Tracking crustal evolution through a detrital zircon database: when/where did S-type granites form?

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A decade ago Campbell and Allen [1] published a zircon age database for the world's major rivers. The drive behind creating such a database was to explore crustal evolution through time. This "naturally selected" (not rock sample biased) database of concordant ages includes a subset of 5500 analyses from 40 rivers sampling all continents but Australia (no major rivers) and Antarctica, that have a suite of elements collected concommitantly on LA-ICPMS with the age data: Zr, Hf, Si, P, Ti, Y, La, Ce, Dy, Nd, Sm, Lu, with Pb, Th and U. The obvious age feature was the superabundance of zircons corresponding to supercontinent periods and that paper examined the potential relationship of supercontinent and mountain formation to erosion and to step-jumps in the rise of atmospheric oxygen.

Here we explore crustal history as recorded in the zircon database's trace element information, specifically where and when did S-type granites form. S-types are granitoids derived principally from melting of sedimentary sources such that they are restite-rich, are always peraluminous and contain Al-rich minerals [2]. They contrast with metaluminous to weakly peraluminous I-types which derive from igneous sources. Classifying fractionated granites *sensu stricto* into I- or S-type is difficult except for phosphorus contents because P_2O_5 increases with fractionation in S-type while in I-types, it decreases [2]. Burnham and Berry [3] have identified S-type zircon trace element characteristics by studying Lachlan Fold Belt (SE Australia) rocks and we adopt their strategy to test for the occurrence of S-types worldwide and through time. Our finding is that S-types are restricted in time and space. They are only common in Europe and Australia, and they have ages spanning 650-400 Ma, the period of Pan-Gondwanan tectonism and soon there after.

[1] Campbell and Allen (2008) *Nat. Geosci.* **1**, 554-558. [2] Chappell and White (1992) *Trans. R. Soc. Edinb*. **83**,1-26. [3] Burnham and Berry (2017) *Nat Geosci.* **10**, 457-460.