The "AGE" program for the calculation of luminescence age estimates

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Abstract
The supplementary ZIP file of this paper contains the AGE program, which can be used for luminescence age calculations of clastic sediments. This paper outlines the use and limitations of this program.

Introduction
At the recent APLED2 meeting in Ahmedabad, it was brought to my attention that quite a number of colleagues still use the DOS-based "AGE" program for the calculation of luminescence ages. This program was actually never made widely available nor did it have any explanatory notes; this paper will address these issues.

The supplementary ZIP file[1] of this paper contains the AGE program, which is written in Quick Basic, a DOS based language. Note that some DOS commands are not supported by Windows XP and Vista, and that Vista users will require DOS emulation software in order to run the program. Particularly, there are problems associated with printing the results. AGE uses the "lprint" command, which is not supported by USB printers. The program is mainly driven by function keys.

The program is based on dose rates from Adamiec and Aitken (1998), beta attenuation factors from Mejdahl (1979), alpha attenuation factors from Bell (1980), and cosmic dose rates from Prescott and Hutton (1988, 1994).

Data input
In the following description, input fields are written in italics.

When the software package is opened, the left side inputs refer to internal dose rate parameters and the right side to external ones. *BETA ATTENUATION* toggles between the calculation of external beta attenuation / self absorption based on the grain size, layer removed and internal infinite matrix dose rate (the external dose rate is then set to zero). *INT. ALPHA / INT. BETA* allows the input of calculated or measured alpha and beta dose rates. The associated *av. α/β-SELFIRR* toggles the use of average internal absorption factors to the supplied dose rates (i.e. if these are infinite matrix dose rates, the absorption factors may have to be applied).

The external sediment values are used for the calculation of the external α and β dose rates. *FOR α/β IRR. ONLY* toggles the addition of the gamma dose rate calculated from the sediment data. Similar to the internal dose rates, external alpha and beta dose rates can be added with or without the calculation of average attenuation factors. In addition, an external gamma dose rate can be added with or without consideration of water attenuation.

The cosmic dose rate attenuation is calculated for average sediment densities of 2 g.cm^{-3} (hard and soft component, after Prescott and Hutton 1988, 1994, see also discussion in Grün 1994). A zero input leads to a zero cosmic dose rate. A surface dose rate is calculated by a non-zero value, e.g. 0.001. Other densities can be calculated by scaling the depth. The cosmic dose rate is only calculated to a depth of 25m, below that, the formula used would give erroneous results. Latitude and altitude corrections (Prescott and Hutton 1994) are not carried out. If these are required, they have to be manually adjusted in the *EXT. GAMMA* entry. The cosmic dose rate is added to the external gamma dose rate.

Text files (with an .AGE extension) with the data are saved in the specified directories. As this is a DOS file, any sample name cannot be longer than 8 characters.

When reading existing data files, or using the F2 function key after the calculation of results, data

[1] The ZIP file associated with this paper can be obtained from the Ancient TL web site at www.aber.ac.uk/ancient-tl/issue27_2/age.zip

entries can be revised using arrow keys and "Enter". A straight second "Enter" restores the previous value, any other input leads to a revision of the previous value. Results are printed using the "ESC" key.

Error calculation

The mean dose rates are calculated from all mean values. The effect of each error input is calculated for the total dose rates as well as all given dose rate components. It is explicitly assumed that the errors are linear within the error range. Note that the errors of the alpha, beta and gamma dose rates do not necessarily add up in quadrature to the error in the total dose rate, because some of the errors in the partial dose rates are highly correlated. The age estimate and its error are not rounded. Please make sure to report only relevant digits.

A program for the calculation of ESR age estimates on tooth enamel is available from the Quaternary Geochronology web-site (see Grün 2009).

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Reviewer

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