Geology and rare metal ore potential of the Peak Range Volcanics, Central QLD

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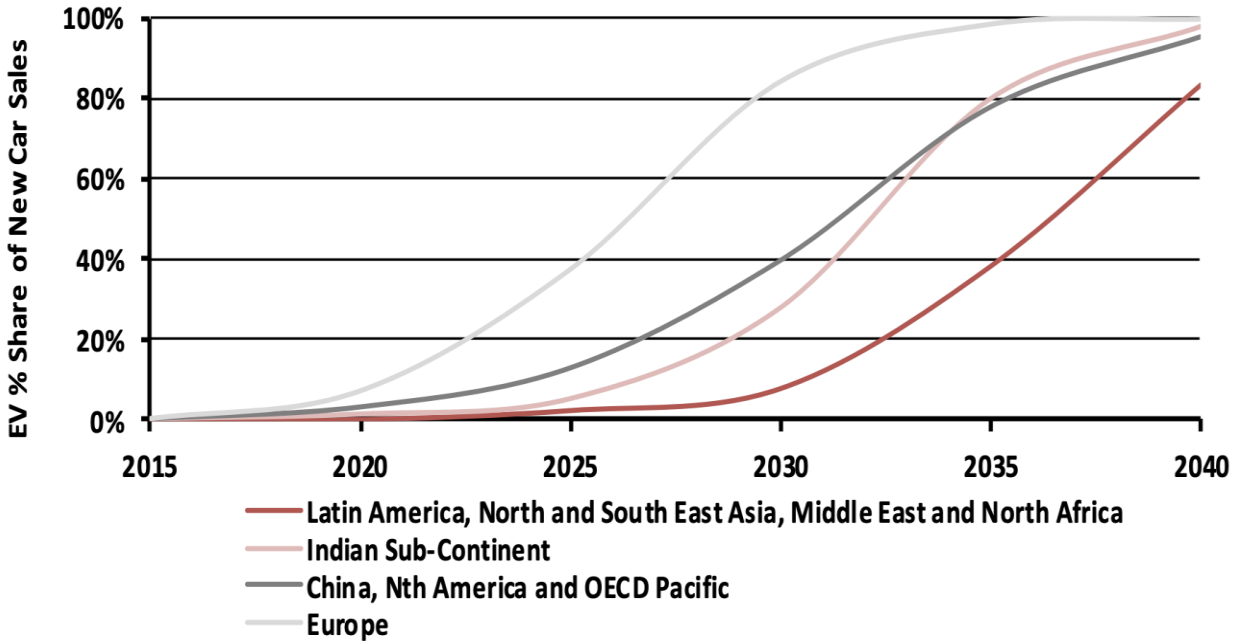
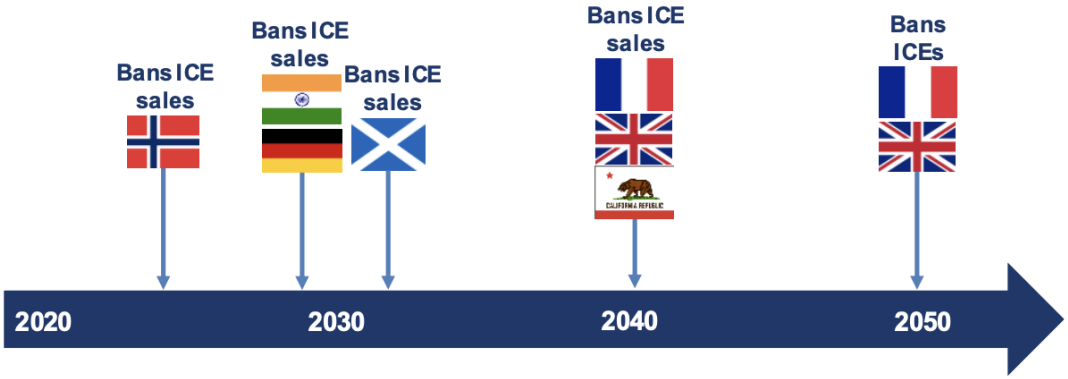
EGRU

Future demands of REE supply….

Figure 43 – Global PEV Adoption Forecasts by Region – DNV GL, 2017

Global adoption of electric vehicles

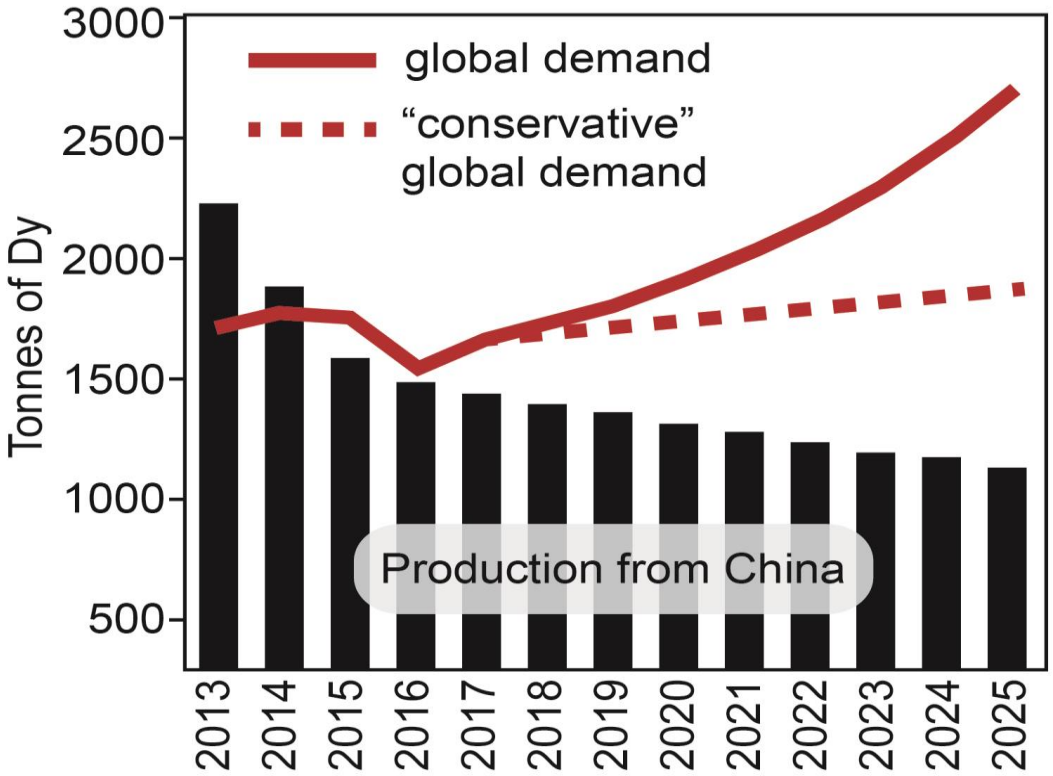




Future bans on internal combustion engines

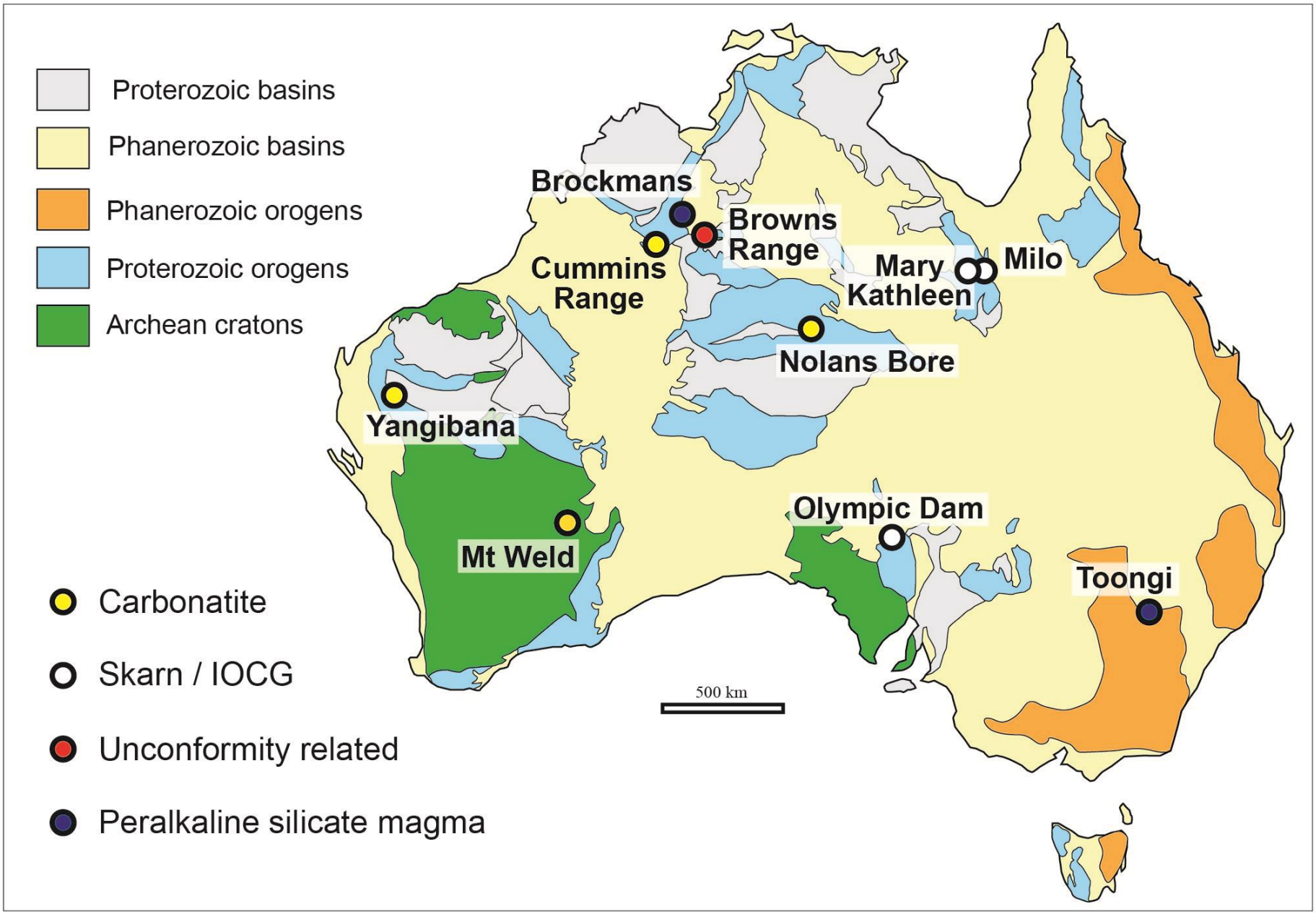
Source: Energeia Research

Future demands of REE supply….

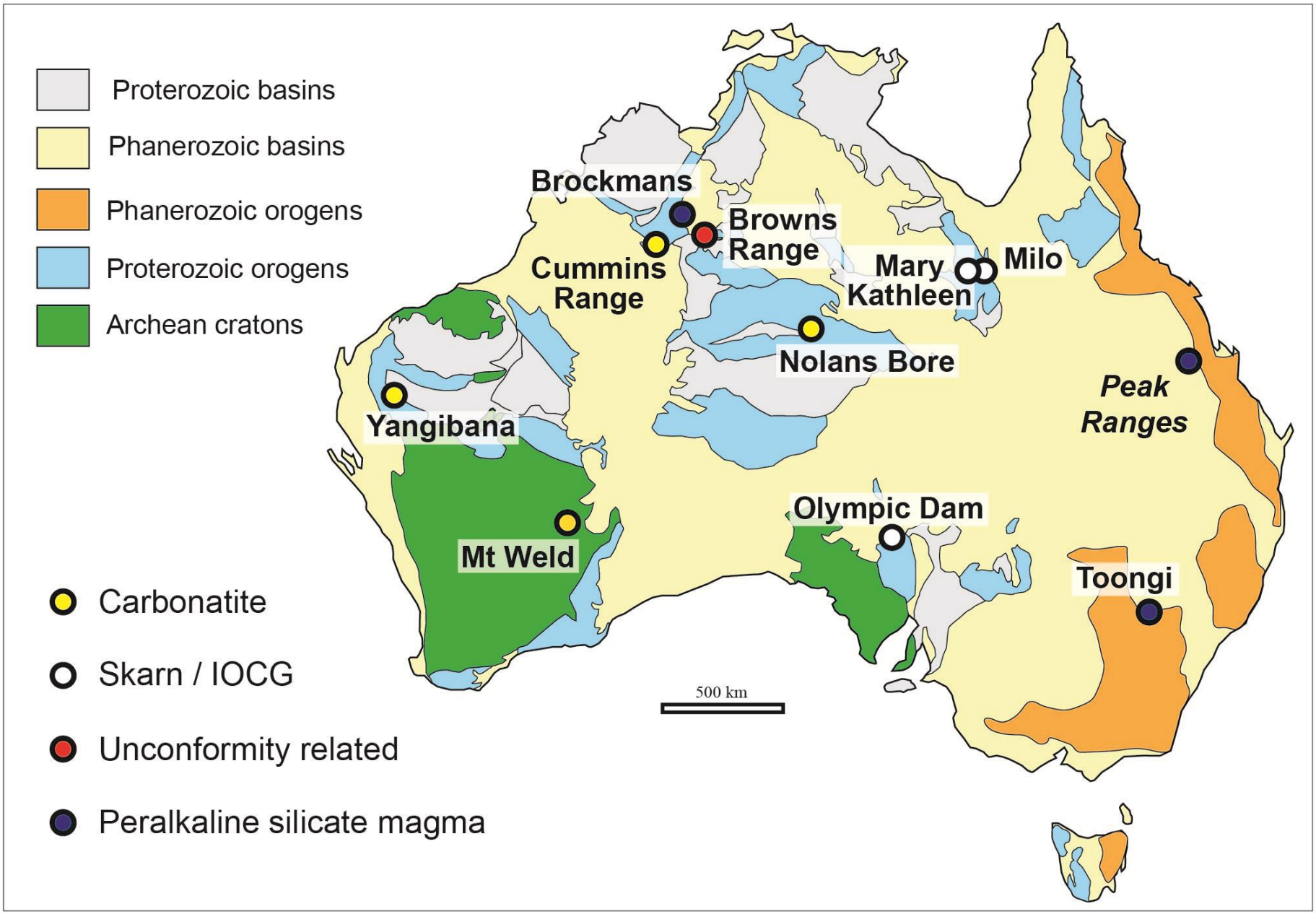


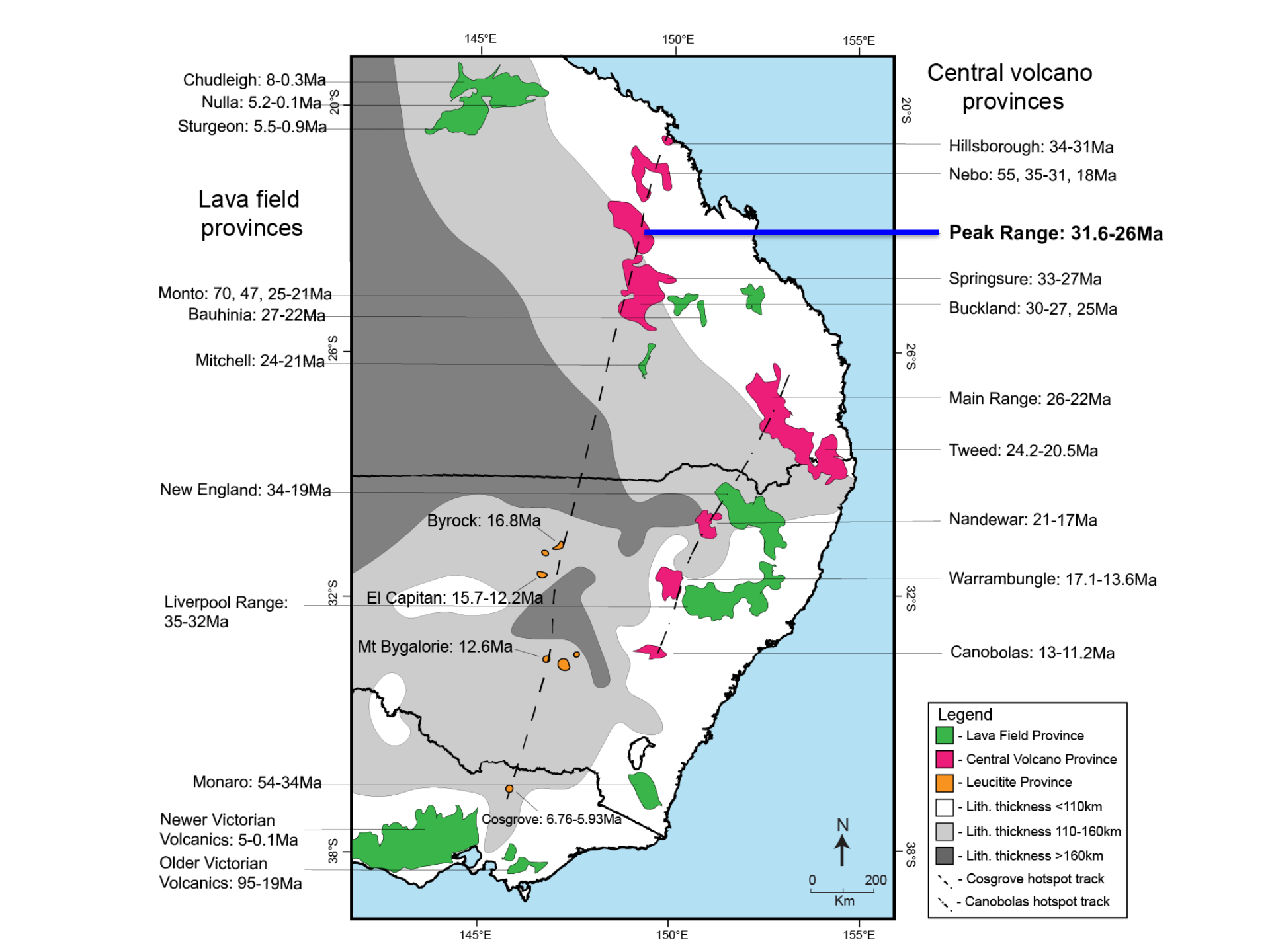
Source: Adamas Intelligence, (2018)

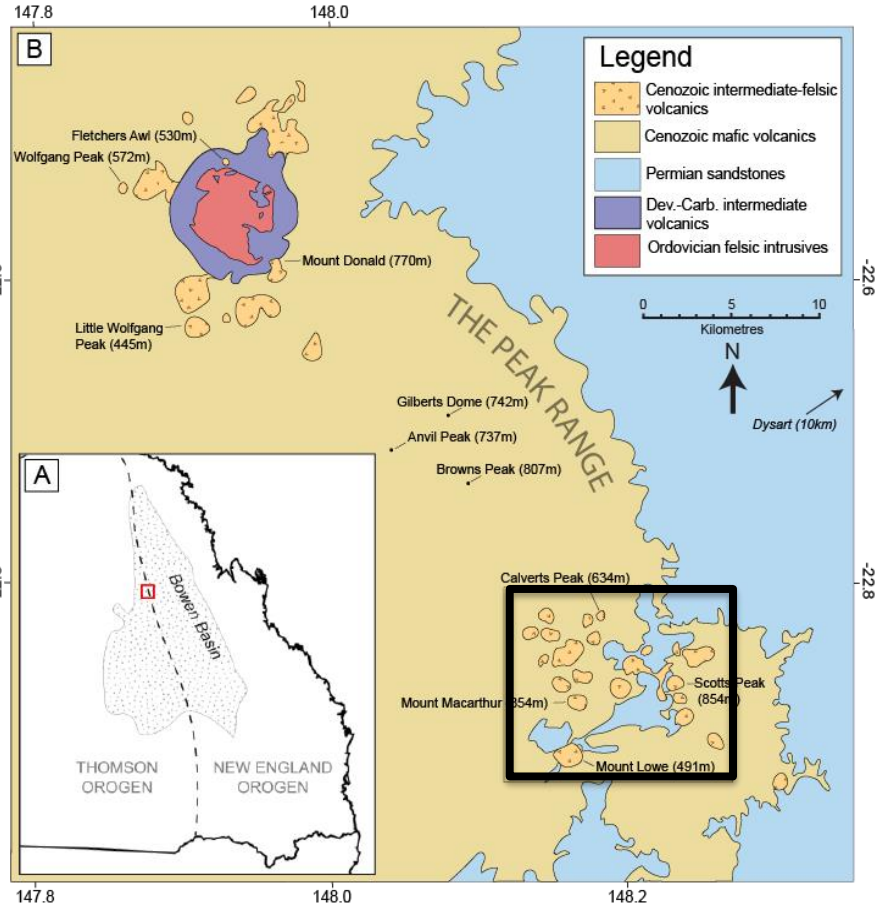
Australia's REE resources

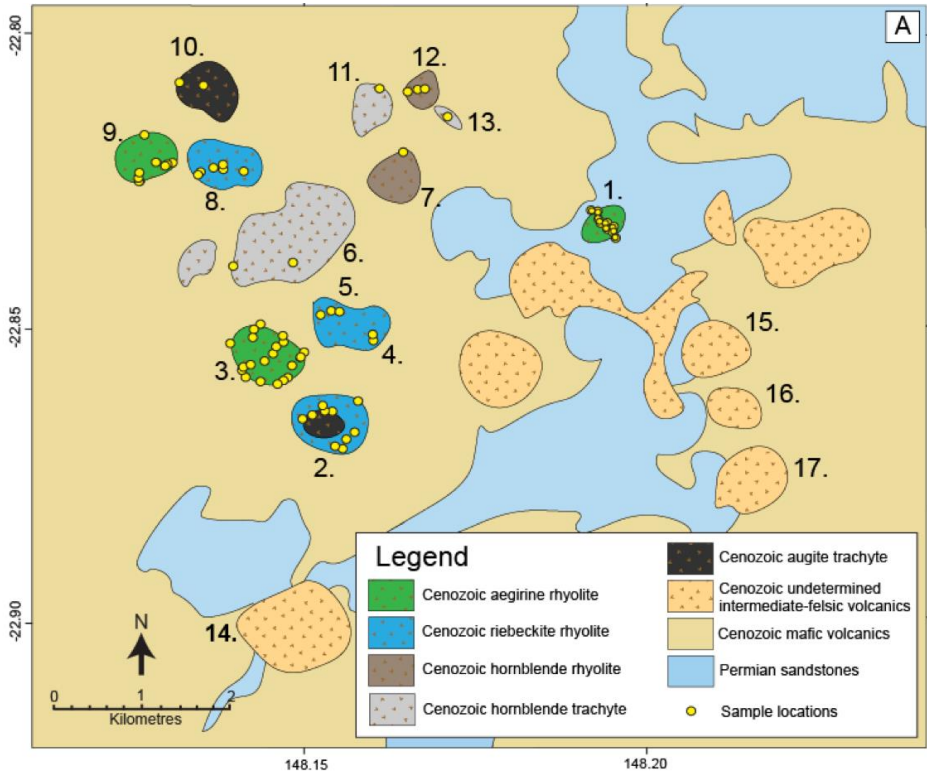


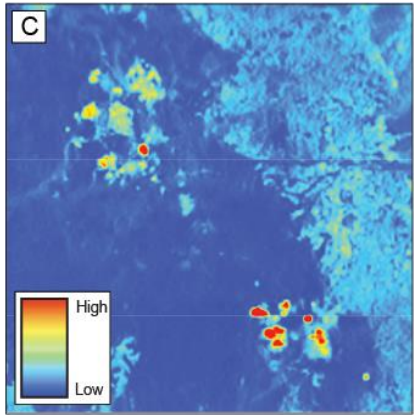
Australia's REE resources

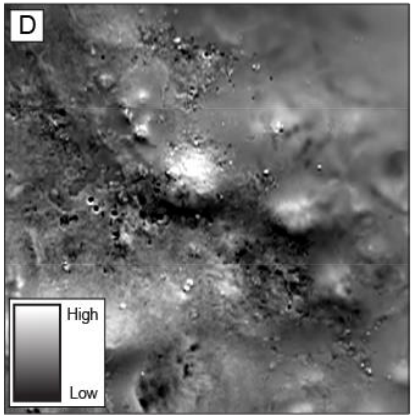


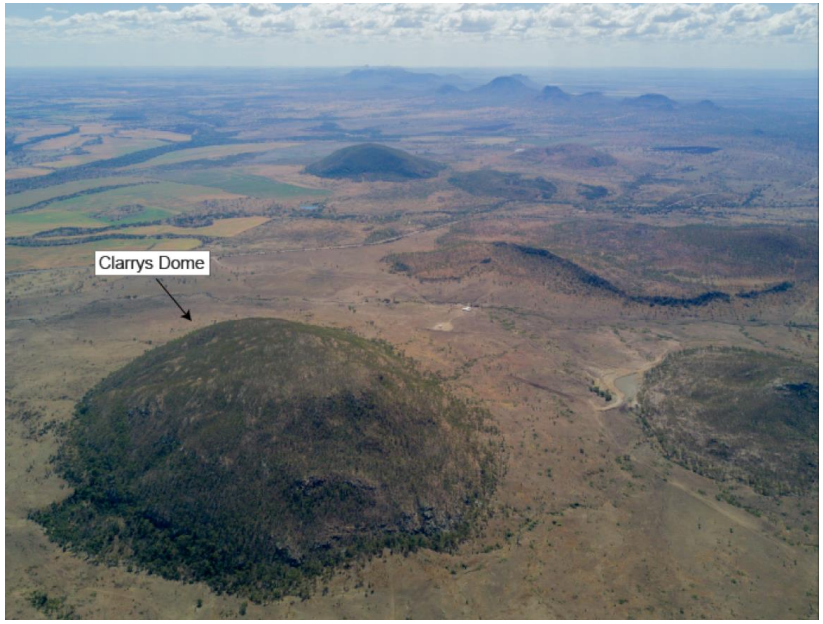

145°E
150°E
155°E
20°S
26°S
32°S
38°S
Chudleigh: 8-0.3Ma
Nulla: 5.2-0.1Ma
Sturgeon: 5.5-0.9Ma
Lava field provinces
Monto: 70, 47, 25-21Ma
Bauhinia: 27-22Ma
Mitchell: 24-21Ma
New England: 34-19Ma
Liverpool Range: 35-32Ma
Monaro: 54-34Ma
Newer Victorian Volcanics: 5-0.1Ma
Older Victorian Volcanics: 95-19Ma
Byrock: 16.8Ma
El Capitan: 15.7-12.2Ma
Mt Bygalorie: 12.6Ma
Cosgrove: 6.76-5.93Ma
Central volcano provinces
Hillsborough: 34-31Ma
Nebo: 55, 35-31, 18Ma
Peak Range: 31.6-26Ma
Springsure: 33-27Ma
Buckland: 30-27, 25Ma
Main Range: 26-22Ma
Tweed: 24.2-20.5Ma
Nandewar: 21-17Ma
Warrambungle: 17.1-13.6Ma
Canobolas: 13-11.2Ma
Legend
- Lava Field Province
- Central Volcano Province
- Leucitite Province
- Lith. thickness <110km
- Lith. thickness 110-160km
- Lith. thickness >160km
- Cosgrove hotspot track
- Canobolas hotspot track
N
0
200
Km


B
147.8
148.0
148.2
-22.6
-22.8
Legend
Cenozoic intermediate-felsic volcanics
Cenozoic mafic volcanics
Permian sandstones
Dev.-Carb. intermediate volcanics
Ordovician felsic intrusives
Fletchers Awl (530m)
Wolfgang Peak (572m)
Mount Donald (770m)
Little Wolfgang Peak (445m)
THE PEAK RANGE
Gilberts Dome (742m)
Anvil Peak (737m)
Browns Peak (807m)
Dysart (10km)
Calverts Peak (634m)
Mount Macarthur (854m)
Scotts Peak (854m)
Mount Lowe (491m)
0 5 10
Kilometres
N
A
Bowen Basin
THOMSON OROGEN
NEW ENGLAND OROGEN

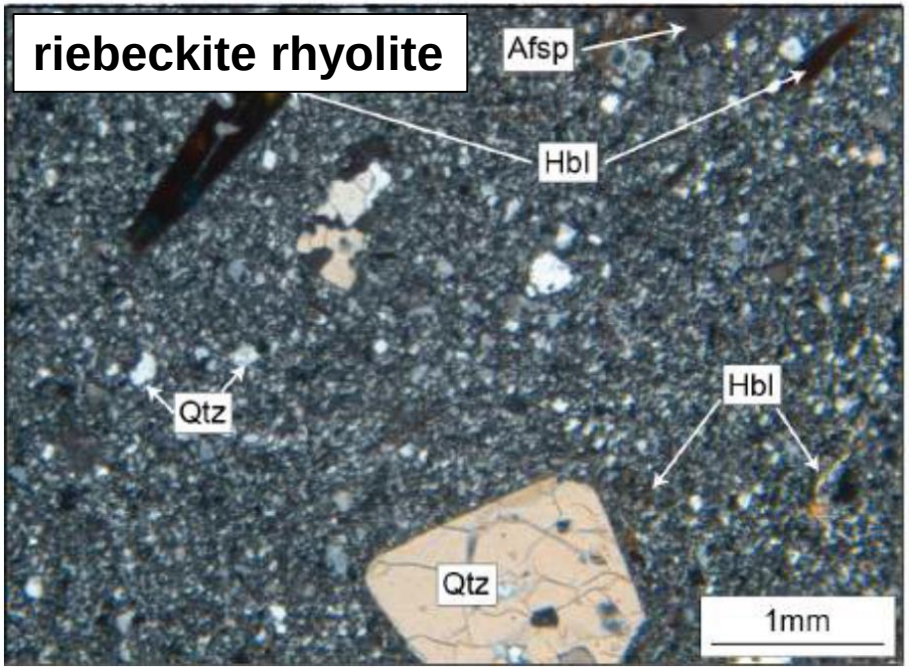

A
-22.80
-22.85
-22.90
148.15
148.20
10.
11.
12.
13.
9.
8.
7.
1.
6.
5.
4.
3.
2.
15.
16.
17.
14.
N
0 1 2
Kilometres
Legend
Cenozoic aegirine rhyolite
Cenozoic riebeckite rhyolite
Cenozoic hornblende rhyolite
Cenozoic hornblende trachyte
Cenozoic augite trachyte
Cenozoic undetermined intermediate-felsic volcanics
Cenozoic mafic volcanics
Permian sandstones
Sample locations

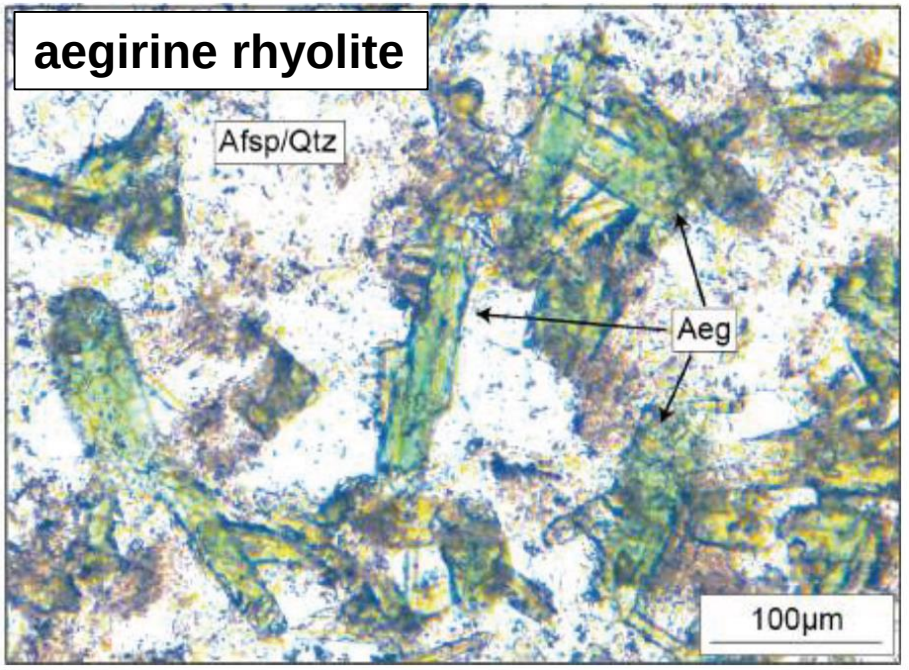

C
High
Low


D
High
Low

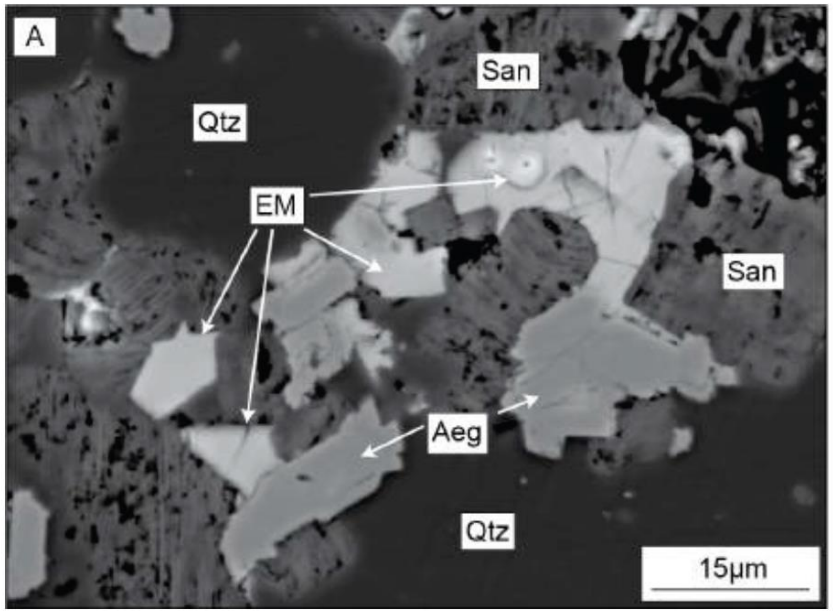

Clarrys Dome

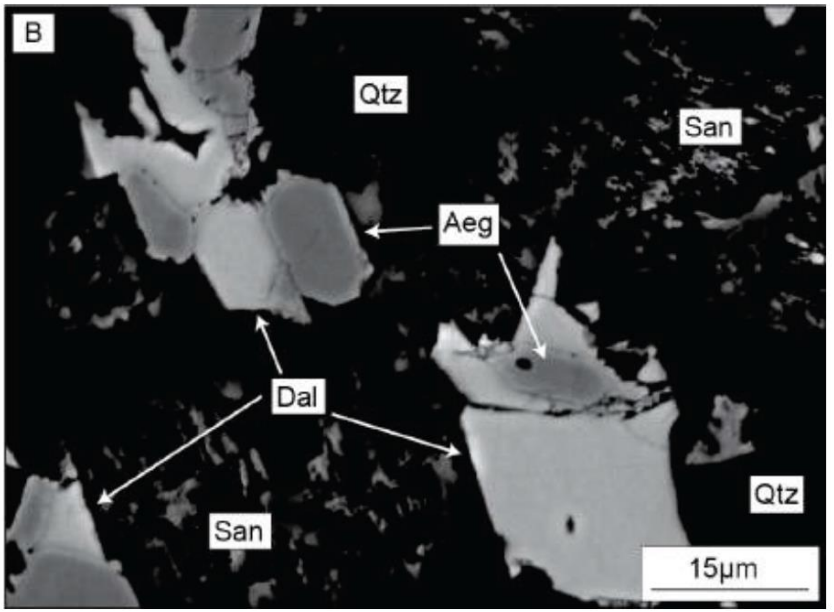
rock-types & mineralogy



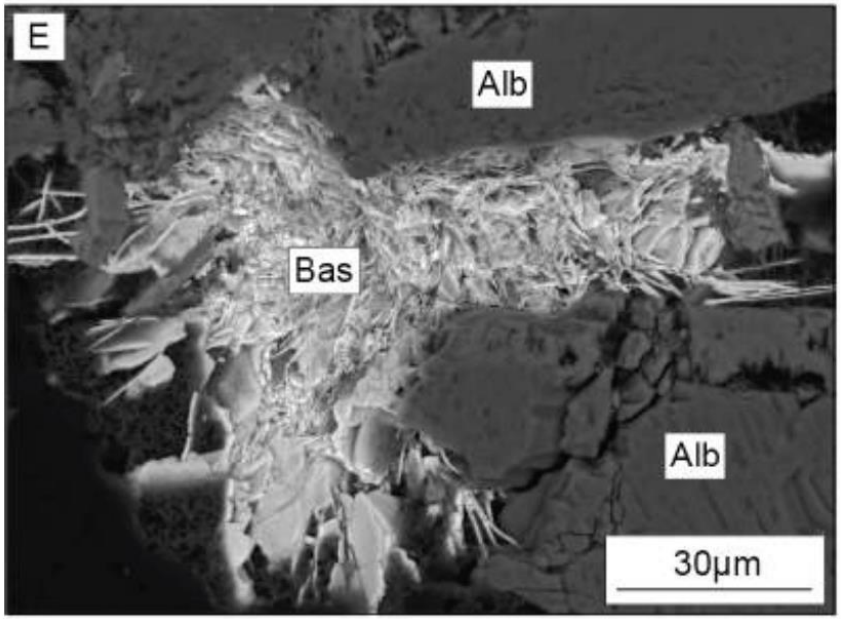


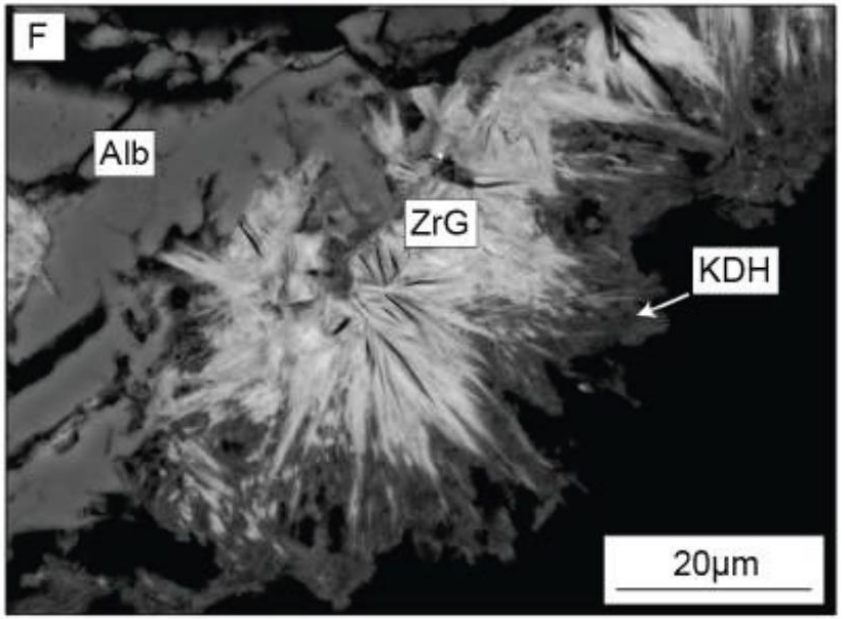
Primary ore: Fine-grained dalyite ($K_2ZrSi_6O_{15}$), eudialyte and aegirine



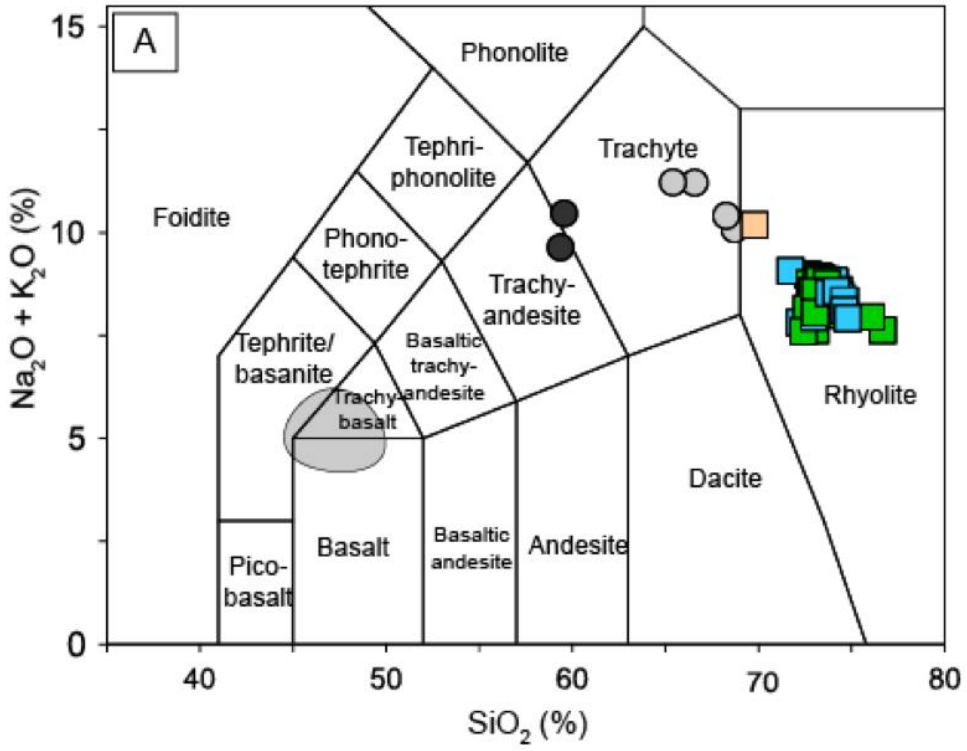


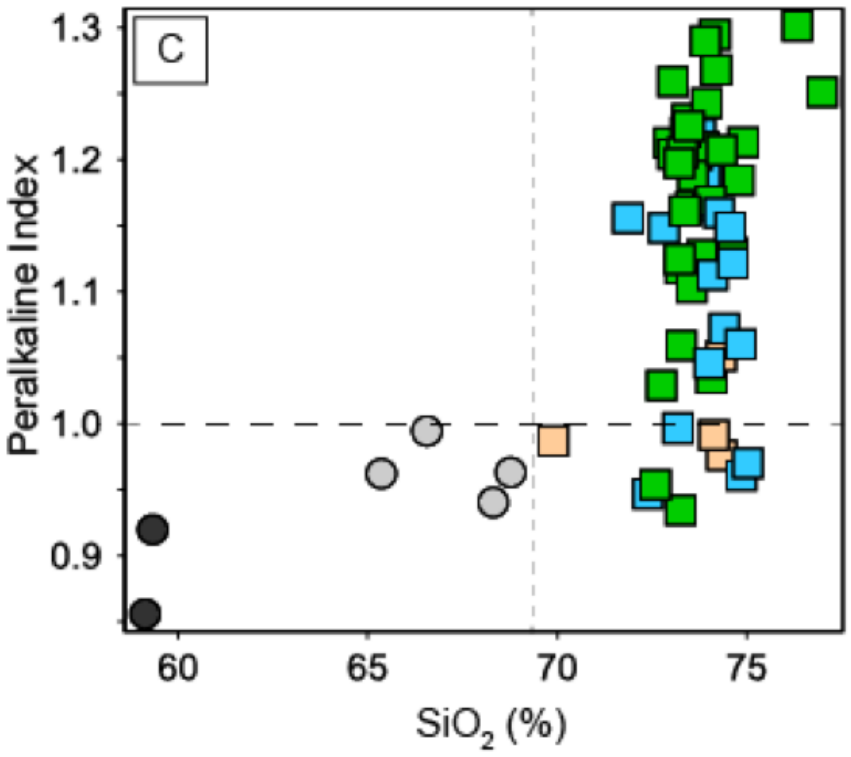
Secondary ore: Zr–gel, Ca-REE carbonates (Basnaesite), clays, quartz





Bulk rock geochemistry





Aegirine rhyolite

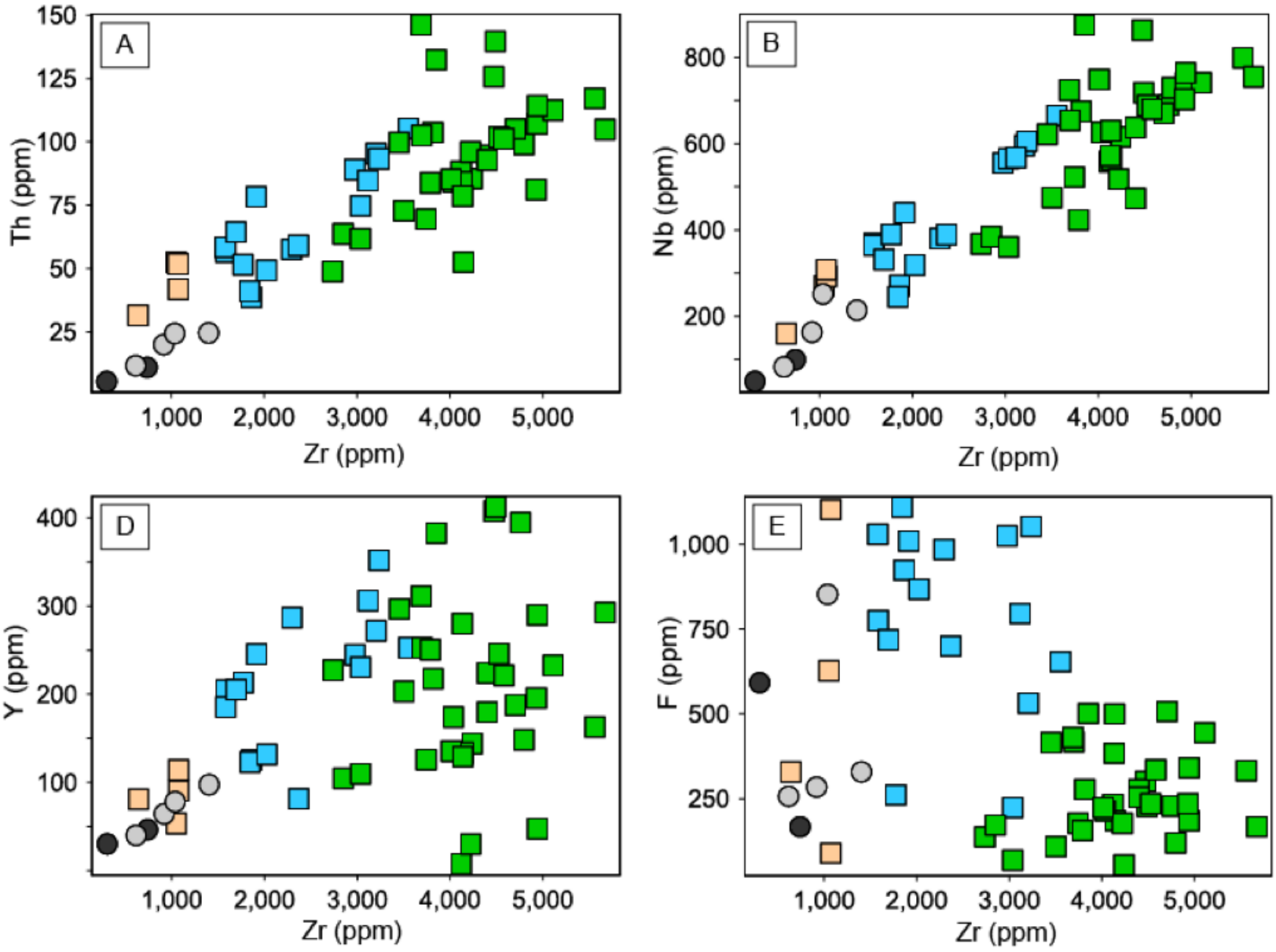
Riebeckite rhyolite

Hornblende rhyolite

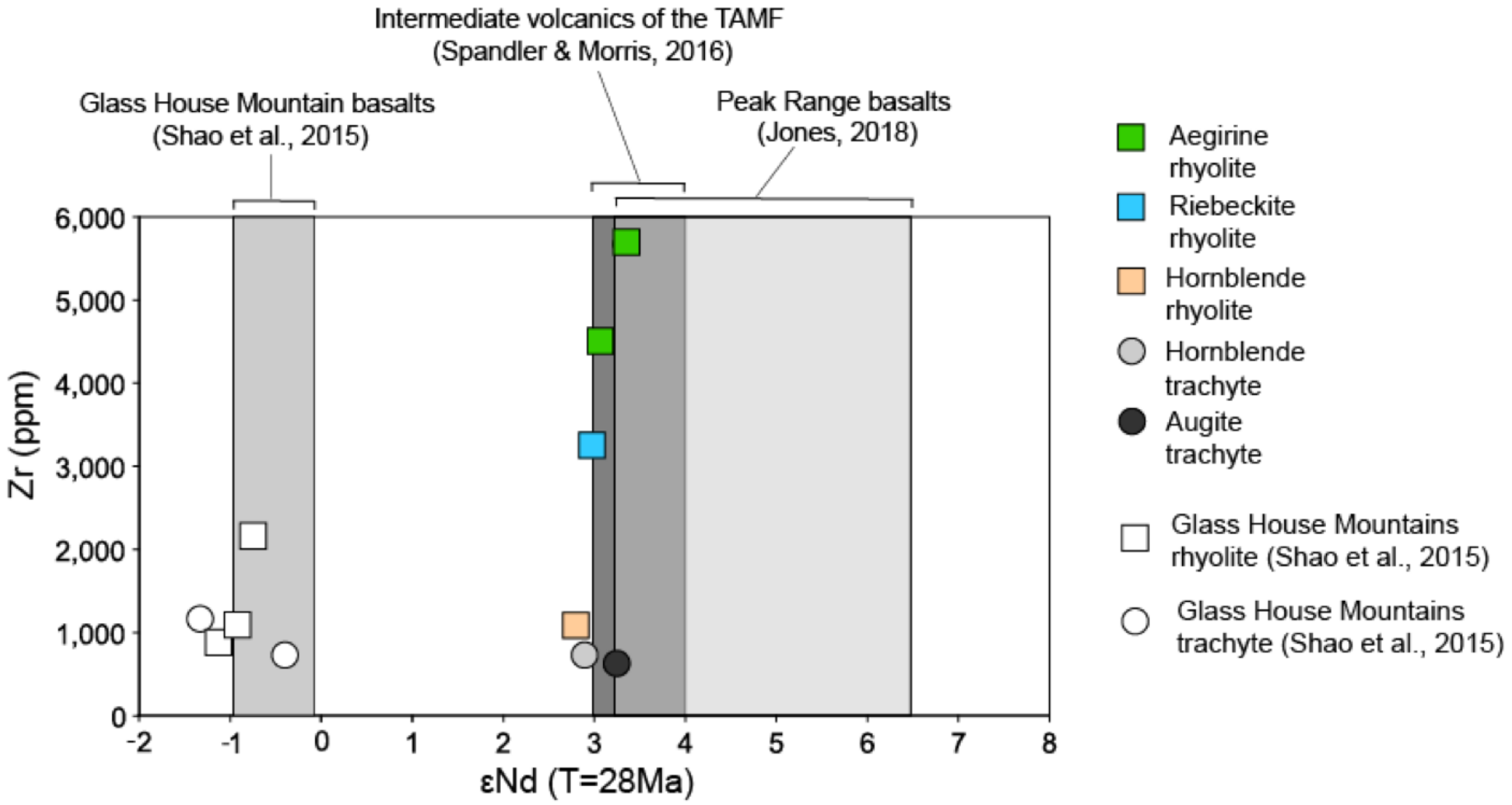
Hornblende trachyte

Augite trachyte

Bulk rock geochemistry



Bulk rock Sm-Nd isotopes



Magma evolution via crystal fractionation

Fractionation modeling

Combining RhyoliteMELT and iterative manual fractionation calculations

low fO_2, 2.5 kbar

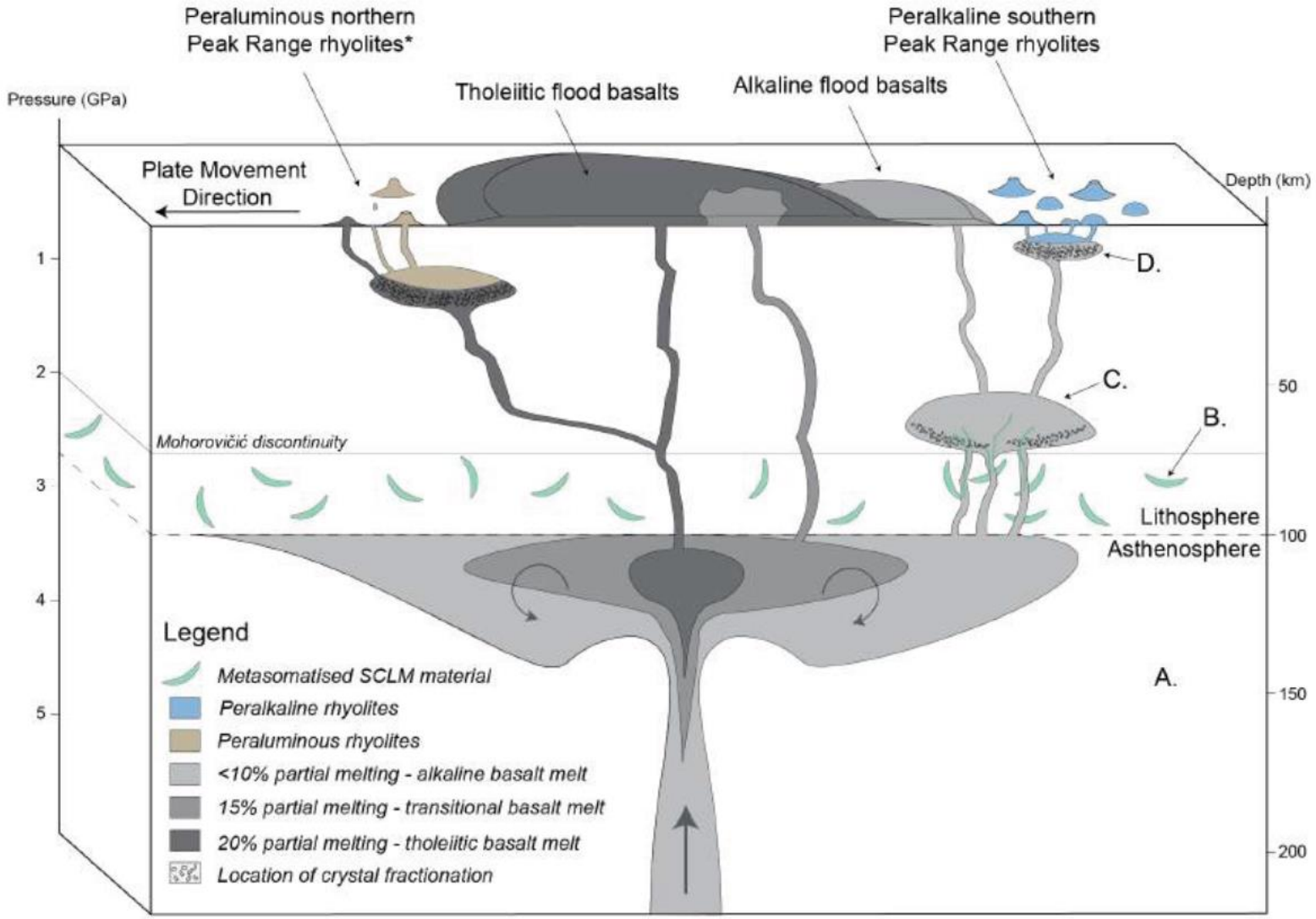
	Percent crystallized	Zr content
alkali basalt Olivine + pyroxene + plagioclase	0%	**~200 ppm**
↓		
augite trachyte Plagioclase + alkali-feldspar + hornblende	65%	**500 ppm**
↓		
riebeckite rhyolite Alkali-feldspar + quartz + aegirine	96%	**1100 ppm**
↓		
aegirine rhyolite	99%	**3100 ppm**

A: *Primitive mantle (Lyubetskaya & Korenaga (2007)*

B: *Metasomatised primitive mantle (PM with added $H_2O+Na_2O+K_2O+TiO_2$)*

C: *Analcite basanite (Mollan, 1965)*

D: *Alkaline olivine basalt (Mollan, 1965)*



Economic considerations

Total aegirine rhyolite bodies:	0.55% ZrO_2,	0.13% TREO,	0.09% Nb_2O_5
Toongi, NSW	1.93% ZrO_2,	0.89% TREO,	0.46% Nb_2O_5
Brockmans, WA	0.90% ZrO_2,	0.21% TREO,	0.36% Nb_2O_5
Foxtrot, Canada	1.30% ZrO_2,	1.07% TREO,	0.08% Nb_2O_5
Round Top Mountain, USA	-	0.06 % TREO	-

Economic considerations

Total aegirine rhyolite bodies:	0.55% ZrO_2,	0.13% TREO,	0.09% Nb_2O_5
Tonnage = >500 Mt			
Toongi, NSW	1.93% ZrO_2,	0.89% TREO,	0.46% Nb_2O_5
Tonnage = 73 Mt			
Brockmans, WA	0.90% ZrO_2,	0.21% TREO,	0.36% Nb_2O_5
Tonnage = 41 Mt			
Foxtrot, Canada	1.30% ZrO_2,	1.07% TREO,	0.08% Nb_2O_5
Tonnage = 3.4 Mt			
Round Top Mountain, USA	-	0.06 % TREO	-
Tonnage = 231 Mt			

Economic considerations

- Peak Ranges aegirine rhyolites reached high rare metal contents through extended fractional crystallization of peralkaline magma
- Could be considered low-grade, high-tonnage resources
- Rare metal equivalent to porphyry Cu-Au systems (Jowitt et al., 2017)

- **Limited work so far:**
- Lots of potential for zones of hydrothermal, or magmatic upgrading of ore metals….
- Lots of potential in other Cenozoic Central Chain volcanoes of Eastern Australia


EGRU
presents an international geological conference on
Sn-W-Critical Metals & Associated Magmatic Systems
24th - 28th June 2019
Tinaroo Lake Resort, Atherton Tablelands, Queensland, Australia
Technical Sessions & Field Trips
New results and concepts about deposits and mineralisation in North America, China, Europe, Africa, and Australia
New ideas about mineralising processes
New insights into the use of mineralogy and chemistry in understanding and exploring for mineralization