



**Australian Government**  

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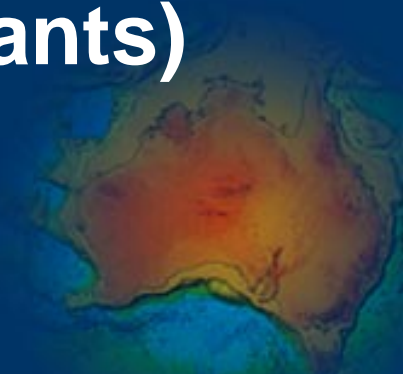
**Geoscience Australia**

# **New Insights into Intrusion-related Gold-Copper Systems in the Tasmanides**

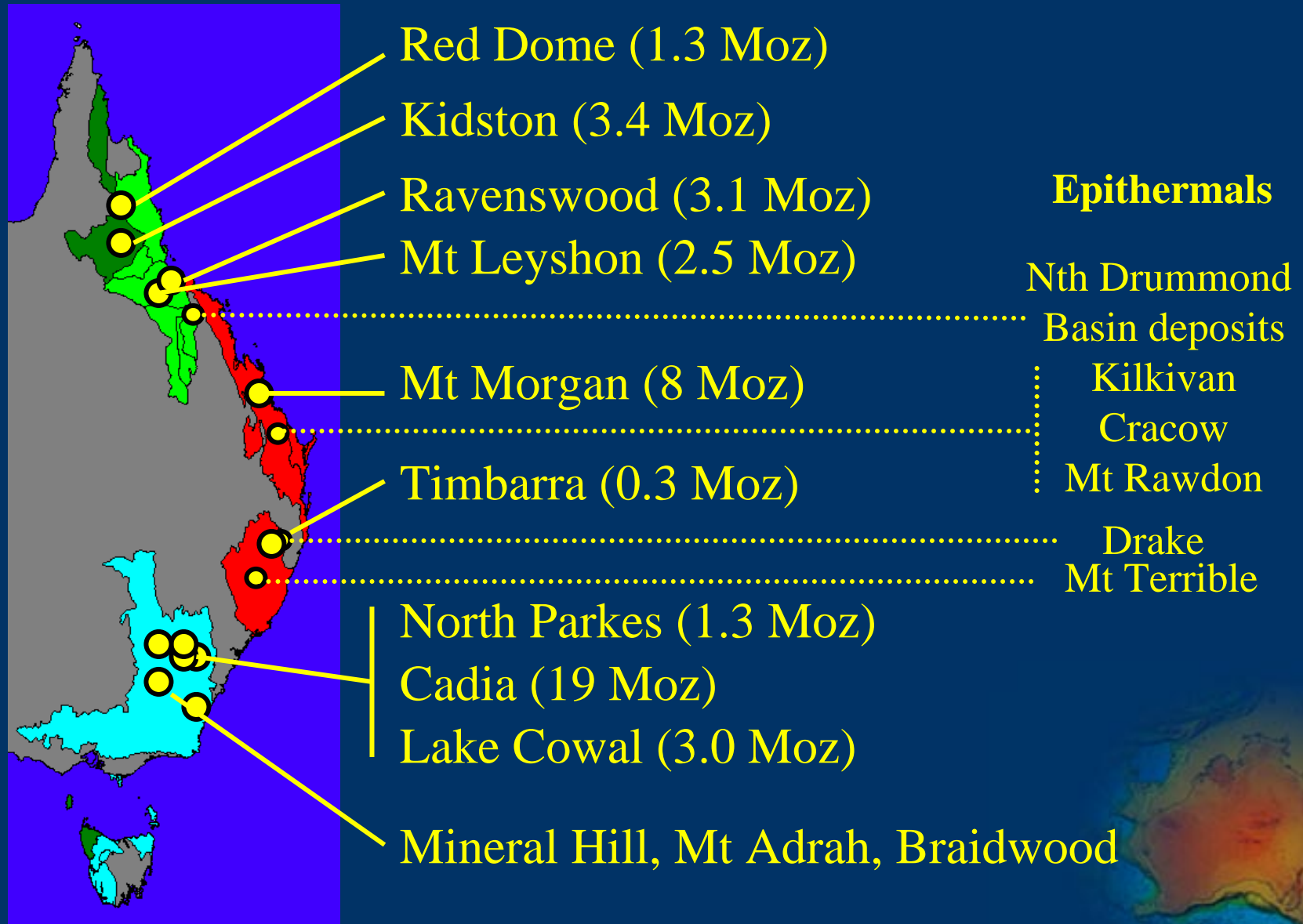
**Dave Champion (GA) &  
Phil Blevin (PetroChem Consultants)**

**Mining 2005**

**Brisbane, 26<sup>th</sup> October 2005**

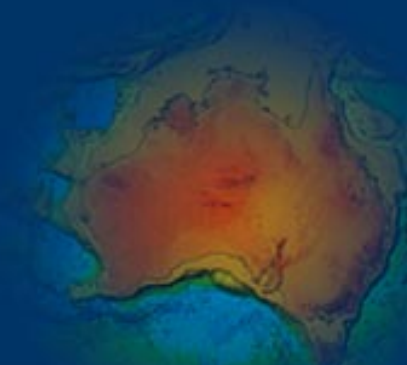


# Some Au-rich intrusion associated systems of eastern Australia



# Outline

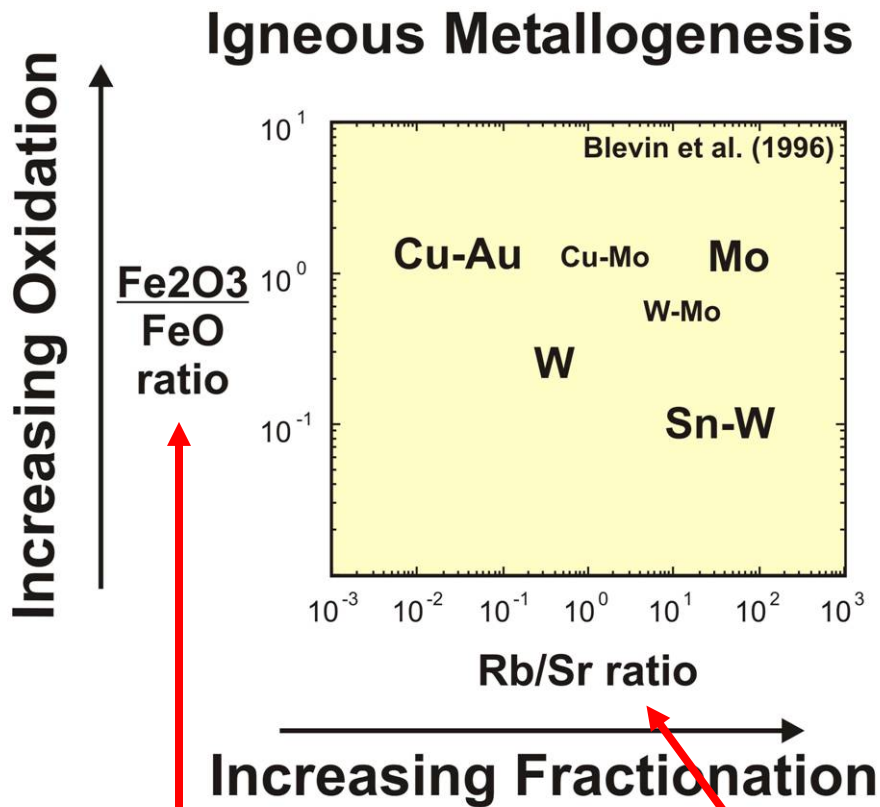
- **Review of igneous metallogeny - commodity type & intrusion parameters**
- **Intrusion-related Au in E Australia**
- **GA project: Igneous metallogenesis in eastern Australia**



# Igneous Metallogenesis

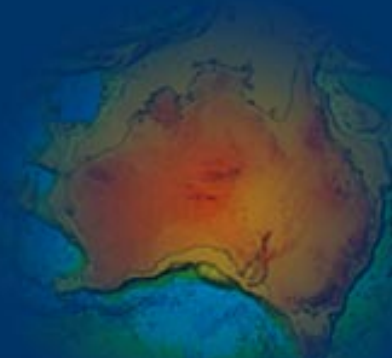
**Blevin et al. (1996)** showed a strong relationship between commodity types & intrusion parameters:

- oxidation state, and
- compositional evolution



Measure of  
Oxidation

Measure of  
compositional evolution



# Igneous Metallogenes

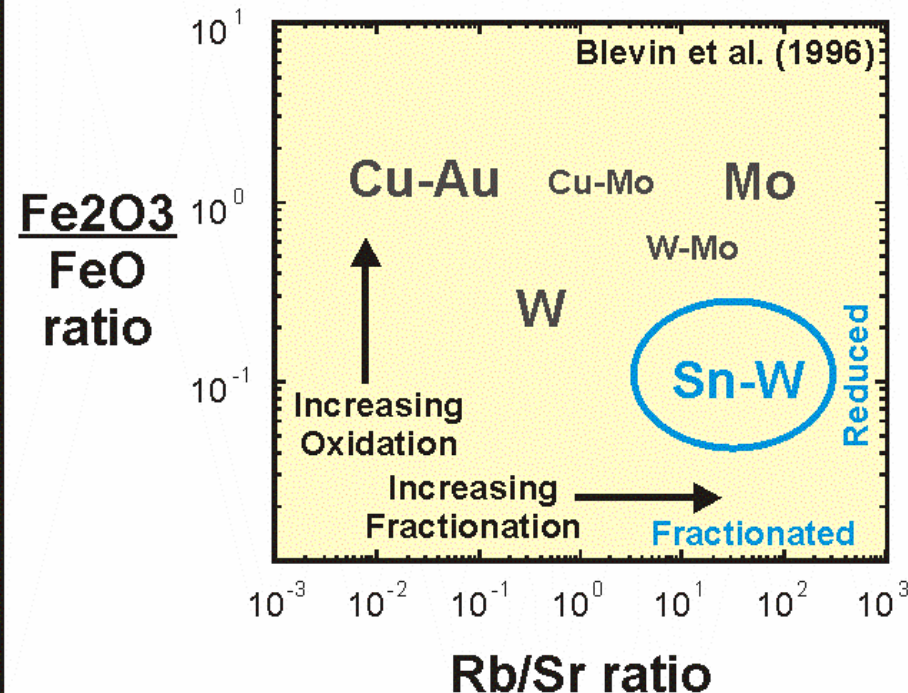
Simple but powerful  
relationship

Can be used predictively

e.g., Sn related to  
reduced, strongly  
fractionated **granites**

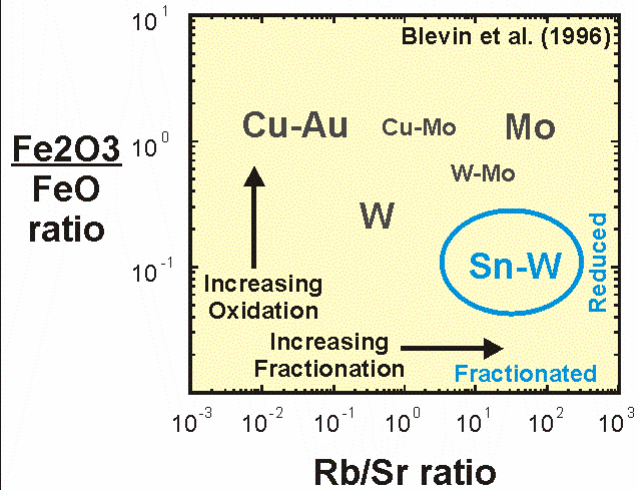
**Why?** Sn<sup>4+</sup> substitutes into ilmenite, biotite, titanite. Sn<sup>2+</sup> is incompatible in magmatic minerals, thus:  
**buildup of Sn occurs in reduced evolved magmas.**

## Igneous Metallogenes



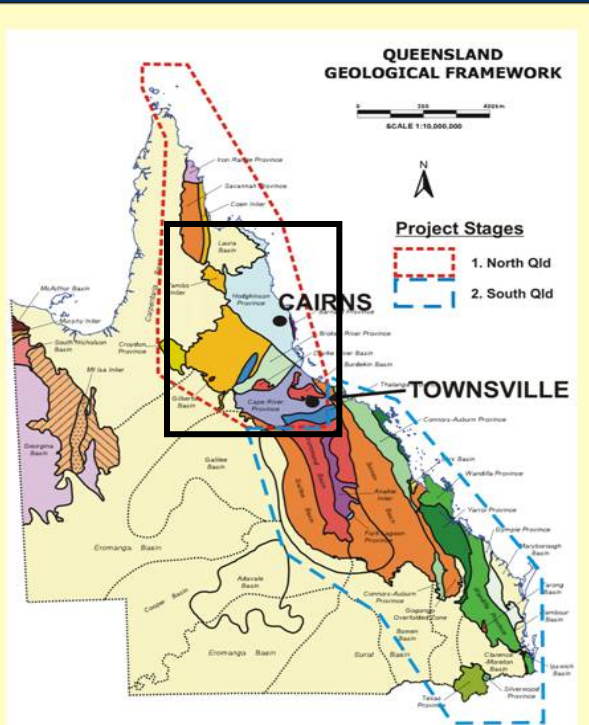
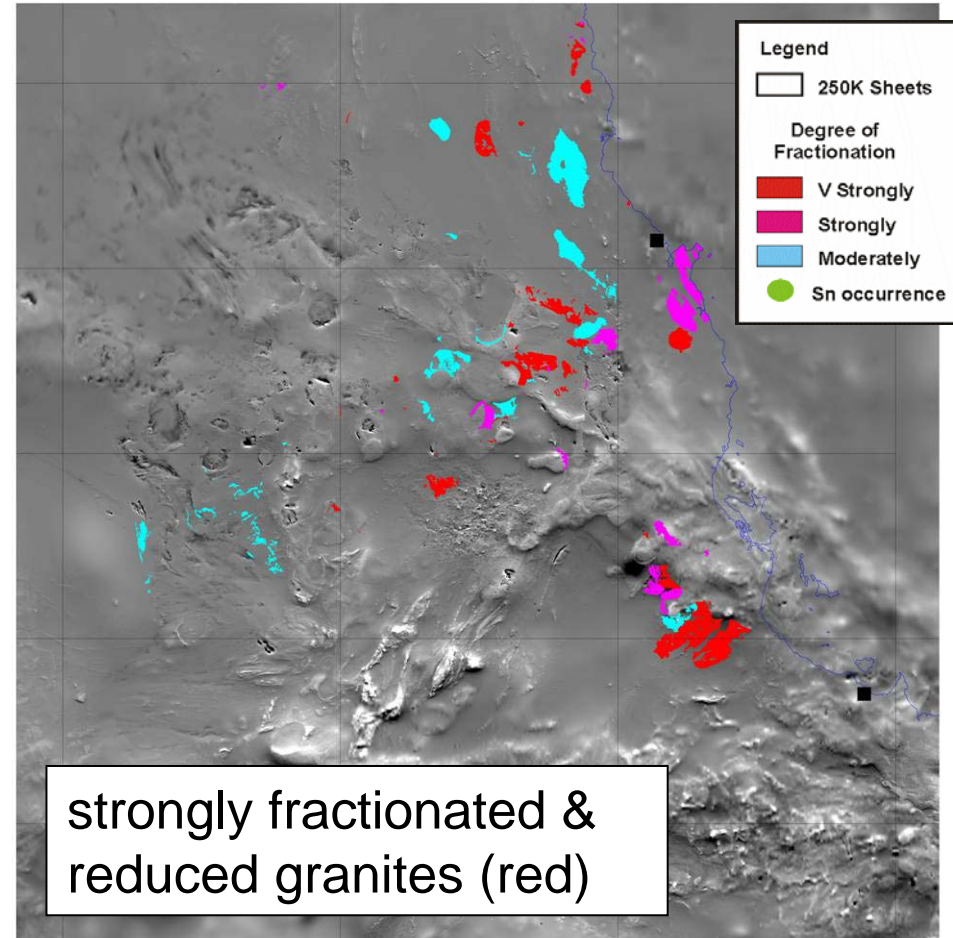


# Igneous Metallogensis



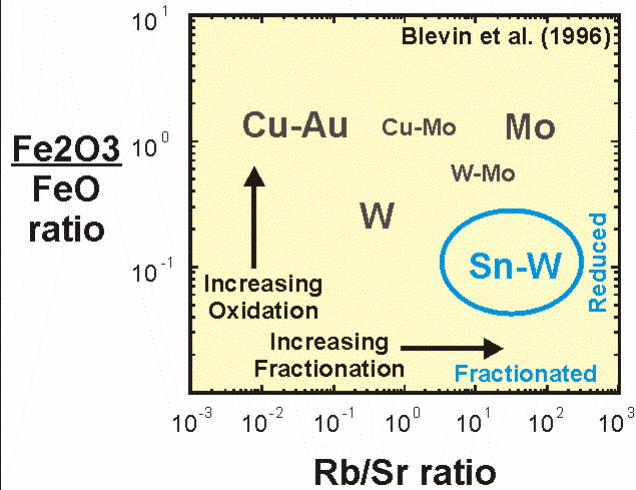
# Sn – North Qld

## Fract/Reduced granites



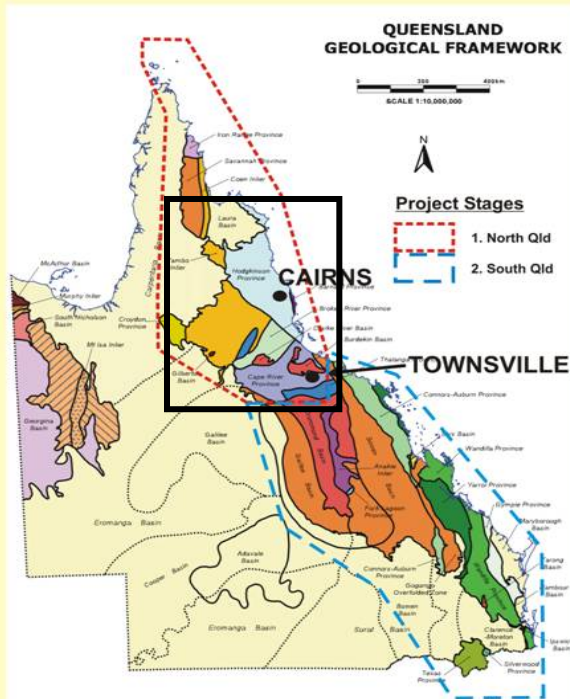
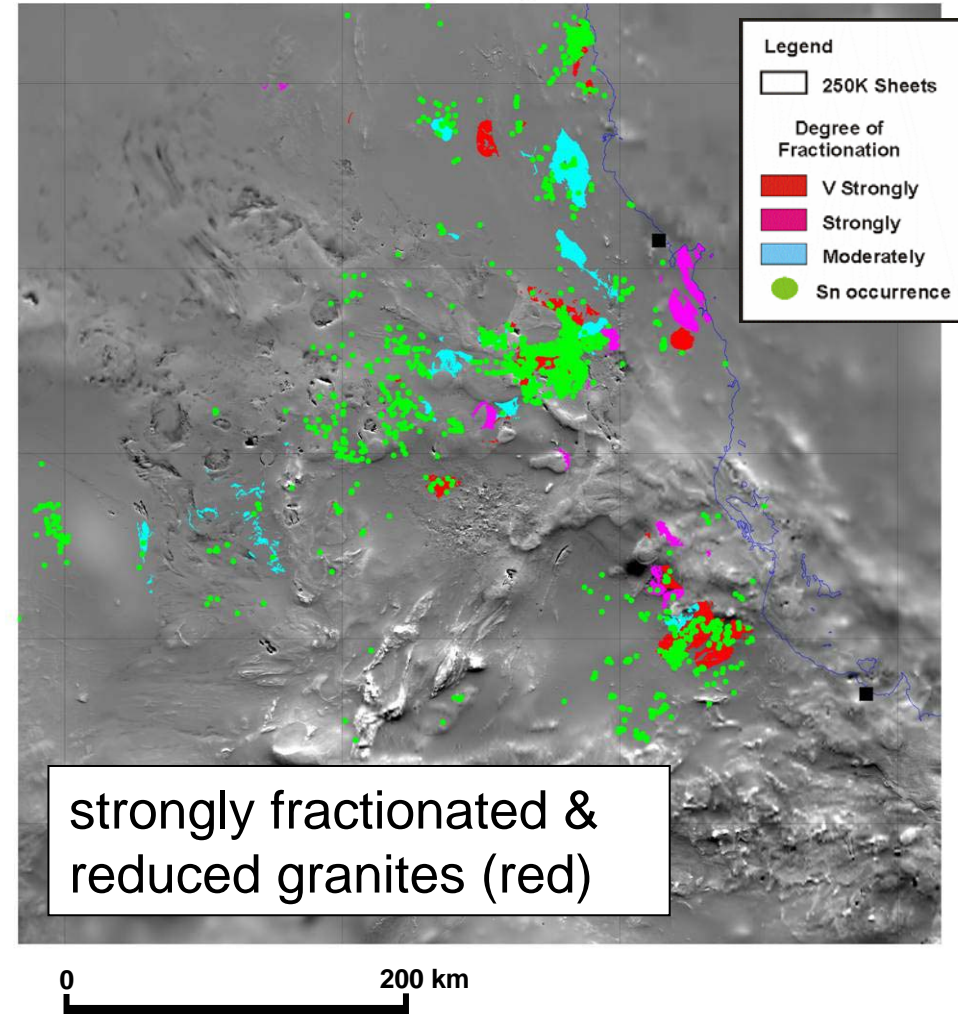
0 200 km

# Igneous Metallogensis



# Sn – North Qld

## Fract/Reduced granites & Sn



# Igneous Metallogeneses - Au

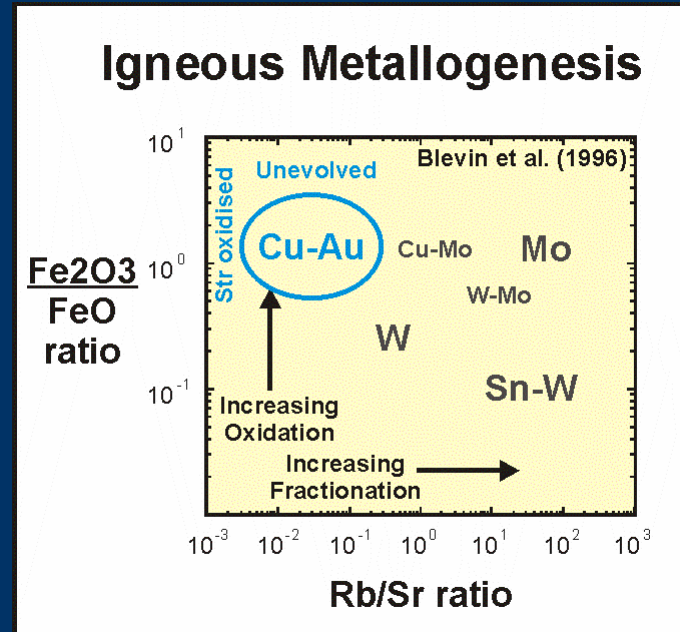
## What about Au?

**Strong relationship between Cu-Au mineralisation and intrusions.**

**Au-only systems controversial.**

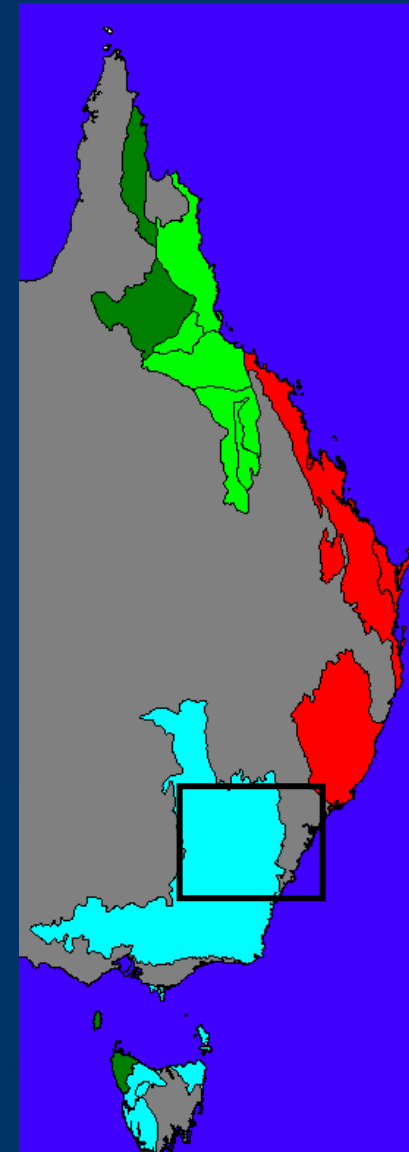
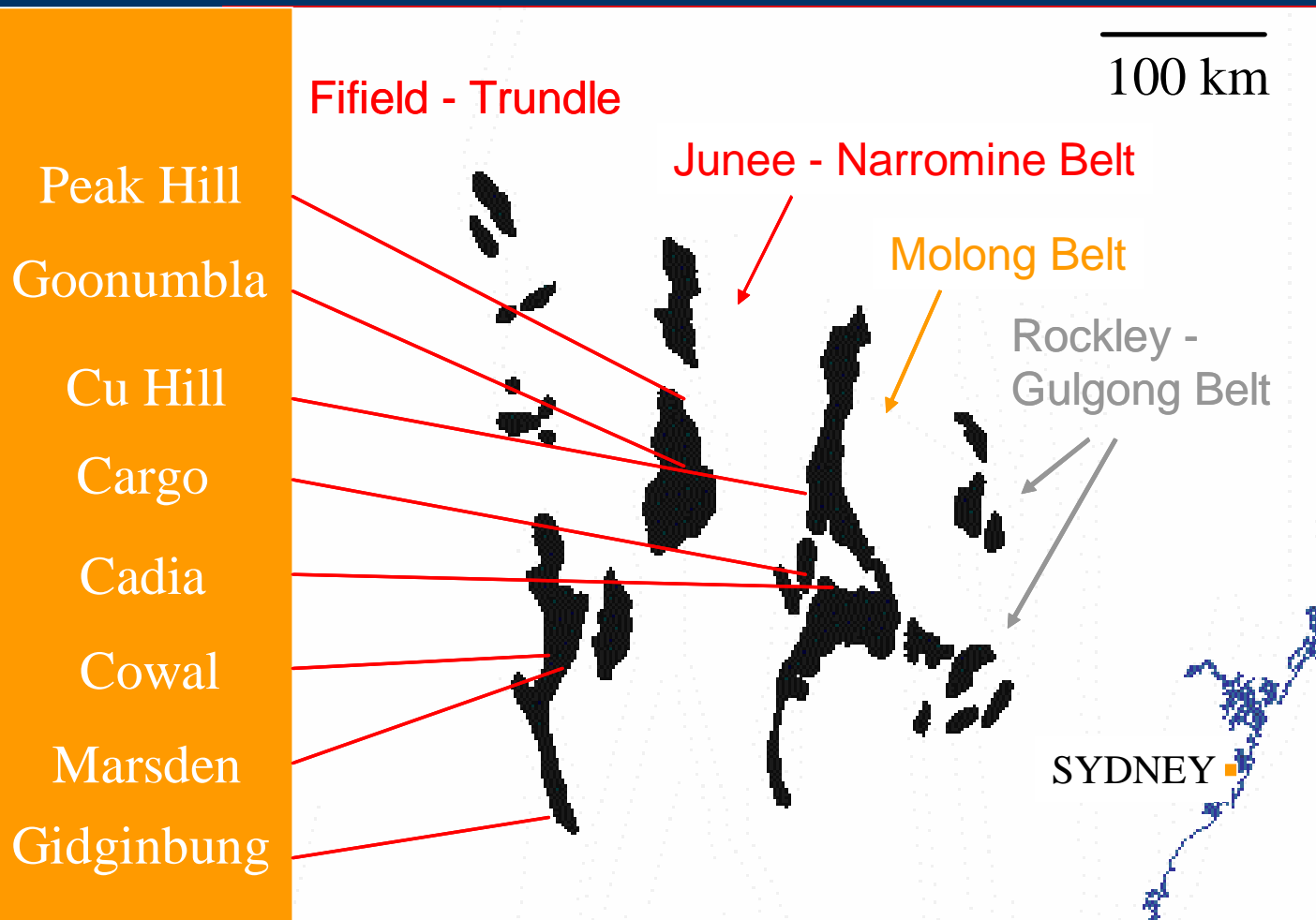
**Cu-Au: strongly oxidised, compositionally unevolved (island arc-like) magmas.**

**Why?** Cu partitions into magmatic sulfides - buildup is preferred in very oxidised magmas where reduced S is absent.



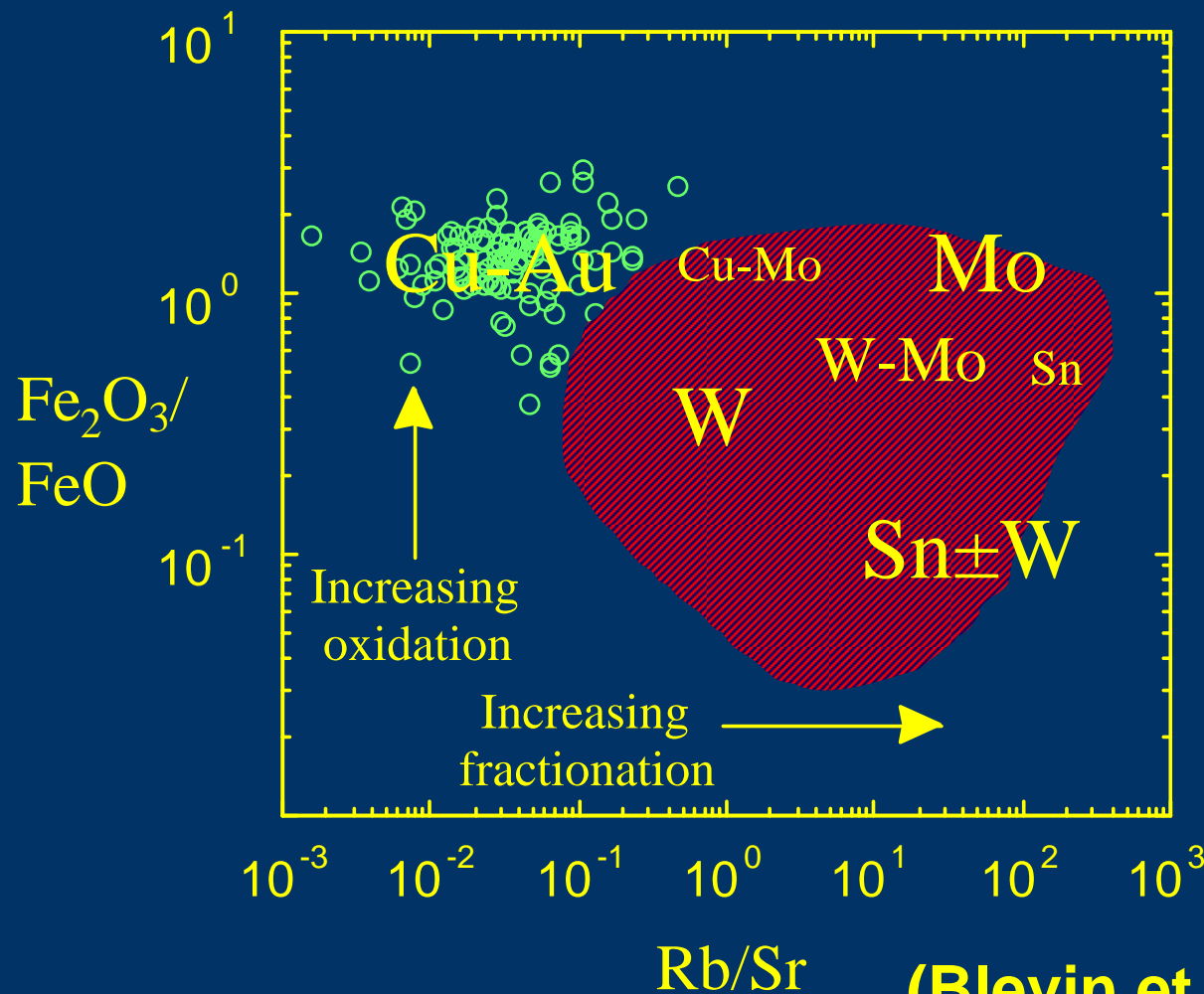


# Cu-Au intrusion related systems – Ordovician, NSW



# Lachlan Fold Belt Magmatism

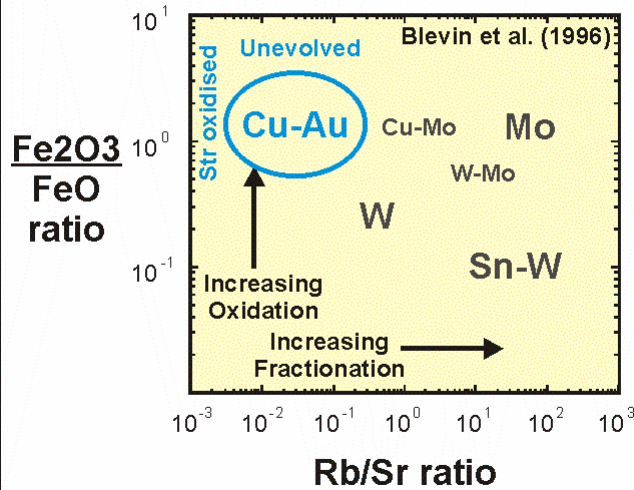
Ordovician Sil-Carb



Ordovician of  
LFB most  
prospective for  
porphyry Cu-Au

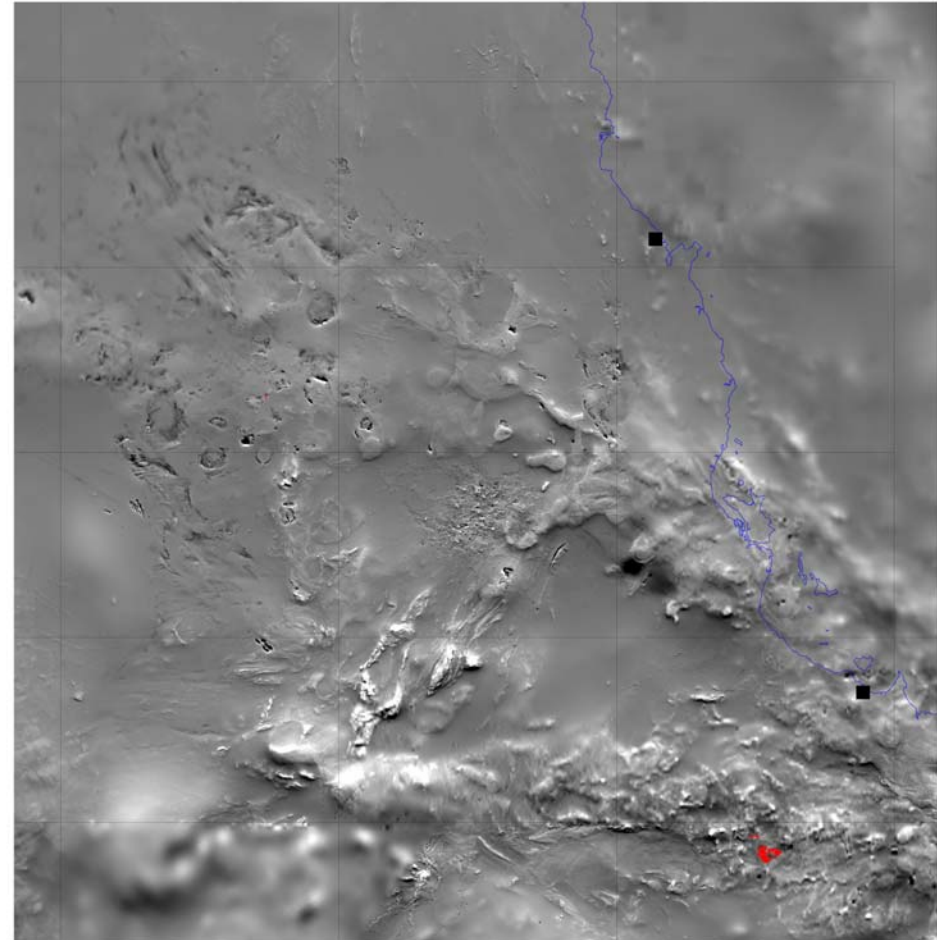
(Blevin et al., 1996)

# Igneous Metallogenesis

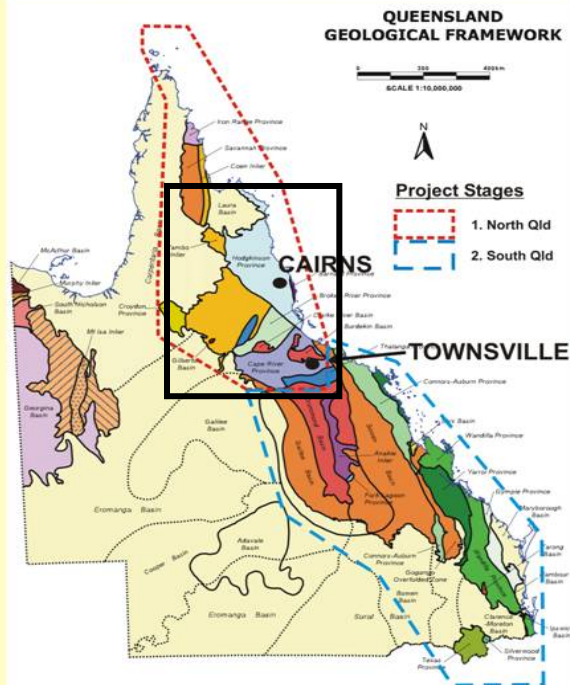


# Cu-Au – North Qld

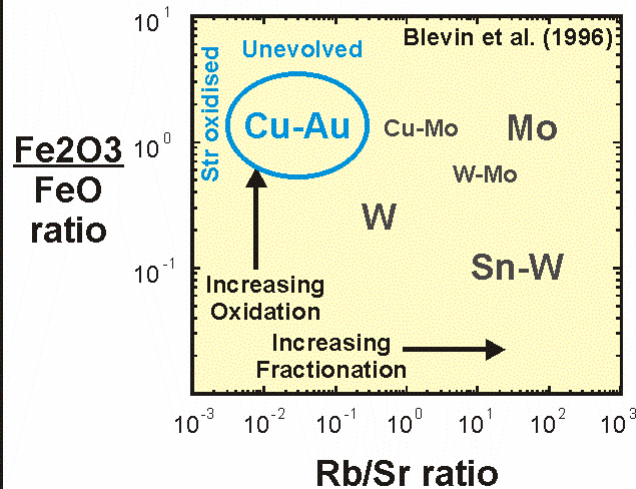
## Str oxidised unfract. granites



0 200 km



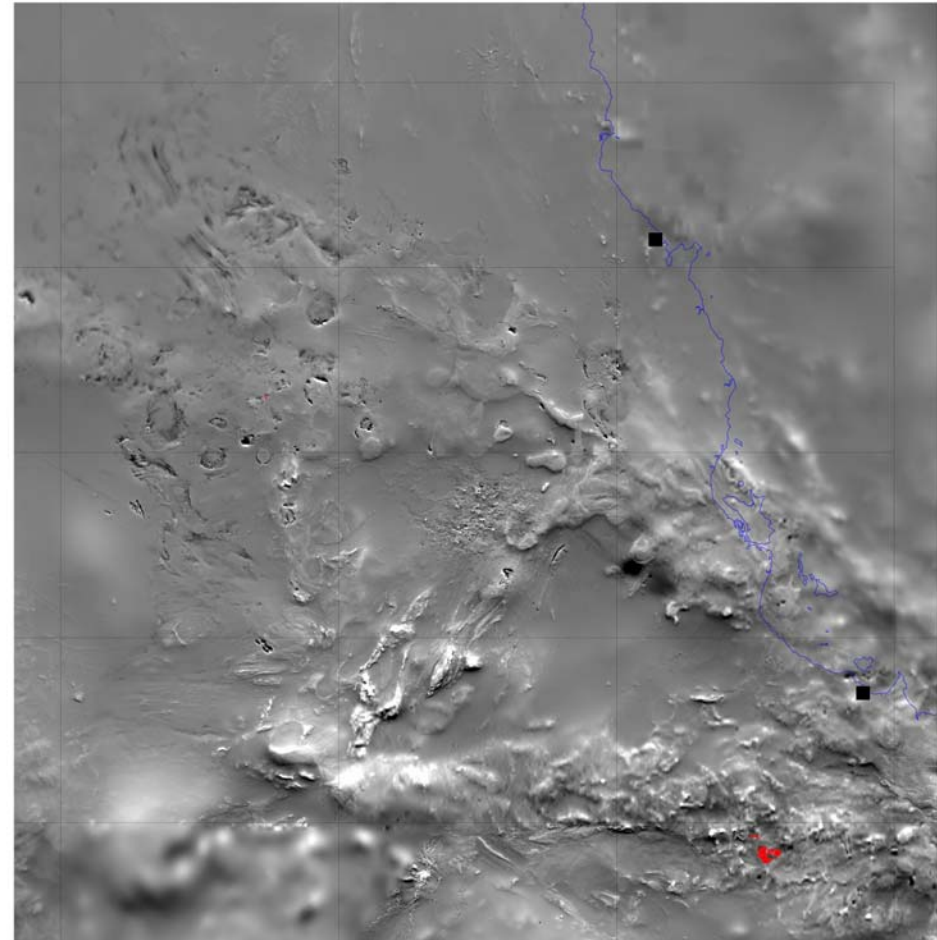
## Igneous Metallogensis



- unevolved, strongly oxidised granites largely absent from north Qld
- as are significant Cu-Au deposits

## Cu-Au – North Qld

### Str oxidised unfract. granites

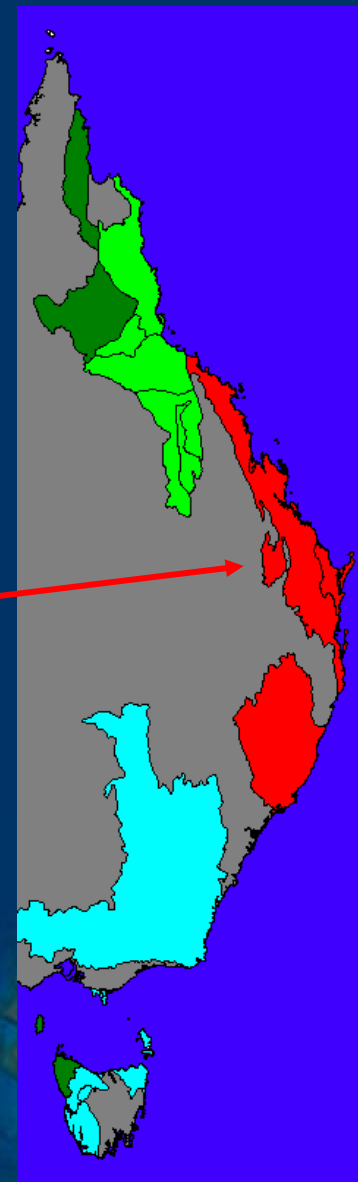


0 200 km

# Eastern Australian exploration

- many E. Australia granites apparently not oxidised enough to fall in the porphyry Cu-Au window
- Exceptions include the Ordovician of NSW; & perhaps Calliope & younger arcs in **New England F.B.**).

What about other intrusion-related gold mineralisation?





# 'Intrusion-related gold' (IRG) Model

**Au ± Bi, W, Mo associated with intermediate to felsic intrusions (e.g., Lang & Baker, 2001)**

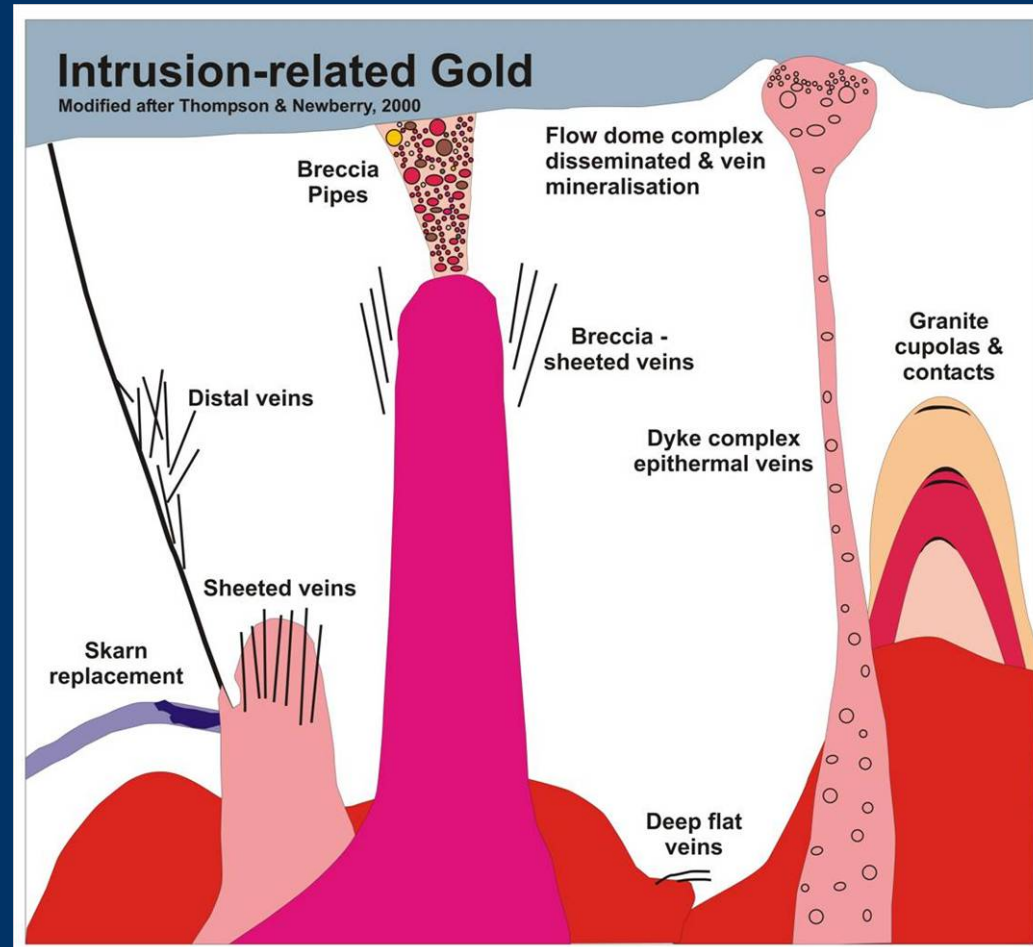
## Examples:

- Fort Knox, US (>200 t Au),
- Kidston, Aust (~140 t),
- Timbarra, Aust,
- ?Pogo, US (~160 t)

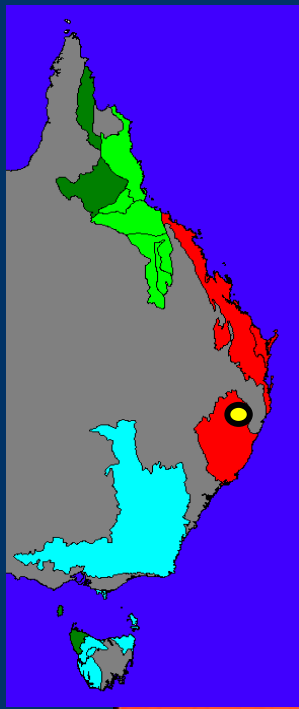
## Variety of styles

(sheeted veins, stockwork veins, breccias, disseminated & greisens, skarns, distal veins?)

## Controversial

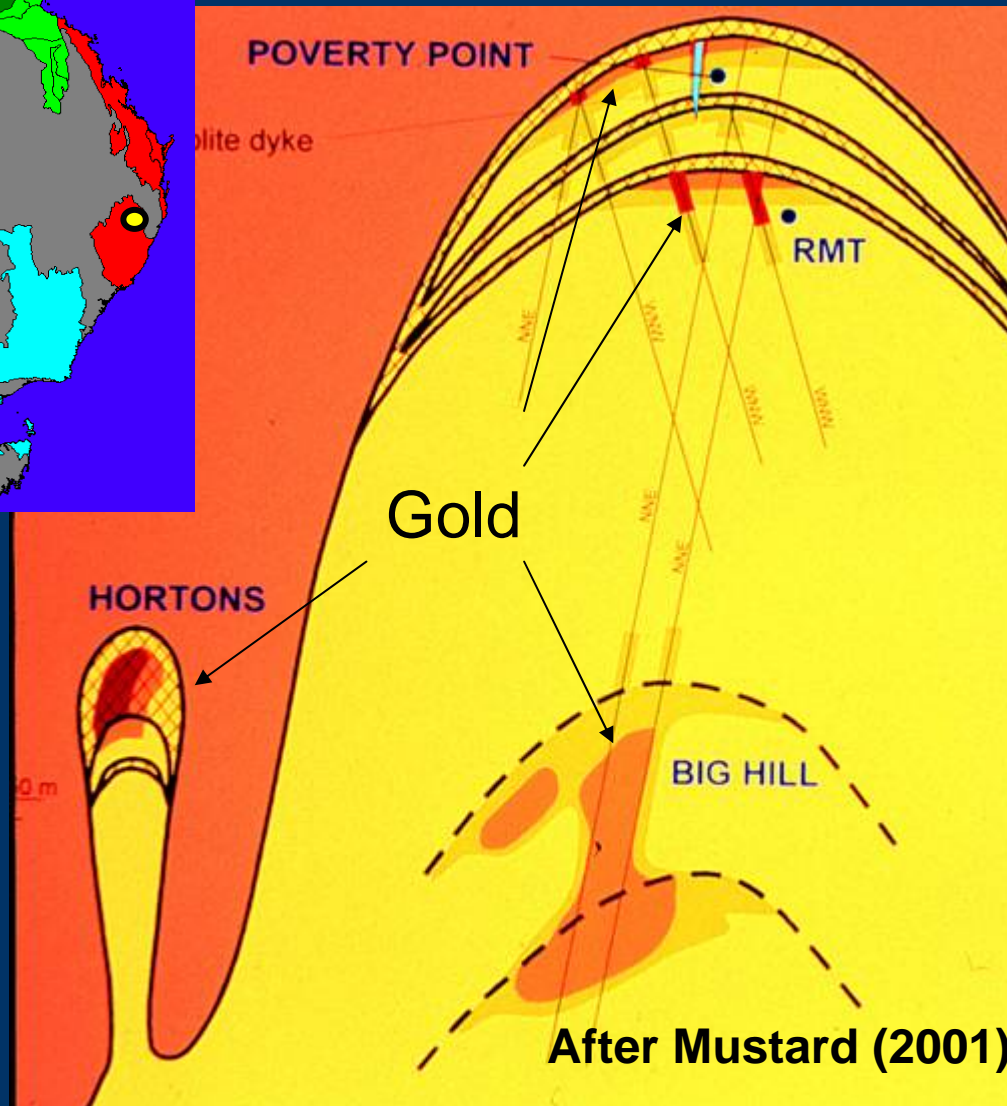


# Intrusion-related Gold



## *Timbarra*

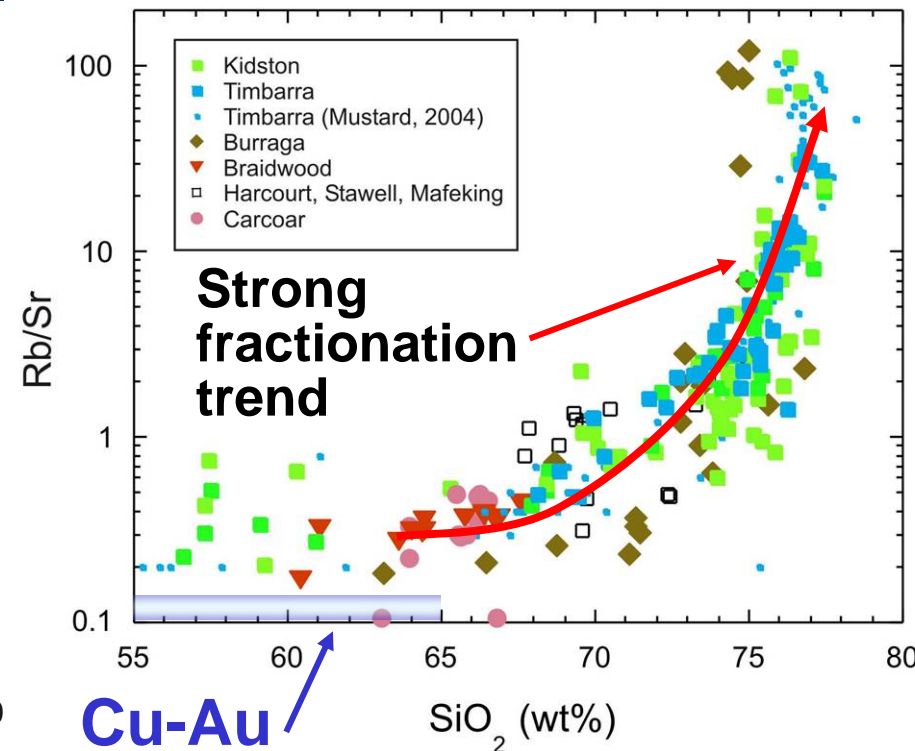
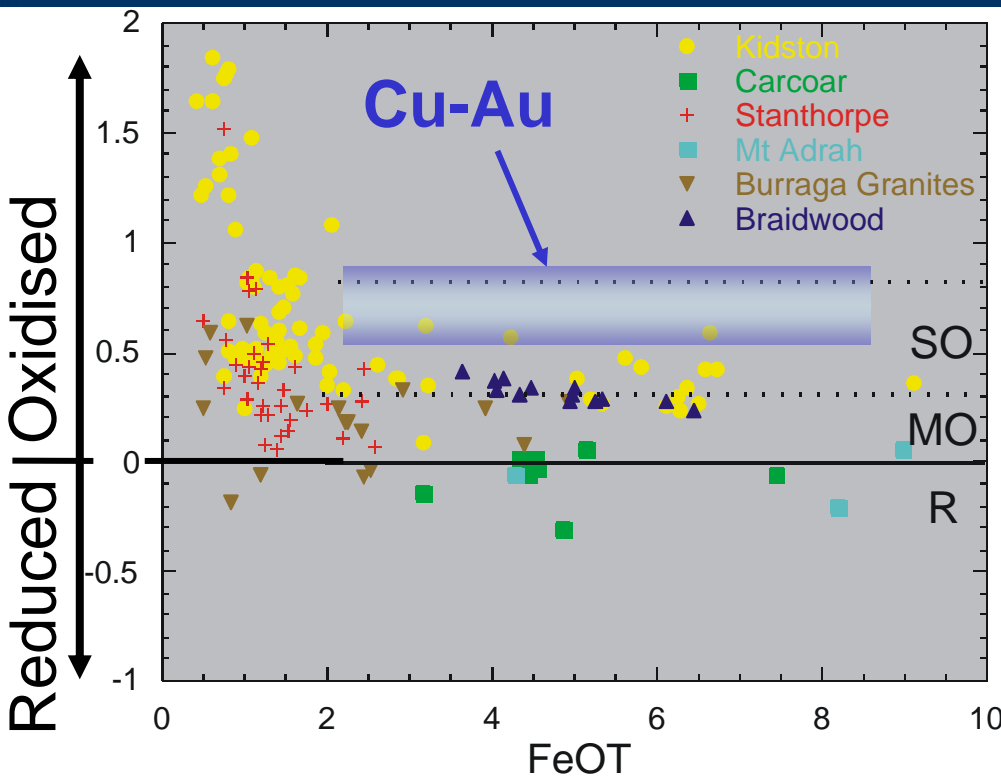
- Au disseminated in granite
- looks like Sn system
- intrusion-related deposit
- <1/2 million ounces Au (sealed though)



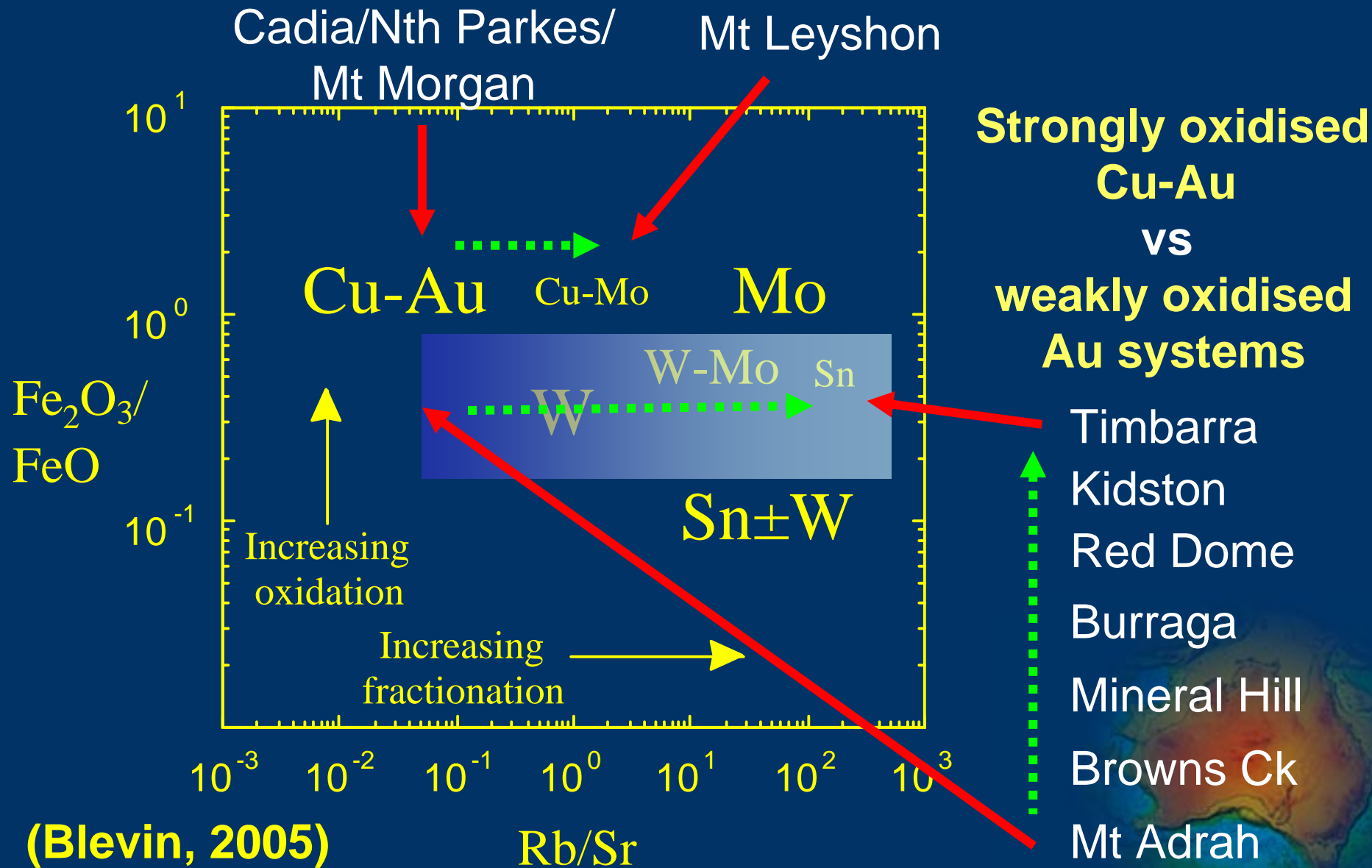
# Australian IRG

Australian IRG deposits associated with weakly to moderately oxidised, & fractionated intrusions.

*Distinct from Cu-Au.*

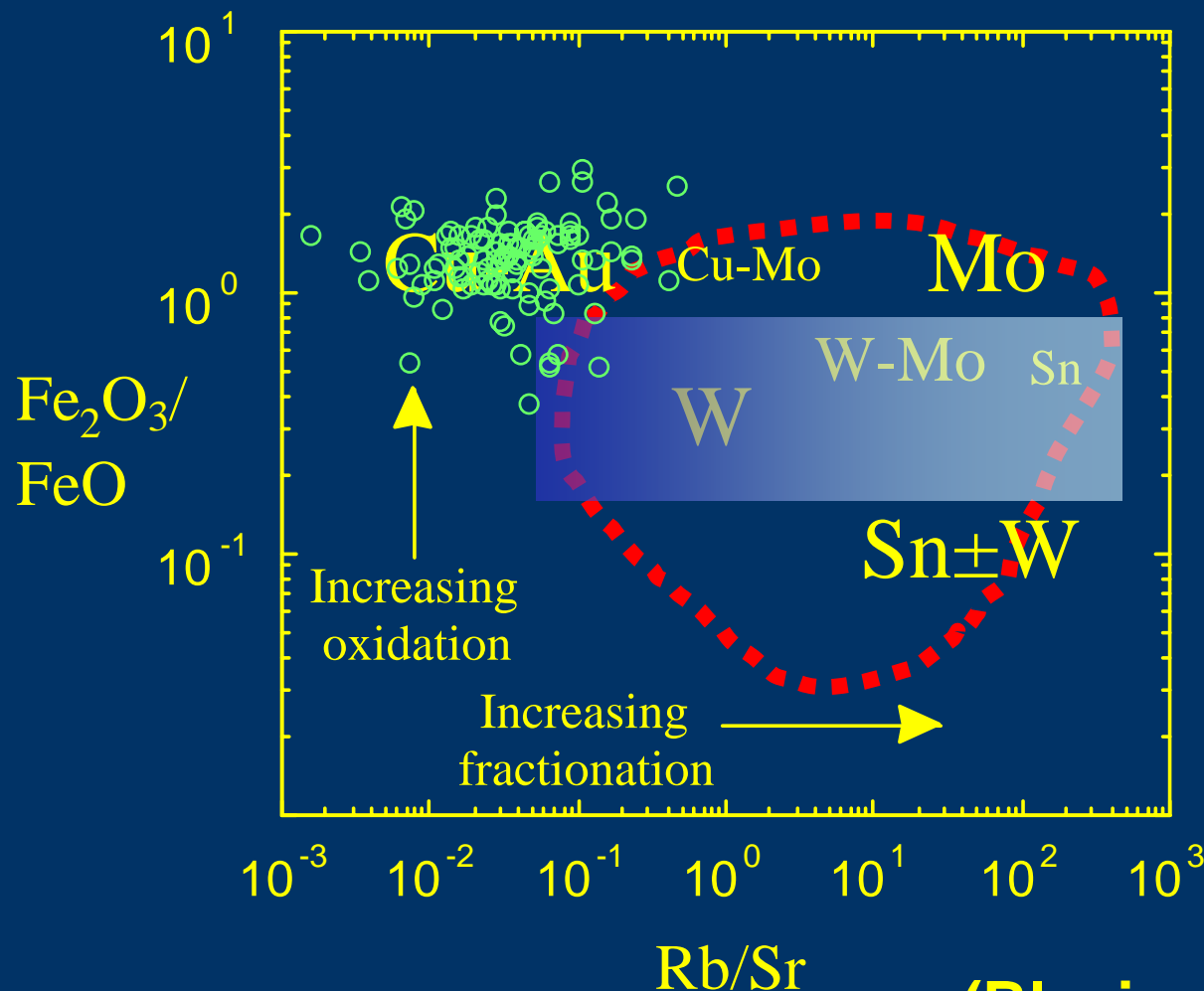


# Australian IRGs vs por Cu-Au



# Lachlan Fold Belt Magmatism

Ordovician Sil-Carb

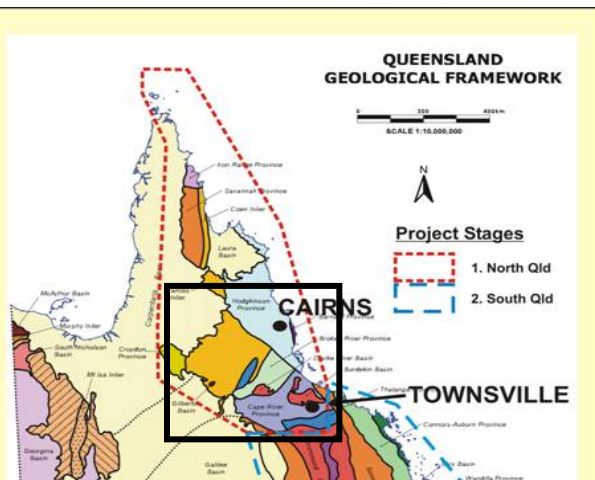
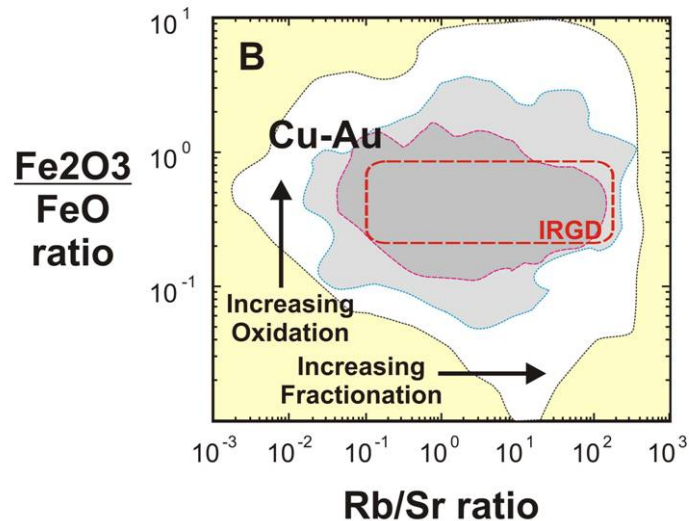


Lachlan F.B.  
prospective for  
granite-related  
Au-only systems

(Blevin et al., 1996)

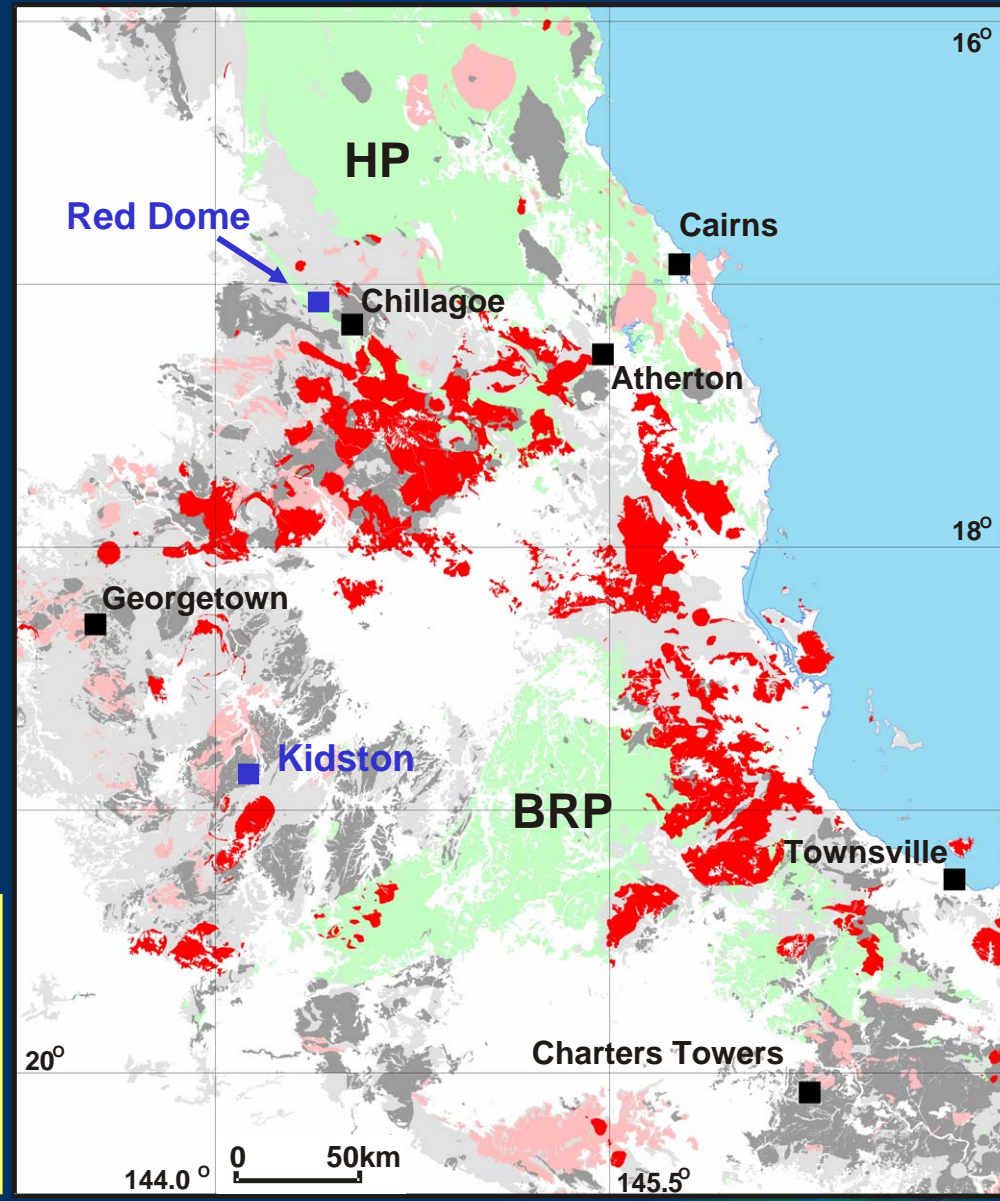


## North Qld Granites



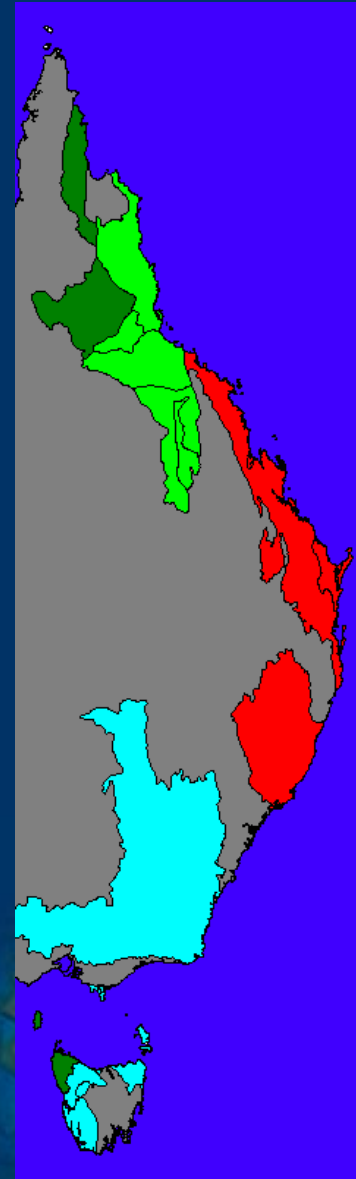
**N Qld also prospective.  
(& by analogy southern  
New England F.B.)**

## IRG – N. Qld



# Conclusions 1

- **Granite characteristics exert strong control on commodities (Sn, W, Mo, Cu, Au)**
- **Granite-related Au in E. Australia covers a range of styles – need to look beyond Cu-Au systems**
- **Eastern Australia still prospective for granite-related gold systems**



# GA's Granite-related mineralisation Project

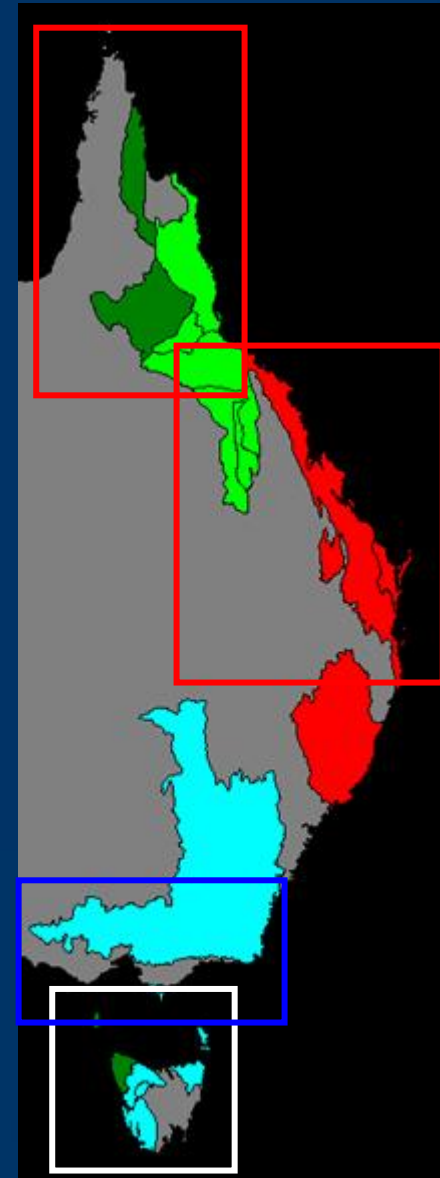
**Metallogenesis of granites of E.  
Aust., using a Minerals System  
approach.**

**Project commenced 2003-04.**

**Current partners:**

- **Geoscience Australia, Mineral Resources Tasmania, Phil Blevin (PetroChem), Geological Survey of Qld, GeoScience Victoria.**

([www.ga.gov.au/minerals/research/national/felsic/aust\\_felsic\\_igneous\\_rocks.jsp](http://www.ga.gov.au/minerals/research/national/felsic/aust_felsic_igneous_rocks.jsp))



# Project Aims – stage 1

- **collate & synthesise available data** (e.g., lithology, mineralogy, geochem, geochron, mineralisation),  
**for all significant intrusive & country rock units of E. Australia.**

(most of this data/knowledge not currently accessible in digital format)

- **produce comprehensive, easily-accessible, easily-interpretable, digital datasets, on the web.**

**All linked to GA's Geological Map of Australia.**



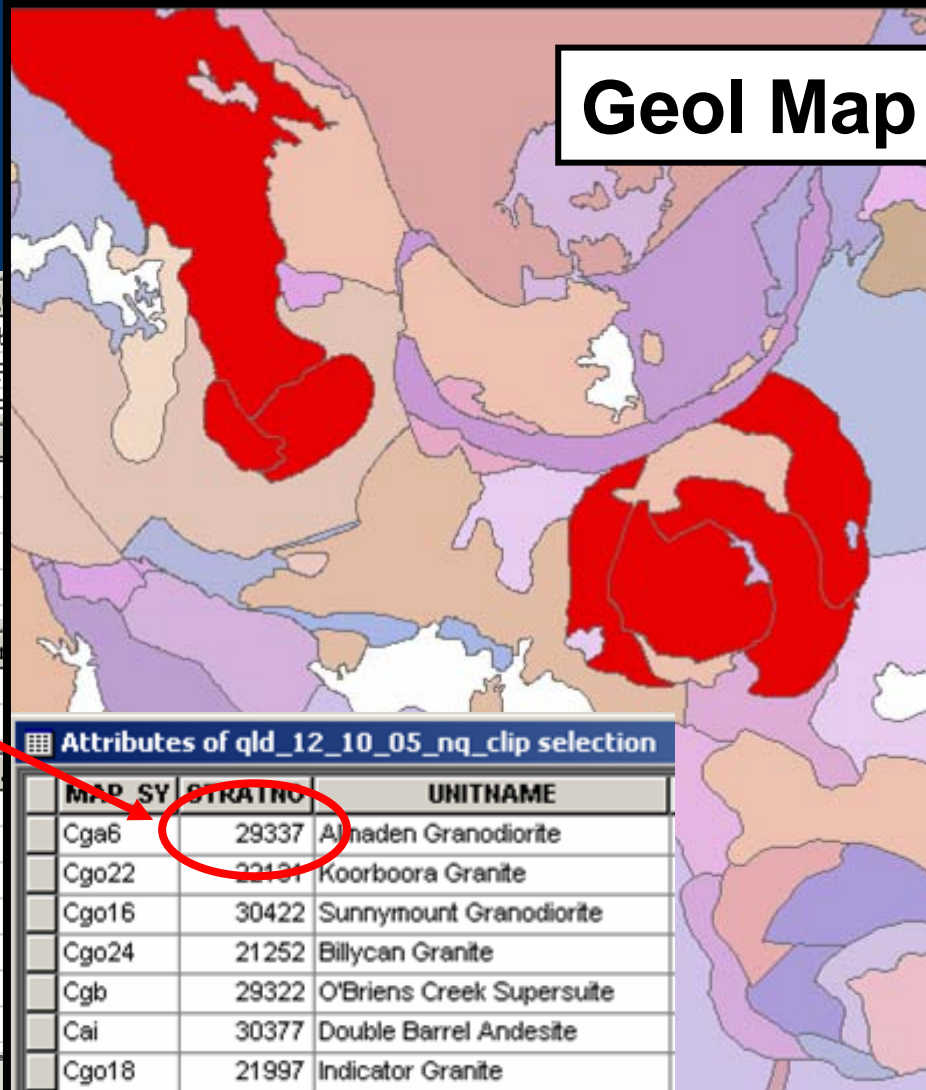
# Compilation datasets

## Geol Map

Stratno	Unit_name	GA_map	dom_lith	Description	Age	
24856	Cookie Spring Tonalite	Oggc	tonalite	hbl-biot tonalite & ton	Cambr	
30003	Collingwood Granite	Pgc10		cord-biot granite	late P	
30003	Big Tableland granite	Pgc10	granite	cord-biot granite	late P	
Stratno	Unit_name	Description	Abur	Av_s	Min_sus	Max
24856	Cookie Spring Tonalite	hbl-biot t				
30003	Collingwood Granite	cord-biot gra		25	10	
-883	Big Tableland granite	cord-biot granite			12	
23497	Columbia Creek Complex	musc-biot granodiorite				
36261						
27642		Cpx Opx Px Mgt Ilm Ttn Mnz Aln Tpz Fr Mus Chl Tour				
23883						
23591			1		1	2

LINKED

Stratno	Unit_name	No	Av_SiO2	Max_SiO2	Min(SiO2)	Av_FeO*
23497	Columbia Cree	3	71.75	72.91	70.62	2.65
27642	Conical Knob M	1	72.7	72.7	72.7	1.73
21535	Convict	3	76.15	76.8	75.14	0.53
27041	Cooktown	3	74.19	74.32	74.06	1.42
36306	Cope	1	76.86	76.86	76.86	0.44
36284	Copper Bush	2	75.59	76.65	74.52	1.54
	Core Shed gran	3	74.15	74.56	73.91	1.59
34130	Cornelia granite	1	72.3	72.3		
21565	Cottell	1	75.6	75.6		
-809	CPmg-Einaslei	1	77.1	77.1		
	CPv	2	55.52	56.54		
21577	Cresent Grano	1	67.49	67.49		
	Crowbar	1	72.97	72.97		
24233	Culba Granodic	4	68.73	71.1		
-845	Curraghmore	2	73.62	73.82		
23529	Dalkum Mgr	2	73.29	73.65		
29262	Dalmore Grano	2	63.17	63.54		
21632	Deadman Gran	2	75.09	77.04		

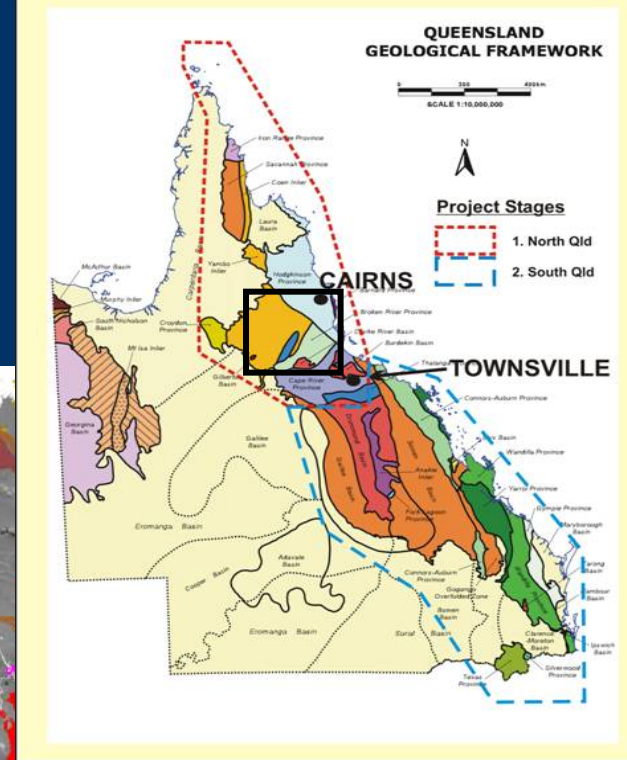
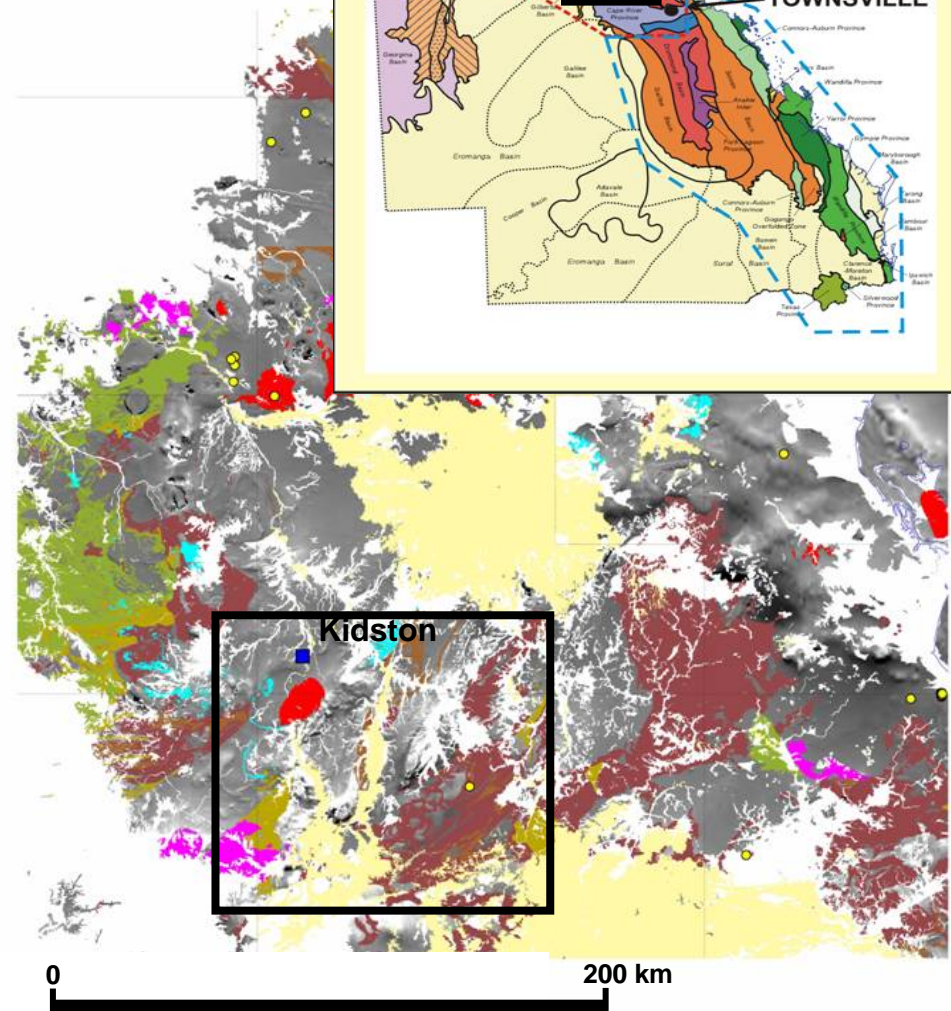
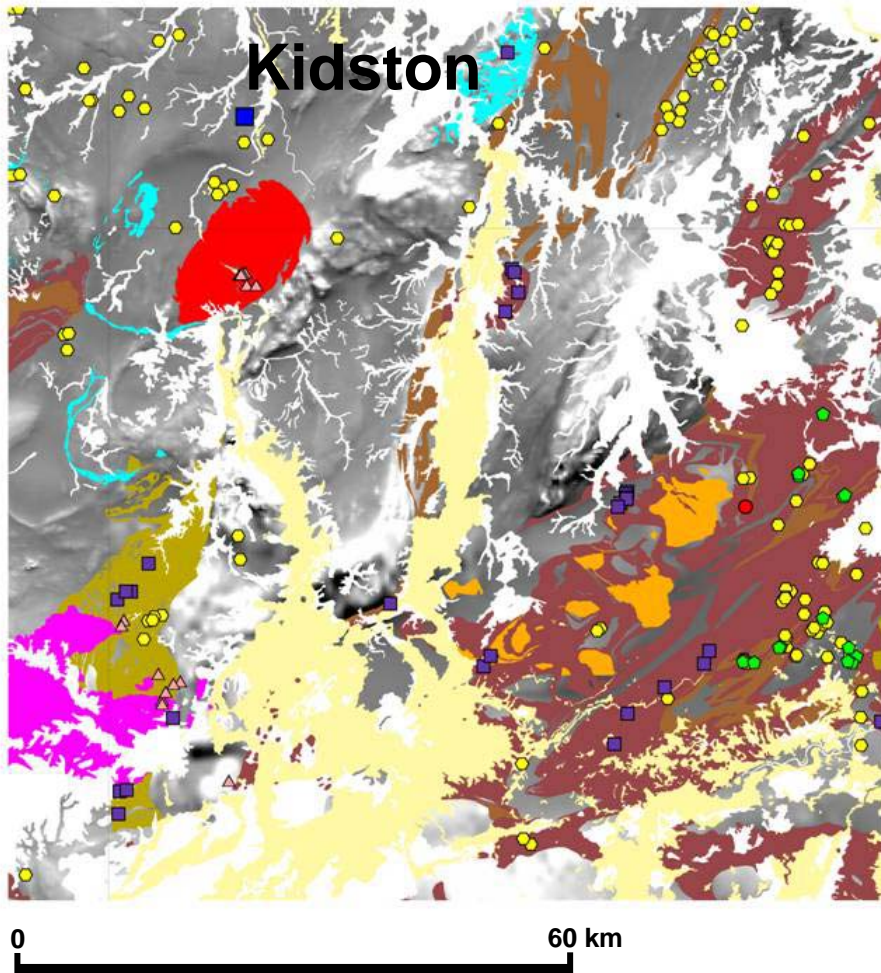


AE			
Reduced	Strongly Reduced	2	Mod_Sr unfractio
Redox_Text	Redox_Text_Full	AV_Fract	AV_Fract_text
Reduced	Strongly Reduced	2	Mod_Sr unfractio
Reduced	Moderately Reduced	4	Weakly fractiona
Reduced	Moderately Reduced	6	Strongly fractiona
unknown	unknown		



# Why this data?

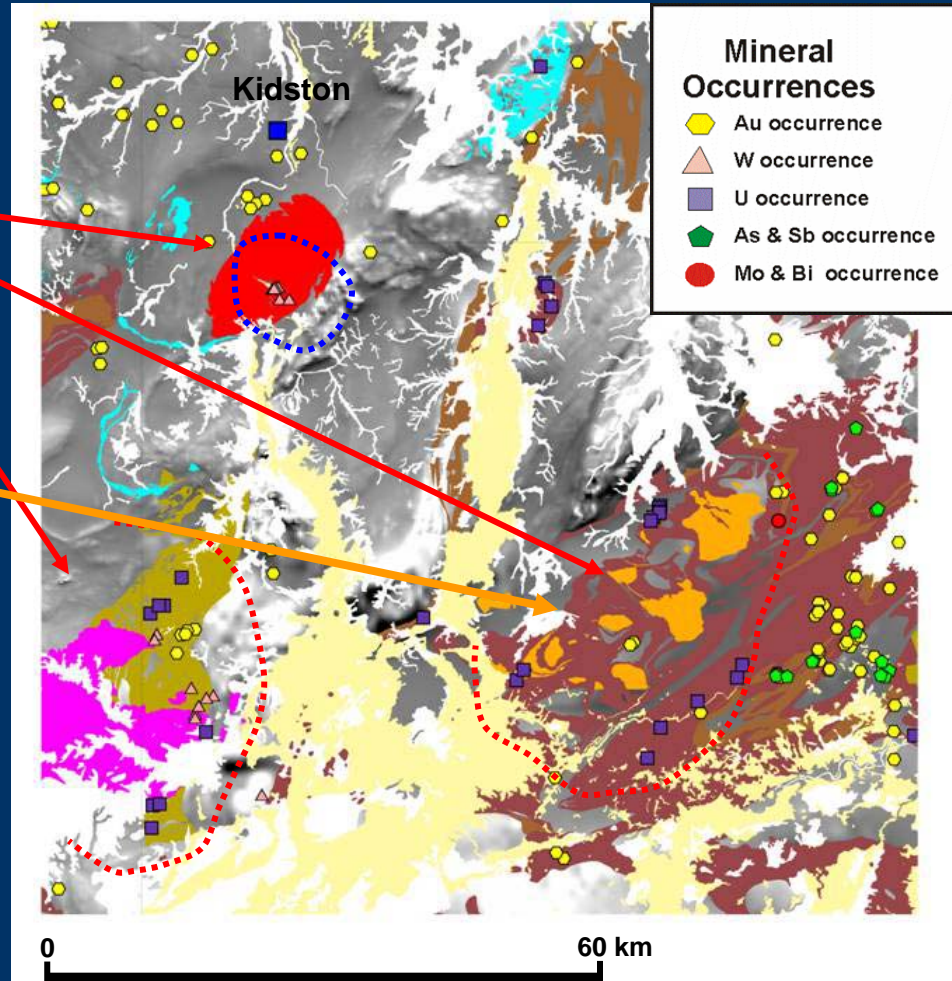
e.g., Kidston region, Qld



# Example - Intrusion-related gold

## *Some IRG ingredients*

- weakly oxidised, evolved, granites
- emplaced at high crustal levels

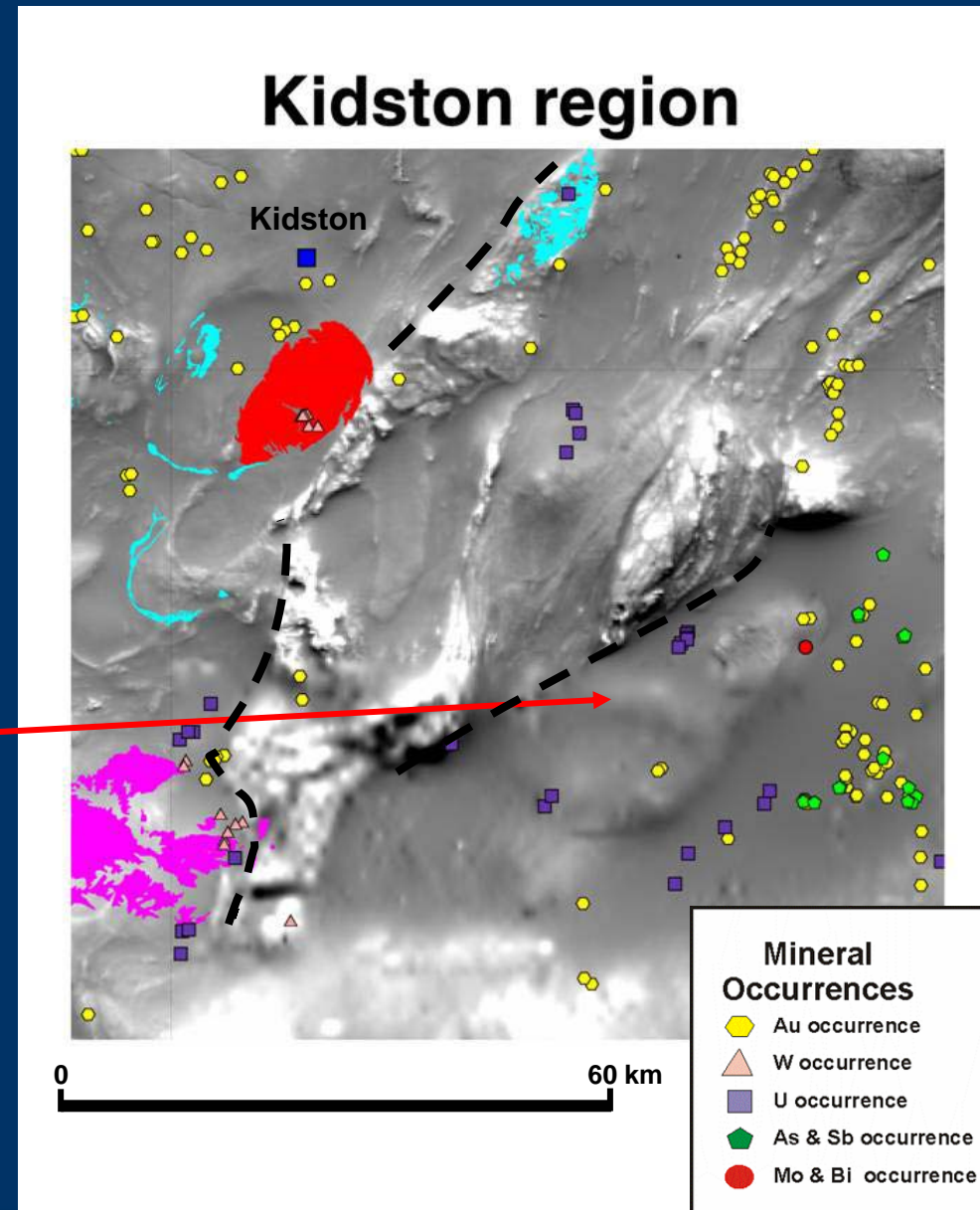




# Example - Intrusion-related gold

## *IRG ingredients*

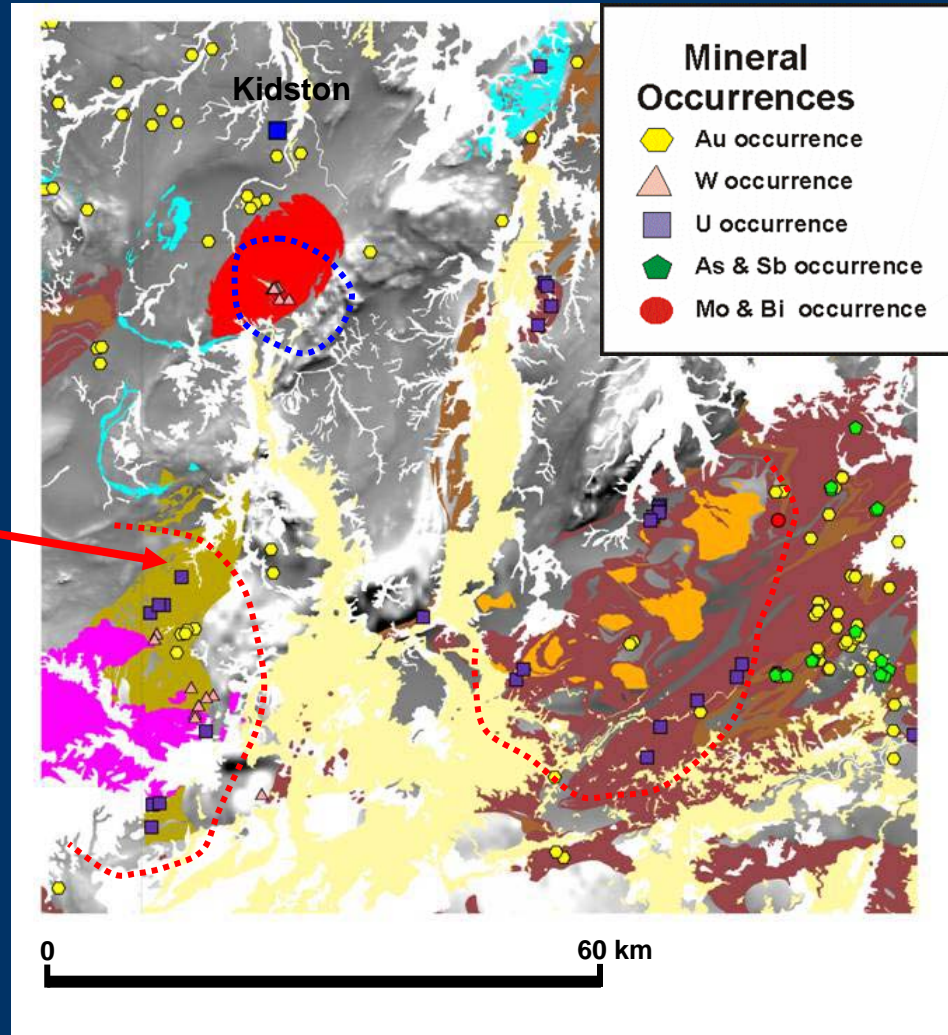
- weakly oxidised, fractionated, granites emplaced at high crustal levels
- larger granite system at depth
- major structures



# Example - Intrusion-related gold

## *IRG ingredients*

- characteristic metal signature (Bi-Au, Mo, W)
- mineral zonation

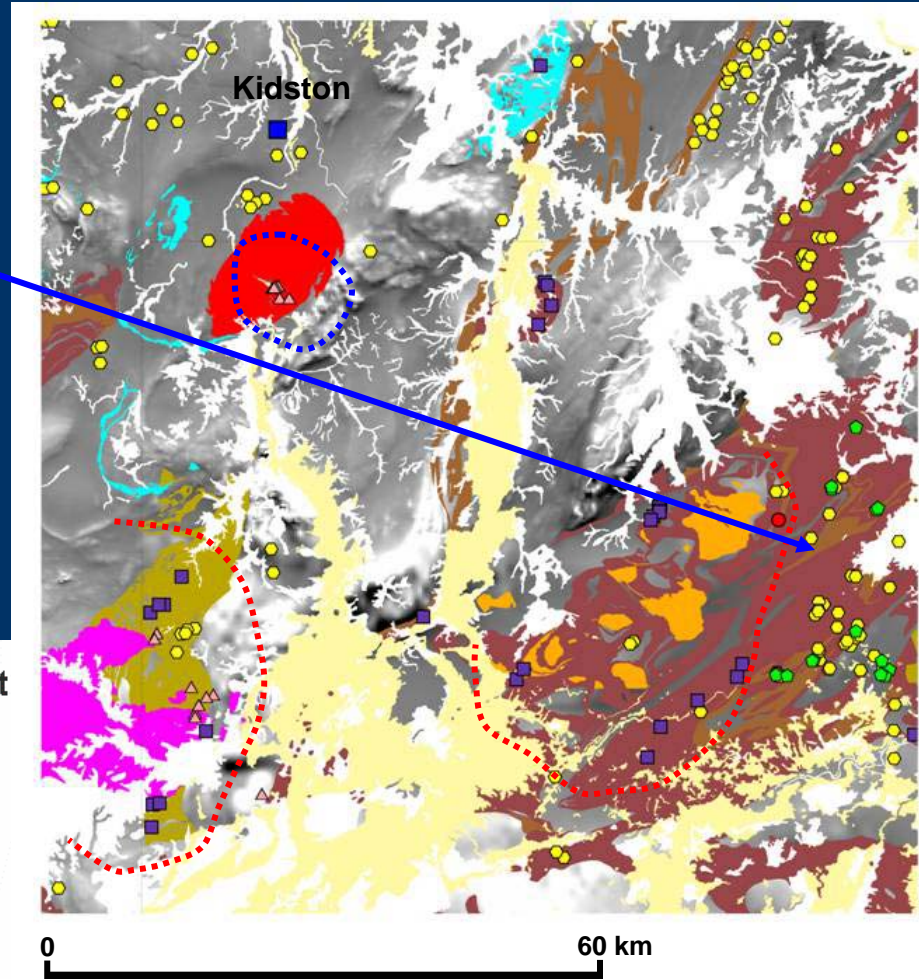
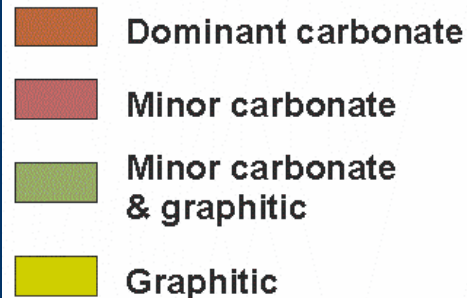


# Example - Intrusion-related gold

## *IRG ingredients*

- graphitic and carbonate-bearing country rocks

### Carbonate & graphite content

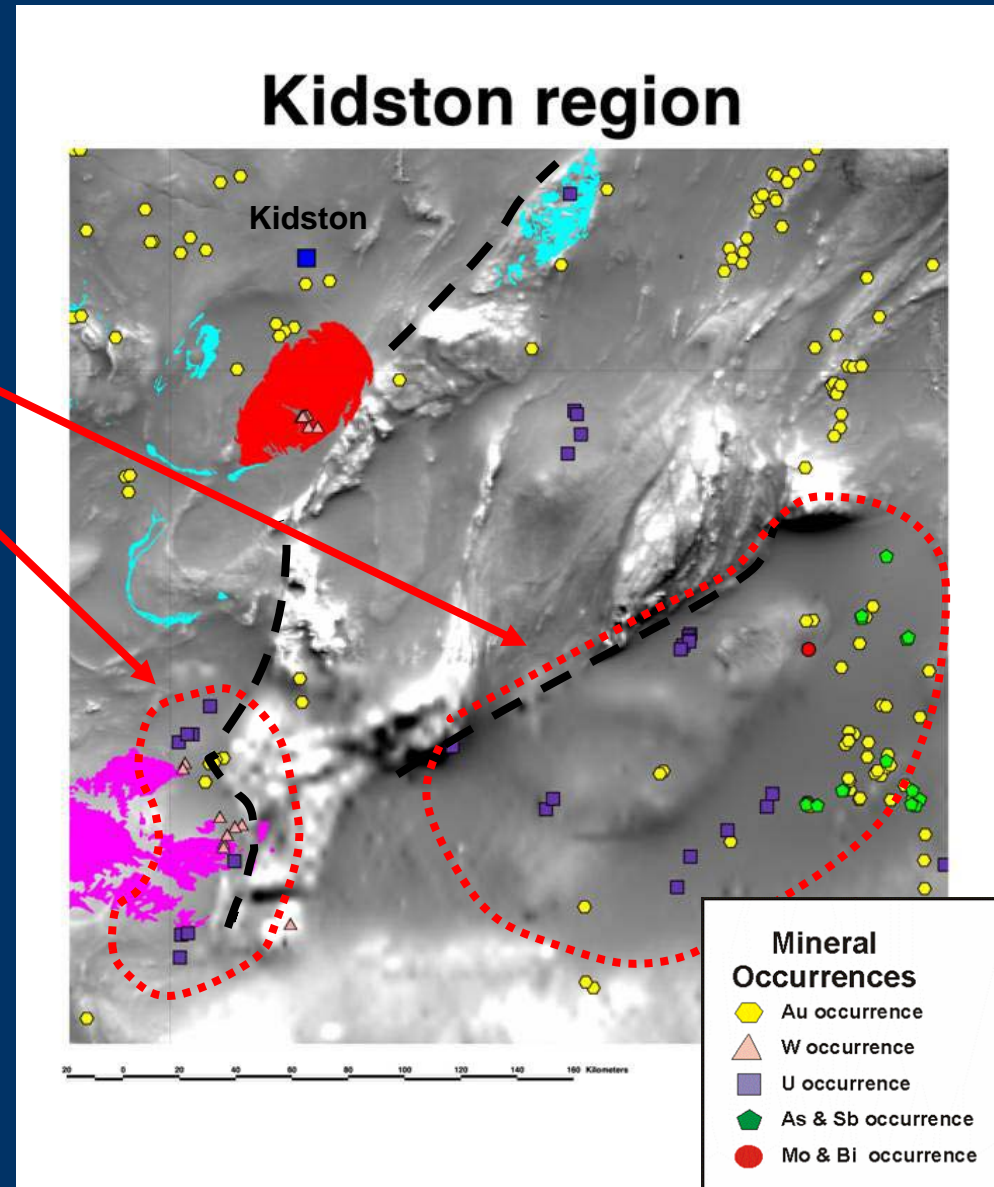




# Example - Intrusion-related gold

## *Some IRG areas?*

- Potential areas?



# Conclusions

- Granite characteristics exert strong control on commodities
- Granite-related Au mineralisation covers a range of styles – need to look beyond Cu-Au systems
- Eastern Australia still prospective for granite-related gold
- **digital datasets from GA/state surveys will facilitate the search for intrusion-related Au systems**

([www.ga.gov.au](http://www.ga.gov.au))

