Comment on 'Rapid Thick Source Alpha Counting' by Readhead (Ancient TL,2.2)

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1. Reproducibility

In 1976 the Oxford TL laboratory changed from individually-made alpha-counting screens to commercially available ones cut from sheets of silver-activated ZnS spread on a Mylar substrate (available directly from Wm. B. Johnson and Associates, Inc., Research Park, Montville, NJ 07045, USA). The main reason for the change was the lack of reproducibility of the 13.85 cm^2 screens when made up by different people and checked with a solid alpha emitting source (Bowman, 1976). Uniformity of the screen will be more difficult to achieve for a screen about 20 times larger. (Although not given in Readhead's paper in Ancient TL, the area given in his thesis was 326.85 cm^2).

2. Background count-rate

Readhead states that the background of commercial screen material is higher than for made-up screens. His value of 7.5 counts/hr for the large screen gives about the same count rate/cm^2 ks as I routinely obtain for commercial screens (6.65×10^{-3}) with a Vycor (low uranium glass from Corning, USA) disc placed on the ZnS surface to protect it from radon daughters in the air and as reported for the same commercial screens (since 1971) by Fisenne and Keller (1981) who used a Whatman filter for the background measurements. Slightly lower backgrounds (1.39×10^{-3} cts/cm^2 ks) have been achieved by Masters (1980) with a high purity unprocessed silicon wafer on the screen. From a detailed study Masters concludes that electronic noise does not contribute to this and that 3/5 of the background originates from cosmic ray interactions which could only be reduced by massive extended shielding with the remaining 2/5 from radioactive contamination.

Readhead's pair background rate (3×10^{-5} cts/cm^2 ks) is compatible with Huntley and Wintle's observation (1981) of 1 pair count in 2 Ms of background counting for a screen of area 13.8 cm^2.

References

Bowman, S. G. E. (1976) Thermoluminescent dating: the evaluation of radiation dosage. Ph.D. thesis, University of Oxford, England.

Fisenne, I. M. and Keller, H. W. (1981) A short history of ZnS on Mylar as an α-scintillation detector. Health Physics, 40, 739-742.

Huntley, D. J. and Wintle, A. G. (1981) The use of alpha scintillation counting for measuring Th-230 and Pa-231 contents of ocean sediments. Canadian Journal of Earth Sciences, 18, 419-432.

Masters, B. J. (1980) Experimental studies of ZnS alpha particle counters and methods for minimizing detector background. International Reliability Physics Symposium 269-274.

Reviewer's Comment (M.J.A.)

Perhaps it is useful to add that the scatter in count-rate reported by Bowman amounted to an overall spread of 13% in the screens made by six different workers. A convenient source for testing screen-to-screen reproducibility can be made by mixing pitchblende into 'Plasticraft' resin. In this way a disc is obtained which rests on the ring at the periphery of the screen so that testing does not contaminate it. By using about one part of pitchblende (uranium content 50%) to one part of resin a count-rate of the order of 300 per second is obtained for a 42 mm diameter screen (area (13.85 cm^2), allowing high precision in 100 seconds of alpha counting.

Although the reproducibility of Johnson screens is excellent within a batch (overall spread less than 3%) we have found substantial batch-to-batch variations. Incidentally, referring to Readhead's Figure 2 it should be noted that some aluminium, although high purity, nevertheless exhibits a significant level of alpha activity and stainless steel is safer for the peripheral ring.