

Spatial and Temporal Provenance Analysis of the Upper Part of the Roper Group, Beetaloo Subbasin, North Australia

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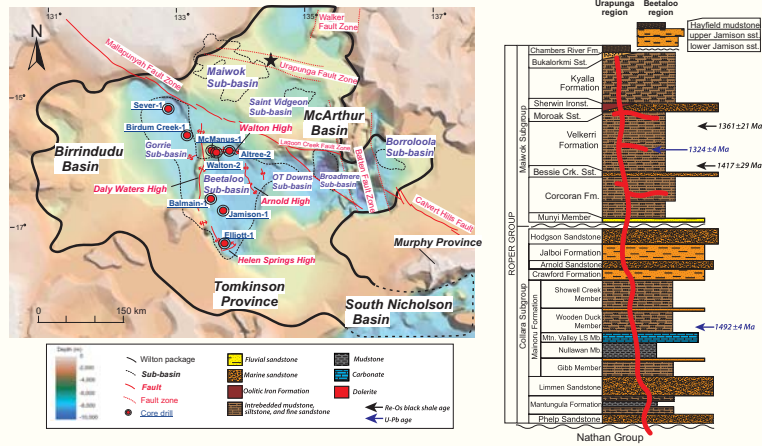


Fig.1 Extension of the Wilton Package

CONSTRAINTS ON DEPOSITION

The maximum depositional ages of the Bessie Creek Sandstone and the Velkerri Formation of the Roper Group are constrained to 1386 ± 13 Ma and 1308 ± 41 Ma, respectively, whereas the overlying Morook Sandstone has no younger detrital zircons, so its maximum depositional age is also constrained as 1308 ± 41 Ma. The Kyalla Formation was deposited after 1313 ± 47 Ma, and two, as yet, informally defined and ungrouped latest Mesoproterozoic to Neoproterozoic sedimentary units, the lower and upper Jamison sandstone, have maximum depositional ages of 1092 ± 16 Ma and 959 ± 18 Ma.

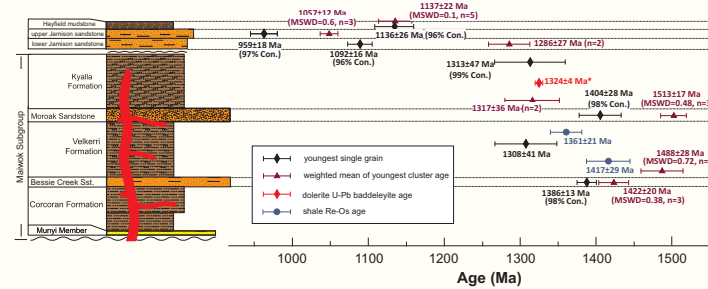


Fig.3 Age constrains of the upper Beetaloo Sub-basin

PROVENANCE ANALYSIS

Zircons from the Maikwok Subgroup were originally sourced from Palaeoproterozoic and earliest Mesoproterozoic rocks. These are consistent with derivation from the surrounding exposed basement. Detrital zircon age variations up-section suggest a systematic temporal change in provenance. The oldest formation analysed (Bessie Creek Sandstone) has a major source dated at ca. 1823 Ma. Rocks of this age are common in northern basement exposures. Samples from the overlying Velkerri Fm. show derivation from a ca. 1590 Ma source, consistent with rocks exposed in Queensland, or the Musgrave Province. The Morook Sandstone and the Kyalla Formation show progressively more ca. 1740 Ma detritus, which we suggest likely reflects new sources in the Arunta Region to the south. Our work also confirms that the siliciclastic basin unconformably overlying the upper Roper Group, and first described as probably of Neoproterozoic age by petroleum explorers in the early 90s, was deposited after the Musgrave Orogeny.

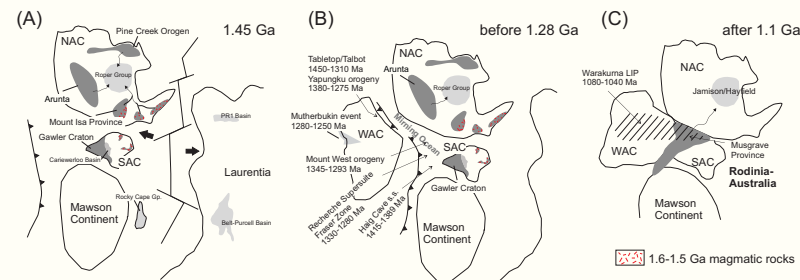


Fig.5 Tectonic evolution of the North Australia Craton

INTRODUCTION

The subsurface Beetaloo Sub-basin of the McArthur Basin, Northern Territory, Australia, comprises a succession of shallow-water, dominantly marine, clastic sedimentary rocks; the volumetrically largest part of the 1000 km-scale outcropping Wilton package. Shale formations in the Roper Group form the world's oldest potential unconventional gas play. We present new LA-ICP-MS detrital zircon U-Pb data from the Roper Group in the Beetaloo Sub-basin, providing new constraints on basin age and provenance. Then new statistical techniques were used to interrogate a large amount of detrital chronological data to investigate the spatial and temporal provenance of the group and illustrate the evolution of the basin and its margins.

GEOLOGICAL SETTING

The Beetaloo Subbasin contains a thick succession and is considered as the depocentre of the Wilton Package (also named the Roper Supergroup). The Maikwok subgroup of Beetaloo Subbasin is characterized by repetitive sandstone and mudstone units deposited from storm-dominated shelf to coastal environment. Three ungrouped units, the lower and upper Jamison sandstone and Hayfield mudstone unconformably overlies Maikwok subgroup.

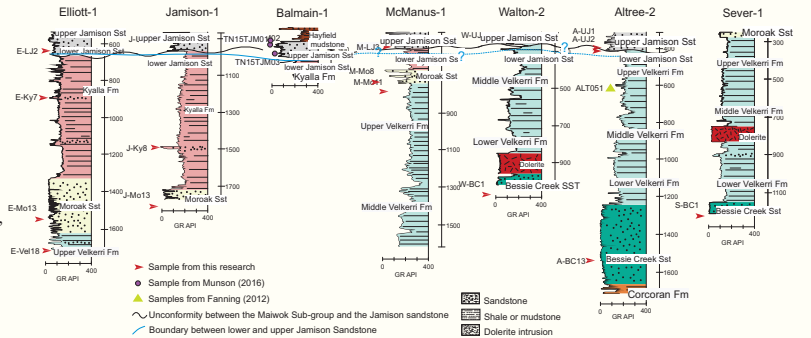


Fig.2 Hyloggers of core drills

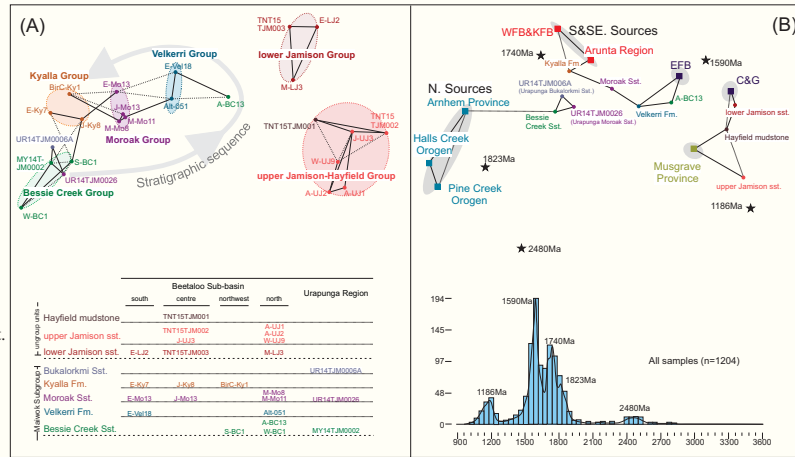


Fig.4 Multidimensional Scaling analysis

TECTONIC IMPLICANTS

The upper Roper Group was mainly sourced from the south (Arunta Region) and southeast (Mount Isa Province), and both spatial and temporal provenance variation existed. Significant temporal variation existed within the upper Roper Group, which is related to the rifting between Proterozoic Australia and Laurentia (after 1.45 Ga) and the Musgrave Orogeny (after 1.2 Ga). The spatial variation indicates separate source areas and sediment pathways, probably influenced by evolving basin architecture. The Jamison sandstone and overlying Hayfield mudstone represent a marked change in provenance and were deposited after the Musgrave Orogeny, representing a newly-recognised siliciclastic basin that may have formed a shallow, long wavelength foreland basin to areas uplifted during the Musgrave Orogeny.

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