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A new method for evaluating age distributions of detrital zircon datasets by incorporating discordant data

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U-Pb ages from detrital zircons play an important role in sediment provenance studies. However, U-Pb ages from detrital zircon populations often contain a discordant component, which is traditionally removed before the age data are interpreted. Many different processes can create discordant analyses, with the most important being Pb-loss and mixing of distinct zircon age domains during analysis. Discordant ages contain important information regarding the history of a detrital zircon population, for example the timing of Pb-loss or metamorphism, and removing these analyses may significantly bias a zircon dataset.

Here we present a new technique for analyzing detrital zircon populations that uses all U-Pb analyses, independent of discordance. We have developed computer code that evaluates the relative likelihood of discordia lines based on their proximity to discordant data points. When two or more data points lie on or near a discordia line the likelihood associated with that line increases. The upper and lower intercepts of each discordia line, as well as the relative likelihood along that line, are stored, and the likelihood of upper and lower intercepts are plotted with age.

There are many benefits to using this technique for analysis of detrital zircon datasets. By utilizing the discordant analyses we allow for the addition of upper and lower intercept information to conventional analysis techniques (i.e. probability density functions or kernel density estimators). We are then able to use a much stricter discordance filter (e.g. < 3%) when analyzing 'concordant' data, thereby increasing the reliability of Pb/Pb ages used in the traditional analysis. Additionally, by not rejecting discordant data from zircon datasets we potentially reduce the overall bias in the analysis, which is a critical step in detrital zircon studies.

This new technique is relatively quick and uses traditional analytical results, while the upper and lower intercept information is obtained automatically with minimal modification of the computer code. The output is also automatically plotted in a way that can be utilized in a similar manner to conventional detrital zircon plots.

In this study, we present examples from previously published Paleozoic and Precambrian detrital zircon analyses. We use our new computer program to re-analyze the data and highlight the new information and interpretations that can be obtained without extra analytical work.