# Fluid Composition in First-order Fault Zones

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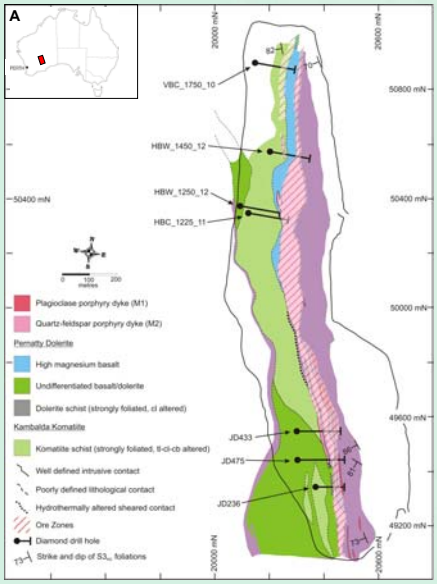


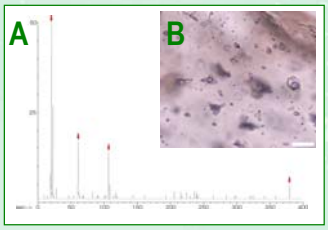

Figure 1. Map of Australia indicating study area location in red. B. Interpreted solid geology map of the New Celebration pit, illustrating the distribution of intrusive rocks, sample locations and ore zones (after Nichols, 2003).

Figure 2. (right) A. Gold spectra illustrating individual fluid inclusions, indicated by red arrow. B. Typical aqueous-carbonic inclusions analyzed in this study.

Table 1. (below) Summary of LA-ICP-MS analyses of fluid inclusions from the New Celebration gold deposit. Analyses are reported in ppm as the average value ± standard deviation.

## Overview

The Boulder-Lefroy Fault Zone (BLFZ) is an interpreted first-order trans-crustal fault zone (Swager, 1989) located in the Eastern Goldfields Province of the Yilgarn Craton, Western Australia. The western segment of the BLFZ hosts the New Celebration gold deposits (Figure 1), which yielded approximately 20,000,000t @ 2.40g/t Au for ~ 1,500,000 oz Au, and is spatially correlated with the world-class Golden Mile and St Ives gold camps. Nichols (2003) identified two gold mineralizing events at New Celebration; an Early gold-telluride event, which is hosted in plagioclase porphyries and mylonites, and a Late gold-only event, which is hosted within and on the contacts of quartz-feldspar porphyries.
Selected fluid inclusions representing the different fluid types from both Early and Late gold mineralizing events, as well as primary fluid inclusions from quartz-feldspar (M2) porphyries, were analyzed by LA-ICP-MS at the University of Leeds. This poster presents preliminary results of these analyses. For a detailed description of the analytical process refer to Allan et al. (2005).




## Results

Table 1 presents the results of LA-ICP-MS analyses on gold-related aqueous-carbonic inclusions, post-mineralization low-salinity and high-salinity aqueous inclusions, and primary (magmatic?) aqueous-carbonic inclusions from quartz phenocrysts in quartz-feldspar porphyry. The most significant result of this study is that gold (up to 51ppm), and other metals, are recorded in low-salinity, aqueous-carbonic (XCO2 0.05-0.75, density 0.60-0.97 g/cm3) fluid inclusions (Figure 2) associated with both gold mineralizing events, as well as in primary inclusions in the quartz phenocrysts. In general, the metal content of Late gold-related fluid inclusions is higher than those associated with Early gold mineralization, and display elevated Mg, K, Cu, Zn, As, Sr, Ba, Pb, Fe, W, Sb and Bi levels. Low salinity post-gold aqueous inclusions display elevated K, Zn, As, Sr, Ag and Pb contents relative to Early gold mineralization, whereas high-salinity post-gold aqueous inclusions contain more K, Cu, Ag, Ba, Ca, Mn and Sn than all other inclusion types, but less Zn, As and Fe. Fluid inclusions within quartz phenocrysts contain elevated Mn, Fe and Mo relative to all gold-related inclusions. Mg, Cu, Zn, As and Sr levels are lower than in gold-related inclusions; Ba, Pb and Bi levels are higher than Early gold-related inclusions but lower than Late gold-related inclusions. K/Ca ratios in fluids from Early gold-related inclusions is <1 whereas in Late gold-related inclusions, post-gold inclusions and in phenocryst inclusions it is >1.

| | Mineralisation Style | Timing | Inclusion Type | Petrographic Description | Salinity wt% NaCl equiv | Mg | K | Cu | Zn | As | Sr | Ag | Ba | Pb | Ca | Mn | Fe | Mo | Sn | Cs | W | Th | U | Sb | Au | Bi |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gold Related | Porphyry | Primary | Aq-cb | primary inclusions in gold related quartz | 4.0±1.5 | 1147±660 | 1581±808 | 163±105 | 75±50 | 43±29 | 5±3 | 3±2 | 18±14 | 3±1 | 2812±1564 | 28±11 | 230±133 | 6±4 | 20±11 | 1±1 | 5±4 | 1 ± 1 | 4 ± 2 | 20±13 | 4±9 | 7±5 |
| | Contact | Primary | Aq-cb | primary inclusions in gold related quartz | 4.51±1.1 | 3704±519 | 3638±1745 | 66±53 | 106±87 | 118±149 | 56±57 | 1 | 55±44 | 30±13 | 574±384 | 39±28 | 584±384 | 6±5 | 20±14 | 2±2 | 309±197 | 3±2 | 3±2 | 31±27 | 5±8 | 30±29 |
| | Fracture | Primary | Aq-cb | primary inclusions in gold related quartz | 4.93±1.1 | 2046±2436 | 5703±2695 | 224±133 | 179±149 | 202±156 | 11±6 | 7±6 | 44±36 | 137±88 | 1314±961 | 34±50 | 463±384 | 7±8 | 30±14 | 2±1 | 4±3 | 3±2 | 1±1 | 66±82 | 5±7 | 72±68 |
| Post Gold | Fracture | Pseudo-secondary | Aq | pseudosecondary trails | 5.9±3.7 | 1091±662 | 7098±2610 | 152±75 | 197±122 | 260±187 | 54±33 | 13±3 | 31±14 | 106±78 | | | | | | | | | | | | |
| | Contact | Late Secondary | Aq | secondary trails | 21.0±1.9 | 2549±1655 | 15127±13867 | 363±390 | 9 | 30±21 | 31±26 | 419±406 | 165±138 | | | | | | | | | | | | | |
| | Fracture | Late Secondary | Aq | secondary trails | 20.6±0.8 | 420±147 | 30142±9464 | 169±74 | 49±37 | | 5±2 | 86±44 | 14±7 | 19±10 | 5202±1299 | 65±51 | 162±57 | | 47±33 | 1±1 | 4±2 | | 6±2 | 8±3 | 2±2 | 10±15 |
| Magmatic | M2 Porphyry | Primary | Aq-cb | primary inclusions in quartz phenocrysts | 6.65±3.0 | 247±150 | 8711±2433 | 33±14 | 39±27 | 35±18 | 3±1 | 4±3 | 14±20 | 10±7 | 2049±1652 | 99±124 | 968±770 | 6±5 | 36±23 | 2±2 | 25±36 | 4±4 | 3±2 | 55±29 | 2±2 | 13±10 |

## Conclusions

•This study presents the first quantitative analyses of gold and other metals in Archean orogenic lode gold fluids
•Low salinity, aqueous-carbonic fluid inclusions, typical of orogenic lode gold deposits worldwide, contain elevated metal concentrations, including up to 51ppm gold.
•K/Ca ratio is high in Late gold-related fluids and post-gold fluids, which potentially indicates a granitic (?) fluid source, or fluids which have equilibrated with granite.
•Early gold-related fluids have a low K/Ca ratio, suggesting a non-magmatic fluid source.
•Cu, Zn, As, Sr, Pb, Mo, Sn, W, Sb and Bi occur in similar concentrations to melt inclusions from gold-related granites at Timbarra (Intrusion related gold system); gold concentrations at New Celebration are higher than at Timbarra.
•K, As, Ag and W occur in similar concentrations to fluid inclusions from Bajo de la Alumbrera (Porphyry Copper-Au. Gold concentrations are higher at New Celebration than at Bajo de la Alumbrera , but all other metals occur in lower concentrations.
•Metal signature of Late gold related inclusions and inclusions in quartz phenocrysts are very similar, suggesting a potential magmatic fluid contribution to Late gold mineralization and post-gold fluids.
•The M2 porphyry and its interpreted underlying magma chamber is potentially a source of metals and fluids, as well as a host of Late stage mineralization.

## References

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