# 245105: volcaniclastic sandstone, Kanowna Belle mine

## *(Panglo Formation, Kalgoorlie Terrane, Eastern Goldfields Superterrane, Yilgarn Craton)*

## Location and sampling

Kurnalpi (SH 51-10), Kanowna (3236)
MGA Zone 51, 362349E 6611735N

Sampled on 21 September 2020

This sample was collected from the 101.43 – 103.42 m depth interval of drillcore GDD534, drilled in 2003 by Placer Dome Asia Pacific Limited at their Golden Valley prospect (Cha, 2004). The drillhole is located on Mount Vetters Station, about 8.8 km east-northeast of Eight Mile Dam, 5.5 km west-northwest of Kanowna Dam, and 1.2 km southwest of the Kanowna Belle open pit.

## Geological context

The unit sampled is the Panglo Formation of the Kalgoorlie Terrane (Davis et al., 2010). The 2657–2640 Ma Panglo Formation consists of metamorphosed sandstone and conglomerate with minor shale, and is thought to be a late basin sequence equivalent to the c. 2656 Ma Kurrawang Formation (Hall et al., 2020). Both the Panglo and Kurrawang Formations unconformably overlie metamorphosed felsic volcaniclastic, siliciclastic and volcanic rocks of the 2692–2655 Ma Black Flag Group or older rocks (Hall et al., 2021). A metadacite collected about 3.4 km to the northeast yielded an igneous crystallization age of 2708 ± 7 Ma (GSWA 104958, Nelson, 1996). A porphyritic microgranite collected about 5.1 km to the east-northeast yielded an igneous crystallization age of 2688 ± 6 Ma (GSWA 245115, Wingate et al., 2021a). A metadacite collected about 7.0 km to the northeast yielded an igneous crystallization age of 2653 ± 9 Ma (GSWA 222662, Wingate et al., 2021b).

## Petrographic description

The sample is a medium- to coarse-grained, altered volcaniclastic sandstone (Fig. 1). Excluding alteration minerals, the sample consists of about 55–60% lithic grains, 30–35% feldspar, 7–8% quartz, <1% opaque minerals and trace chlorite-altered biotite. The amount of matrix is unclear due to phyllic alteration, although the aggregate appears to be closely-packed, suggesting the amount of matrix is low. The alteration consists mainly of pervasive fine sericitization of plagioclase and small patches of rhombic carbonate. Lithic grains are subangular to subrounded, up to 2 mm in size, and appear to be silicified. Most are composed entirely of microcrystalline material, although some contain plagioclase ± quartz grains, which suggests the clasts were derived from the groundmass of a felsic volcanic rock. Feldspar is angular, up to 1 mm in size, and essentially non-abraded. Despite pervasive sericite alteration, faint multiple twinning suggests the feldspar is entirely plagioclase (probably albitized). Quartz grains are transparent, angular, up to 1.5 mm in size, and exhibit weak undulose extinction. Small embayments indicate the quartz is volcanic-derived. Opaque minerals are mainly pyrite, which forms disseminated mostly cubic grains up to 0.3 mm across, and minor subhedral magnetite grains up to 0.1 mm in size. Subhedral ex-biotite laths up to 0.25 mm long are altered to chlorite but retain lamellar texture. The sandstone is moderately well sorted and appears to lack significant matrix, and is texturally submature to mature. The provenance is interpreted as felsic volcanic, and the sample is neither deformed nor obviously metamorphosed.

## Zircon morphology

Zircons isolated from this sample are colourless and mainly euhedral. The crystals are up to 250 μm long, and mostly elongate, with aspect ratios up to 4:1. In cathodoluminescence (CL) images, concentric zoning is ubiquitous, many crystals contain high-U, metamict zones, and a few appear to contain older cores. A CL image of representative zircons is shown in Figure 2.

## Analytical details

This sample was analysed on 4–5 June 2021, using SHRIMP-B. Ten analyses of the M257 standard were obtained during the session, of which eight analyses indicated an external spot-to-spot (reproducibility) uncertainty of 0.50% (1σ) and a $^{238}U/^{206}Pb^{*}$ calibration uncertainty of 0.18% (1σ). Calibration uncertainties are included in the errors of $^{238}U/^{206}Pb^{*}$ ratios and dates listed in Table 1. Common-Pb corrections were applied to all analyses using contemporaneous isotopic compositions determined according to the model of Stacey and Kramers (1975).

## Results

Nnineteen analyses were obtained from 18 zircons. Results are listed in Table 1, and shown in a concordia diagram (Fig. 3).

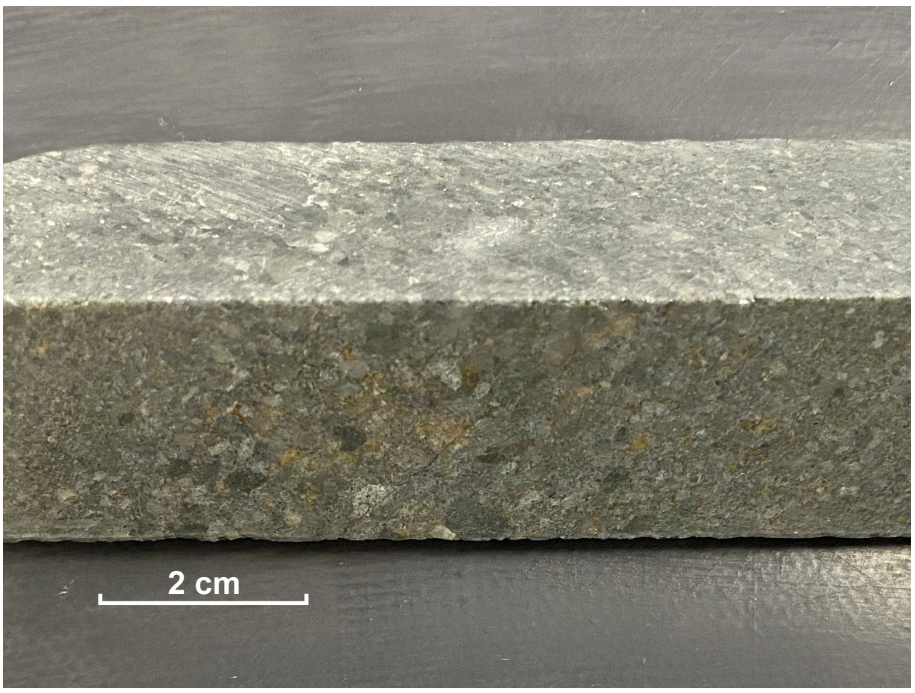


**Figure 1.** **Drillcore image (wet surface) of sample 245105: volcaniclastic sandstone, Kanowna Belle mine**

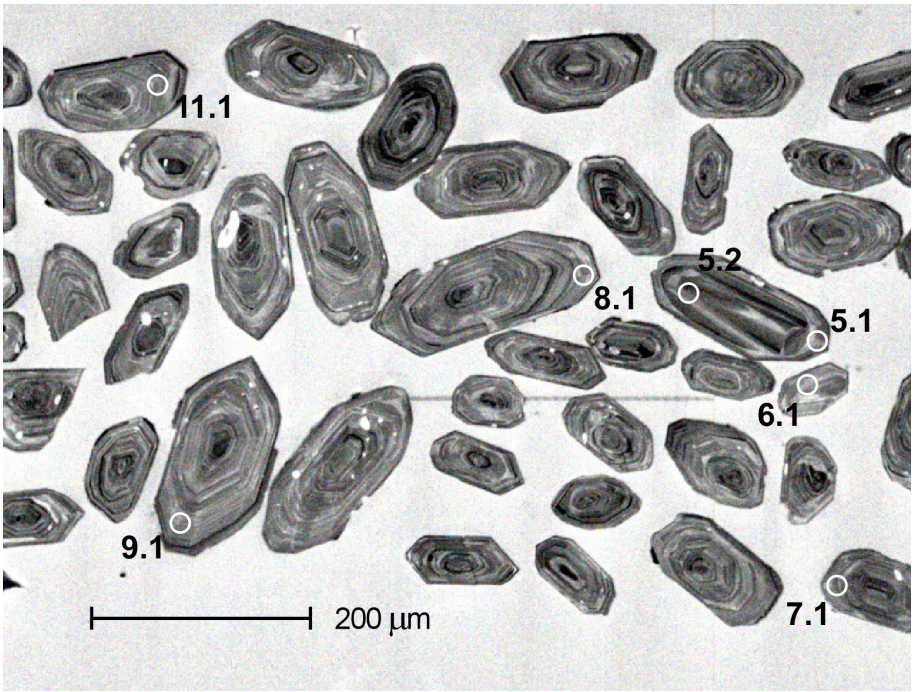


**Figure 2.** **Cathodoluminescence image of representative zircons from sample 245105: volcaniclastic sandstone, Kanowna Belle mine. Numbered circles indicate the approximate locations of analysis sites**

**Table 1. Ion microprobe analytical results for zircons from sample 245105: volcaniclastic sandstone, Kanowna Belle mine**

| Group ID | Spot no. | Grain. spot | $^{238}U$ (ppm) | $^{232}Th$ (ppm) | $\frac{^{232}Th}{^{238}U}$ | $f204$ (%) | $^{238}U/^{206}Pb$ ± 1σ | | $^{207}Pb/^{206}Pb$ ± 1σ | | $^{238}U/^{206}Pb^*$ ± 1σ | | $^{207}Pb^*/^{206}Pb^*$ ± 1σ | | $^{238}U/^{206}Pb^*$ date (Ma) ±1σ | | $^{207}Pb^*/^{206}Pb^*$ date (Ma) ±1σ | | Disc. (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | 16 | 15.1 | 94 | 69 | 0.74 | -0.028 | 1.991 | 0.020 | 0.17979 | 0.00099 | 1.991 | 0.020 | 0.18004 | 0.00100 | 2624 | 22 | 2653 | 9 | 1.1 |
| I | 12 | 11.1 | 82 | 64 | 0.78 | 0.048 | 2.006 | 0.032 | 0.18054 | 0.00105 | 2.007 | 0.032 | 0.18012 | 0.00108 | 2607 | 34 | 2654 | 10 | 1.8 |
| I | 17 | 16.1 | 91 | 57 | 0.63 | 0.073 | 2.070 | 0.021 | 0.18083 | 0.00101 | 2.071 | 0.021 | 0.18018 | 0.00105 | 2540 | 21 | 2655 | 10 | 4.3 |
| I | 7 | 6.1 | 80 | 48 | 0.60 | -0.051 | 2.020 | 0.022 | 0.18004 | 0.00109 | 2.019 | 0.022 | 0.18050 | 0.00113 | 2594 | 23 | 2658 | 10 | 2.4 |
| I | 8 | 7.1 | 101 | 62 | 0.61 | 0.203 | 2.018 | 0.020 | 0.18240 | 0.00098 | 2.022 | 0.020 | 0.18059 | 0.00109 | 2590 | 21 | 2658 | 10 | 2.6 |
| I | 11 | 10.1 | 68 | 42 | 0.62 | 0.357 | 2.046 | 0.023 | 0.18378 | 0.00120 | 2.054 | 0.024 | 0.18060 | 0.00142 | 2558 | 24 | 2658 | 13 | 3.8 |
| I | 18 | 17.1 | 114 | 87 | 0.76 | 0.000 | 2.015 | 0.019 | 0.18061 | 0.00089 | 2.015 | 0.019 | 0.18061 | 0.00089 | 2598 | 20 | 2658 | 8 | 2.3 |
| I | 6 | 5.2 | 113 | 80 | 0.71 | 0.048 | 2.035 | 0.020 | 0.18107 | 0.00093 | 2.036 | 0.020 | 0.18064 | 0.00095 | 2576 | 21 | 2659 | 9 | 3.1 |
| I | 1 | 1.1 | 102 | 79 | 0.78 | -0.045 | 2.007 | 0.040 | 0.18051 | 0.00105 | 2.006 | 0.040 | 0.18091 | 0.00107 | 2608 | 43 | 2661 | 10 | 2.0 |
| I | 9 | 8.1 | 106 | 77 | 0.72 | 0.041 | 1.961 | 0.020 | 0.18135 | 0.00098 | 1.962 | 0.020 | 0.18099 | 0.00100 | 2656 | 22 | 2662 | 9 | 0.2 |
| I | 15 | 14.1 | 108 | 70 | 0.64 | 0.077 | 2.044 | 0.020 | 0.18182 | 0.00095 | 2.046 | 0.020 | 0.18113 | 0.00099 | 2566 | 21 | 2663 | 9 | 3.7 |
| I | 19 | 18.1 | 85 | 62 | 0.73 | 0.000 | 2.020 | 0.021 | 0.18145 | 0.00104 | 2.020 | 0.021 | 0.18145 | 0.00104 | 2593 | 23 | 2666 | 10 | 2.8 |
| I | 13 | 12.1 | 86 | 41 | 0.48 | -0.034 | 1.995 | 0.022 | 0.18120 | 0.00109 | 1.995 | 0.022 | 0.18150 | 0.00111 | 2620 | 23 | 2667 | 10 | 1.8 |
| I | 4 | 4.1 | 110 | 98 | 0.89 | 0.035 | 2.000 | 0.019 | 0.18208 | 0.00091 | 2.001 | 0.019 | 0.18177 | 0.00093 | 2613 | 21 | 2669 | 8 | 2.1 |
| I | 3 | 3.1 | 88 | 69 | 0.78 | -0.089 | 1.970 | 0.022 | 0.18099 | 0.00114 | 1.968 | 0.022 | 0.18179 | 0.00119 | 2648 | 25 | 2669 | 11 | 0.8 |
| I | 2 | 2.1 | 80 | 48 | 0.59 | 0.000 | 1.905 | 0.023 | 0.18184 | 0.00123 | 1.905 | 0.023 | 0.18184 | 0.00123 | 2720 | 27 | 2670 | 11 | -1.9 |
| I | 10 | 9.1 | 112 | 78 | 0.69 | 0.261 | 2.004 | 0.019 | 0.18439 | 0.00093 | 2.009 | 0.019 | 0.18206 | 0.00105 | 2604 | 21 | 2672 | 10 | 2.5 |
| I | 5 | 5.1 | 98 | 43 | 0.44 | 0.071 | 2.080 | 0.021 | 0.18335 | 0.00101 | 2.082 | 0.021 | 0.18272 | 0.00105 | 2529 | 21 | 2678 | 9 | 5.6 |
| I | 14 | 13.1 | 113 | 88 | 0.78 | 0.048 | 2.020 | 0.019 | 0.18316 | 0.00093 | 2.021 | 0.019 | 0.18273 | 0.00095 | 2592 | 21 | 2678 | 9 | 3.2 |

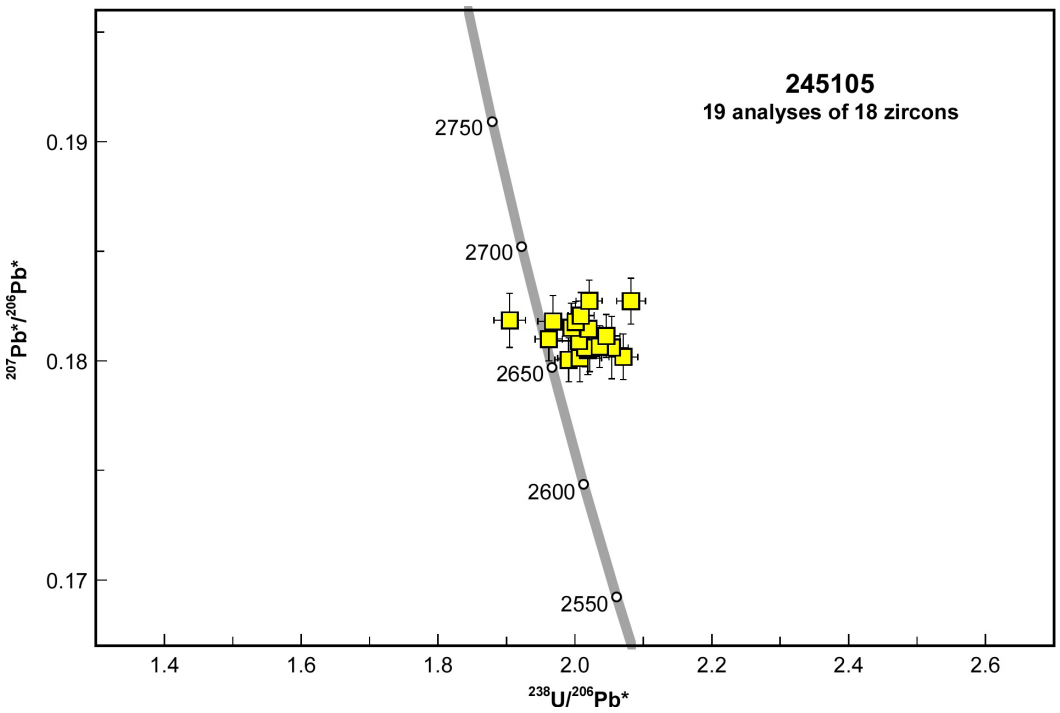


**Figure 3. U–Pb analytical data for sample 245105: volcaniclastic sandstone, Kanowna Belle mine. Yellow squares indicate Group I (magmatic zircons)**

## Interpretation

The analyses are concordant to moderately discordant (Fig. 3), and form a single group, based on their $^{207}Pb^*/^{206}Pb^*$ ratios.

Group I comprises 19 analyses (Table 1), which yield a weighted mean $^{207}Pb^*/^{206}Pb^*$ date of 2664 ± 4 Ma (MSWD = 0.64).

The date of 2664 ± 4 Ma for the 19 analyses in Group I is interpreted as the igneous crystallization age of the volcanic rock.

## References

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## Recommended reference for this publication

Wingate, MTD, Fielding, IOH, Lu, Y and Smithies, RH 2021, 245105: volcaniclastic sandstone, Kanowna Belle mine; Geochronology Record 1835: Geological Survey of Western Australia, 4p.

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