

SUITES WITH PARTICULAR REFERENCE TO GRANITES OF EASTERN AUSTRALIA

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This presentation closely follows that in the published paper:

White A.J.R., Allen, C.M., Beams, S.D., Carr, P.F., Champion, D.C, Chappell B.W., Wyborn, D. & Wyborn, L.A.I. 2001, Granite suites and supersuites of eastern Australia. *Australian Journal Earth Science* **48**, 515 – 530.

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“Separate granite plutons in southeastern Australia can commonly be grouped into suites on the basis of shared similarities of field, petrographic and compositional data. Granites in different plutons of the same suite share common properties or exhibit a sequence of such features. Rocks of the same suite are cogenetic, but the details of their genesis need not be known or agreed on, to group granite units in such a way. These rocks are cogenetic in the sense that they shared a similar petrogenesis and were derived from source materials of essentially the same composition, whereas differences between suites reflect analogous differences in their source rocks. The term suite is lithologic or lithodemic in a stratigraphic sense and is closely analogous to the lithostratigraphic term group. As such, the plutons within a suite need not be of the same age, and age is not a factor in recognising a suite. However, the fact that the petrogenesis of the components of a suite resulted in such similar products means that their ages are likely to be similar. Granite plutons that share many similar features, but which also show distinct differences and which may be assigned to more than one suite, may be grouped into supersuites. The allocation of granites to suites is fundamental to understanding their petrogenesis. Suites vary in the complexity of their compositional variation. Simple suites show variations in element abundances that are highly correlated and the dispersion of composition within such suites is considered to result from varying degrees of fractionation of entrained restite from a melt. Intricate suites vary in composition in more complex ways and their variation is considered to be a consequence of processes such as fractional crystallisation. Any mineralisation is generally associated with intricate suites, and the occurrence of mineralisation and its precise character is generally specific to particular suites.”

SUITES

with particular reference to

GRANITES

of eastern Australia

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Melbourne

Reference

White A.J.R., Allen, C.M., Beams, S.D., Carr, P.F., Champion, D.C, Chappell B.W., Wyborn, D., & Wyborn, L.A.I., 2001. Granite suites and supersuites of eastern Australia. *Australian Journal Earth Science* 48, 515 - 530.

The concept of suites has been used for more than 50 years in the same way as defined in the AGI Glossary of Geology
“a set of apparently co-magmatic igneous rocks”

Here we say a suite is a group of granitic rocks with common textural, mineralogical and chemical characteristics, or a sequence of such characteristics, based initially on field, then petrographic and finally on chemical composition.

Simple suites – elements show linear chemical variations.

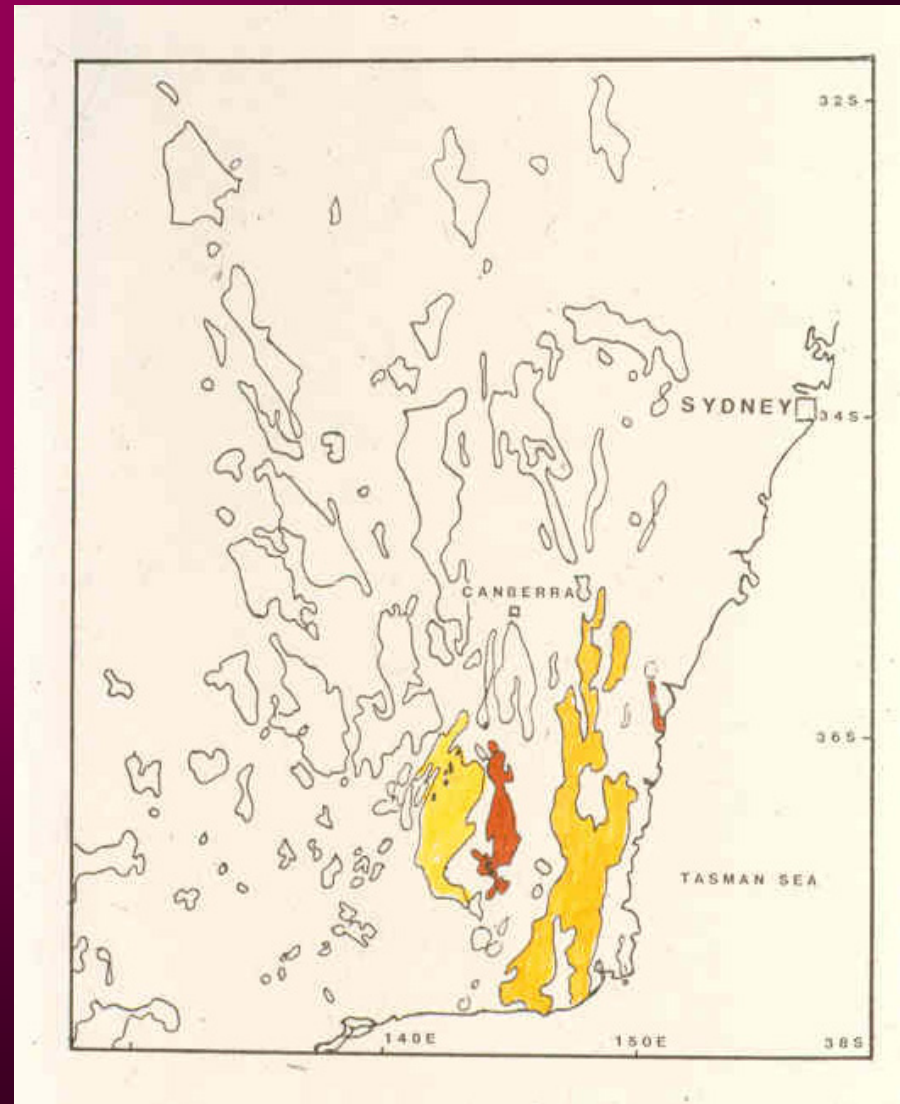
Intricate suites – some elements non-linearly related.

When there are small differences in characteristics, granites are placed into **supersuites**.

Why assign granites to suites ?

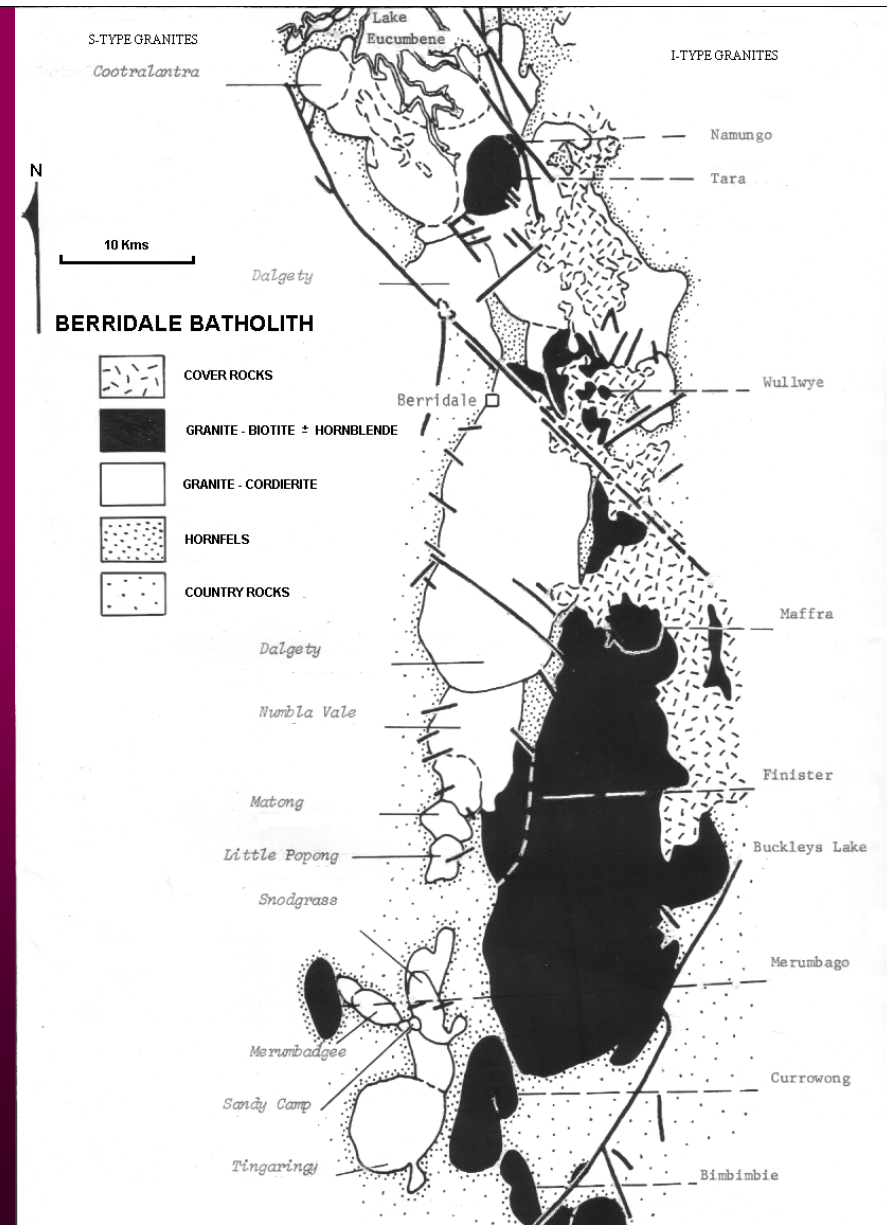
**If the data from “batholiths”
are considered together, there is
commonly confusion. This is illustrated
using data from two batholiths in
southeastern
Australia**

**Consider granites
of the Berridale
Batholith
shown in red
below**



GRANITES of BERRIDALE BATHOLITH

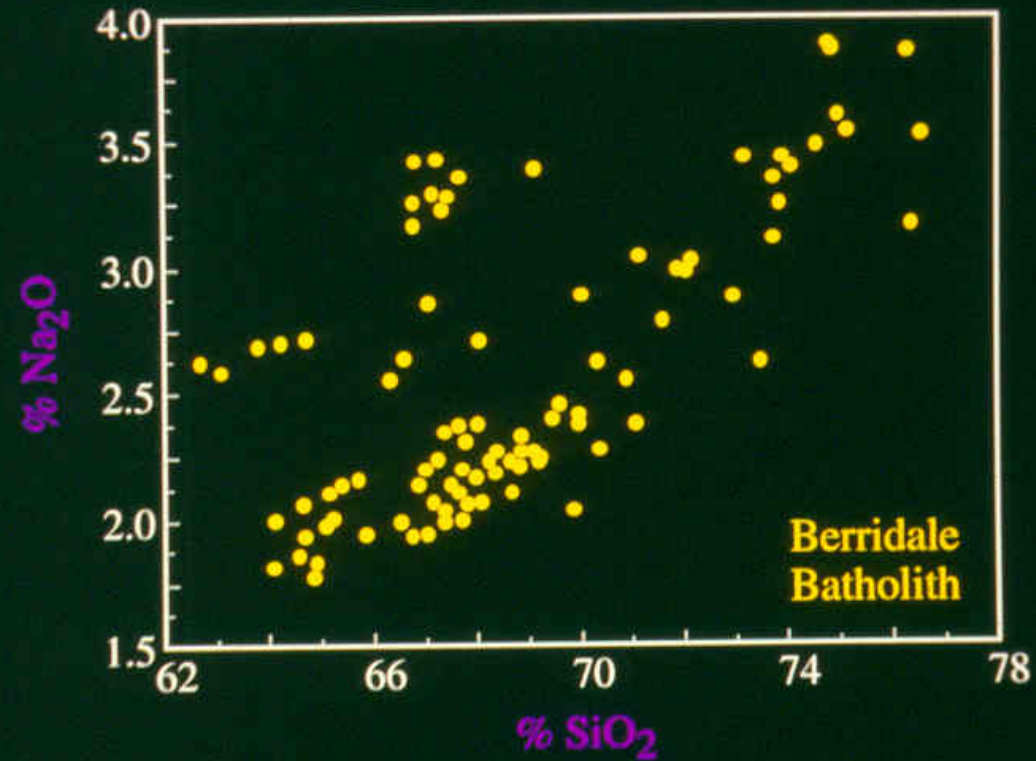
35 separate
plutons
many with
distinctive field
and
mineralogical
characteristics



SOME PLUTONS OF THE BERRIDALE BATHOLITH - Granite mineralogy

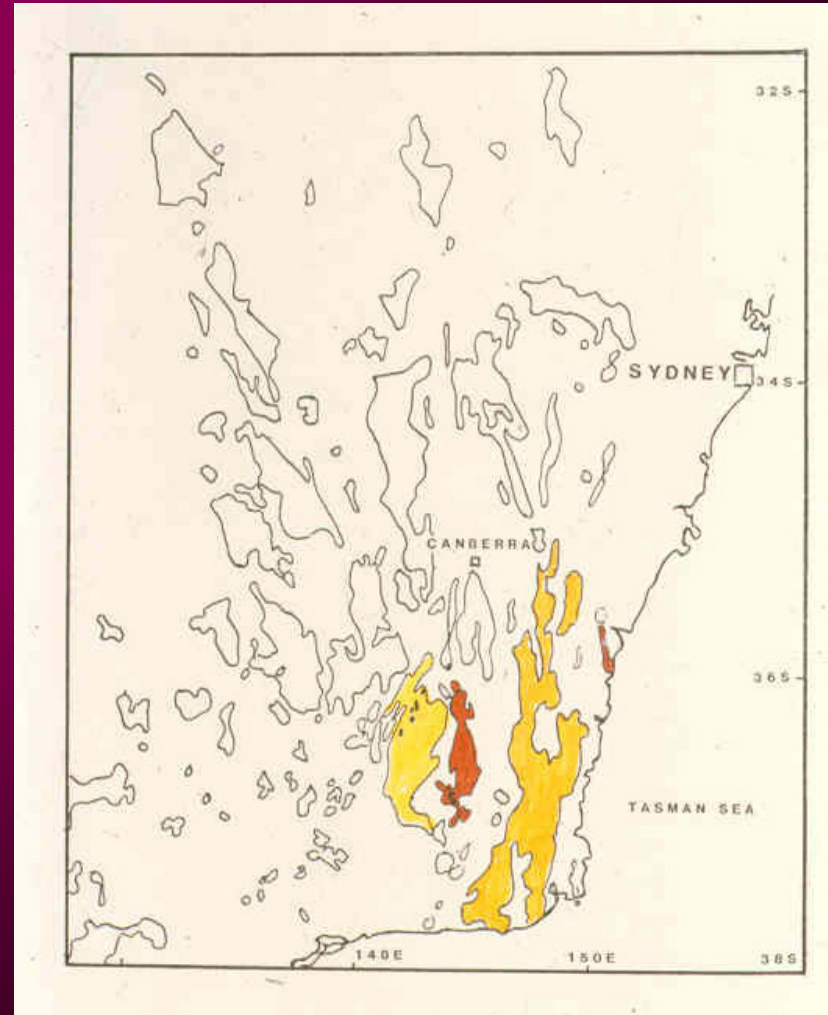
Cootralantra	Mafic biotite cordierite + ilmenite
Tingaringy	Moderately mafic cordierite + ilmenite
Dalgety	Biotite ± cordierite ± magnetite with pseudomorphs after orthopyroxene
Numbla Vale	Felsic biotite cordierite ± magnetite
Tara	Biotite hornblende + allanite + titanite +magnetite
Namungo	Felsic biotite + garnet +andalusite
Buckleys Lake	Biotite + titanite + allanite + magnetite
Currowong	Biotite hornblende + magnetite + allanite
Bimbimbie	Biotite + magnetite + allanite
Finister	Biotite hornblende + ilmenite

Berridale Batholith Na_2O

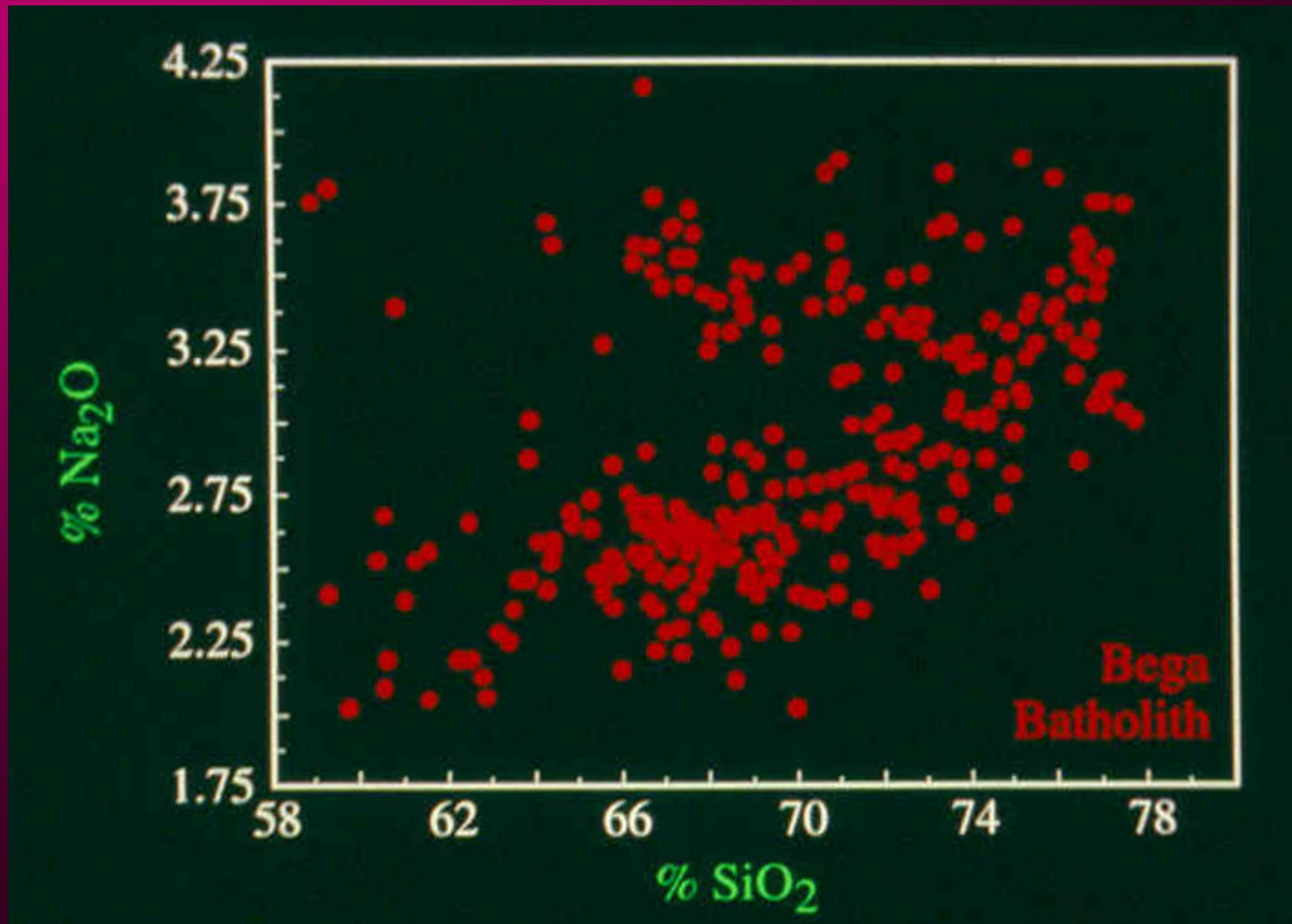


**Consider granites
of the Bega
Batholith shown
in orange below**

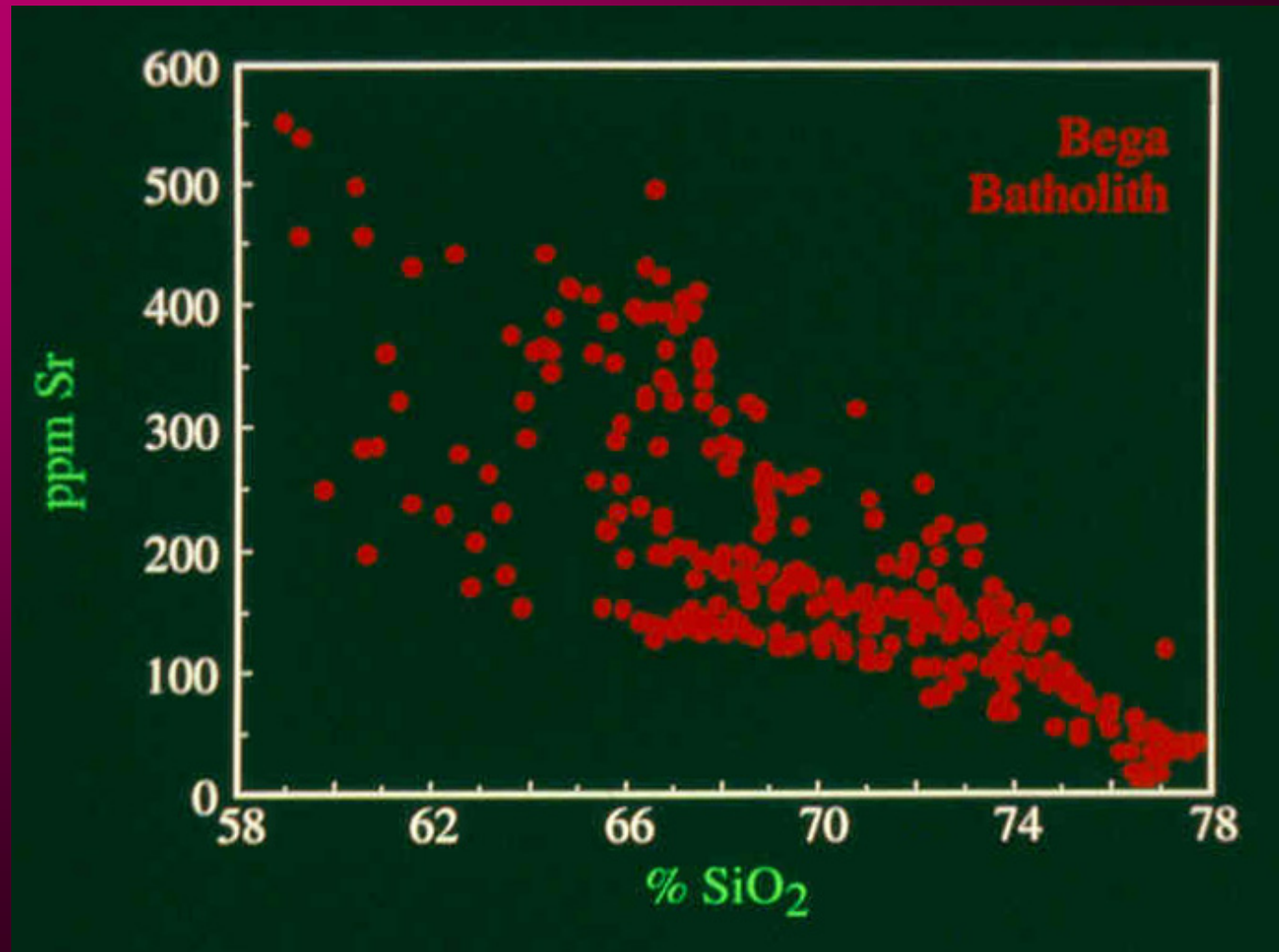
**Area 8620 km²
140 separate
mappable units
including
Moruya**



Bega Batholith Na_2O



Bega Batholith Sr

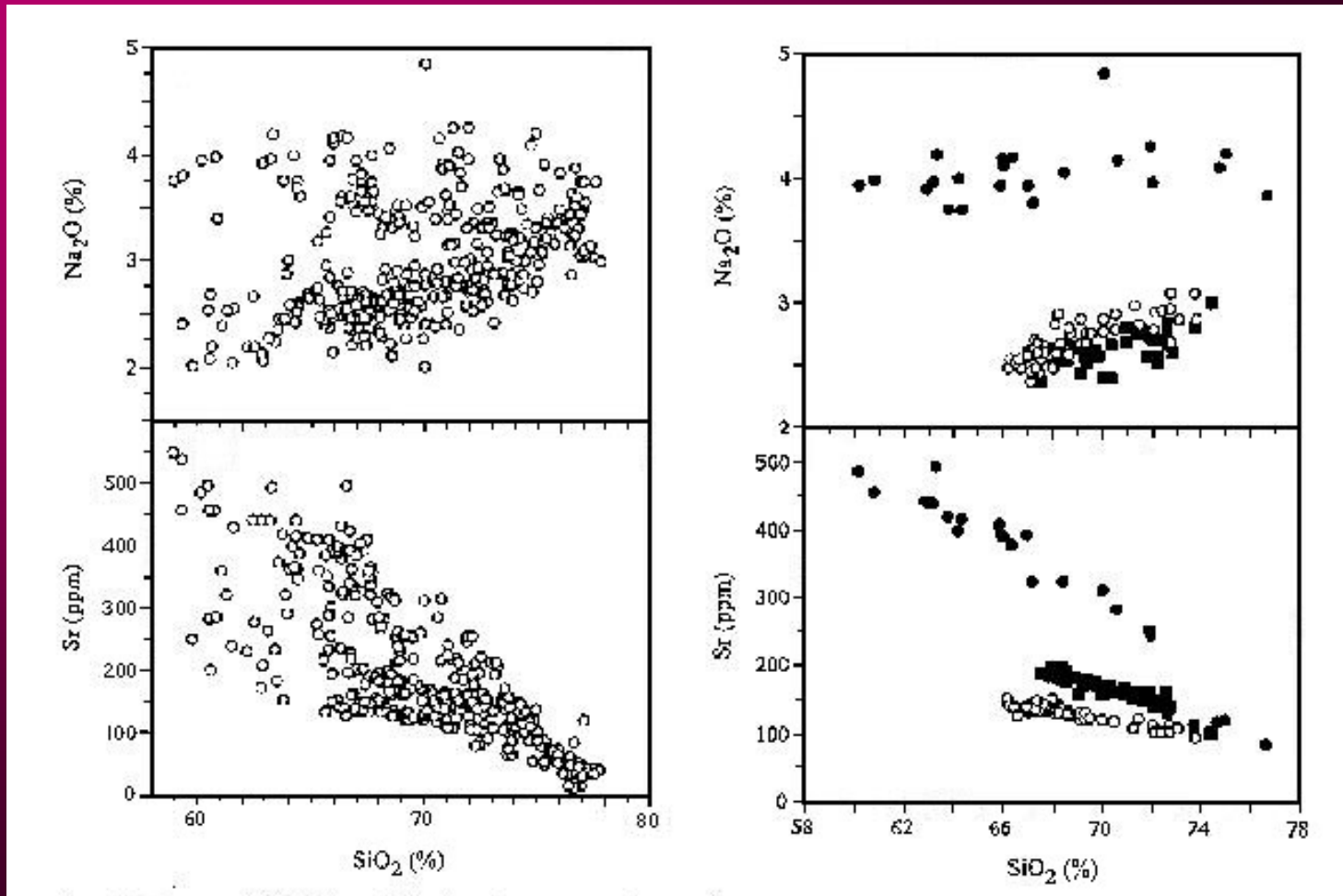


ORDER OR DISORDER IN BATHOLITHS

The data presented so far appear to show disorder.

To get order out of the chaos we assign each
pluton to a suite

SOME SUITES OF THE BEGA BATHOLITH



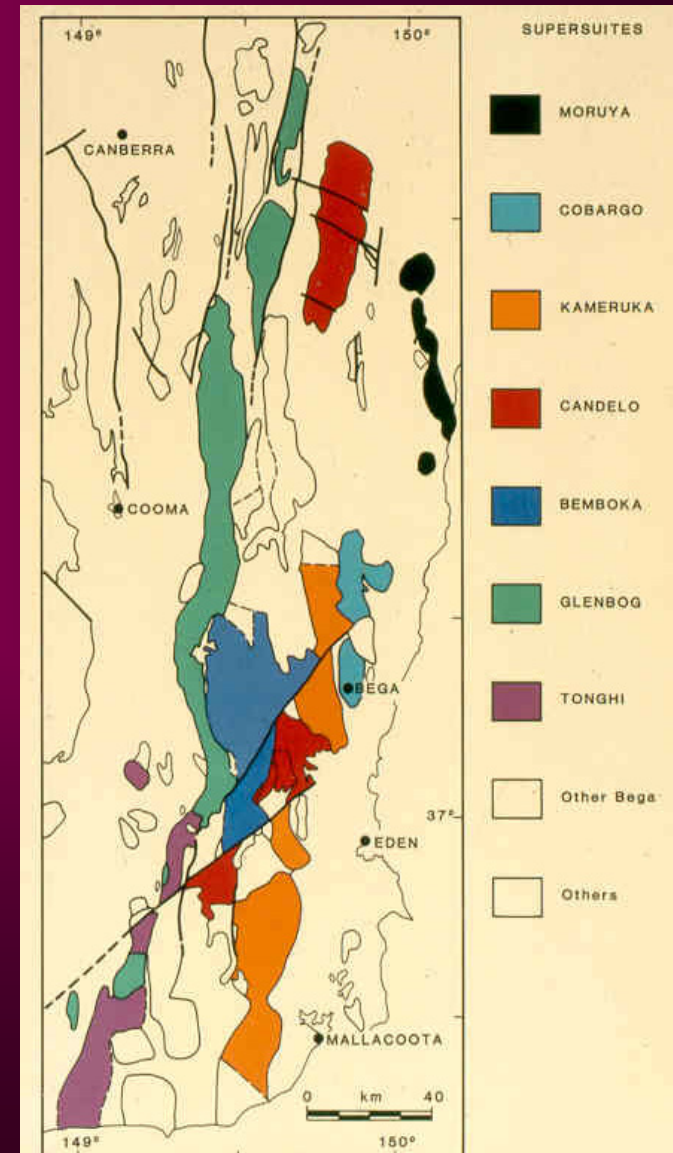
SUPERSUITES OF THE BEGA BATHOLITH

**Separated by screen of
hornfels**

**Trend parallel to grain
of country rocks**

**Highest Sr in east lowest
in west**

Highest Na₂O in east



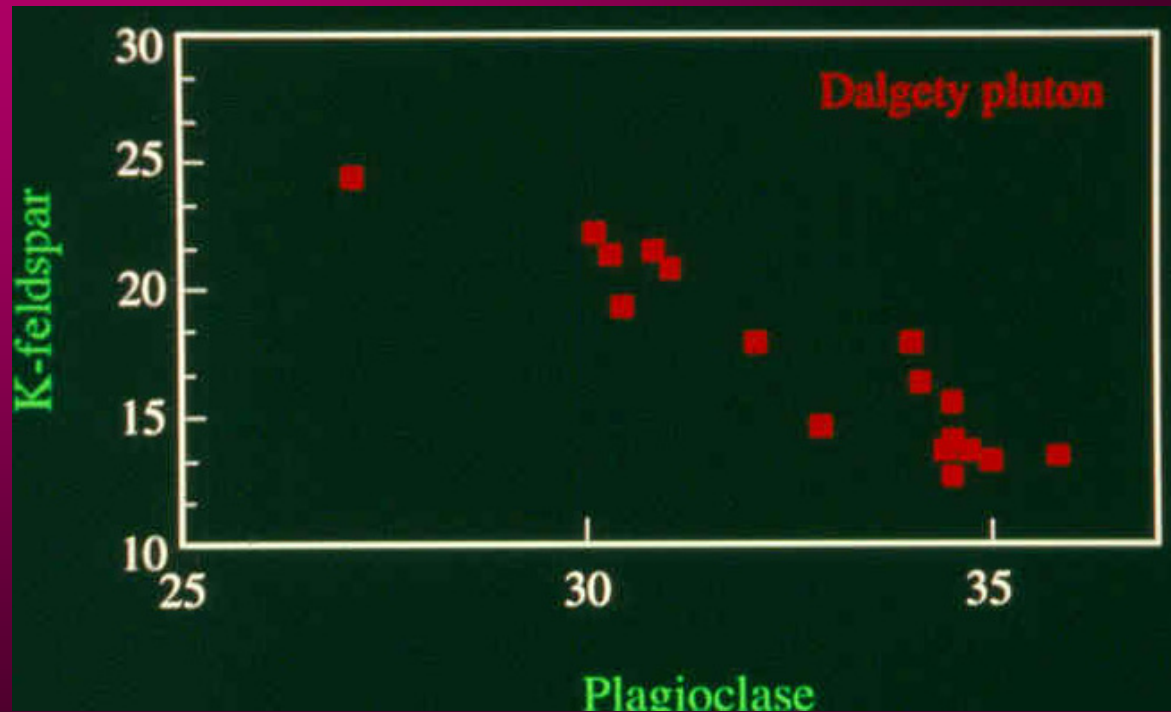
Allocation of Rocks to a Suite

Assumption. Rocks of a single mappable unit or pluton are comagmatic.

Variation in chemical and mineralogical composition within most plutons is so regular and systematic that it is considered to result from some fundamental process inherent in the production of those plutons.

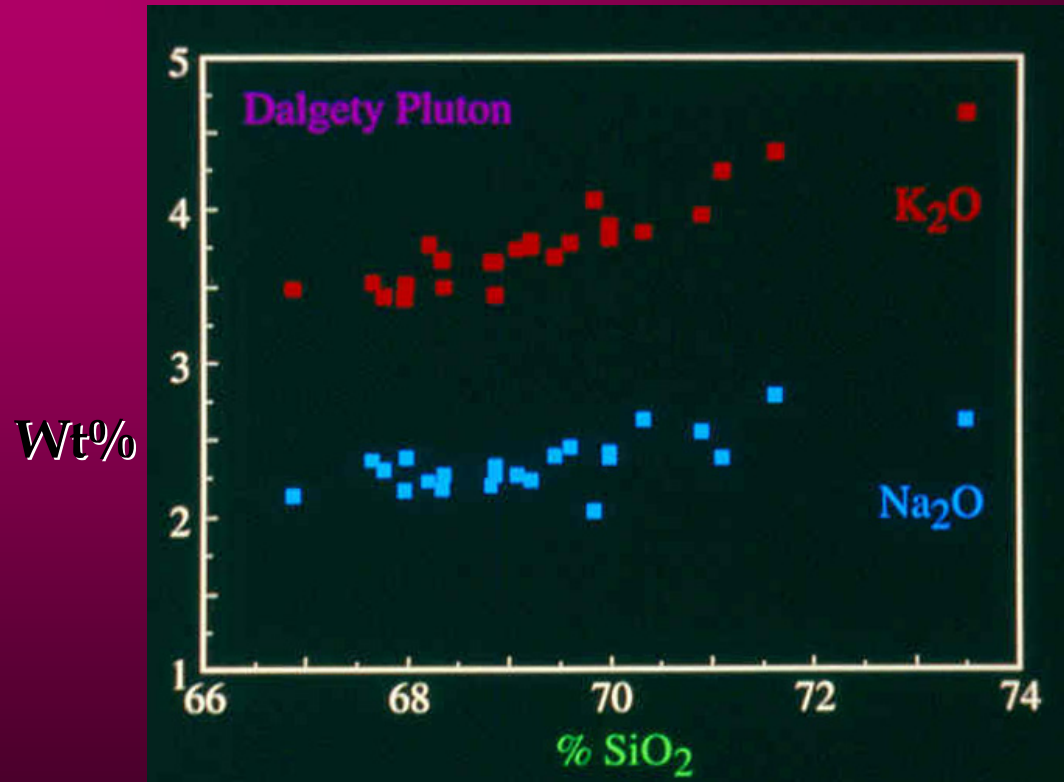
There is no need to know the reason for this variation. Suites are non-genetic

Mineral variation within the Dalgety unit of the Berridale



There is a linear correlation of modal plagioclase and alkali feldspar

Variation of K_2O and Na_2O relative to SiO_2 within the Dalgety unit of the Berridale



Chemical and mineralogical variation within a single pluton is systematic. Variation may be large.

Systematic variation within a particular pluton may be the same as those within another pluton of the region , or an extension of the trends within the other pluton

This is the basis of assigning granites to suites

**RIGOROUS CHEMICAL GROUPING
INTO SUITES**

**The method of assigning eight intrusions
within the Kosciusko Batholith into the
Jindabyne Suite**

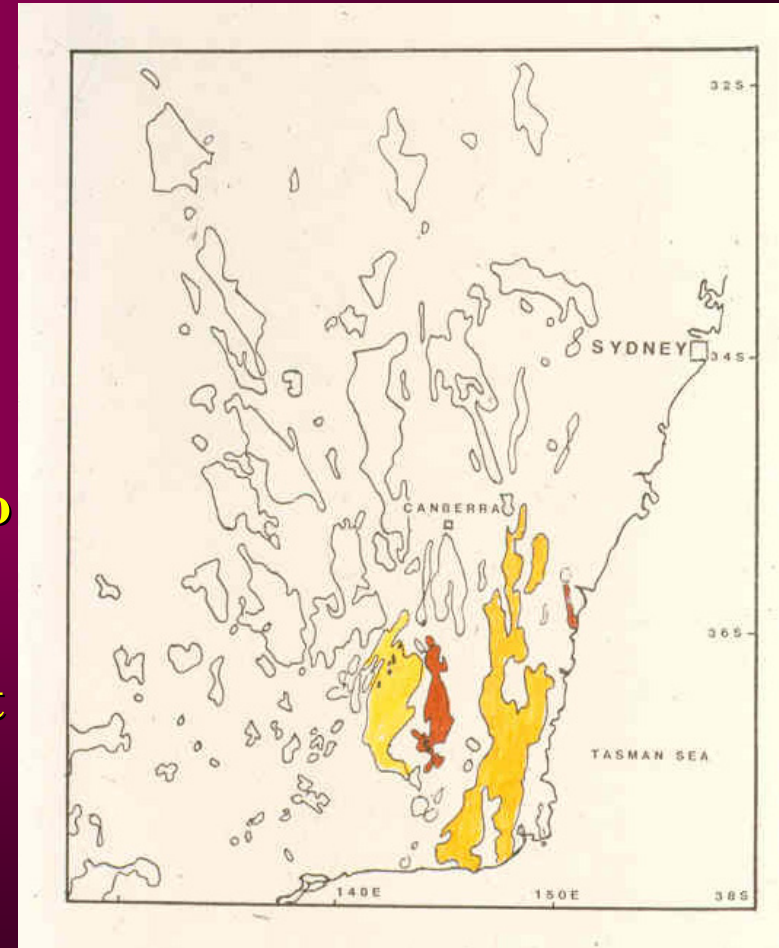
Map of SE Australia

Kosciuszko Batholith (yellow)

**Jindabyne Suite
plutons (black)**

**All are tonalites metaluminous to
peraluminous**

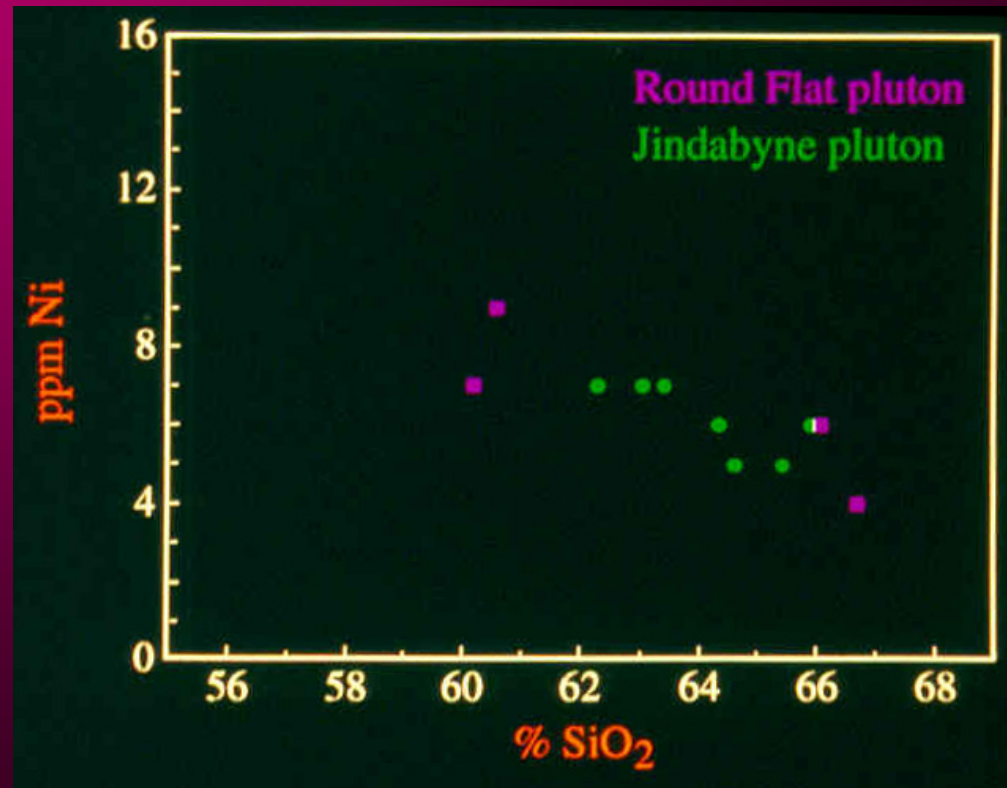
**All have magnetite + allanite but
no titanite**



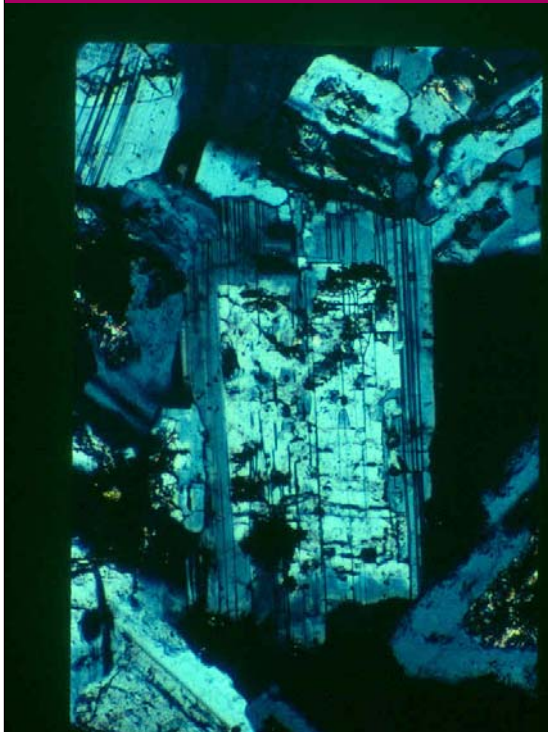
Jindabyne and Round Flat Plutons Ni versus SiO₂

JINDABYNE
Small tonalite
pluton 17Km²

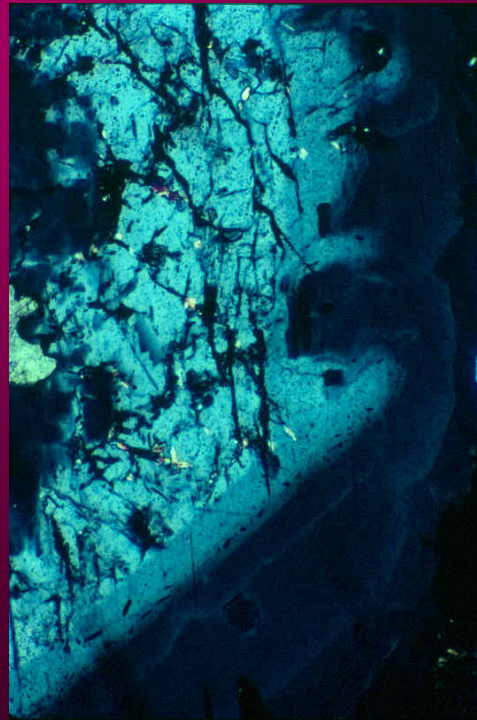
ROUND FLAT
Small (7Km²)
composite pluton
of tonalite 20 Km
north of
Jindabyne.
Rocks of this
unit extend the
Jindabyne trend



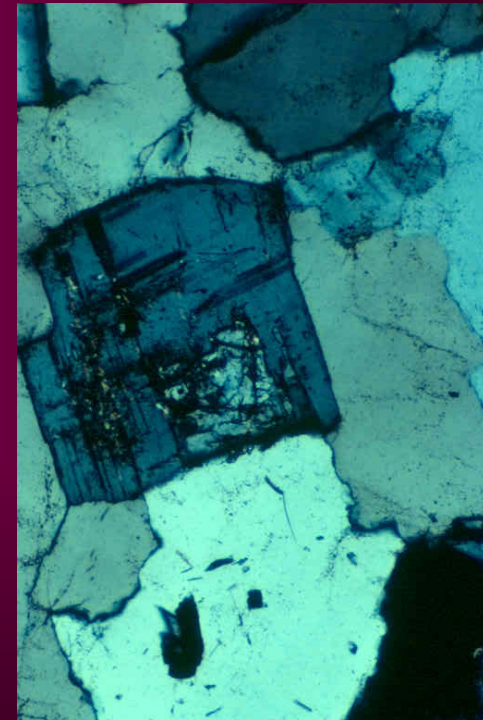
**Cores within plagioclase near An_{80}
Jindabyne Suite Tonalites
From separate intrusions**



SiO₂ 55%



SiO₂ 60%

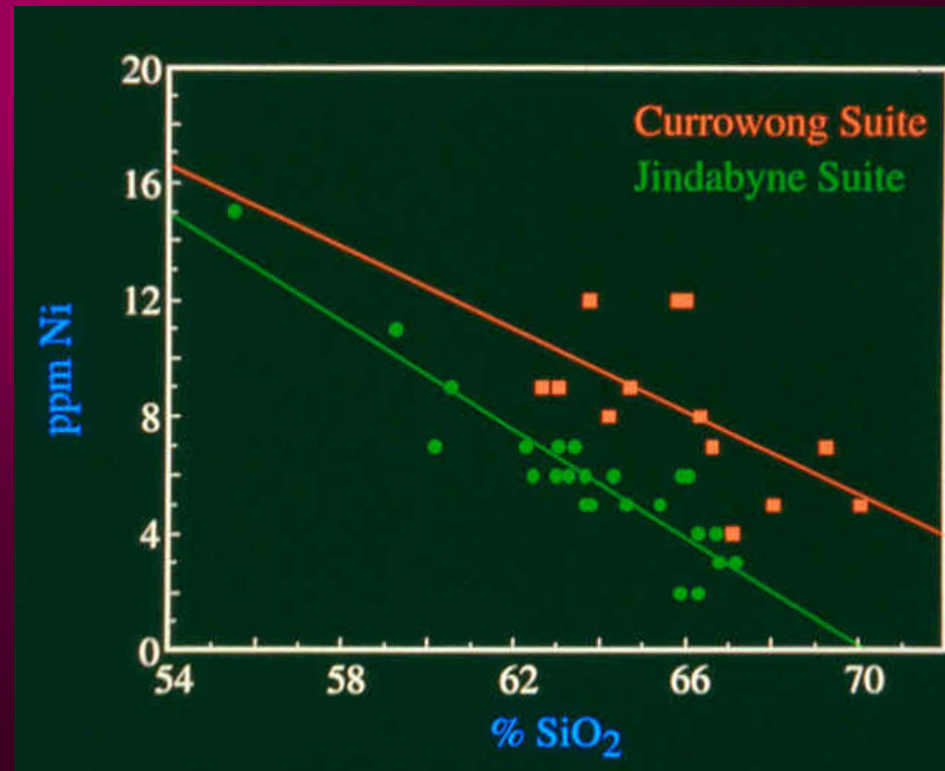


SiO₂ 67%

Comparison of Jindabyne and Currowong Suites - Ni versus SiO₂

Currowong Suite granites occur in Southern part of Berridale Batholith

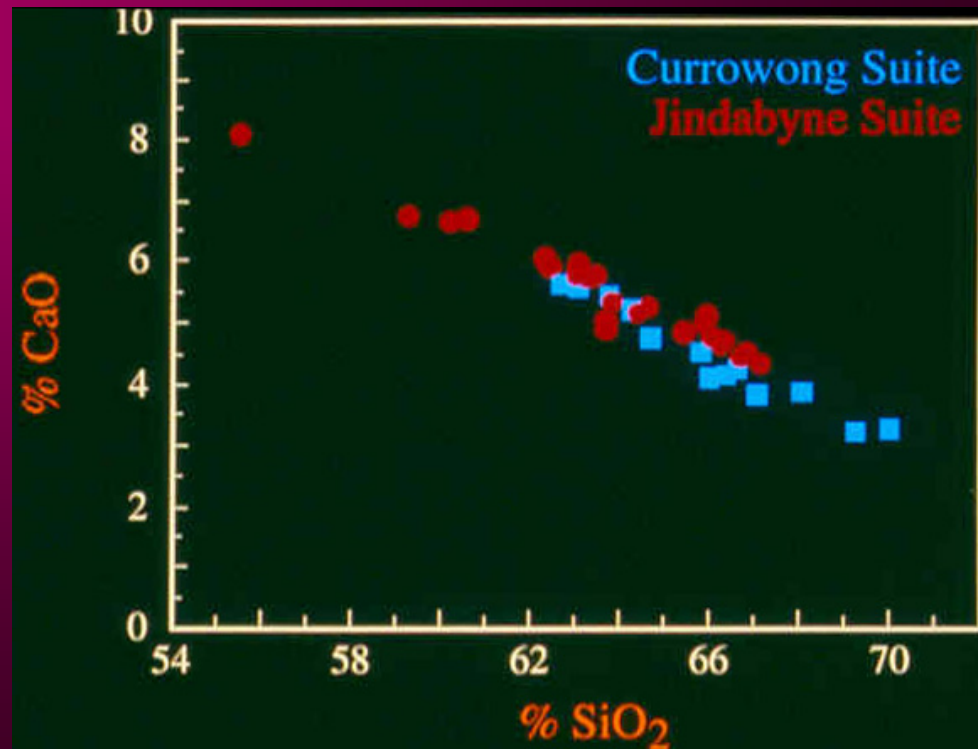
Mineralogically similar to tonalites of Jindabyne Suite with magnetite + allanite. No titanite and cores within plagioclases near An₈₀. BUT Ni is higher as is K₂O etc.
This is a different Suite



Comparison of Jindabyne and Currowong Suites - Ca versus SiO₂

Some elements show very little difference e.g. calcium.

Some elements are virtually the same.



All elements must be on trend for a
rock to be a member of a particular
suite

If only a few elements are off trend
then the rock is not of the same suite
but of the same supersuite

Summary of Suite classification

from Champion 1991 (PhD thesis, ANU)

Classification requires that all rocks from one pluton (pluton A) be included in one and the same suite (suite A) and that these rocks are related in some fundamental manner. Rocks of other plutons B and C etc are then tested to see whether they belong to suite A or not: if the rocks from pluton B are not on the trend defined by suite A, then they do not belong to suite A but another suite.

Suites as thus defined are non-genetic

Criticisms of Suite classification

Criticisms of the suite classification (eg Whitten et al. 1987, Amer. Journ. Sci., 287) based on statistical packages designed for other problems are invalid.

Wall et al. 1987 (Jour. Geol., 95) stress the study of variation within individual plutons. They argue that suites may not represent co-magmatic lineages. However, if granites of plutons with a wide distribution effectively have the same compositions this must be genetically and economically significant.

EXAMPLE OF SIMPLE SUITES Glenbog Suite

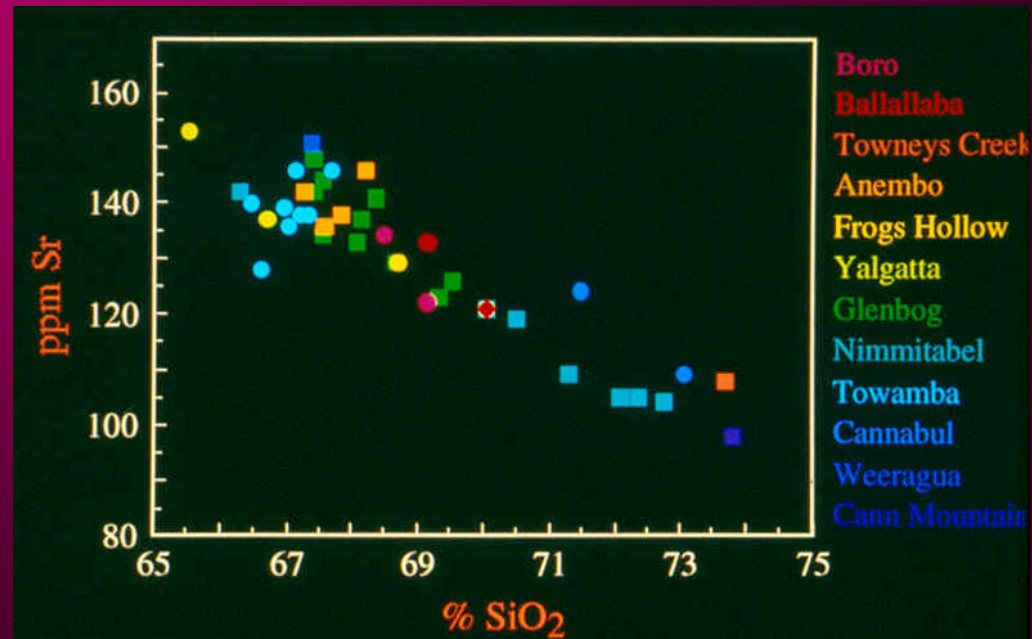
Comprises 12 plutons
strung

out over 265 km.

Area 1510 Km²

Named from Glenbog
Pluton in centre of
string

All rocks with hornblende
except most felsic
+ magnetite. No
titanite. Quartz occurs
as large aggregates



EXAMPLES OF SIMPLE SUPERSUITES

1 Glenbog Supersuite

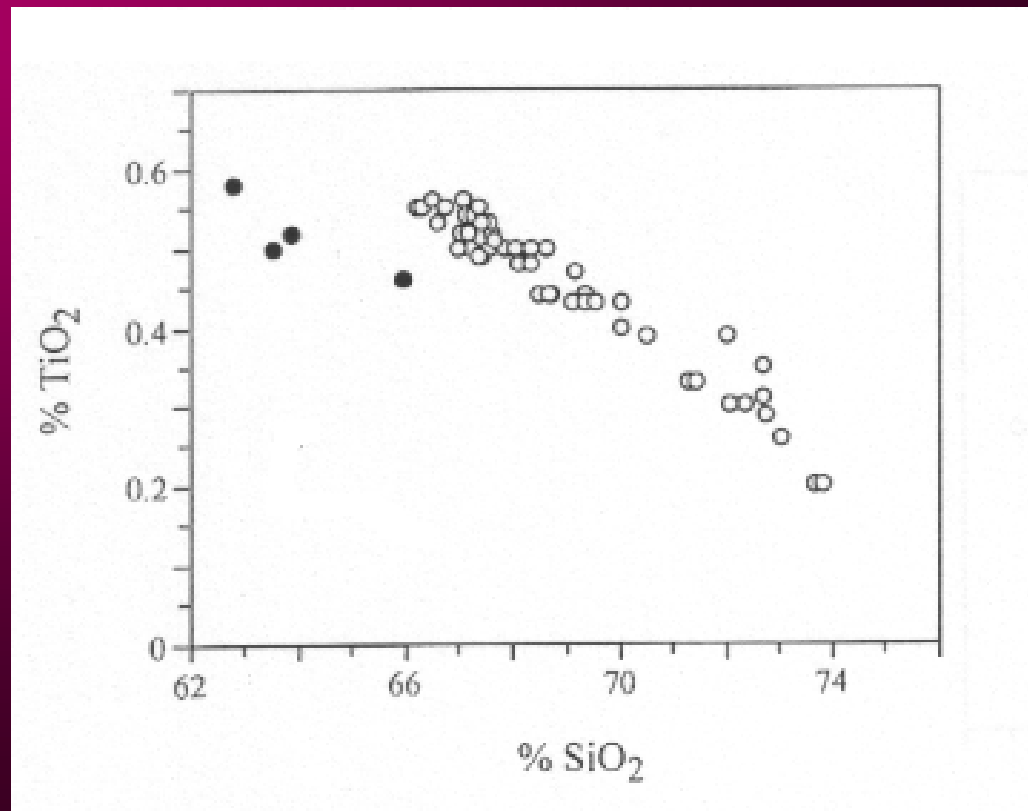
Comprises Glenbog Suite (12 plutons) & Blue Gum Suite (2 plutons) & volcanics

Named from Glenbog Suite

All rocks with hbe except most felsic + magnetite. No titanite. Quartz large aggregates mostly absent in

Blue Gum Suite

Blue Gum lower Zr, Nb & TiO₂



EXAMPLE OF SIMPLE SUPERSUITES

2 Bullenbalong Supersuite

Comprises six suites
and 42 plutons
& volcanics

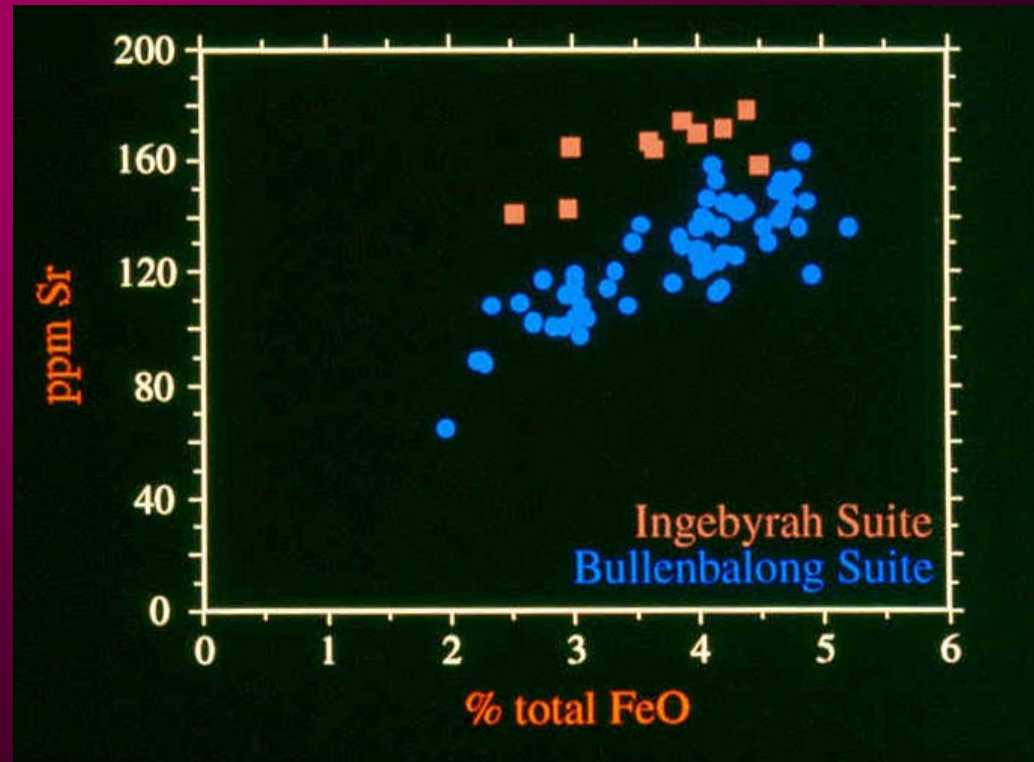
Named from
Bullenbalong Suite

All rocks with
cordierite, red-brown
biotite

No magnetite.

Ingebyrah Suite

(2 plutons) has higher
Sr and large quartz



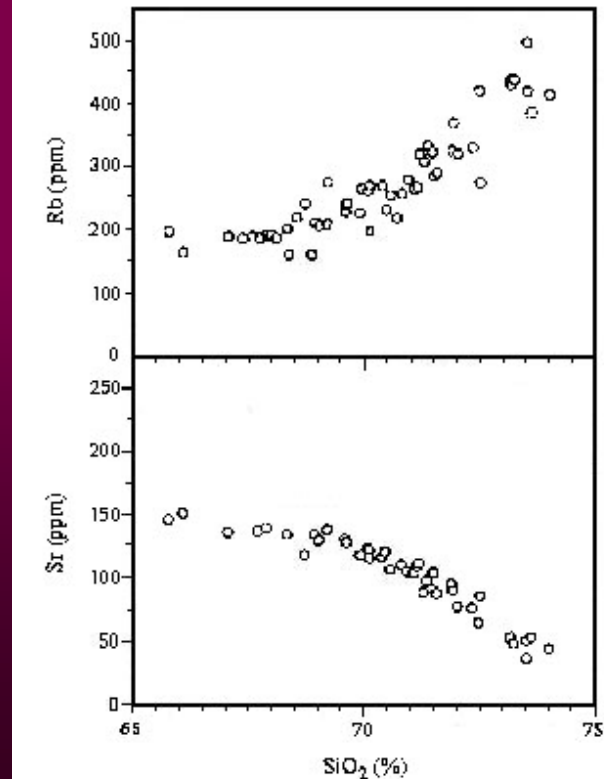
INTRICATE SUPERSUITES & SUITES

some elements display curved trends on variation diagrams

1 Koetong Suite 6740 Km²

Mafic rocks have cordierite + red-brown biotite as in the Bullenbalong Suite.

Felsic rocks as in Koetong Pluton have muscovite + red-brown biotite



INTRICATE SUPERSUITES & SUITES

some elements display curved trends on variation diagrams

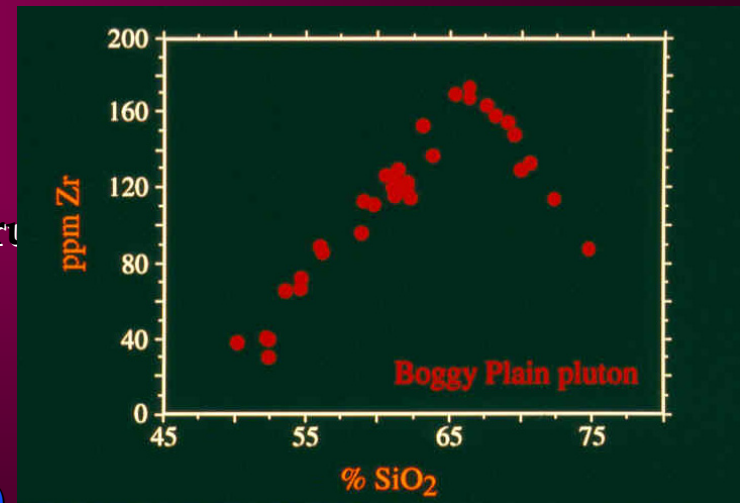
2 Boggy Plain Super-suite.

Supersuite extends for 500 kms through central part of Lachlan

Rocks range from oxidized pyroxenites through gabbros to felsic granites and felsic volcanic.

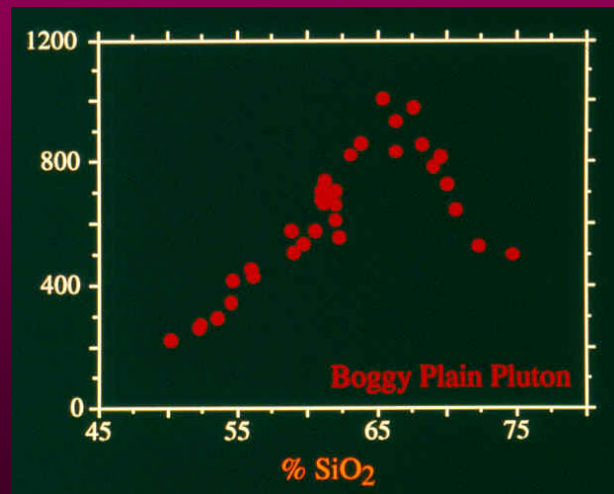
Boggy Plain Suite consists of only the concentrically zoned Boggy Plain (36 km²)

Boggy Plain contains almost whole range of Supersuite compositions except certain most felsic rocks



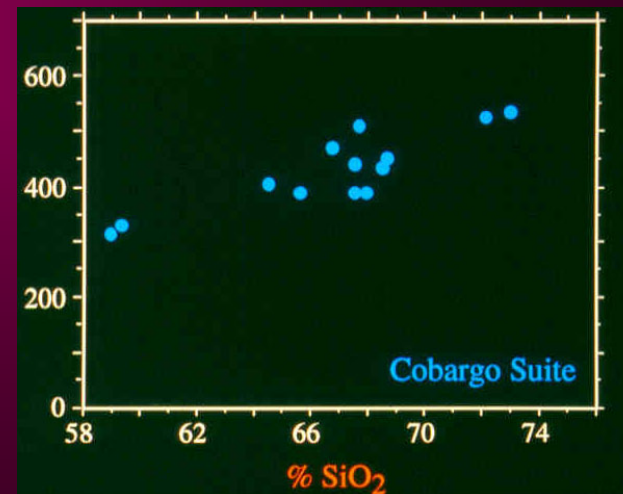
INTRICATE SUPERSUITES & SUITES (comparison)

**Ba Boggy Plain
Suite
(intricate)**



↑
ppm Ba

**Ba Cobargo
Suite
(simple)**



INTRICATE SUPERSUITES & SUITES

some elements display curved trends on variation diagrams

2 Boggy Plain Supersuite

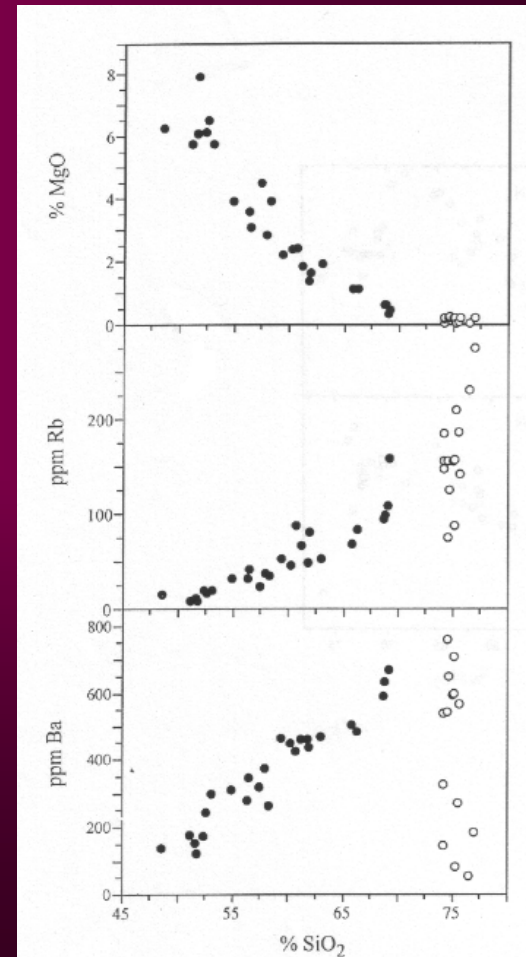
Nallawa Suite Yeoval Batholith

360 km north of Boggy Plain Pluton

Higher Ti & Lower Cr and Ni than
Boggy Plain Suite

SiO₂ 48.5 to 77.0 % but total range only
in several plutons

Big range in Rb values at 75 % SiO₂
not seen in Boggy Plains Pluton data.



FIELD OBSERVATIONS AND SUITES

Suites are not just “geochemical families”. Field, hand sample, petrographic and geophysical data should all be used to assign a rock to a suite.

Examples

Jindabyne Suite rocks are all tonalites or close to tonalites and all have magnetite, allanite and no titanite.

A suite similar to Jindabyne but different (Currowong) comprises granites with K- feldspar recognisable with a hand lens. alkali feldspar is not seen in Jindabyne Suite rocks

Glenbog Suite rocks all have large quartz crystals.

Some suites are oxidised and others are reduced. Use a hand magnet, susceptibility meter or total magnetic intensity maps. Be careful here because these methods are based on total magnetite content whereas oxygen fugacity is not.

SUITES SUPERSUITES AND MINERALISATION

Simple supersuites are normally not mineralised. e.g. Bullenbalong has no tin mineralisation whereas the more intricate Koetong Supersuite has world class tin at Ardlethan. Rocks of the latter supersuite show evidence for fractional crystallisation

Appreciable mineralisation may be confined to specific suites within a supersuite. Only Yeoval and Bannimboola Suites of the Boggy Plain Supersuite have appreciable mineralisation.

“Hiltaba Suite Granites” as used in studies of the Gawler Craton in South Australia is incorrect and will do nothing to find Olympic Dam type mineralisation in the region even though the stockbrokers still like the term.