Assessing the effects of non-detrital material on U-series comminution measurements

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The ability to resolve the timing of fine particle production (comminution) holds potential for greatly expanding geochronologic constraints in several Quaternary geologic systems. Comminution dating measures physical disequilibrium of intermediate daughter products of the ^{238}U decay chain. Previously published comminution ages relied on difficult measurements and modelled values of crystal size, shape, and geometry; as well as assumptions about the effectiveness of leaching procedures on removal of secondary, non-detrital material. These limitations lead to highly uncertain comminution dates and therefore impinge on the utility of the technique. The primary goal of this work is produce more accurate $^{234}U/^{238}U$ measurements by isolation of pure mineral separates.

Elimination of secondary material is an essential step in the process of measuring a comminution age. This work presents an updated procedure for sequential extraction of secondary minerals. We test our ability to isolate comminute material by measuring the isotopic composition of leached residues as well as the elemental composition of leachates. Residue $^{234}U/^{238}U$ values plot on a standard two-component mixing model allowing us to assess the isotopic composition and concentration of our non-detrital material. With this model, we are able to approximate the fraction of non-detrital material left in our sample. We demonstrate the effectiveness of our procedure on comminuted material from several different geologic settings and age domains.