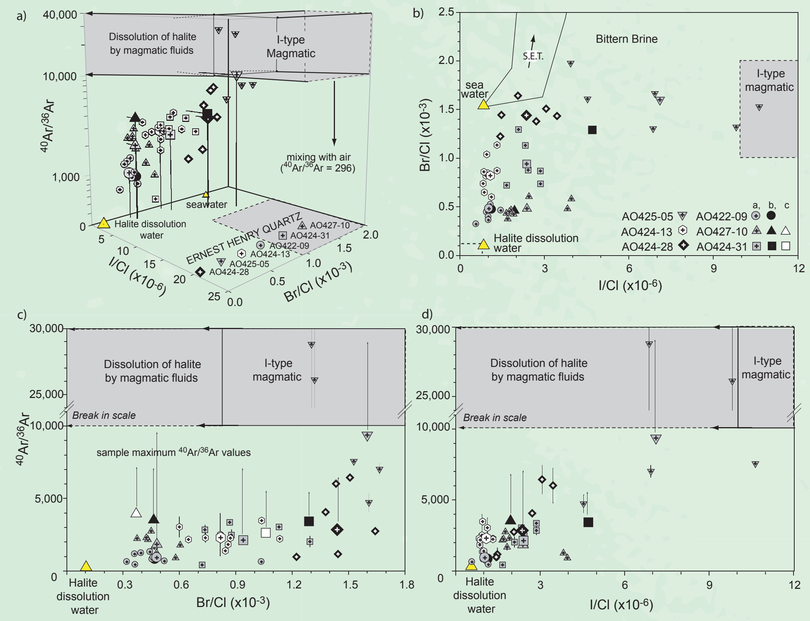
Noble gas and halogen evidence for rare magmatic fluid in crustally dominated IOCG.

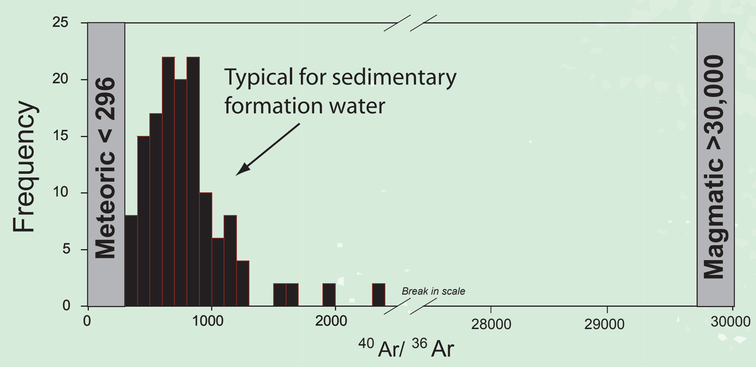
1) Ernest Henry - Convective circulation of magmatic and crustal fluids



$^{40}Ar/^{36}Ar$, Br/Cl and I/Cl plots exhibit a complex distribution of data. Two fluid end-members are defined. 1) A magmatic fluid with $^{40}Ar/^{36}Ar$ ~ 29,000 and mantle like Br/Cl and I/Cl, and 2) A halite dissolution fluid with low Br/Cl, I/Cl and $^{40}Ar/^{36}Ar$ of <2000. Other samples have high maximum $^{40}Ar/^{36}Ar$ values but low Br/Cl values that cannot be explained by mixing of two fluid end-members, but require either multiple fluids or multiple fractionation processes.

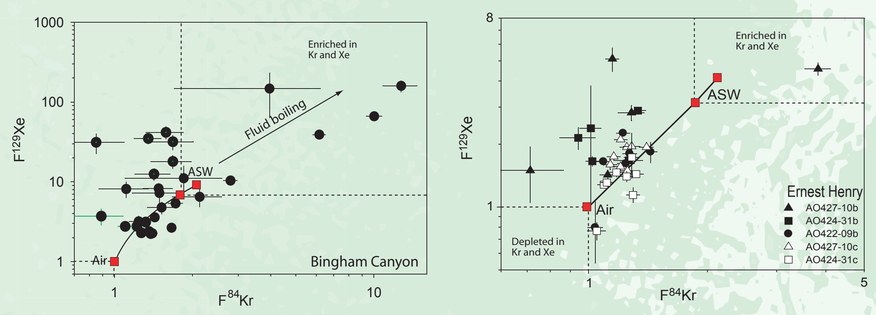
The simplest explanation for the data is convective circulation of a magmatic fluid derived from A-type magmas sourced from crustal rocks with a mantle source at 2.2-2.6 Ga and sedimentary formation waters sourced from the upper crust with variable dissolution of halite by both fluid end-members.

2) Magmatic fluid absence - Osborne



The $^{40}Ar/^{36}Ar$ values determined for Osborne are with one exception <2,000, and mostly <1,000, similar to values determined in MVT ore deposits formed from crustal sedimenatry formation waters.

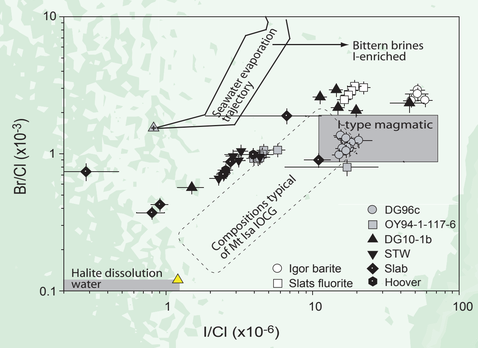
3) Definitive evidence for crustal fluids



The noble gas elemental ratios of Kr/Ar and Xe/Ar are unfractionated in IOCG in the range expected for air and Air Saturated Water (ASW). This indicates that vigorous phase separation has not occurred. In contrast Porphyry Copper Systems such as Bingham have fractionated F-values of >10-100 indicating that vigorous fluid-boiling has occurred. As a result the concentration of ^{36}Ar is depleted in Porphyry Copper systems but not IOCG. The low $^{40}Ar/^{36}Ar$ values determined in IOCG fluids cannot be attributed to overprinting by minor surface or brine components. Instead the data distribution indicates that magmatic fluids and sedimentary formation waters were of equal importance at Ernest Henry and that crustal fluids dominated at Osborne.

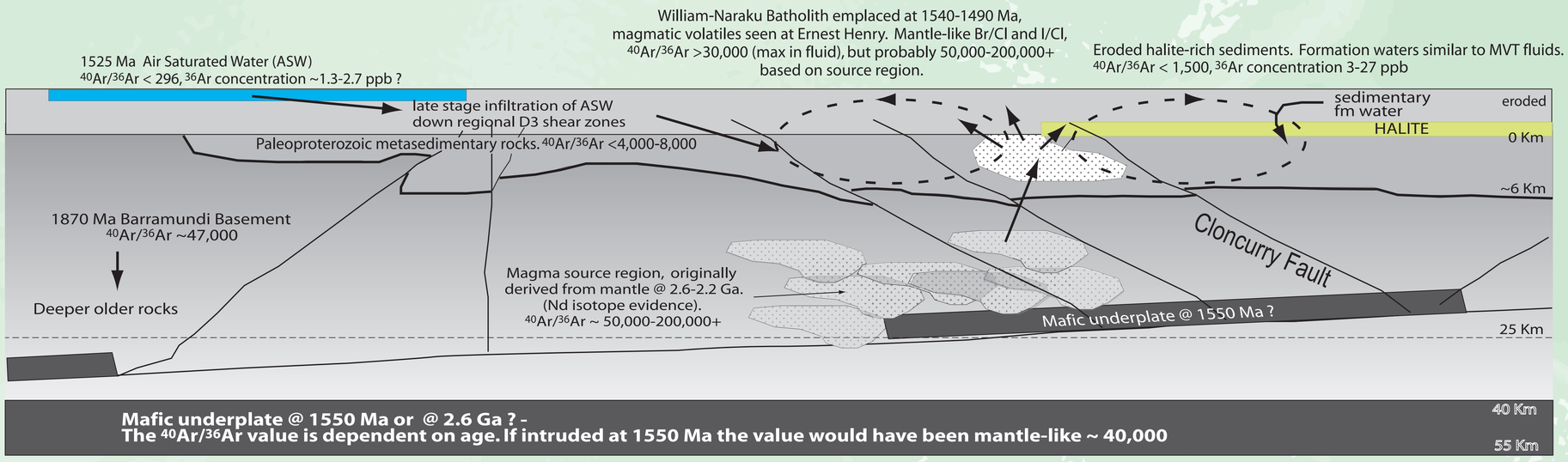
4) The Wernecke analogue

Wernecke IOCG have been studied as an analogue to Mt Isa. These prospects are of special interest because they are not associated with granitic intrusions. Br/Cl and I/Cl exhibit a similar data distribution at Wernecke to the Mt Isa IOCG. This distribution is explained by crustal bittern brines dissolving halite.



5) Genetic model for Isan IOCG

The $^{40}Ar/^{36}Ar$ composition of the different lithological reservoirs can be estimated using the K-Ar decay equation, mean ^{36}Ar concentrations and K-concentrations plus lithological ages characteristic of Isan rock units. These model values are supplemented with published data from the MORB mantle, MVT ore deposits and PCD ore deposits to produce the schematic diagram below. The majority of deposits studied (Eloise, Osborne, Starra, and the Wernecke prospects) are dominated by crustal fluids but the magmatic fluid present at Ernest Henry suggests the granitic intrusion may drive convective circulation in the Isan deposits.



Schematic East-West cross section based on the siesmic transect of the Eastern Foldbelt, Mt Isa. Possible noble gas reservoirs are indicated.

predictive mineral discovery

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