A new approach to mixture modelling for geochronology

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Mixture modelling is a well known problem in statistics and arises in geochronology where we want to determine the number and statistics of age components from a spectrum of single analyses, or to assess whether a group of ages can be considered to represent a single population. Most methods rely on specifying both the form and number of the component distributions in advance. The need to specify symmetrical distributions can be a problem in geochronology as some analyses may have suffered loss or gain of the parent or daughter isotopes for a given system, leading to skewness and/or relatively heavy tailed distributions.

Here, we present a new generalised mixture modelling method that avoids these restrictions. We have formulated the problem in a Bayesian framework, with considerable flexibility in the class of distributions we can consider by specifying relatively loose *a priori* information concerning the form and number of the distributions. In particular, we allow for both symmetical and skewed distributions and estimate parameters associated with these from the data. However, rather than dealing with the observed ages, as in previous approaches, we make the inferences of components from the 'true' ages, i.e. the ages had we been able to observe them without analytical error. We also estimate the probability distribution on the number of components during the estimation process. This allows a direct, quantitative assessment of the resolution of different numbers of components.

We demonstrate our approach on two data sets: uranium-lead (U-Pb) zircon ages from the Khorat basin of northern Thailand and the Carrickalinga Head formation of southern Australia.