Correlation of highly altered tuffs in Permo-Triassic coal basins of eastern Australia using zircon composition

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Tuffs provide regional stratigraphic markers that aid in coal seam correlation for exploration and assessent of resoures and their character. Although viewed as instantaneous time markers of regional scale, tuffs can be numerous and when deposited in peat mires, they are highly altered. TIMS instrumentation can give highly precise and accurate U-Pb zircon ages and SHRIMP and LA-ICP-MS can be accurate at the 1-2% level but zircon composition itself has been overlooked as a correlation indicator. Whereas the eruption age of young, unaltered tuffs can be precisely dated by $^{40}Ar/^{39}Ar$, for instance, zircon chronology has the nagging problem of zircon over-robustness; they can survive partial melting events, and can persist in magma systems for time scales on the order of TIMS precision. Pristine, young tuffs have glass and major mineral compositions that are unique to each tuff and when compared to those in a stratigraphic section, mineral compositions suggest an overall evolution among tuffs on the time scale of ~0.3 Ma as demonstrated by the very large volume ancient Yellowstone systems.

LA-ICP-MS technology allows measurement of a dozen elements other than those necessary for U-Pb geochronology in a single zircon ablation. We tested 8 zircon populations from tuffs in coals thought to be “the same age” knowing one to be “more mafic” to see how well trace elements and derived parameters work for correlation along with age. One would expect that the following indicators would be controlled by source(s), melting conditions, and magma evolution: Ti and P content of zircon, the slope of the heavy to middle REE patterns and Eu and Ce anomalies. Results of tip ablations indicate that the tuffs *are* the same age with an average uncertainty of 3 Ma (2σ) when each population was analysed 16 times in a round robin of one ablation from each population, then standards. This is except one sample which is 8 Ma older than the sample from one meter *below* it in the same drill hole, in the same unit. Ignoring the “more mafic” tuff that was compositionally distinct, this older population has the highest Ti, P and Th/U, smallest Ce and Eu anomalies and lowest REE slope, all suggesting that it is different.