The diverse origins of breccias within the Gawler Range Volcanics:

Lithological characteristics, formation processes and implications for mineral prospectivity

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With special thanks to Ken Cross
Gawler Range Volcanics
Breccias & coarse ‘fragmentites’

- Minor lithology but important for unravelling magmato-tectonic evolution of the GRV
- Potential hydrothermal fluid pathways and mineral deposit hosts
Gawler Range Volcanics

- Occupy central part of Gawler Craton
- Overlie discordantly Archean to Paleoproterozoic rocks
- Coeval with Hiltaba Suite granites
- c. 1590 Ma tectonothermal event
- Gawler SLIP
Gawler Range Volcanics

- Magmatism associated with major mineralisation event
- SA’s IOCG belt at eastern margin
- Operating mines at Olympic Dam and Prominent Hill
- Au and Ag-Pb-Zn deposits at western and southern margin
- Breccias play an important role in a number of these deposits
Gawler Range Volcanics

- GSSA undertook major collaborative drilling program (MSDP) along southern GRV margin
- Characterisation and understanding of mineral systems associated with the GRV-HS event
- Accompanied by mapping project
Study Area: Southern GRV margin
GRV architecture & breccia occurrences

- Gently N-dipping succession of mainly coherent felsic volcanics (subaerially erupted lavas)
- Southern GRV margin strongly faulted (syn-magmatic)
- Hiltaba Suite granite intrusions (early/late; sub/intra GRV)
GRV architecture & breccia occurrences

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• Stratiform breccias: autoclastic - pyroclastic - sedimentary - (tectonic)
• Steeply oriented breccias: tectonic – dyke/vent/pipe (“intrusive”)
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Autoclastic & volcanogenic sedimentary

Hiltaba area

Mount Friday Formation

Yardea Dacite
(Pondanna Dacite Mb.)

Eucarro Rhyolite

Paney Rhyolite

Mt Friday Fm.

**fluvially reworked volcaniclastic deposits; hydrothermal alteration**

fractured flow-banded lava flow top

autobreccia carapace at top of lava flow
Autoclastic & volcanogenic sedimentary rocks

Hiltaba area

Drillhole MSDP07

~85 m volcanogenic sedimentary rocks

Matrix-supported breccias
Conglomerates and mudstones
Mudstone intraclasts
Soft-sediment deformation-mobilisation

Water-lain debris/mud & hyperconcentrated flows, minor mud suspension settling
Autoclastic & volcanogenic sedimentary

Hiltaba area

Drillhole MSDP05

~95 m extrusive-coherent & autoclastic-peperitic rhyolite,
minor volcanogenic-sedimentary rocks

autobreccia

Eucarro Rhyolite

clastic dykes in fractured rhyolite

sedimentary breccias

laminated mudstones
Autoclastic & volcanogenic sedimentary

Geochemical anomalies due to hydrothermal fluid flow
Autoclastic & volcanogenic sedimentary

Hiltaba area

Drillhole MSDP05

~95 m autoclastic-peperitic and coherent rhyolite, minor volcanogenic-sedimentary

Yardea Dacite (Pondanna Dacite Mb.)

bubble wall glass shards

pyroclastic components $\rightarrow$ explosive volcanism in proximity

pumice fragments
Pyroclastic flow deposits

Mount Double Ignimbrite

~40 m of flow-banded, densely welded rheoignimbrite, partly rich in rhyolitic lithic and pumice clasts, top with alternating crystal-rich/poor ash tuffs

Proximal pyroclastic deposits - dense welding – no hydrothermal fluid flow
• Stratiform breccias: autoclastic - pyroclastic - sedimentary - (tectonic)
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Pyroclastic, vent-pipe & ‘intrusive’ breccias

Menninnie Dam Ignimbrite & Hydroexplosive Volcanic Centre

Rhyolite intruded steep fracture zone, groundwater interaction – diatreme formation

Sub-paleolandsurface network of polymict breccias and intrusive rhyolite: feeder zone tectonic – peperitic – intrusive breccias & near-surface volcanic vent breccias

Phreatic-phreatomagmatic explosions deposited pyroclastic breccias onto paleo-landsurface proximal to volcanic vent

Blanketed by Menninnie Dam Ignimbrite sheet

Parts of breccias show hydrothermal Pb-Zn-Ag mineralisation

Menninnie Dam Ignimbrite
extrusive rhyolite
polymictic to rhyolite/pumice breccias
1590 Ma paleo-landsurfe
fiamme-bearing vent breccias
tectonic-epistemic intrusive breccias

‘Intrusive’ breccias (vent-pipe?)

Paney area

Drillhole MSDP08 - Black Eagle Rock

Massive to bedded volcaniclastics & intrusive rhyolite, intersected ~170 m below GRV paleo-landsurface

Massive to bedded volcaniclastics & intrusive rhyolite, intersected ~170 m below GRV paleo-landsurface

bedded volcaniclastics

disseminated pyrite
GRV architecture & breccia occurrences

- Stratiform breccias: autoclastic - pyroclastic - sedimentary - (tectonic)
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Tectonic breccias

Paney: Black Eagle Rock Fault Zone
Tectonic breccias

Paney: Black Eagle Rock Fault Zone
Tectonic breccias

Paney area: Black Eagle Rock Fault Zone: MSDP08 & 09

massive monomict dacite breccias; range from crackle-mosaic breccias to matrix-supported chaotic breccias and clast-poor cataclasites

sericite – chlorite – epidote - calcite alteration
Tectonic - hydrothermal breccias

Mount Ive area: The other “Olympic Dam”?
Tectonic - hydrothermal breccias

Mount Ive area: The other “Olympic Dam”? Hematite breccias
Summary

- The shown breccias document autoclastic, pyroclastic, sedimentary and tectonic fragmentation and transportation processes in the formation of the GRV.

- The breccias facilitated horizontal and vertical hydrothermal fluid flow as evidenced in the alterations.

- Dense welding of pyroclastic deposits seems to inhibit significant fluid flow.
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