Evidence for the composition and tectonic affinity of continental crust between 4.3 and 3.0 Ga from the trace element composition of detrtial zircons from Jack Hills

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The composition and origin of Earth's early crust remains hotly debated with many arguments based on the Hf isotope composition of Archaean detrital zircons from Jack Hills in western Australia. One thing that is not in dispute is that these zircons derive from igneous source rocks. Here we adopt a novel approach by using partition coefficients to invert the trace element composition of 4.3-3.0 Gyr Jack Hills zircons to calculate the composition of the melts from which they crystallised. The average SiO_2 content of these melts was 59 wt. %. They had Th/Nb ratios around 5, an oxygen fugacity close to FMQ and crystallised at around 700 ºC. Such features strongly indicate that the protolith for the Jack Hills zircons was an andesite potentially formed in a convergent margin setting. Unlike some recent suggestions, we find no evidence for secular variation in SiO_2, fO_2, T or Th/Nb between 4.3 and 3.0 Gyr implying little change in the composition or tectonic affinity of the early crust from the Hadean to Eoarchaean. The results are consistent with an early onset of modern-style plate tectonics on Earth but may not demand it.