Detrital zircons and the distribution of S-type granites through time

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A global database compilation of 7042 detrital zircon U-Pb age and trace element data from 51 major rivers shows secular variations in the relative contributions of igneous (I-type) and sedimentary (S-type) components to the magma sources through time. Overall there are age peaks at 2.75-2.4, 1.95-1.65, 1.2-1, 0.65-0.4 and 0.35-0.15 Ga, which correlate with the timings of supercontinents assembly. The average abundance of S-type granites has been quantified using two methods: (i) comparing the cumulative distribution of P concentrations for selected time intervals, and (ii) using plots of molar (REE+Y) against P. The former is based on the average P content in S-type granite zircons being greater than in I-types, resulting from the high solubility of apatite in strongly peraluminous S-type granitic magmas. The latter is based on the substitution of REE^{3+} ($+Y^{3+}$) for Zr in zircon from S-type granites being charged balanced by P^{5+}, leading to a near 1:1 correlation between (REE+Y) and P in S-type zircons. The results from both methods show a similar pattern: the most important period of S-type zircon production coincides with the timing of the Gondwana assembly and the least important with the formation of Superia (Archean). The latter is consistent with the dominantly mantle-like oxygen isotopic values in Archean zircons, which is interpreted to result from restricted incorporation of supracrustal material into granitic melts at that time. Both methods also show that Rodinia was a period of low S-type zircon production, unlike the preceding supercontinent, Nuna. The increase in supracrustal melt production, revealed by the age distribution of S-type zircons, correlates with the rise of atmospheric oxygen. The production of S-type granites and the rise of atmospheric O_2 both require deep burial of vast amounts of sedimentary material: one to promote melting of sedimentary rocks, the other to preserve organic C, produced by algae and cyanobacteria, so that it cannot back react with atmospheric oxygen.