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Ancient TL

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"I found that holding it a while near the flame of a candle (from which yet I was careful to avert my eyes) and being immediately removed into the dark, it disclosed some faint glimmering, but inferior to that it was wont to acquire by rubbing. And after holding it near a fire, that had but little flame, I found the stone to be rather less than more excited, than it had been by the candle. I likewise endeavoured to make it shine, by holding it a pretty while in a very dark place, over a thick piece of iron, that was well-heated, but not to that degree as to be visibly so. And though at length I found, that by this way also the stone acquired some glimmering, yet it was less than by either of the other ways abovementioned." Sir Robert Boyle, in "Observations made this 27th of October, 1663 about Mr. Clayton's Diamond."

IN THIS ISSUE . . .

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IN MEMORIAM

All of you are probably aware of the unfortunate, sudden passing of Dr. David Zimmerman, the founder and editor of the Ancient TL newsletter. Many of you will have met David at various conferences. Some of you will have had the pleasure, as did we for eight years, of working with him on scientific problems. The latter will have some idea of our sense of loss.

Perhaps the most important characteristic of a scientist is a deep respect for truth - the ability to live with nature as it reveals itself through experiments and not confuse it with nature as we would sometimes wish it to be. This trait David had in abundance. His integrity was of the highest order. If he said something, then it was so. A deeply dedicated person, he exemplified the very best aspects of our profession. We miss the constant interchange of ideas and his quiet, cheerful presence in our midst. I am sure that he would have wanted us, and you, to continue work. He set high standards, and we shall have to strive hard to match them.

The Washington University Center for Archaeometry

MORE HINTS ON SPURIOUS REDUCTION

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An earlier report (S. Sutton and D. Zimmerman, 1977, Ancient TL No.1, p.7) has stressed the importance of reducing TL oven oxygen levels in avoiding significant spurious signals. Additional dangers of oxygen contamination are present when the "oxygen-free" inert gas flows to the oven through lengthy sections of tubing. This note reports experiences with a long nylon gas line, and shows that the use of copper tubing in similar circumstances is highly preferable.

Oxygen contamination was measured at the end of a 40 m length of plasticised nylon tubing (Type II, supplied by Enots Ltd, Lichfield, Staffs, England) of inner diameter 5 mm and 1.2 mm wall thickness, which was fed from a high purity Argon gas bottle.

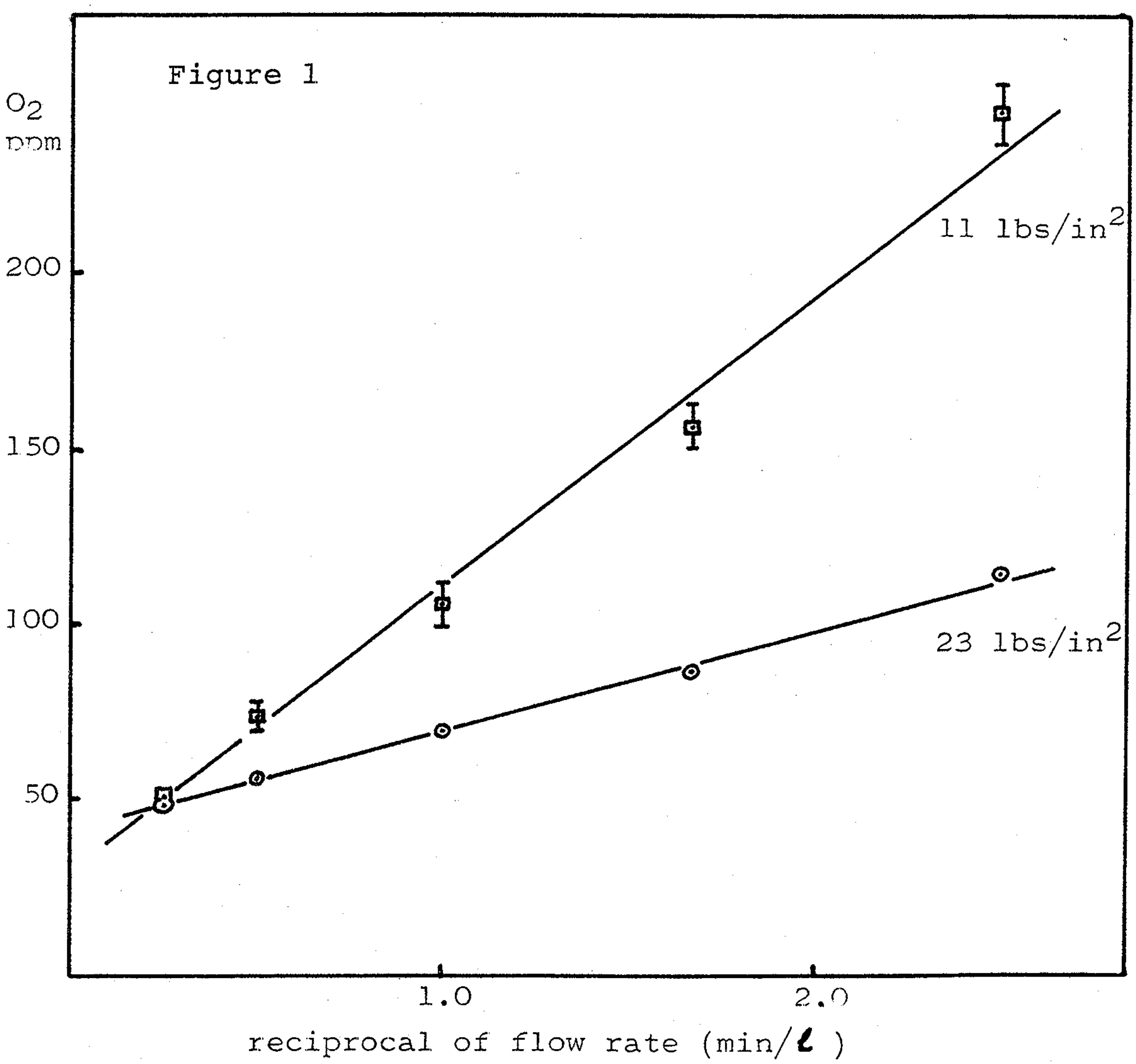
The oxygen measuring device was a Couloximeter, (obtainable from Chemical Sensor Development, 910 Franklin Terrace, Minneapolis, Minnesota 55406) described by P.A. Hersch, (1973), August 1973, American Laboratory, p.29. Upstream of the meter the line incorporated a by-passable column of oxygen absorber, a humidifier, and a micro-electroyser capable of producing oxygen for calibration purposes. During measurements the gas flow through the meter was held at a fixed value of approximately 40 cc/min. Back diffusion of oxygen was prevented by a non-return valve at the vent. The line could be additionally vented immediately upstream of the couloximeter.

Equilibrium oxygen contamination levels in the argon gas were measured as the flow rate through the nylon line was varied between 400 cc/min and 4 ℓ/min. Fig. (1) shows two plots of contamination levels Vs. the reciprocal of the flow rate, one for a line excess pressure of 11 lbs/in^2, the other for 23 lbs/in^2. Neither of the plots shows significant departure from linearity, implying that the rate of ingress of oxygen into the gas line is independent of gas flow rate. Oxygen ingress rates were 1.7 $\mu\ell$/min at STP per m of tubing at 23 lb/in^2 excess pressure, and 3.2 $\mu\ell$/min at 11 lbs/in^2. (An oxygen diffusion rate of 4 $\mu\ell$/min per m of 'Tygon' tubing is quoted in literature supplied with the couloximeter). A 10 m length of the nylon line was pressure tested at 90 lbs/in^2. No measurable loss of pressure occurred over 24 hours, but, with the line submerged in water, small bubbles formed uniformly over its surface. We therefore believe the observed oxygen ingress to be due to diffusion rather than leakage.

For comparison, similar couloximetric tests were carried out on an all-copper gas line 17 m long of inner diameter 4.9 mm and 700 μm wall thickness. The line was fed by argon gas from the same bottle as used in the previous experiments. At a flow rate of 40 cc/min, an equilibrium contamination of 3 ppm O_2 was measured. This level dropped to 0.8 ppm when the argon flow rate was increased to 1.5 ℓ/min.

A length of nylon coiled tubing has been useful as a flexible connecting section between the gas line and the bottle. This has an extended length of 8 m, and was shown to be responsible for a significant fraction of the oxygen contamination. A nitrogen gas bottle, having a nominal oxygen contamination of 5 ppm, was connected to the all copper line described above. During fast flushing an 8 ppm oxygen level was measured, and at a flow rate of 40 cc/min, 10 ppm. Inserting the coil of nylon tubing in the gas line increased the contamination at the lower flow rate to 20 ppm.

During normal usage, the TL oven is evacuated and then filled with inert gas and flushed at a rate which is generally several litres/min. Periods of usage alternate with longer intervals of no gas flow, the lengths of the intervals depending on the work in hand. It is therefore difficult to estimate the effective flow rate, and the resulting contamination of the gas used in past work. However, these results suggest that our earlier finding that the high flow rate of 5ℓ/min is beneficial in reducing spurious TL levels may result from the ingress of oxygen into the supply line rather than evolution of O_2 from the heated sample, as had been supposed.



A BLUE-UV ABSORBING FILTER FOR LABORATORY ILLUMINATION

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In the preparation of TL samples, it is important to avoid the optical effects of laboratory illumination. Exposure to room light can both induce and bleach stored TL in many minerals, blue-UV light being more effective than red. These effects can be avoided by preparing samples in subdued light with as little blue-UV component as possible. Lighting of this kind can be obtained from red blubs, red fluorescent tubes or white fluorescent tubes fitted with blue-UV absorbing filters. In the latter scheme, it is possible to obtain illumination which more closely approximates normal white lighting and, therefore, creates a more comfortable working environment. We report here on a suitable fluorescent tube filter.

UV absorbing filters for fluorescent tubes are offered by Solar Screen Co., 53-11 105th St., Corona, New York 11368. They are available in clear and amber (cost: $28 for twenty-four 48-inch long jackets). We have measured transmission spectra (Fig. 1) using a Cary spectrophotometer and have found the amber to be preferred because of its better absorption of blue light.

The effect of the amber light and sunlight on stored TL was measured for five geologic minerals: quartz, microcline, labradorite, zircon and apatite. Each mineral was powdered, annealed, and irradiated. The TL response was then measured for three aliquots; one exposed to sunlight, one exposed to amber light and a "control" aliquot which was kept dark. The change in stored TL due to exposure to the light was expressed as a percentage of the "control" TL. Use of the "control" aliquot for normalization corrects for thermal decay and anomalous fading. Table 1 shows the results for the five minerals.

An amber light exposure of 130 lux·hours produced a maximum change in stored TL of 10%. For the TL of all five minerals to change less than 1%, the sample exposure must be less than about 10 lux·hours. The length of time to receive this exposure depends, of course, on the illumination level in the room. We find a tabletop illumination of about 10 lux of amber light to be satisfactory. (Uniform illumination is best obtained with indirect lighting.) In this case, samples should not be exposed for more than one hour. As a further safeguard, we recommend that each fluorescent tube be filtered with at least two amber jackets to further reduce blue light.

FIG. 1
"SOLAR SCREEN" TRANSMISSION SPECTRA

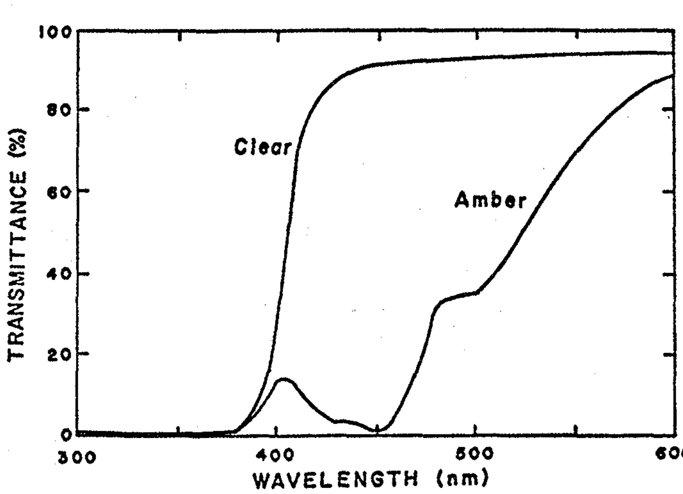

TABLE 1

Percentage Change in TL at 350°C in Glow Curve

Sample	Sunlight through glass (40,000 lux·hrs.)*	Amber light (130 lux·hrs.)*
Quartz	-71	-6
Microcline	-69	-8
Labradorite	-48	+10
Zircon	-91	-3
Apatite	-90	-3

* exposure measured with Gossen exposure meter

LETTER TO THE EDITORS

With regard to the Americium-241 sources (A. K. Singhvi and M. J. Aitken: Americium-241 for Alpha-Irradiations; Ancient TL, No. 3), I have been informed by the North American distributor, Amersham/Searle, that, "In all probability, the cut edges of the strip would leak Americium, as well, the repeated evacuation under vacuum would lead to the spread of Americium, and the contamination of the vacuum chamber and pump". In order to avoid this, Amersham recommends that they "cap the edges by forging a metal foil piece over the edges".

Consequently, I have had our six sources capped by Amersham after they were purchased; the cost was $50. I believe that this was a worthwhile investment, and it seems to me that it would be prudent for future purchasers of these sources to require that they be capped by the manufacturer before shipment.

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INTERLABORATORY CALIBRATION OF RADIOACTIVE SOURCES

The following calibration kit is now available:

A) 1/4 g coarse-grain fluorite powder (MBLE Super S) gamma irradiated to 100 rads,

B) 6 fine-grain fluorite discs beta-irradiated to 100 rads,

C) 6 fine-grain fluorite discs alpha-irradiated to an equivalent beta dose of 100 rads, of known a-value,

D) 12.5 micron aluminium foil for checking alpha source spectra,

E) Smoky-glass filter for taping onto the bottom of the photomultiplier housing so as to reduce the TL intensity to a manageable level.

There will be a nominal charge of £50. We would prefer to issue it free but such an inordinate amount of work has gone into it that we are obliged to cover some of it.

Apply to: Dr. M. J. Aitken, Research Laboratory for Archaeology and the History of Art, 6 Keble Road, Oxford, OX1 3QJ, England.

PRELIMINARY ANNOUNCEMENT - 1980 TL SEMINAR

A second Specialist Seminar on Thermoluminescence Dating is planned for 1-6 September 1980 at Oxford. Those who participated in the 1978 Seminar will be sent details when available; others interested in attending should write to Dr. M. J. Aitken (The Research Laboratory for Archaeology and the History of Art, 6 Keble Road, Oxford OX1 3QJ). As before the orientation will be towards those actively engaged in thermoluminescence and a limitation to seventy participants is envisaged.

RESEARCH POSITION AVAILABLE

SIMON FRASER UNIVERSITY
A position is available at the postdoctoral level to do research in the use of thermoluminescence dating on archaeological material. A strong background in experimental solid state physics is preferred. Salary for a PDF will be the NSERC rate of $925-$990 per month. Applications with other similar qualifications will also be considered. Applications, including a curriculum vitae and the names of three referees, should be sent to Dr. D. J. Huntley, Physics Department, Simon Fraser University, Burnaby, B.C. V5A 1S6.

SOME RECENT BIBLIOGRAPHY

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