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Investigating spatial and temporal detrital zircon trends in sedimentary basins: A provenance study of the subsurface Adavale Basin, Queensland, Australia.

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Trends of detrital zircon age spectra from stratigraphic sections in sedimentary basins provide insight into the temporal variability of zircon sources throughout the lifespan of the basin. This concept can be augmented by adding a systematic spatial strategy to sampling to capture the lateral trends for each stratigraphic level. Such a study gives better understanding of integrated spatial and temporal variations across sedimentary systems. Here we present a study of the Devonian subsurface Adavale Basin working on legacy drill core material to investigate the spatial and temporal trends in detrital zircon distributions. We present data from sandstone petrography, detrital zircon U-Pb geochronology and detrital zircon grain morphologies. Guided by biostratigraphic constraints, five stratigraphic levels in the Adavale Basin were targeted for sampling across multiple locations along a ∼200 km long transect in order to detect the lateral and vertical variation of detrital zircon age spectra. A total of 1717 concordant U-Pb zircon ages were acquired from 15 sandstone samples, constituting a robust database to which statistical correlation tests could be applied. These data have been integrated with zircon morphology data obtained from object extraction using threshold techniques in the image analysis software JMircoVision. We interpret our data as follows: (1) there was continuous input from a plutonic/volcanic Ordovician zircon source (∼480 Ma), (2) there was subordinate reworking of metasedimentary basement rocks with distinctive zircon grain morphologies (high sphericity) and (3) there was addition of a syn-depositional volcanic zircon source ∼380 - 360 Ma, having high lateral variability across the basin. Our detrital zircon data suggest the sedimentary infill of the Adavale Basin was supplied from relatively proximal sources, ones < 200 km away. Resulting zircon age populations correspond to silicic igneous and metasedimentary source rocks known from basement intersections in drill core from the Thomson Orogen and outcrops in the Anakie Inlier. Our data highlight the importance of both vertical and lateral sample coverage in provenance studies in order to capture the complexity of sediment sources, moreover zircon morphology data help differentiate the identity of discrete source lithologies.