**Appendix 1 for**

Middle-late Mesoproterozoic tectonic geography of the North Australia Craton: U–Pb and Hf isotopes of detrital zircons in the Beetaloo Sub-basin, Northern Territory, Australia

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Sample description

1. U-Pb dating samples

Three sandstone samples were selected for U–Pb analysis and the sample information is presented in Table 1. Detrital Zircon U–Pb discordance was calculated by dividing the 206Pb/238U age by the 207Pb/206Pb age and multiplying by 100. The 207Pb/206Pb ages are used and results were plotted using Excel add-in Isoplot (Ludwig 2003).

Table 1 Summary of detrital zircon U–Pb samples

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Core drill** | **Coordinate** | **Sample** | **Depth (m)** | **Formation** | **concordant/total analyses** | **Lithology** |
| Elliott-1 | E: 133.7551°  S:17.4025° | EN-Ky4 | 1021.5 | Kyalla Fm | 92/127 | fine-grained sandstone with interlaminated siltstone/shale |
|  |  | EN-Mo8 | 1367.3 | Moroak Sst. | 59/113 | quartz-granule-  rich medium to coarse-grained sandstone |
| Jamison-1 | E: 133.7672°  S: 16.7749° | JN-Ky6 | 1587.0 | Kyalla Fm | 36/57 | fine-grained sandstone |

**Kyalla Formation (EN-Ky4)**

One hundred and sixteen zircons were analysed from EN-Ky4 and of these, ninety one are within 10% of concordance. These zircons range in Pb207/Pb206 age from 2991 Ma to 1517 Ma. A major peak is identified on the kernel density plot at 1727 Ma, with majority of the analyses sitting between 2073–1571 Ma. Minor peaks are seen at 1781 and 1622 Ma. The youngest near concordant grain within EN-Ky4 is 1517 ± 58 Ma.

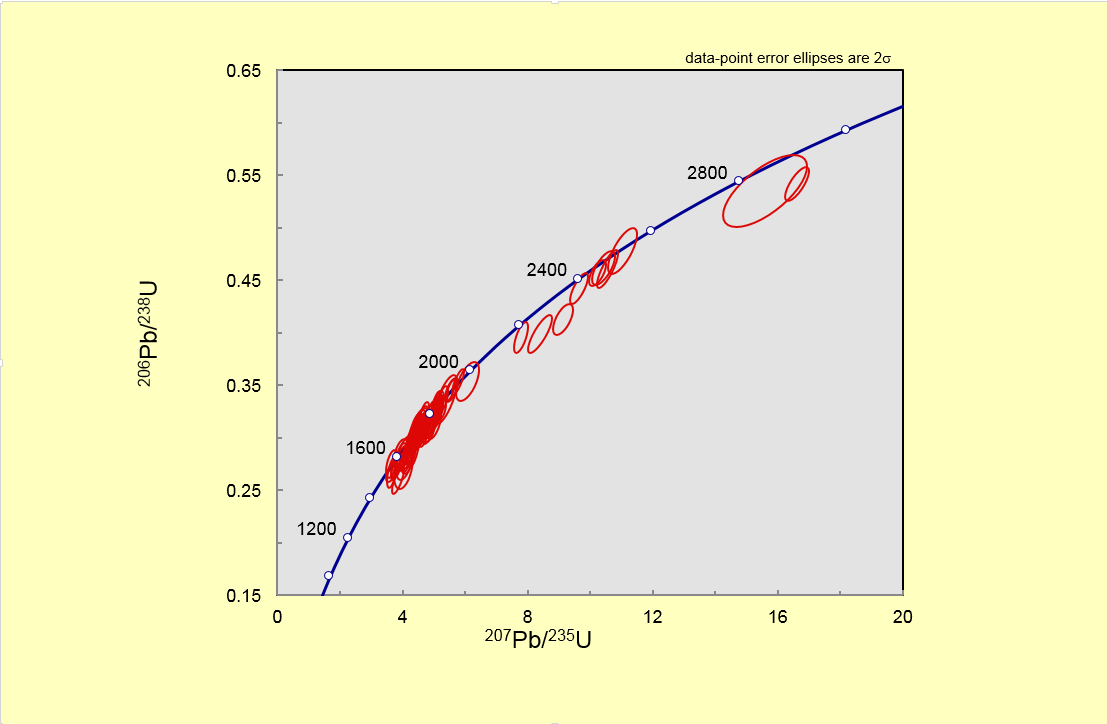


Fig 1 Detrital zircon U–Pb Wetherill concordia plot of sample EN-Ky4

**Moroak Sandstone (EN-Mo8)**

One hundred and thirteen zircons were analysed. Of these seventy seven are within 10% of concordance and have a range of Pb207/Pb206 ages between 3073–1502 Ma. The kernel density plot highlights one major peak at 1697 Ma, with majority of the data sitting between 1823–1502 Ma. A minor peak is seen at 1561 Ma, with one solitary grain at 3073 ± 26 Ma. The youngest analysis yielded a Pb207/Pb206 age of 1502 Ma ± 75 Ma.

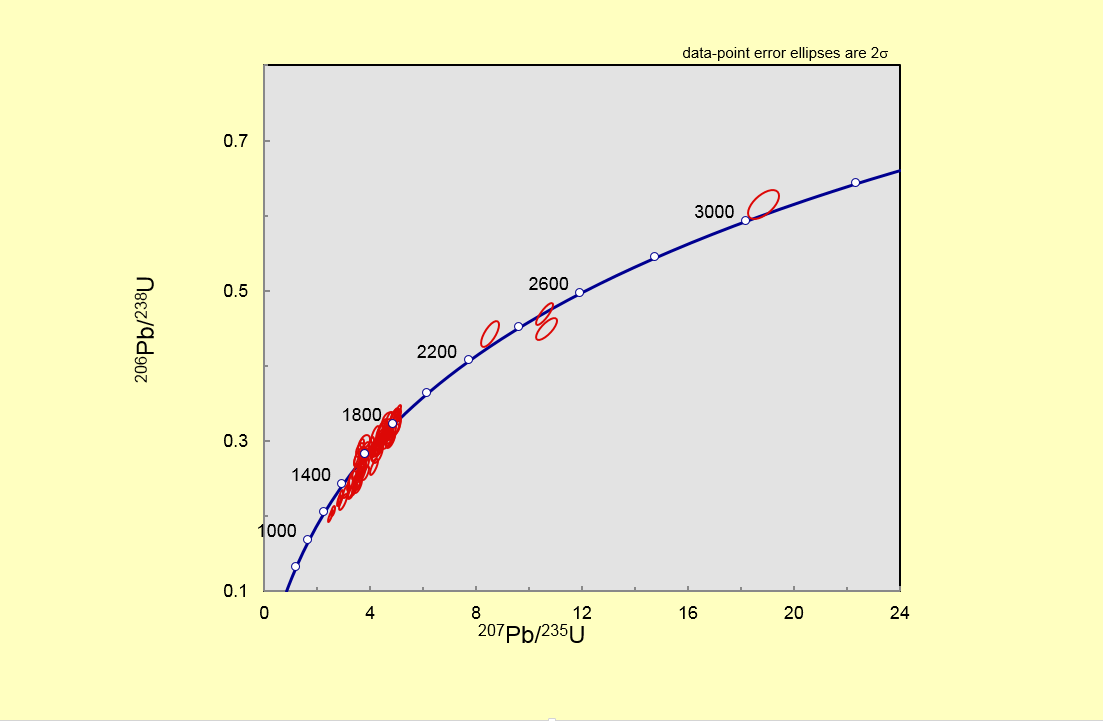


Fig 2 Detrital zircon U–Pb Wetherill concordia plot of sample EN-Mo8

**Kyalla Formation (JN-Ky6)**

Thirty six, less than 10% discordant analyses (n=57), yielded Pb207/Pb206 ages between 1883 and 1360 Ma. A majority of the data sit between 1794–1647 Ma, with a dominated peak and a minor peak highlighted in the kernel density estimates at 1723 Ma and 1795 Ma, respectively. The youngest grain analysed in this sample yielded a Pb207/Pb206 age of 1360 ± 47 Ma.

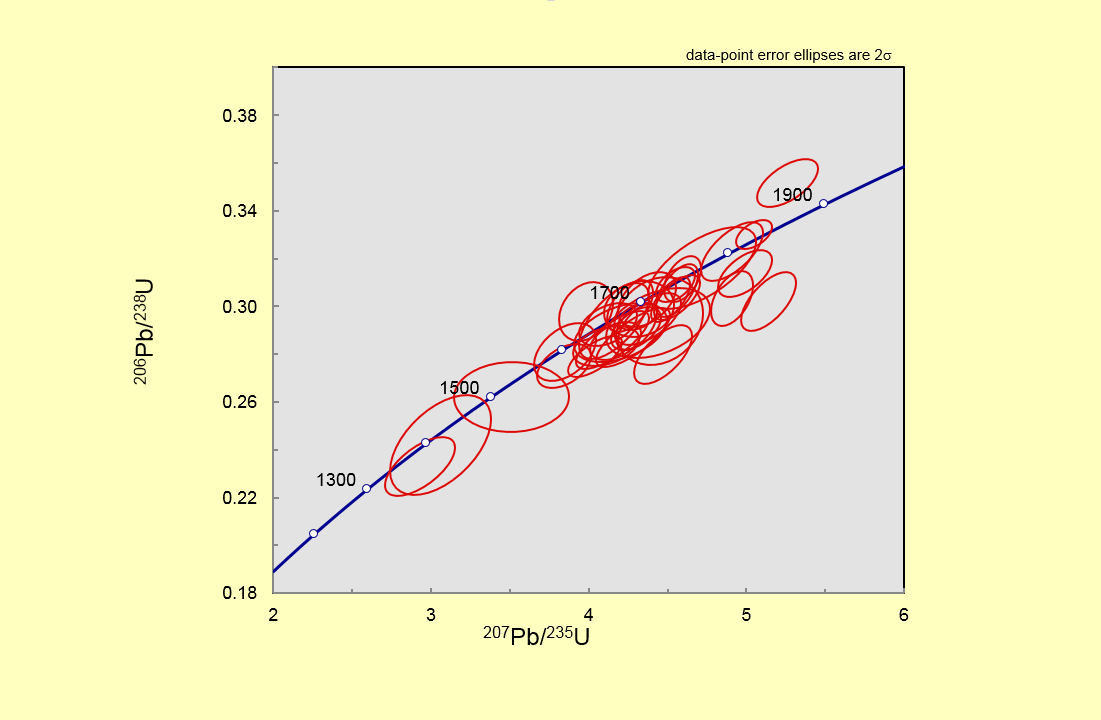


Fig 3 Detrital zircon U-Pb Wetherill concordia plot of sample JN-Ky6

1. Lu–Hf isotope sample

Detrital zircon hafnium data were collected from fourteen samples that previously published by Yang *et al.* (2018). Individual zircon initial 176Hf/177Hf value (176Hf/177Hfi) and epsilon hafnium (εHf(t)) was calculated and plotted according to the published age. Detailed sample information is presented in Table 2.

Table 2 Summary of detrital zircon Lu–Hf samples

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Core drill** | **Coordinate** | **Sample** | **Formation** | **Number of analyses** | **Rock type** |
| Elliott-1 | E: 133.7551°  S:17.4025° | E-LJ2 | lower Jamison sst. | 13 | coarse-grained sandstone |
|  |  | E-Ky7 | Kyalla Fm | 24 | medium-grained sandstone |
|  |  | E-Mo13 | Moroak Sst. | 15 | coarse-grained sandstone |
|  |  | E-Vel18 | Velkerri Fm. | 17 | fine-grained siltstone |
| Jamison-1 | E: 133.7672°  S: 16.7749° | J-UJ3 | upper Jamison sst. | 16 | coarse-grained sandstone |
|  |  | J-Ky8 | Kyalla Fm | 16 | fine to medium- grained sandstone |
|  |  | J-Mo13 | Moroak Sst. | 16 | coarse-grained sandstone |
| Walton-2 | E: 133.6388°  S: 15.9051° | W-UJ9 | upper Jamison sst. | 16 | coarse-grained sandstone |
|  |  | W-BC1 | Bessie Creek Sst. | 15 | coarse-grained sandstone |
| McManus-1 | E: 133.6242°  S: 15.919° | M-LJ3 | lower Jamison sst. | 11 | coarse-grained sandstone |
| Altree-2 | E: 133.786592°  S:15.923645° | A-UJ1 | upper Jamison sst. | 15 | coarse-grained sandstone |
|  |  | A-BC13 | Bessie Creek Sst. | 12 | coarse-grained sandstone |
| Sever-1 | E: 132.843963° S:15.24646° | S-BC1 | Bessie Creek Sst. | 19 | coarse-grained sandstone |
| Birdum Creek-1 | E: 133.1395°  S: 15.625° | BirC-Ky1 | Kyalla Fm | 16 | fine to medium- grained siltstone |

References

Ludwig, K.R. (2003). User's manual for Isoplot 3.00: a geochronological toolkit for Microsoft Excel (No. 4). Kenneth R. Ludwig.

Yang, B., Smith, T.M., Collins, A.S., Munson, T.J., Schoemaker, B., Nicholls, D., Cox, G., Farkas, J. & Glorie, S. (2018). Spatial and temporal detrital zircon U–Pb provenance of the hydrocarbon-bearing upper Roper Group, Beetaloo Sub-Basin, Northern Territory, Australia. *Precambrian Research*, **304**, 140-155.