better than argon in the region of the "Spurious TL" component but the improvement is not great.

From the point of view of economics (at least in this country) there is little to choose between the nitrogen/hydrogen mixture and high purity argon. However, it does have a price advantage by a factor of about 2.5 over ultra high purity nitrogen (less than 2 ppm oxygen, less than 1 ppm water).

Sutton, S.R. and Zimmerman, D.W., Ancient TL 1, 7 (1977)

FIG. 1