Secular Archaean

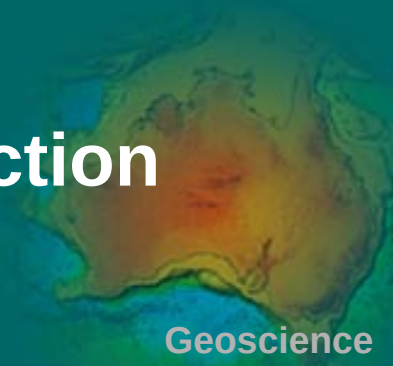
Pronounced secular trends from

1. **early sodic granites (TTGs)**
2. **later potassic granites**

However, also

1. **LILE- & LREE-enriched, high MgO, Mg#, Ni, Cr, intermediate to felsic magmas, and**
2. **alkaline magmatism**

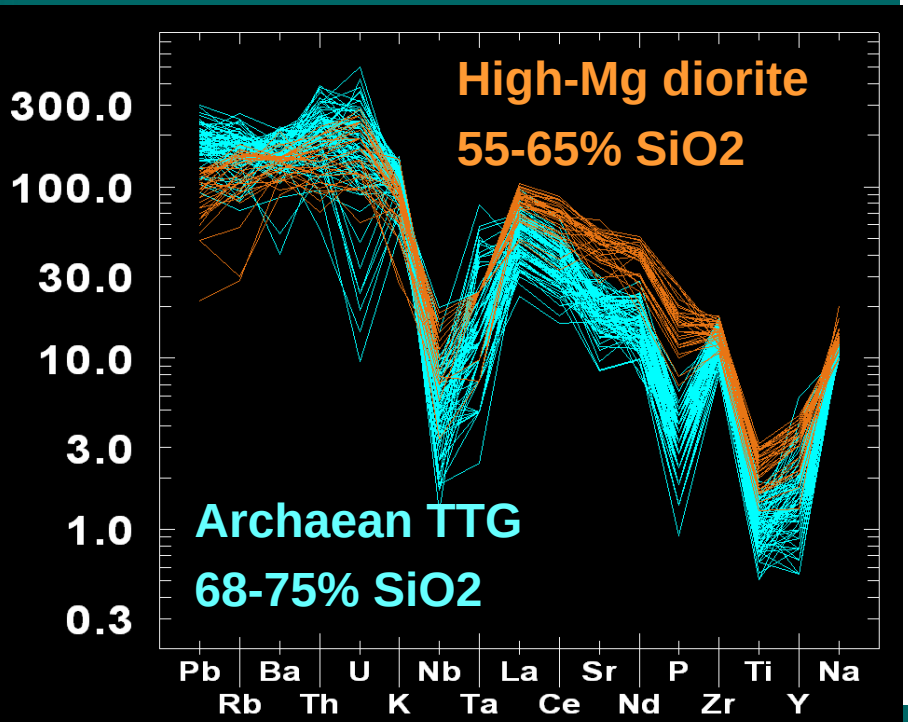
Which we interpret as indicating subduction increasing mantle-wedge influence?

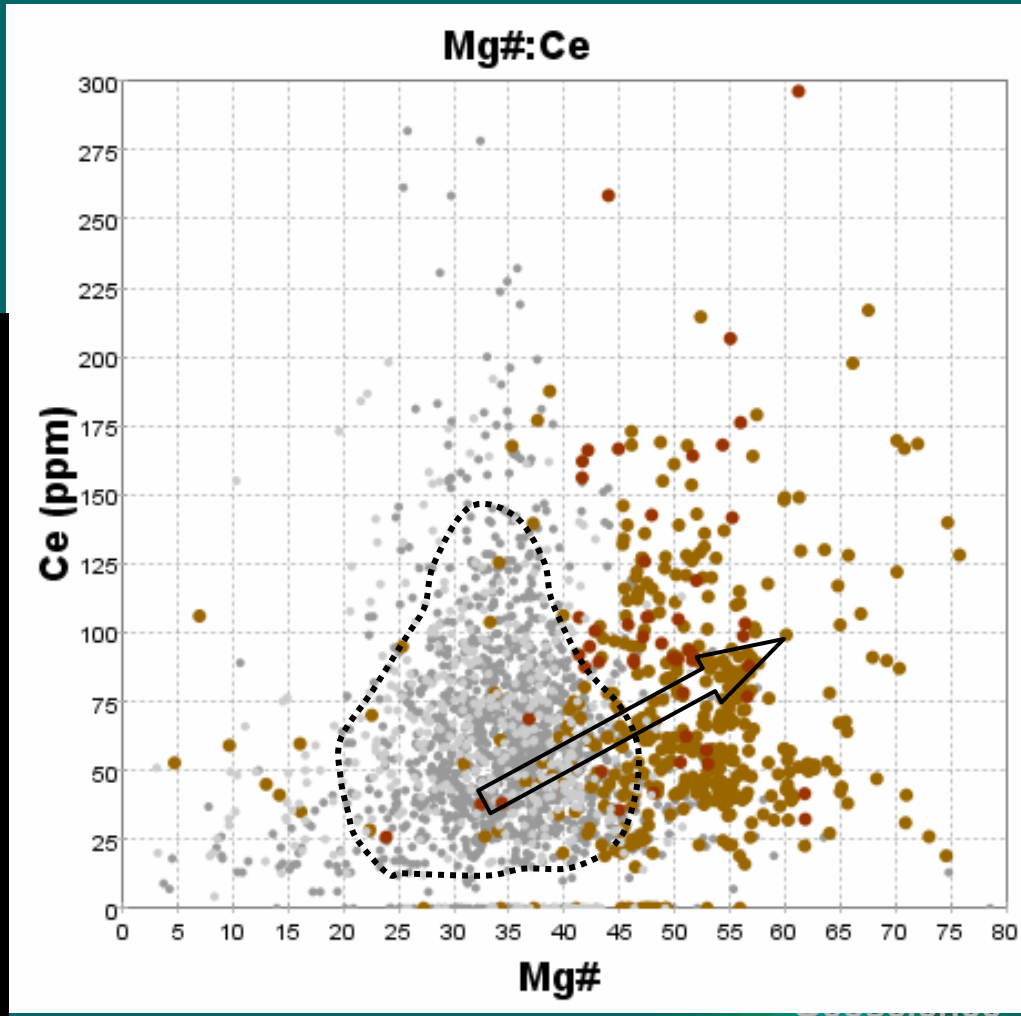


Archaean High-Mg diorites

Enrichment thought to represent slab-melt & slab-fluid metasomatism

Supported by primitive isotope signatures





Secular changes – post-Archaean

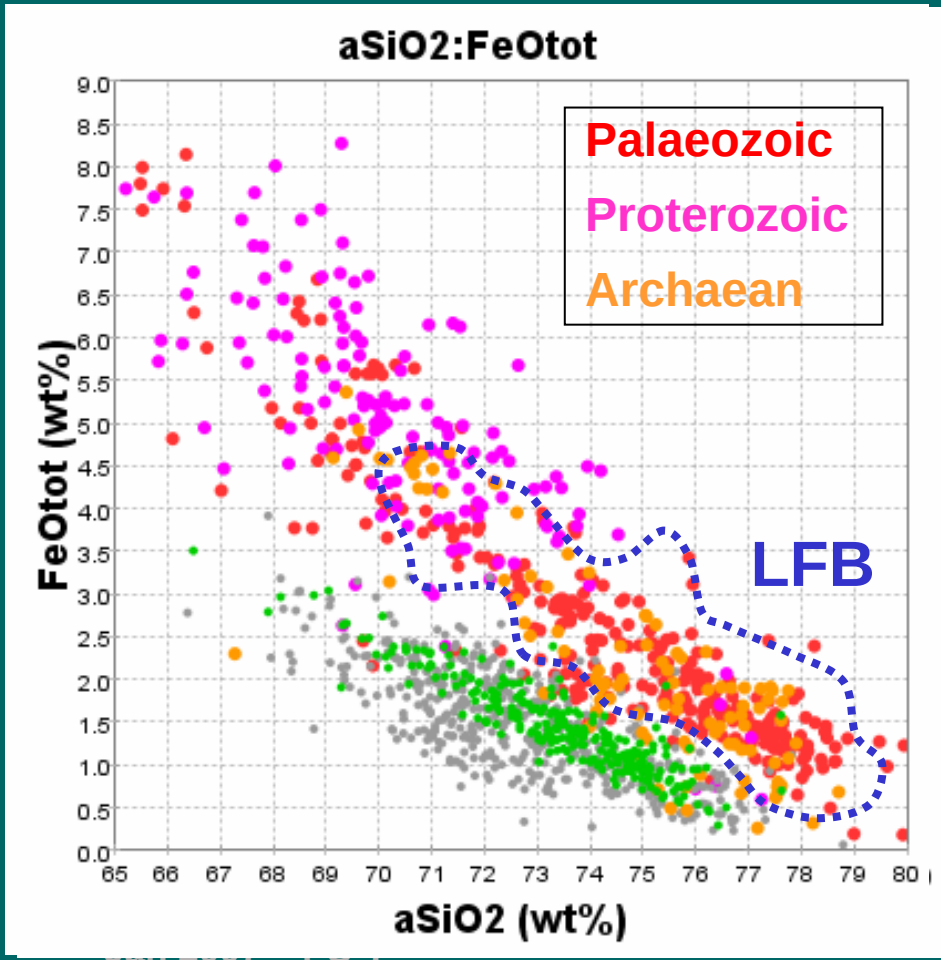
If correct, then post-Archaean granites reflect:

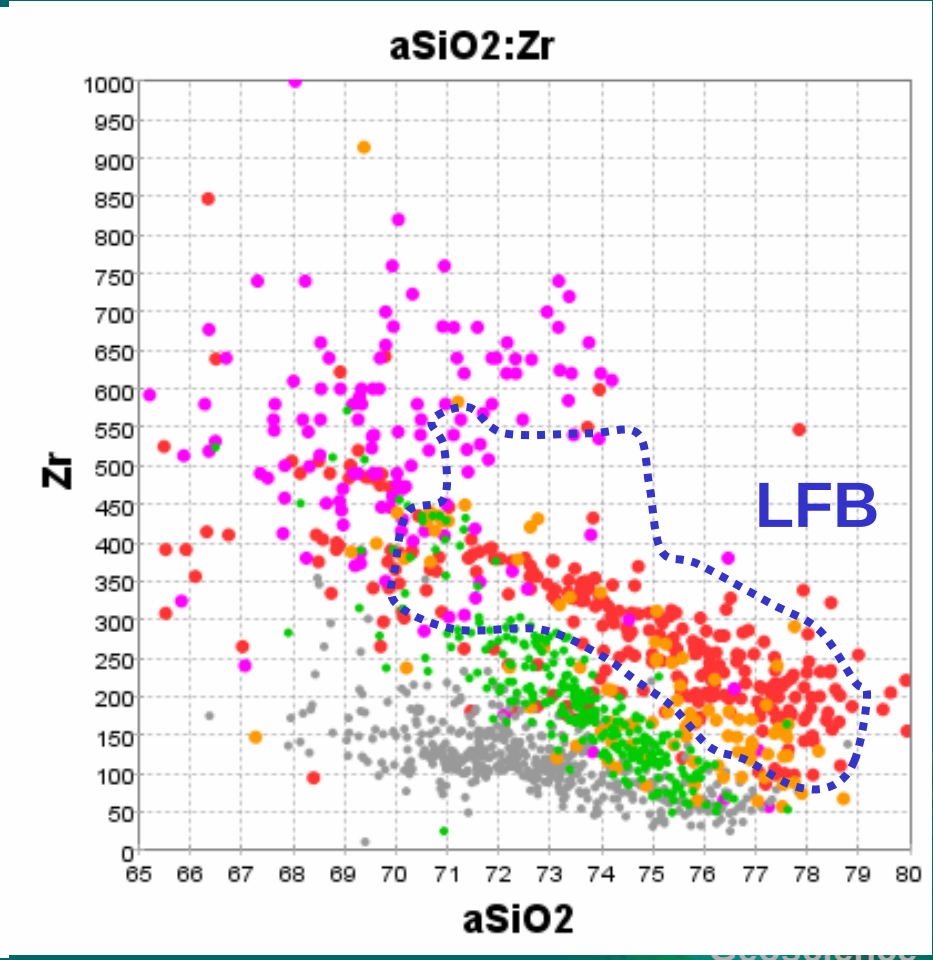
- **changed processes: from Archaean style (slab melting/plumes etc) to modern style tectonics, (esp., subduction) & its variability**
- **an increasingly heterogeneous protolith = increasing regional differences**
- **increased crust-mantle interaction?, especially for potassic granites**

Are there features that haven't changed? Yes

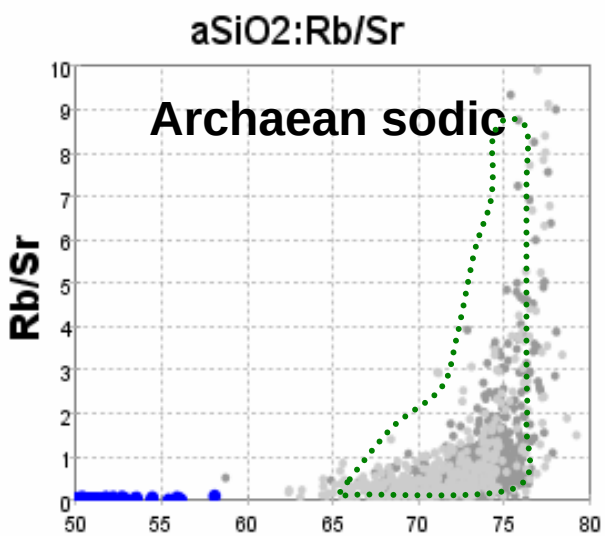
A-types through time

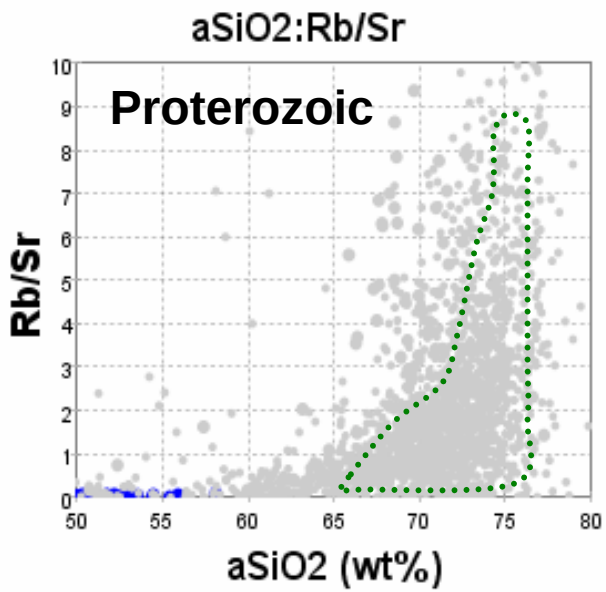
Little apparent change in A-type/Fe-rich granites through time, from Paleoarchaean onwards

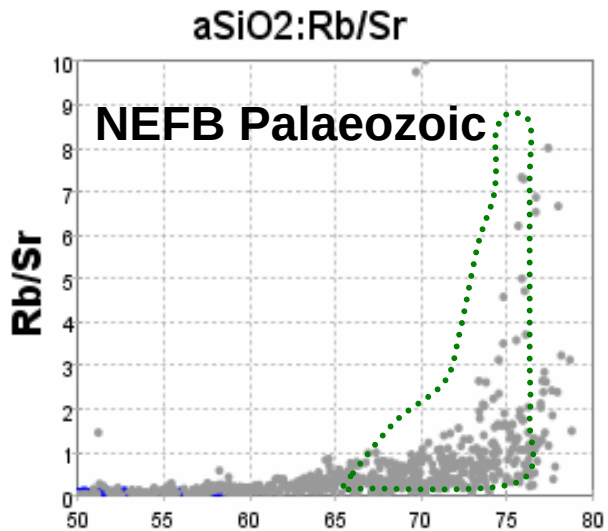


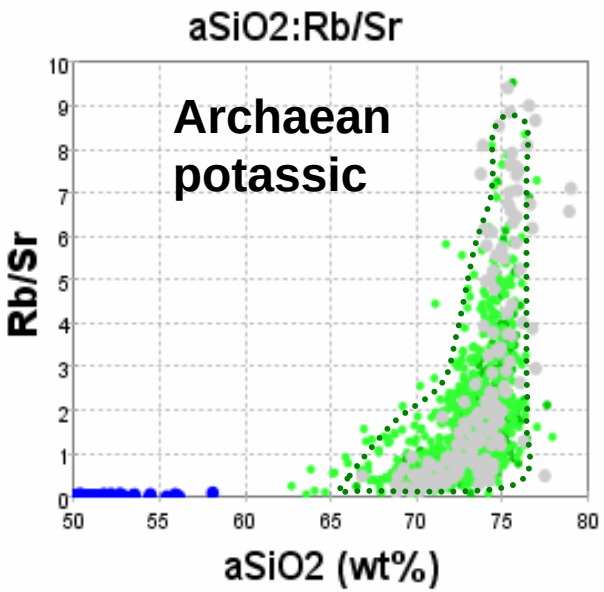


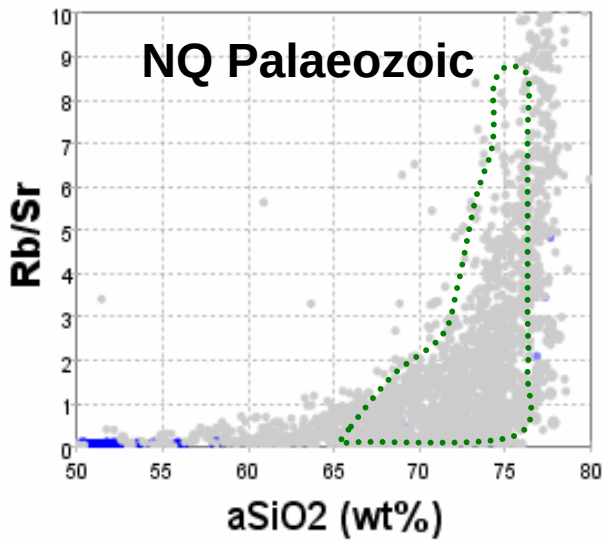
Degree of differentiation

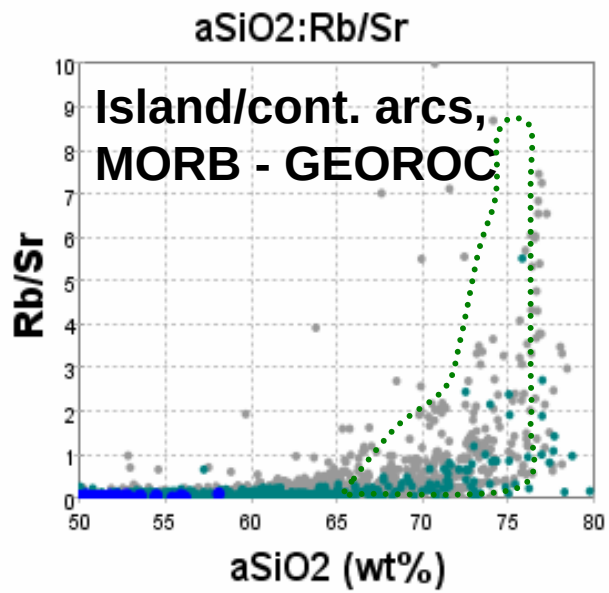






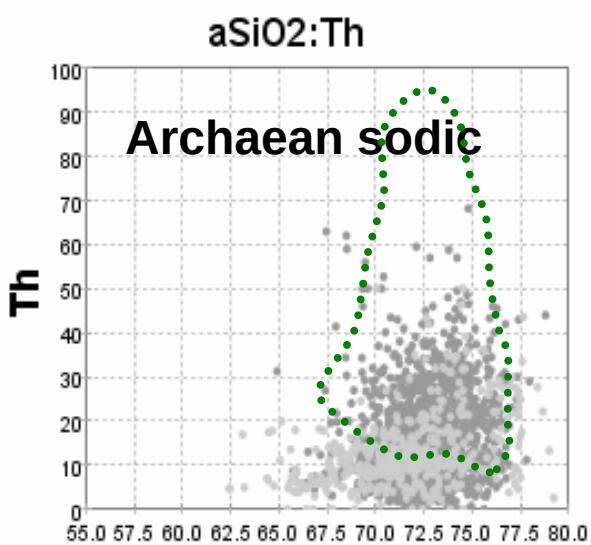


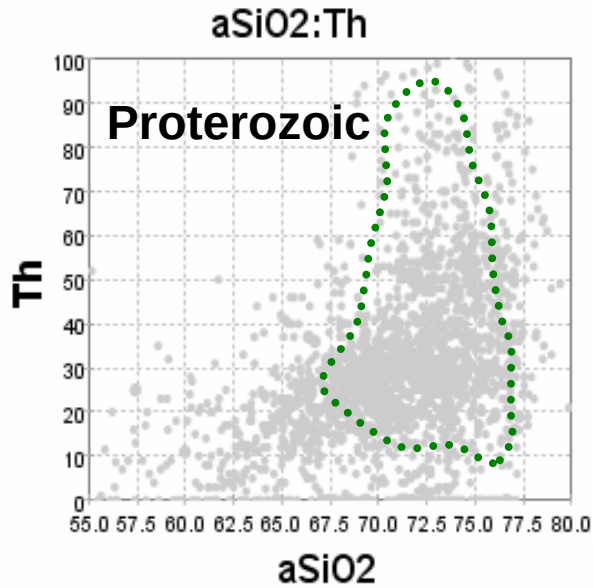


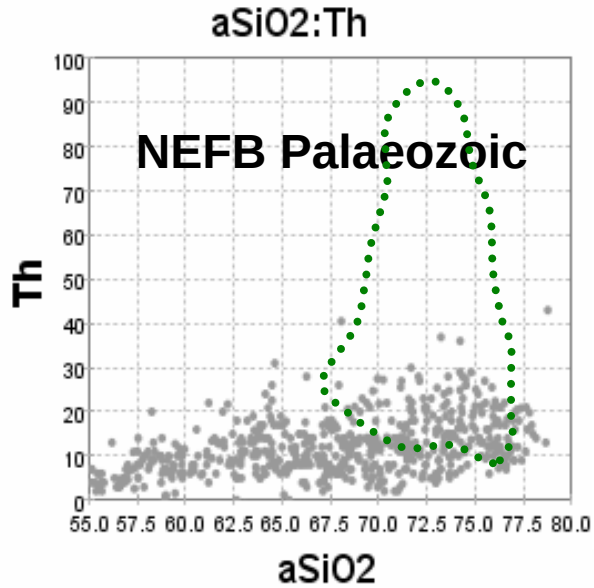


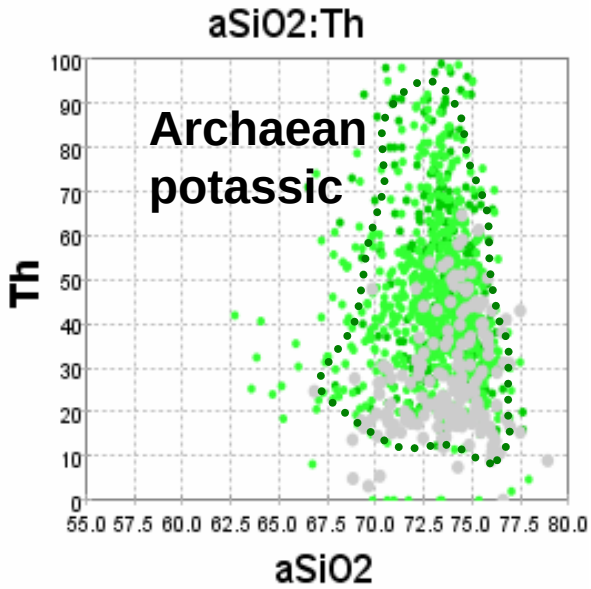
Th through time

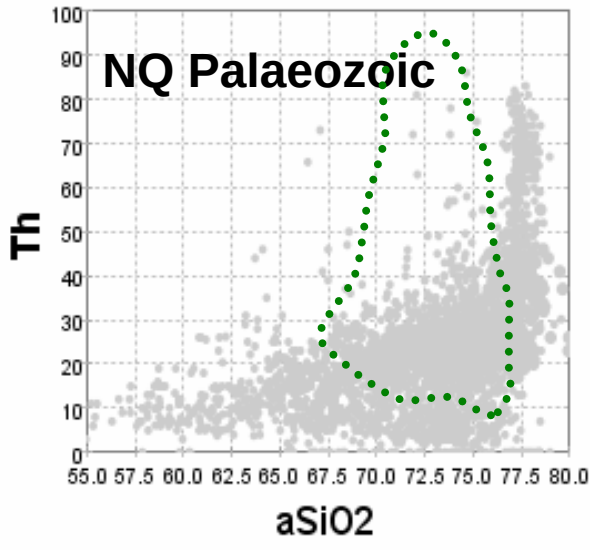
Th-rich granite from mid-Archaean = crust input

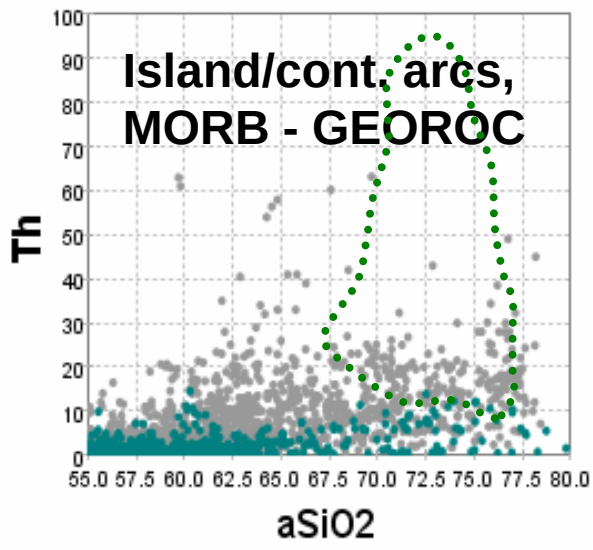






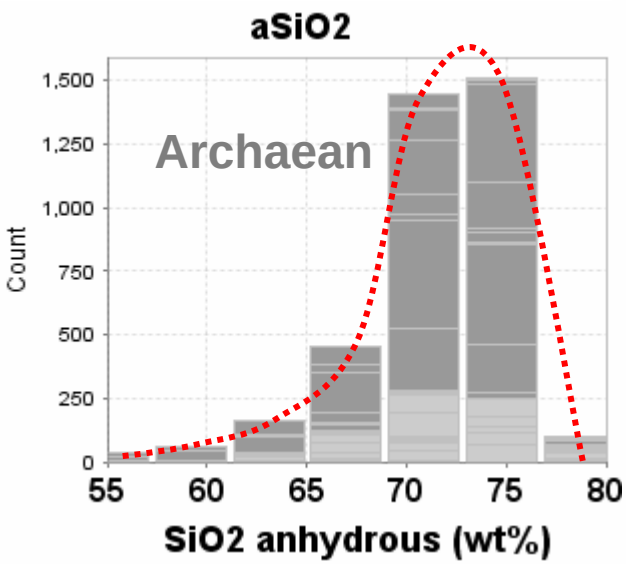


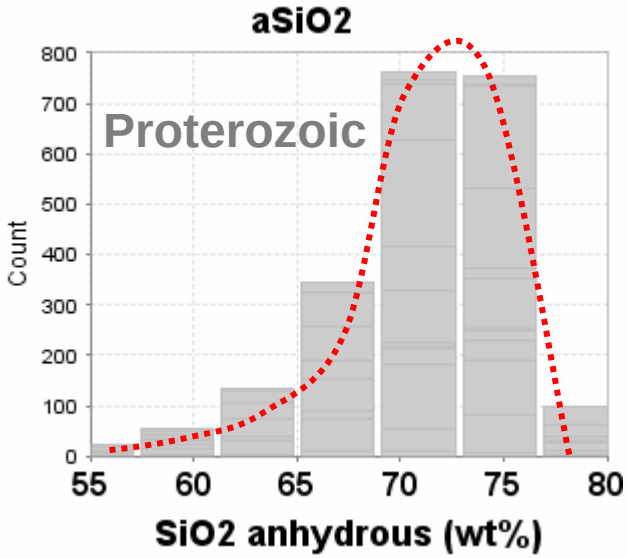


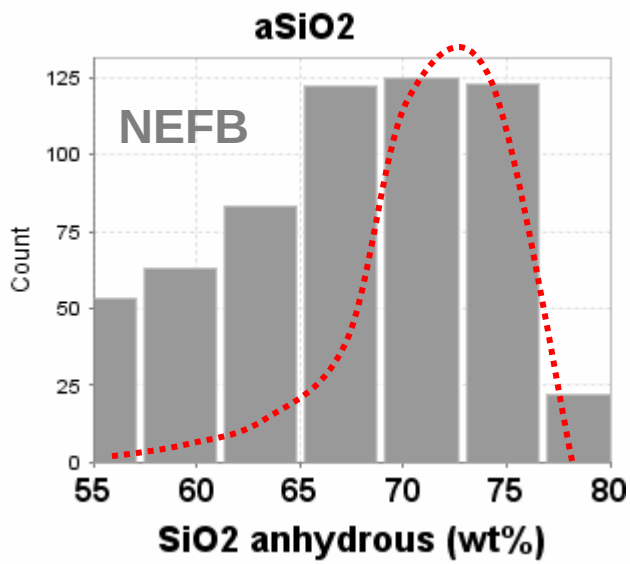


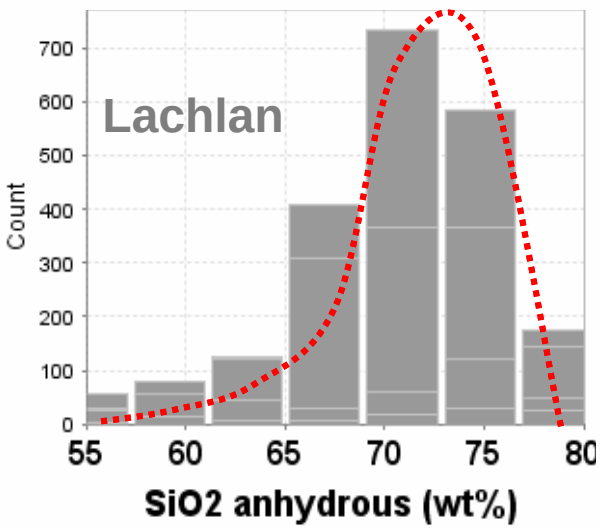
SiO2 distribution

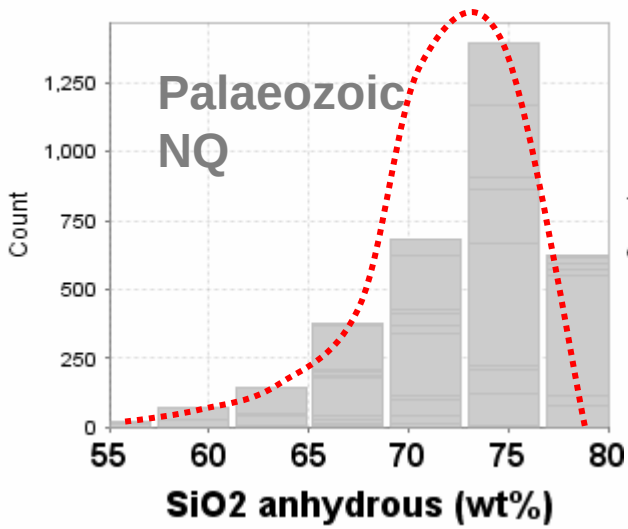
Most of Australia's magmatic history dominated by felsic compositions; esp Archaean & Proterozoic

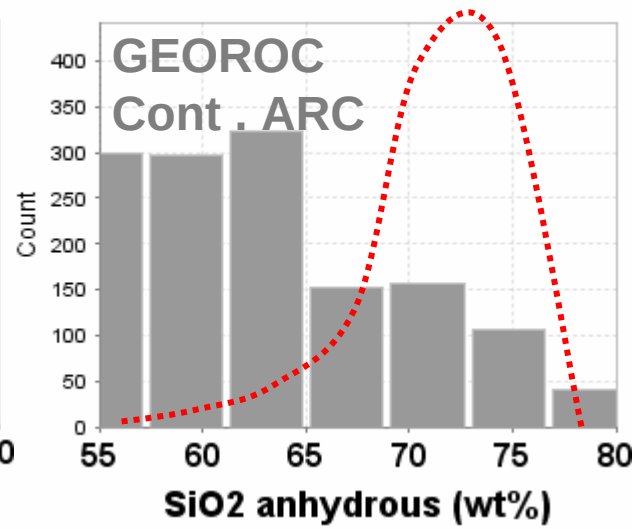










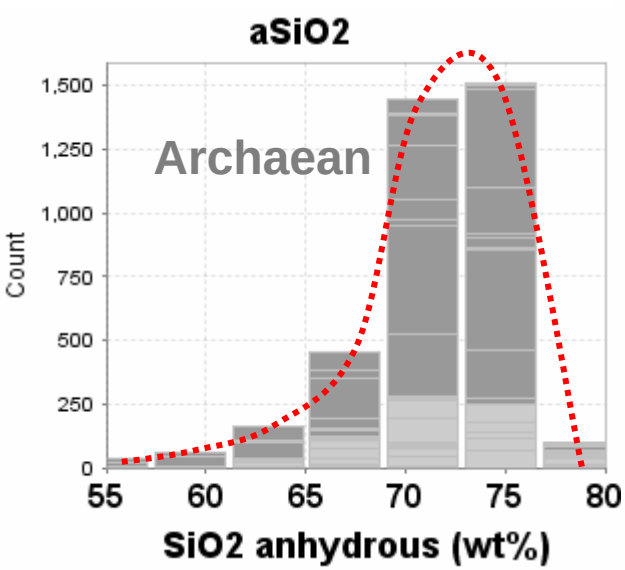


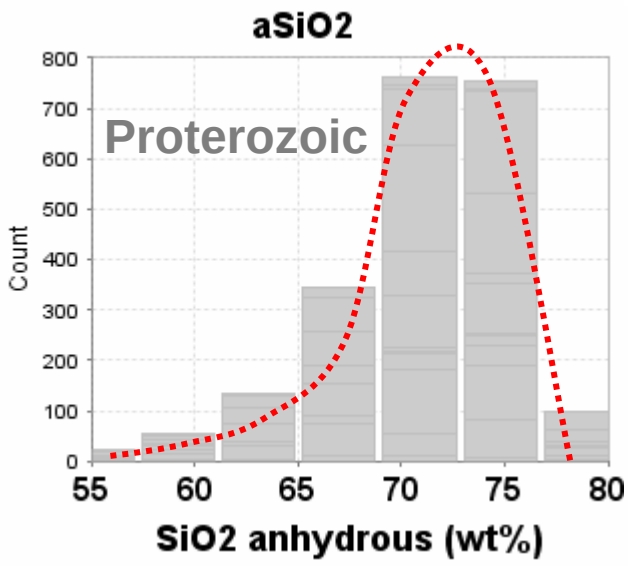
Crustal contribution

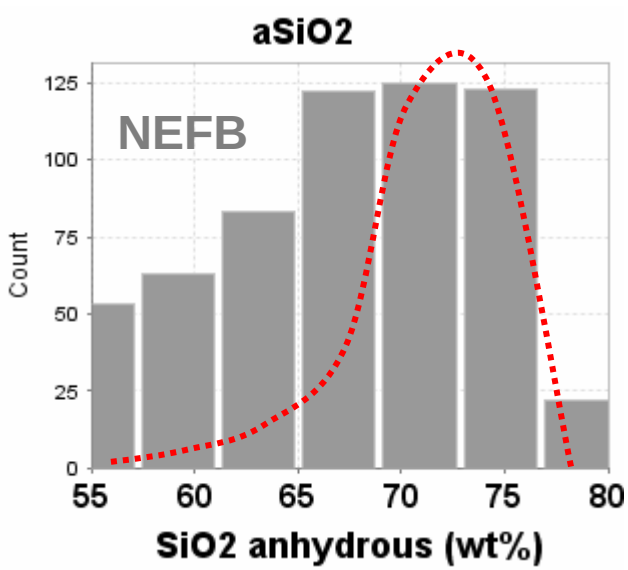
Australia's magmatic history dominated by felsic compositions; esp Archaean & Proterozoic

Chemistry (e.g., high Th) consistent with this

Doesn't rule out modern style tectonics; suggests extensional orogenies (e.g., Collins, 2002)





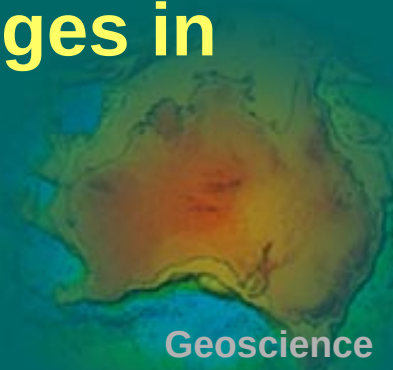


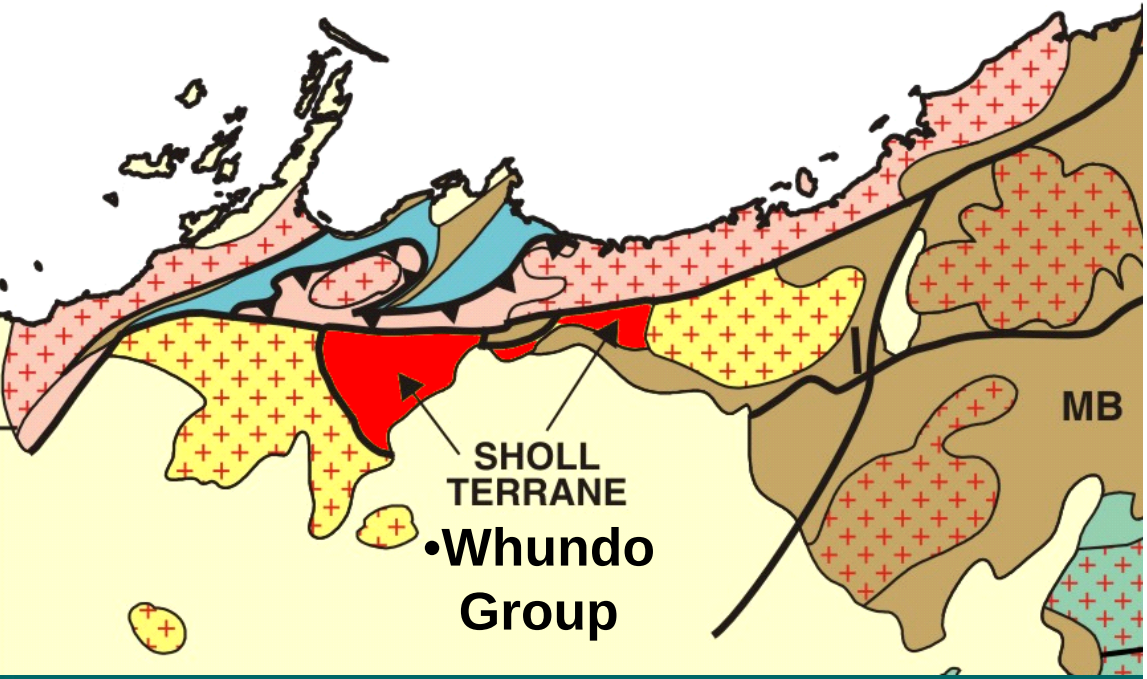
Conclusions

- granite types occur through time, though relative abundances change
- sodic granites abundant in Archaean; mostly minor since
- medium- to high-K granites appear mid-late Archaean, common since
- Archaean most distinctive, with a pronounced secularity; not obvious after this
- A-types, enriched intermediate rocks, alkaline granites also occur in Archaean

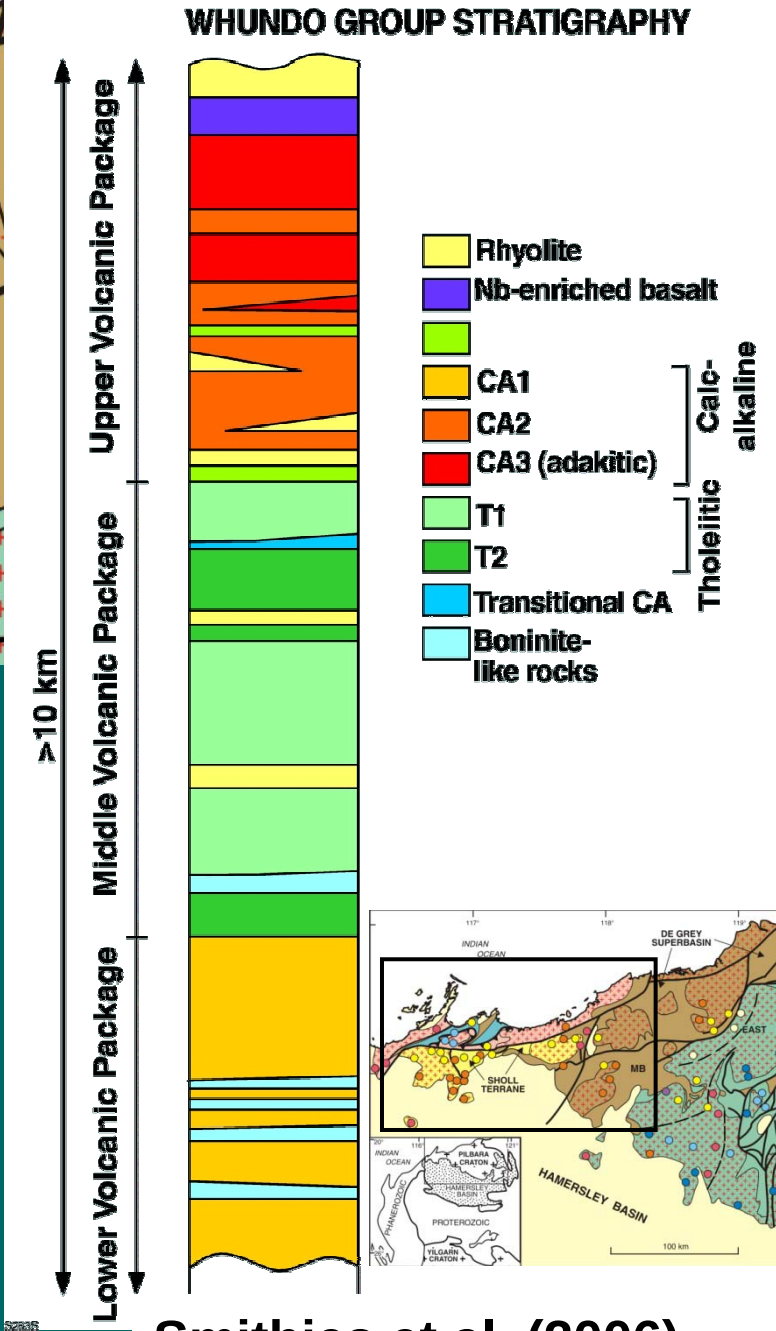
Secular trends – Archaean vs rest

- **Australia's magmatic history dominated by felsic compositions and significant crustal contribution; esp Archaean & Proterozoic**
- **'classic' island/continental arc rocks largely missing in Archaean & Proterozoic. Local examples present though, from 3.1 Ga**
- **secular changes appear to reflect changes in degree, if not style, of tectonics; and increasingly heterogeneous protoliths**

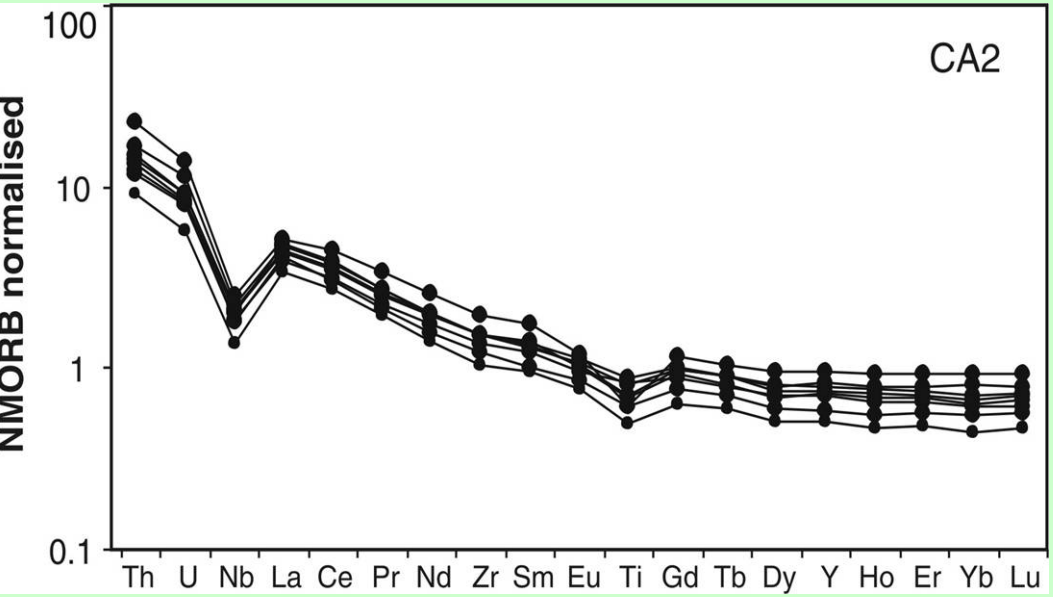


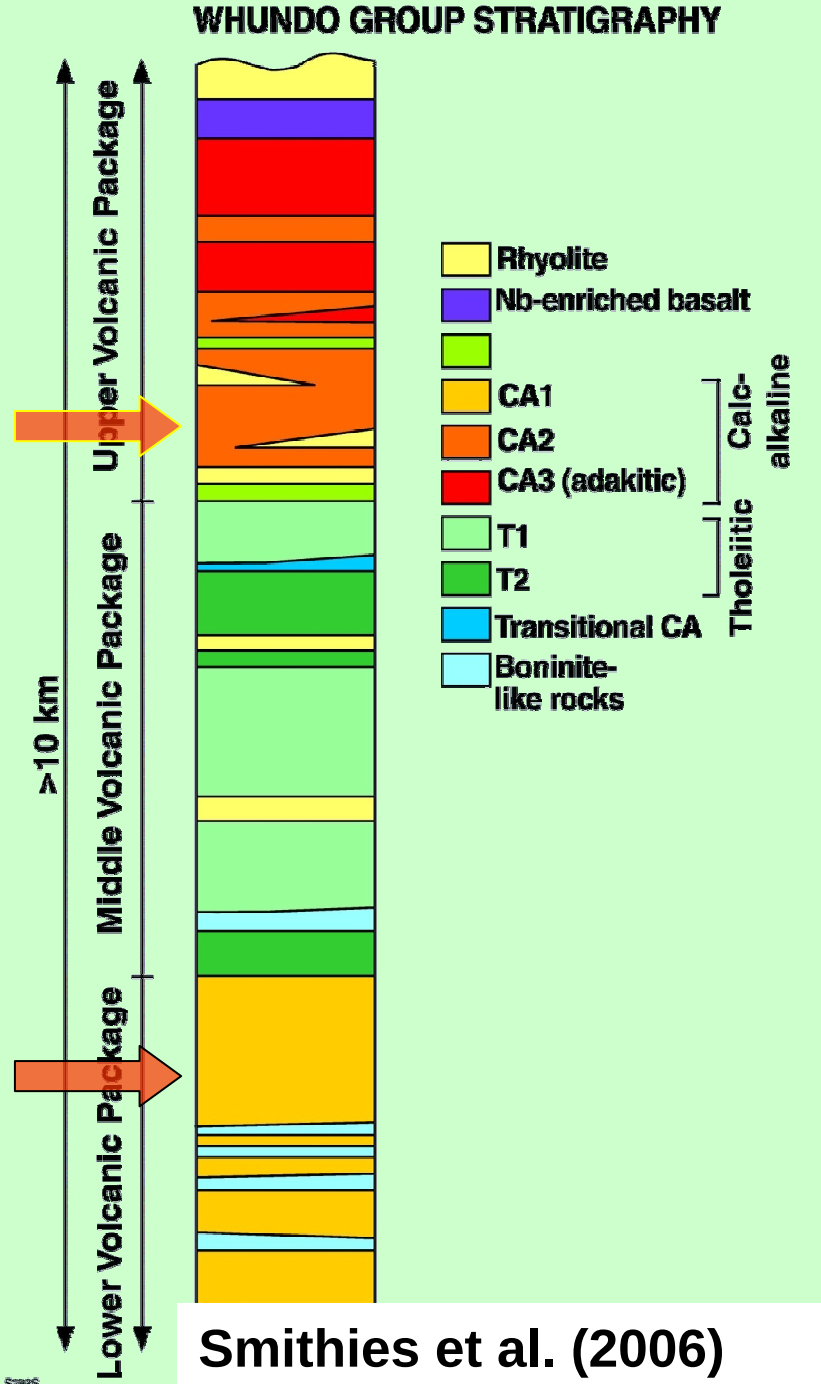


- 3.12 Ga Whundo Group
- ~10 km thick exotic terrain
- wide range of magmatism
- juvenile compositions/isotopes
- no evidence for felsic basement



Smithies et al. (2006)

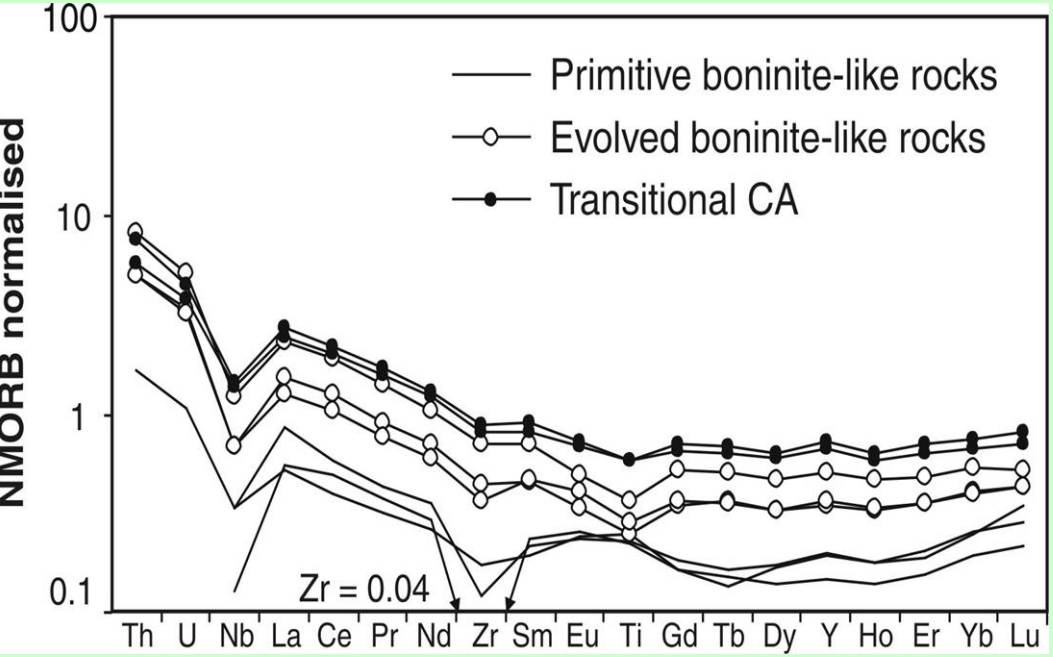




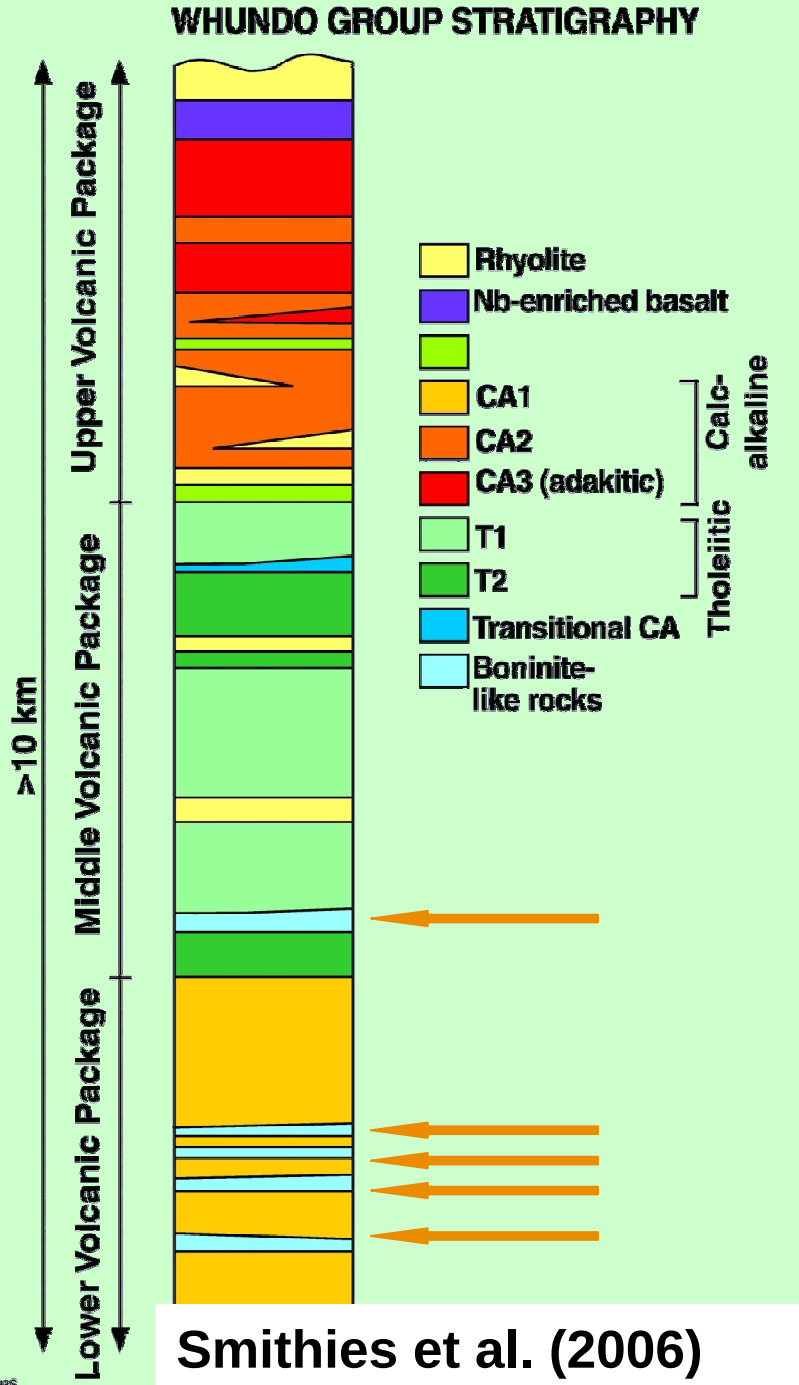
- **Calc-alkaline basalt and andesite**

- **Trace element enrichments cannot be accounted for through contamination by any locally or regionally available crustal component.**

Smithies et al. (2006)

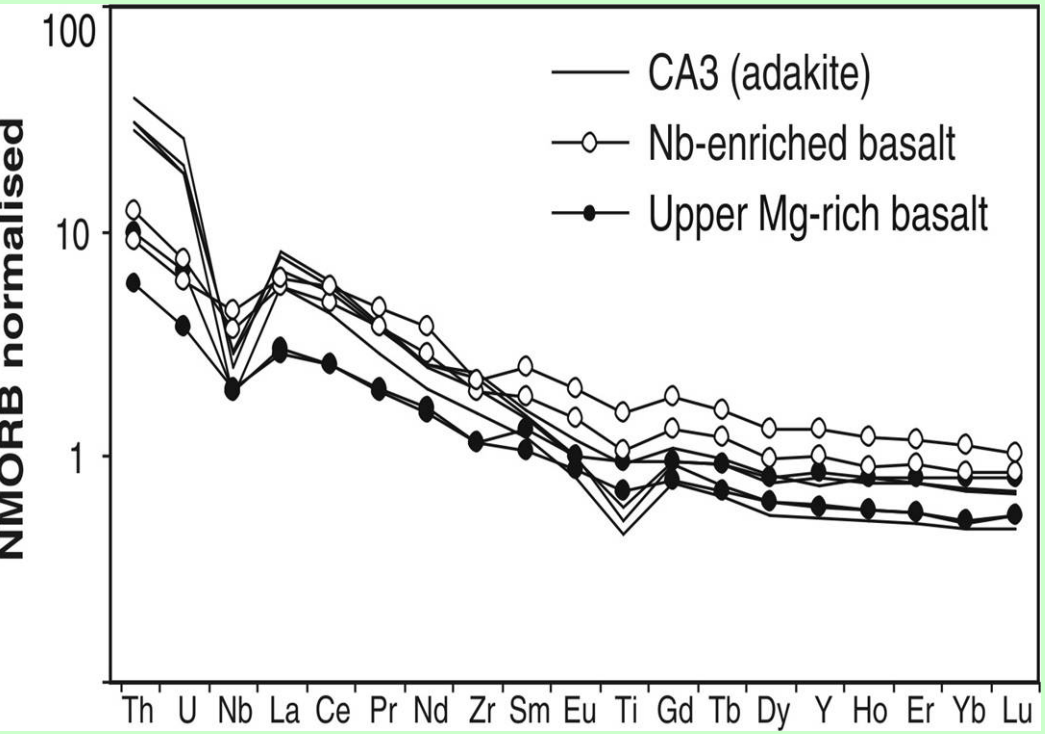


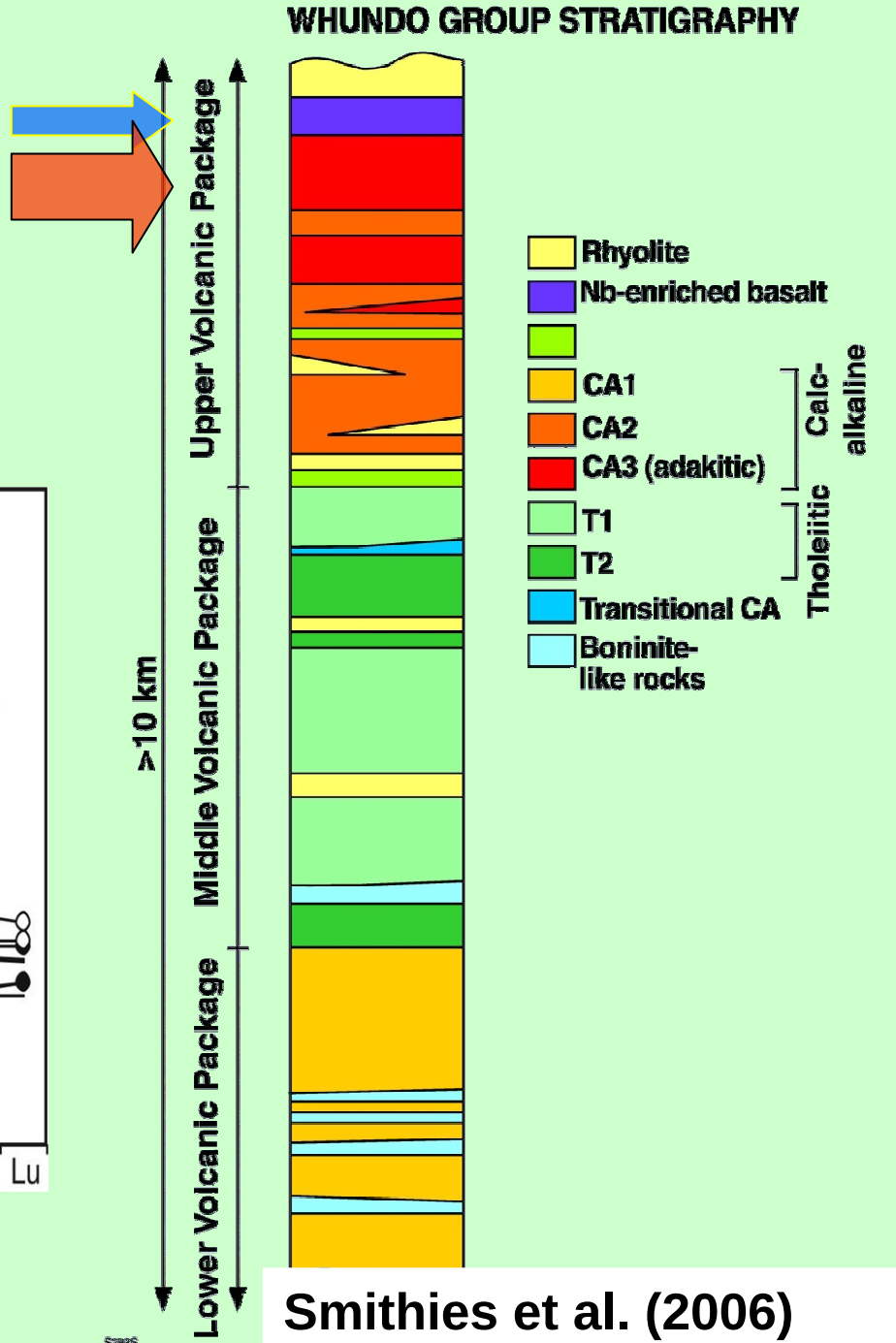
- **Boninites**



Smithies et al. (2006)

- **Adakite**
- **high-Nb basalt**





Smithies et al. (2006)

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