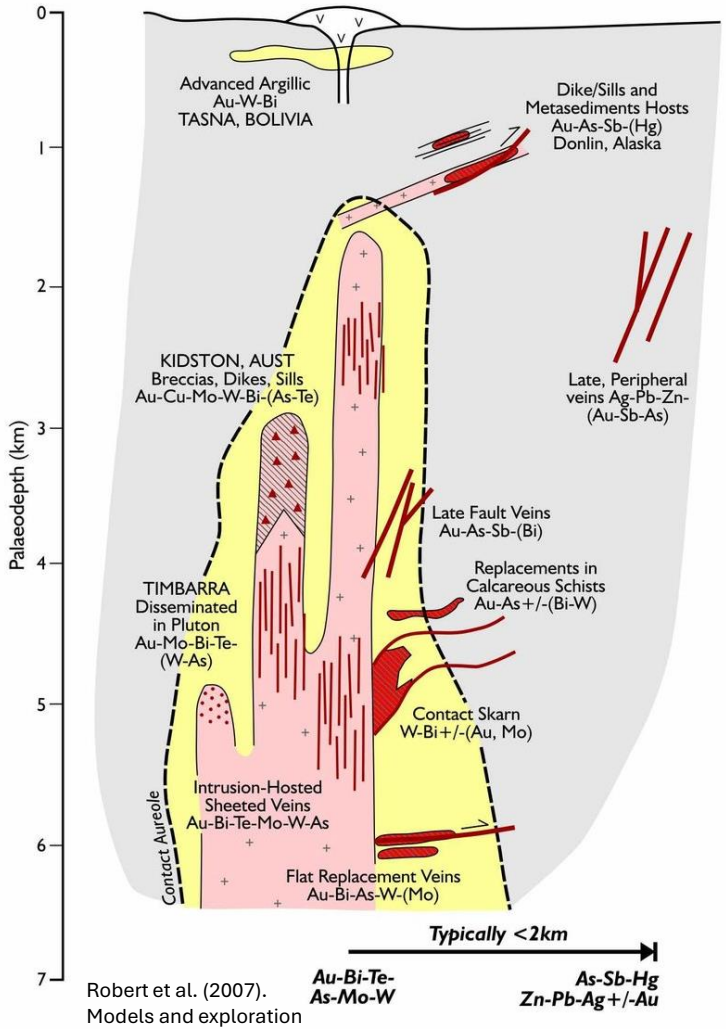
Earth Sciences
New Zealand

Pluton Map characterisation for intrusion-related mineral exploration

Mark Rattenbury, Matt Sagar, Kevin Faure, Andy Tulloch, Rose Turnbull

West Arm Leucogranite dikes cutting Refrigerator Orthogneiss tonalite, Delta Burn, eastern Fiordland

Intrusion-related mineralisation: New Zealand



Robert et al. (2007). Models and exploration methods for major gold deposit types

New Zealand Journal of Geology and Geophysics, 1985, Vol. 28: 97–109 97
0028–8306/85/2801–0097$2.50/0

Greisen-related scheelite, gold and sulphide mineralisation at Kirwans Hill and Bateman Creek, Reefton district, Westland, New Zealand

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Keywords Karamea Batholith; Greenland Group; greisen; geochemistry; alteration; scheelite; gold; base metals; sulphides; quartz

INTRODUCTION

The area discussed is situated within a north–northwest-trending structural zone, informally named the Shaw-Drysdale-Bateman Creek corri-

NEW ZEALAND JOURNAL OF GEOLOGY AND GEOPHYSICS, 2016
VOL. 59, NO. 3, 436–456
http://dx.doi.org/10.1080/00288306.2016.1174946

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RESEARCH ARTICLE

Polymetallic mineralisation associated with Carboniferous I-type granitoids in central Stewart Island, New Zealand

AH Allibone[a], D MacKenzie[b], R Turnbull[c], A Tulloch[c] and D Craw[b]

[a]Rodinian (NZ) Ltd, Wanaka, New Zealand; [b]Department of Geology, University of Otago, Dunedin, New Zealand; [c]GNS Science, Dunedin, New Zealand

NEW ZEALAND JOURNAL OF GEOLOGY AND GEOPHYSICS, 2017
VOL. 60, NO. 3, 270–295
https://doi.org/10.1080/00288306.2017.1316747

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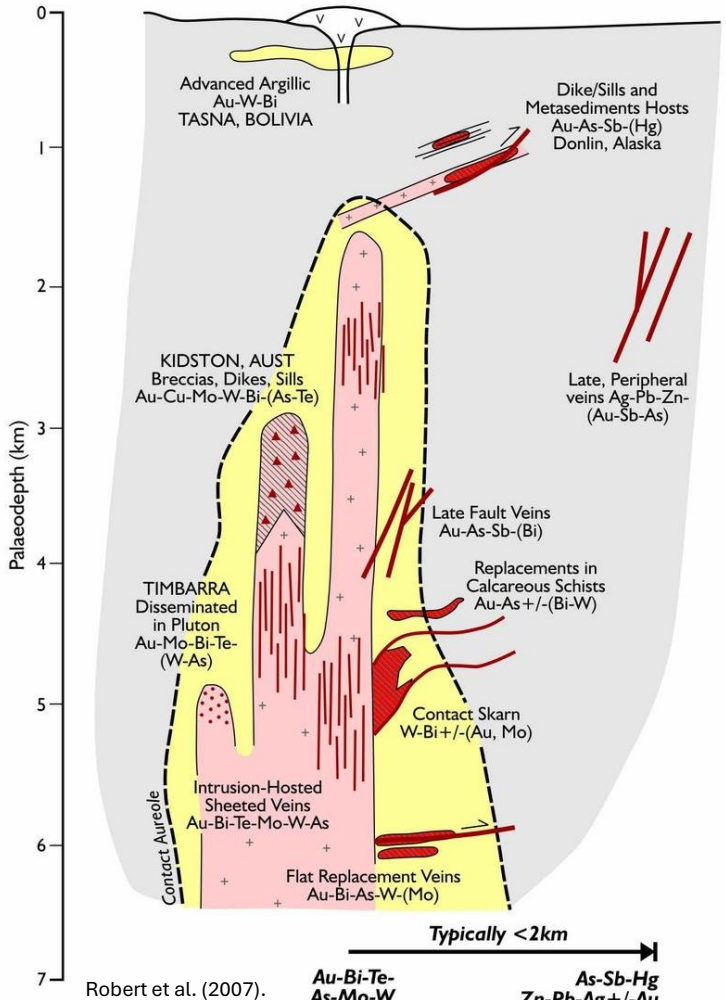
RESEARCH ARTICLE

Check for updates

The ultramafic–intermediate Riwaka Complex, New Zealand: summary of the petrology, geochemistry and related Ni–Cu–PGE mineralisation

R. E. Turnbull[a], W. B. Size[b], A. J. Tulloch[a] and A. B. Christie[c]

Intrusion-related mineralisation: Sams Creek



Robert et al. (2007). Models and exploration methods for major gold deposit types

New Zealand Journal of Geology and Geophysics, 1991, Vol. 34: 429–440
0028–8306/91/3404–0429 $2.50/0 © Crown copyright 1991

Gold mineralisation in a syntectonic granite dike, Sams Creek, northwest Nelson, New Zealand

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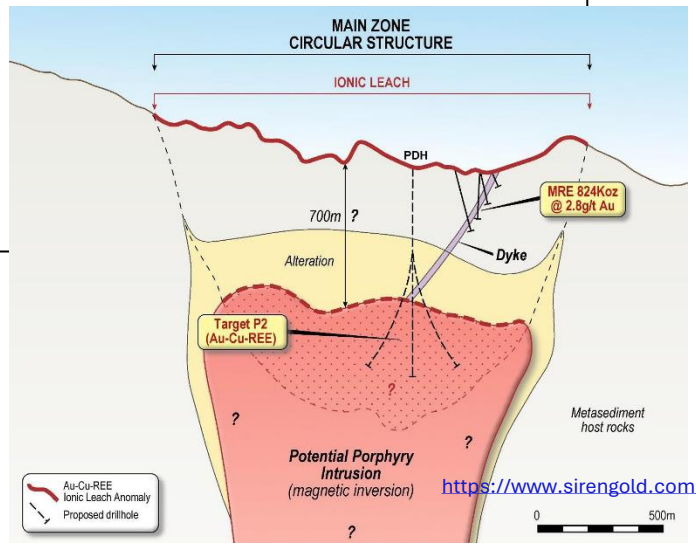


https://www.sirengold.com.au/site/projects/sam-s-creek

MONOGRAPH 31

MINERAL DEPOSITS OF NEW ZEALAND EXPLORATION AND RESEARCH

EDITED BY ANTHONY B CHRISTIE

Exploration Update (2011–2015) on the Sams Creek Porphyry Gold Deposit, North-west Nelson

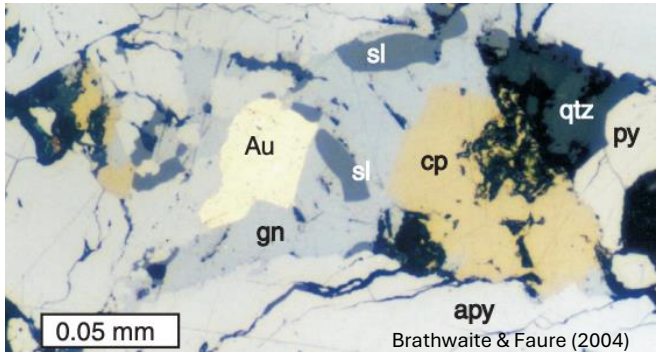
P Angus[1], R Jongens[2], M Phillips[3], M McCulloch[4], Y Nazimova[5] and G Ryan[6]

ELSEVIER
Journal of Geochemical Exploration
Volumes 78–79, May 2003, Pages 613-616

Abstract

Gold mineralisation in the polymetallic Sams Creek peralkaline microgranite, South Island, New Zealand

Kevin Faure, Robert L. Brathwaite, Cornel E.J. de Ronde



Brathwaite & Faure (2004)

Pluton Map

Pluton Map has been a five-year project to characterise Aotearoa New Zealand's plutons, supported by the NZ Government's Strategic Science Investment Fund through the Understanding Zealandia and Kaitiakitanga ki Te Riu-a-Māui science programmes

Parallel geological map improvements were supported by the Regional Geological Map Archive and Datafile, one of the NZ Government's Nationally Significant Collections and Databases

Two main thrusts:

1. **Pluton geological map base**: Establish pluton mapped extents by confirming the mapped extents of known plutons, incorporating updates where needed and identifying new plutons within areas of undifferentiated plutonic rock
2. **Pluton properties data**: Identify characteristic chemistry and emplacement age for each pluton and classify each with stratigraphic and petrogenetic parameters

Plutons across Te Riu-a-Māui Zealandia

There is ~ 20,000 km^2 of plutonic rock across onshore Aotearoa New Zealand

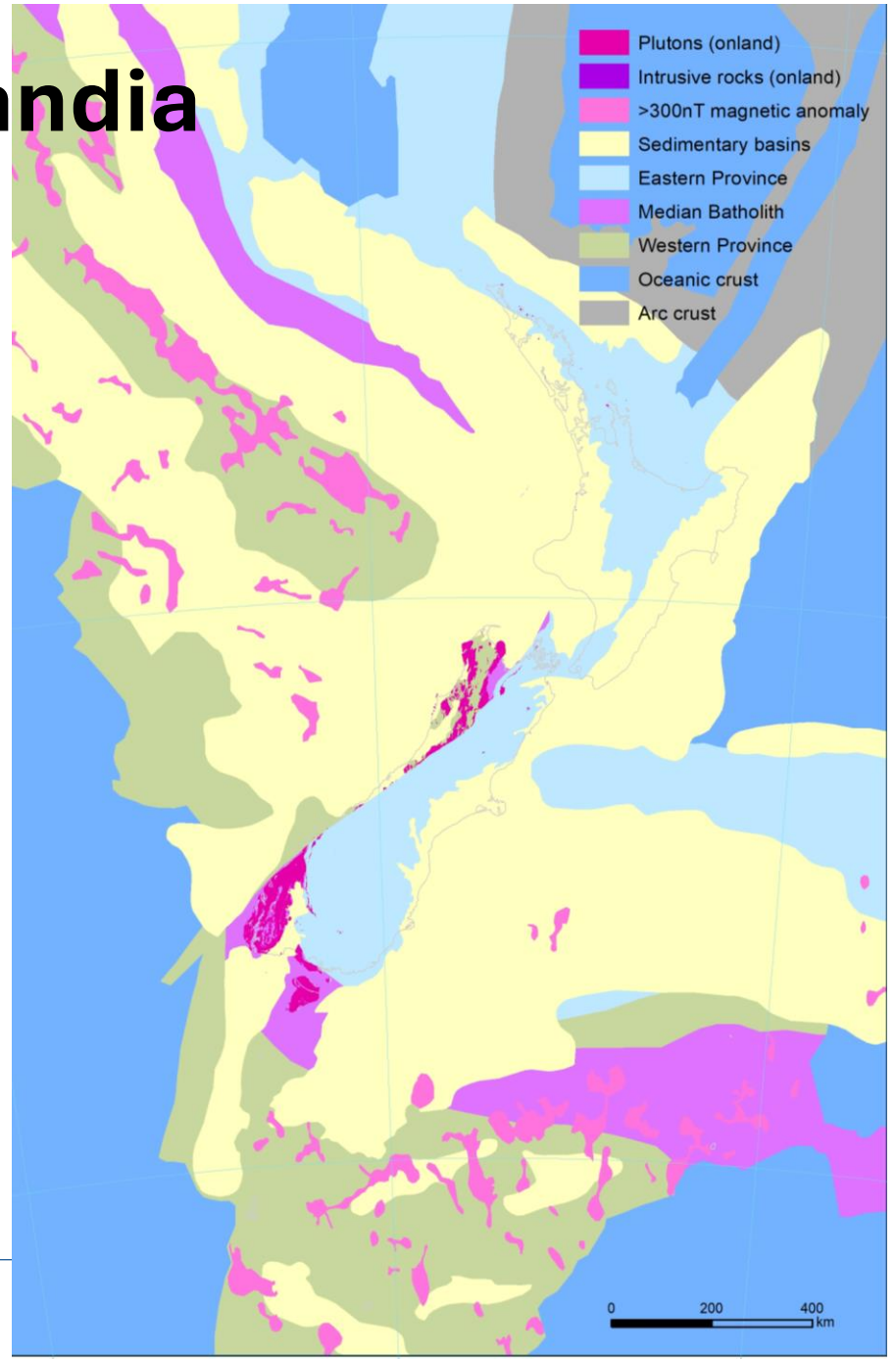
Many magnetic anomalies offshore are attributed to igneous intrusions, noting that significant volumes of weakly-magnetic plutons may also be present

Pluton Map has identified 336 plutons with generally well mapped extent, almost all onshore

Plutonic rock not differentiated as plutons represents approximately 8.6% of that

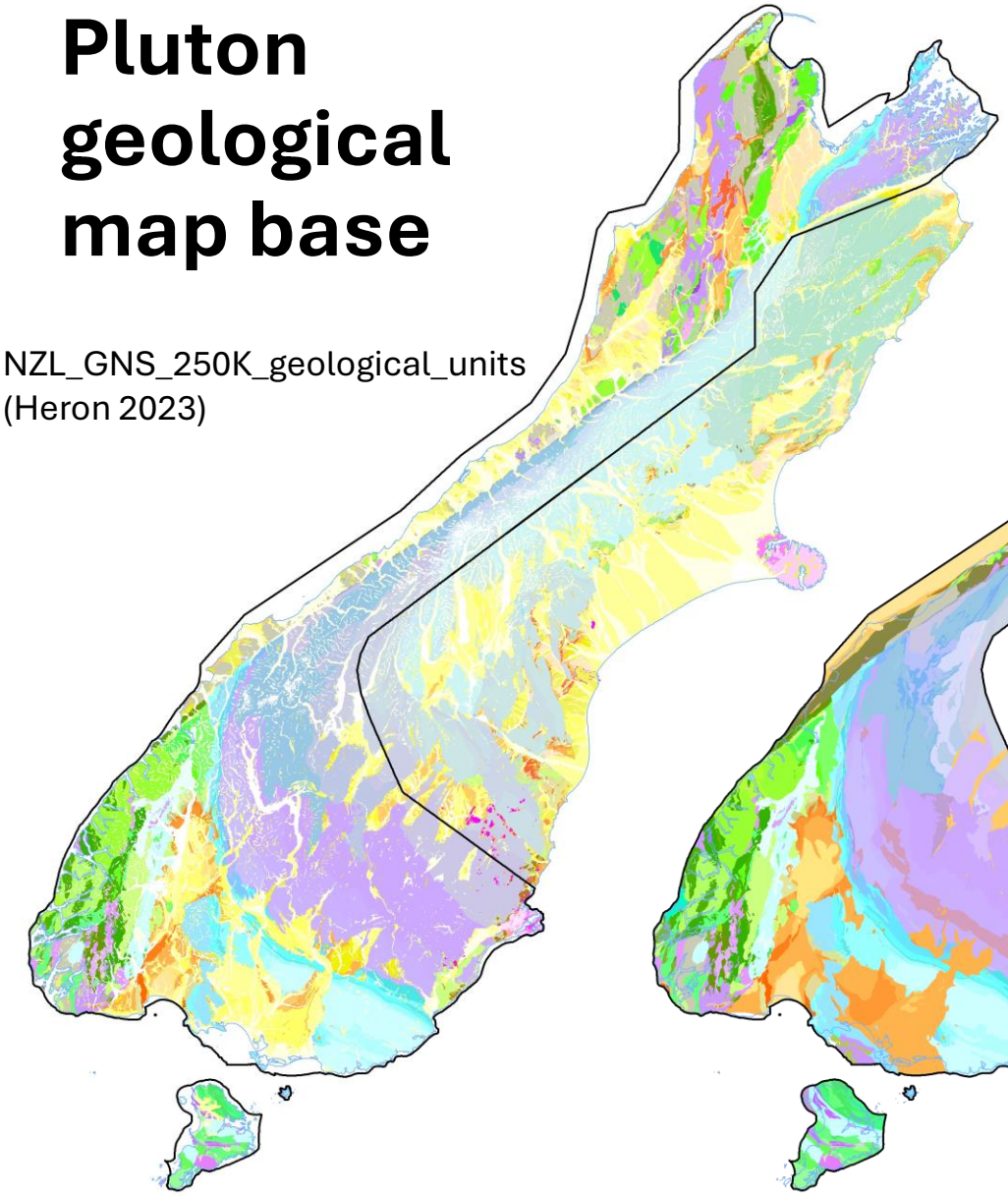
A further 25 intersections of plutonic rock in boreholes are known although the extents of the plutons are generally not known

There are further intrusive igneous rocks associated with tectonised mafic and ultramafic complexes, such as the Dun Mountain Ophiolite Belt, and Cenozoic volcanic arcs

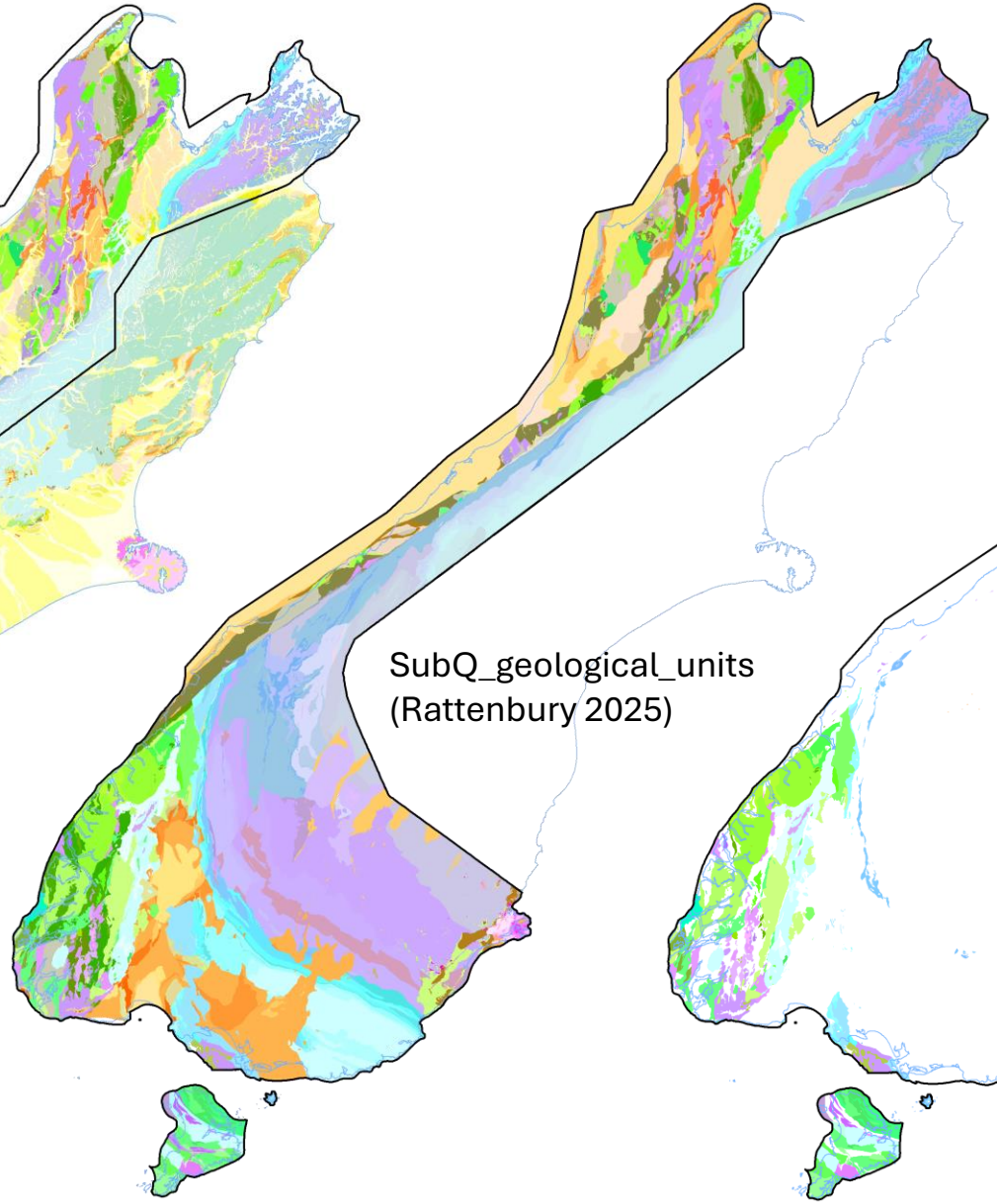


Pluton geological map base

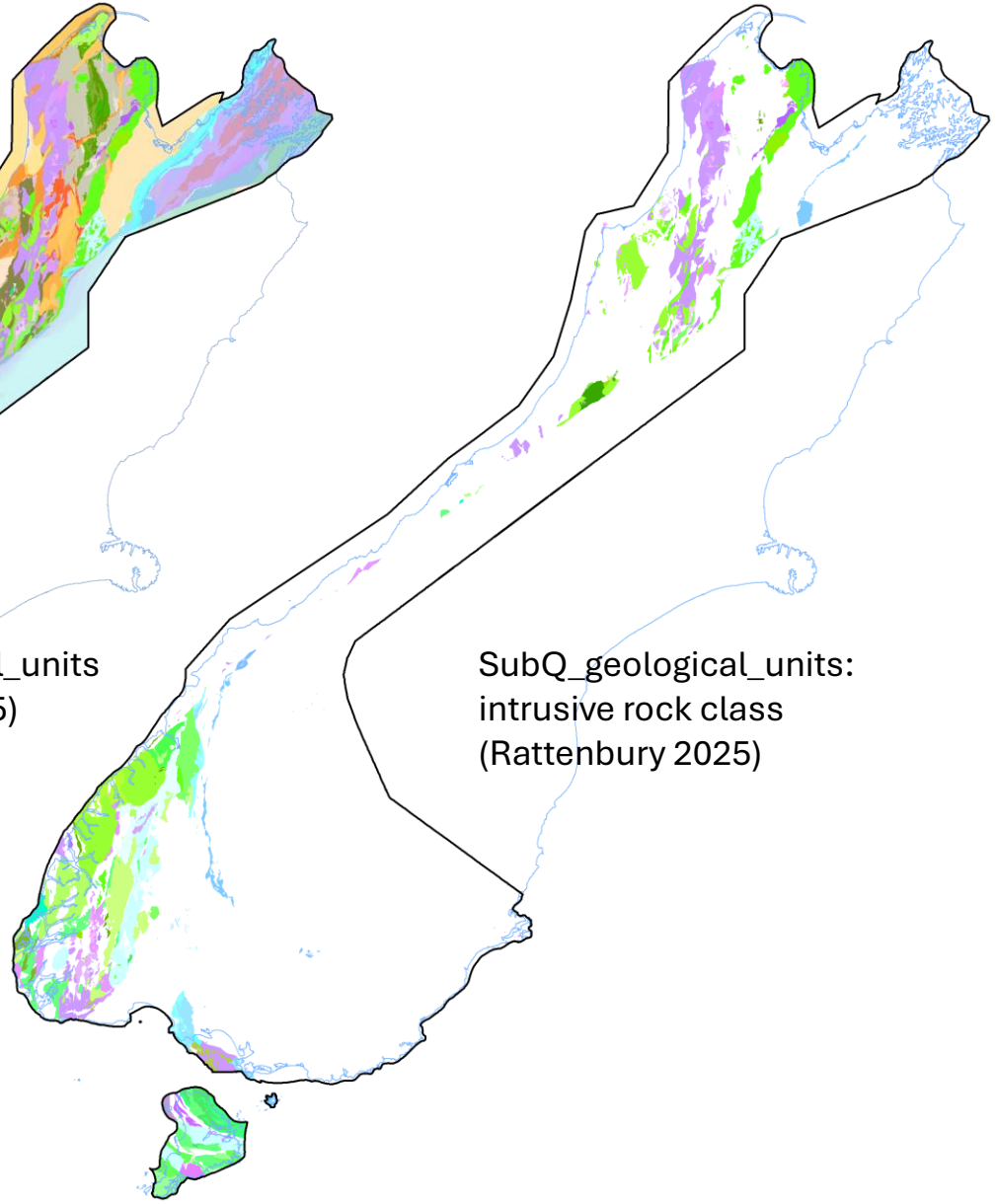
NZL_GNS_250K_geological_units
(Heron 2023)



SubQ_geological_units
(Rattenbury 2025)



SubQ_geological_units:
intrusive rock class
(Rattenbury 2025)

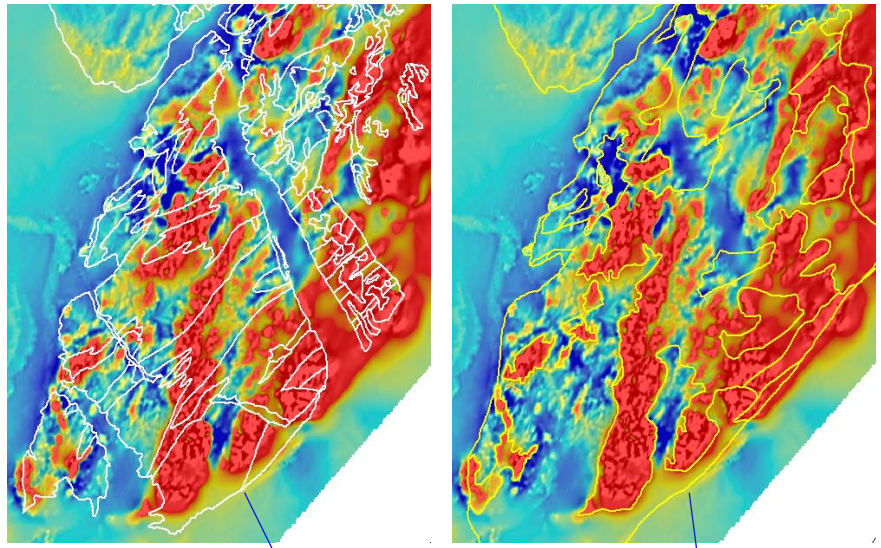


Newly-mapped plutons

Through the duration of the project, 47 newly named and 43 newly mapped or remapped plutons have been delineated

Most of these are in plutonic rock areas in Northwest Nelson and West Coast, previously differentiated only to petrogenetic suite level

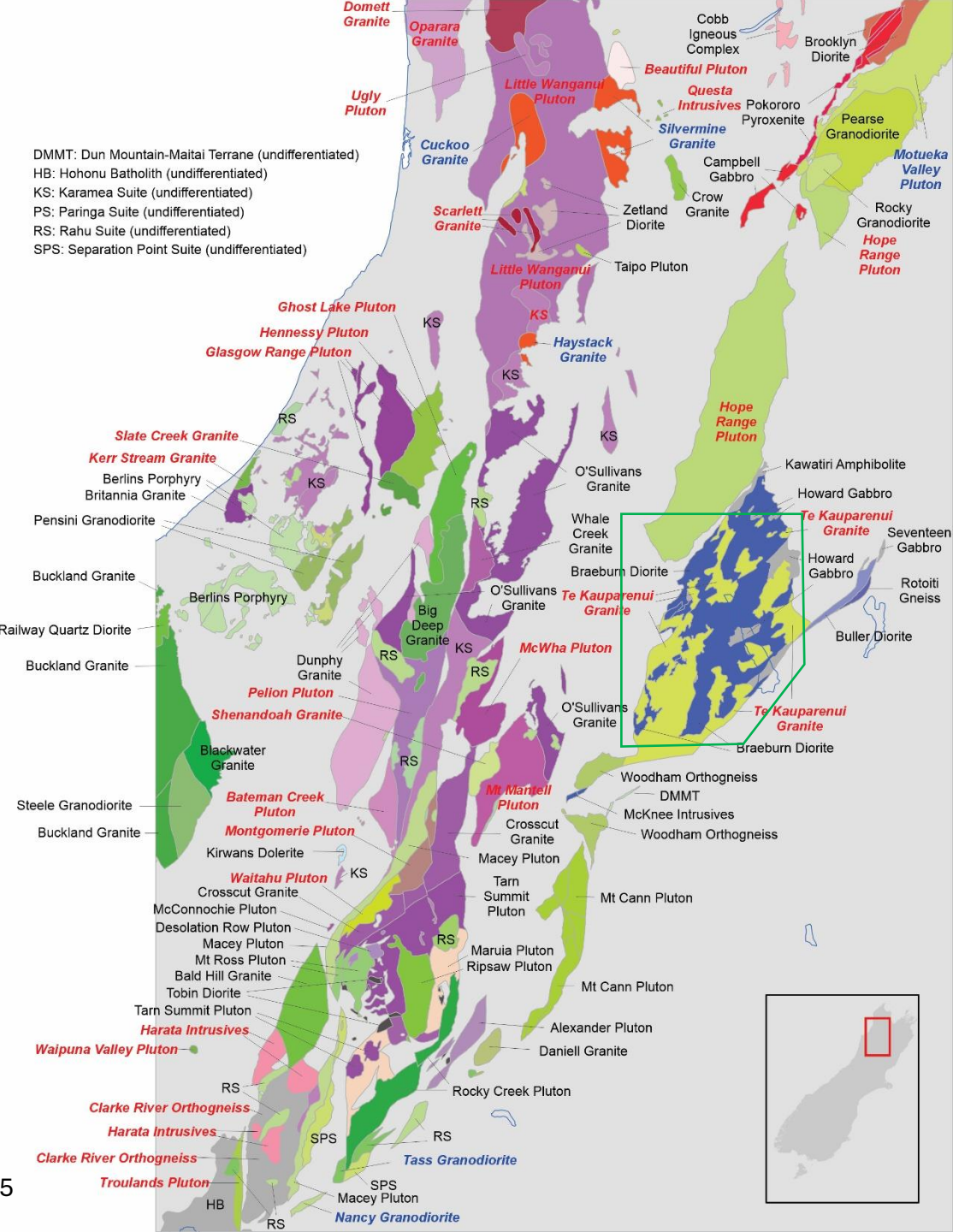
Aeromagnetic data interpretation has been important for distinguishing between plutons and defining their boundaries



Total magnetic intensity, reduced to pole in the Lake Rotoroa area (NZP&M data, Thomson Aviation 2020)

250K_geological_units_2023 (excluding Quaternary)

subQ_geological_units_2025



Pluton properties data

More than 40 mineralogical, textural, structural, geochronological, geochemical, isotopic and other physical properties as well as stratigraphic and petrogenetic classification have been compiled

Analytical properties are based on the “key sample” concept –real samples, well-dated and considered to be representative of the pluton in terms of its chemistry and mineralogy

New geochronology (U-Pb zircon ICP-MS)

QA/QC’d geochemistry (XRF)

New O isotope data (whole-rock, quartz, feldspar)

In its Atlas form, Pluton Map has 43 symbolised maps showing selected properties, ratios and other calculated parameters

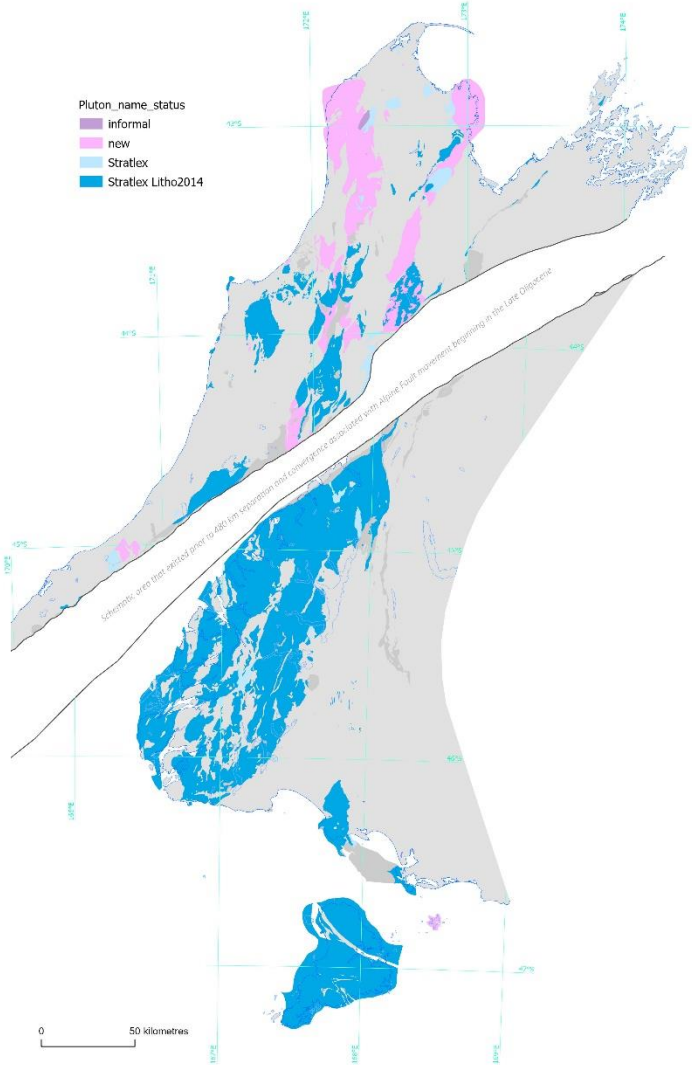
Pluton_name_status - Hope Range Pluton granite (Separation Point Suite)

Batholith	Median
Suite_name	Separation Point
Dominant_mafic_mineral	biotite
Subsidiary_mafic_minerals	<Null>
Dominant_aluminous_mineral	<Null>
Subsidiary_aluminous_minerals	<Null>
Accessory_minerals	<Null>
Groundmass_grain_size	<Null>
Dominant_primary_structure	<Null>
Subsidiary_primary_structure	<Null>
Dominant_primary_texture	<Null>
Secondary_structure	<Null>
Secondary_texture	<Null>
Lat_WGS84	-41.72882
Long_WGS84	172.499134
Key_age_sample	P46102
U_Pb_age_notes	Same sample as OU49213
U_Pb_age_Ma	106.6
U_Pb_age_abs_2s	0.8
U_Pb_age_method	TIMS
U_Pb_age_standard	NA
U_Pb_age_mineral	Monazite
U_Pb_age_ref	Tulloch and Kimbrough (unp
Key_chemistry_sample	P46102
Key_chemistry_method	XRF
Alphabet_type	I-adakitic
Fe2O3T_MgO	1.36
Ba_Rb	13.71
ASI_Frost2001	1.14
AI_Frost2008	0.07
Fe_star_Frost2001	0.85
MALI_Frost2001	7.12
ZrCeYNb_ppm	118
Rb_Sr	0.11
K_Rb	332
Sr_Y	106
eU_ppm	0.7

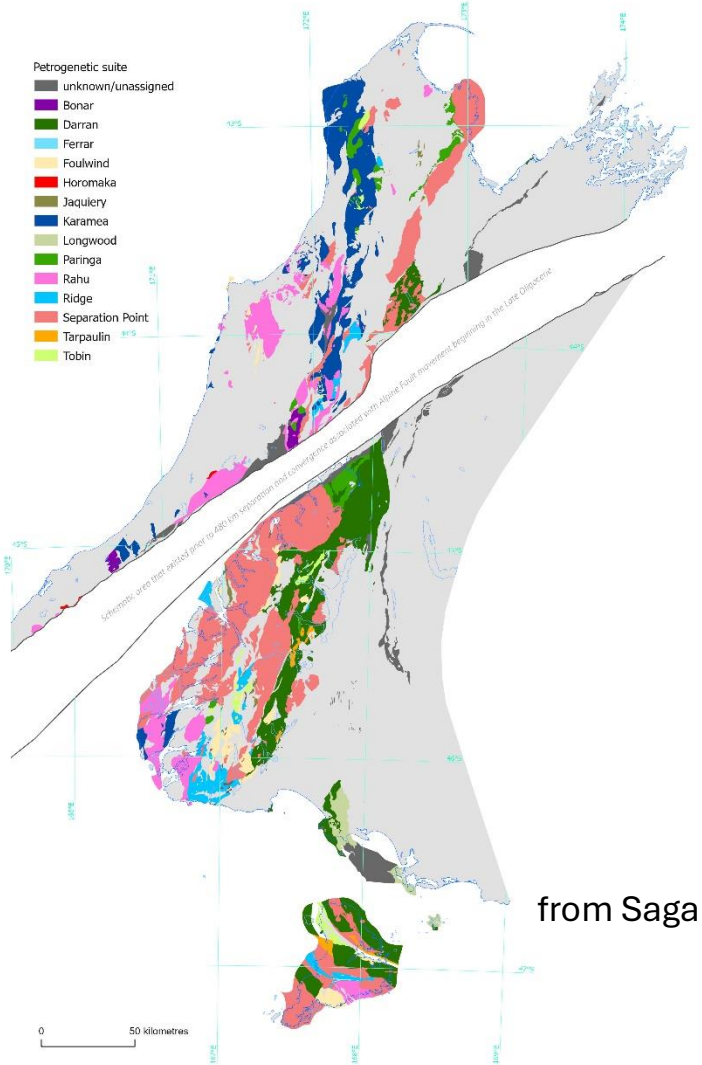
Pluton_name_status - Hope Range Pluton granite (Separation Point Suite)

Fe2O3T_pct_key	1.17
MnO_pct_key	0.03
MgO_pct_key	0.19
CaO_pct_key	1.57
Na2O_pct_key	5.49
K2O_pct_key	3.2
P2O5_pct_key	0.03
LOI_pct_key	0.48
Majors_total_pct_key	99.91
As_ppm_key	<Null>
Ba_ppm_key	1097
Ce_ppm_key	20
Cr_ppm_key	4
Cu_ppm_key	-0.5
Ga_ppm_key	15
La_ppm_key	14
Nb_ppm_key	5
Ni_ppm_key	-0.5
Pb_ppm_key	24
Rb_ppm_key	80
Sc_ppm_key	-0.5
Sr_ppm_key	741
Th_ppm_key	3
U_ppm_key	-0.5
V_ppm_key	7
Y_ppm_key	7
Zn_ppm_key	33
Zr_ppm_key	86
d18O_key_sample	P46102
d18O_quartz_key	9.3
d18O_feldspar_key	8
d18O_amphibole_key	<Null>
d18O_zircon_key	5.7
eHf_zircon_key	1.8
Sri_wholerock_key	<Null>
eNd_wholerock_key	<Null>

Pluton Map Atlas: examples of classification properties

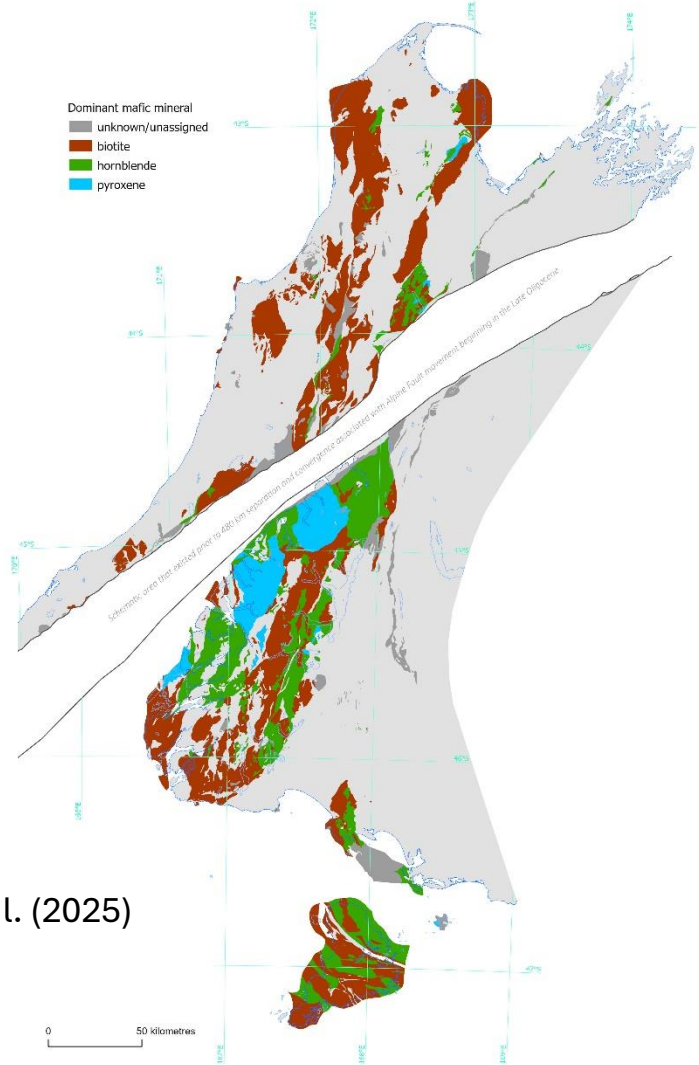


Pluton name status



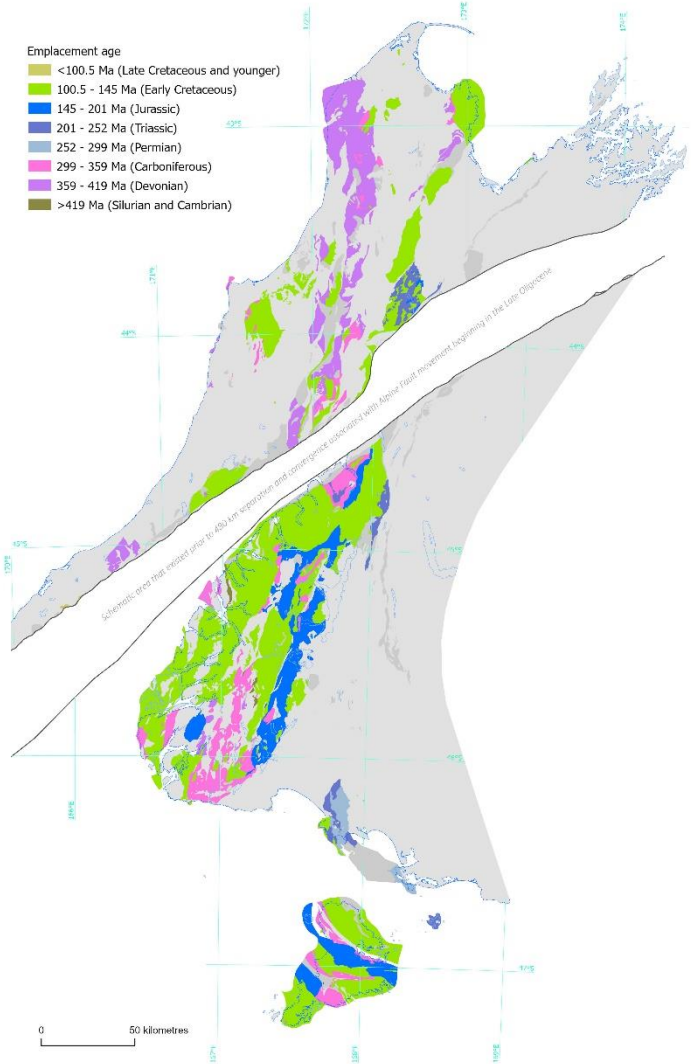
Petrogenetic suite

from Sagar et al. (2025)

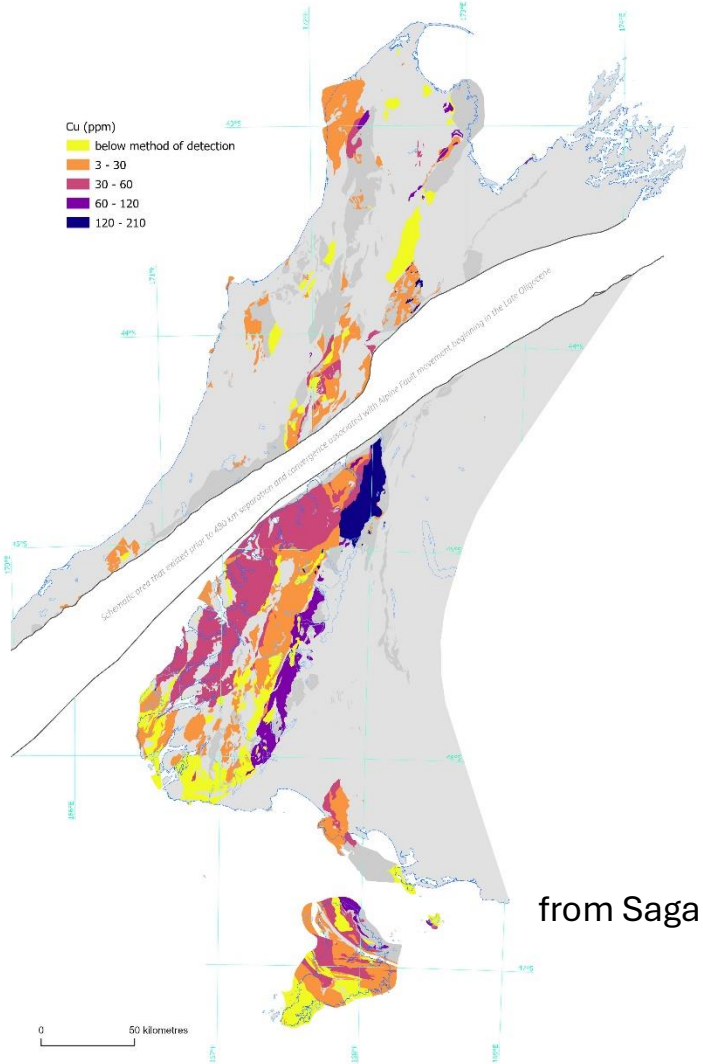


Dominant mafic mineral

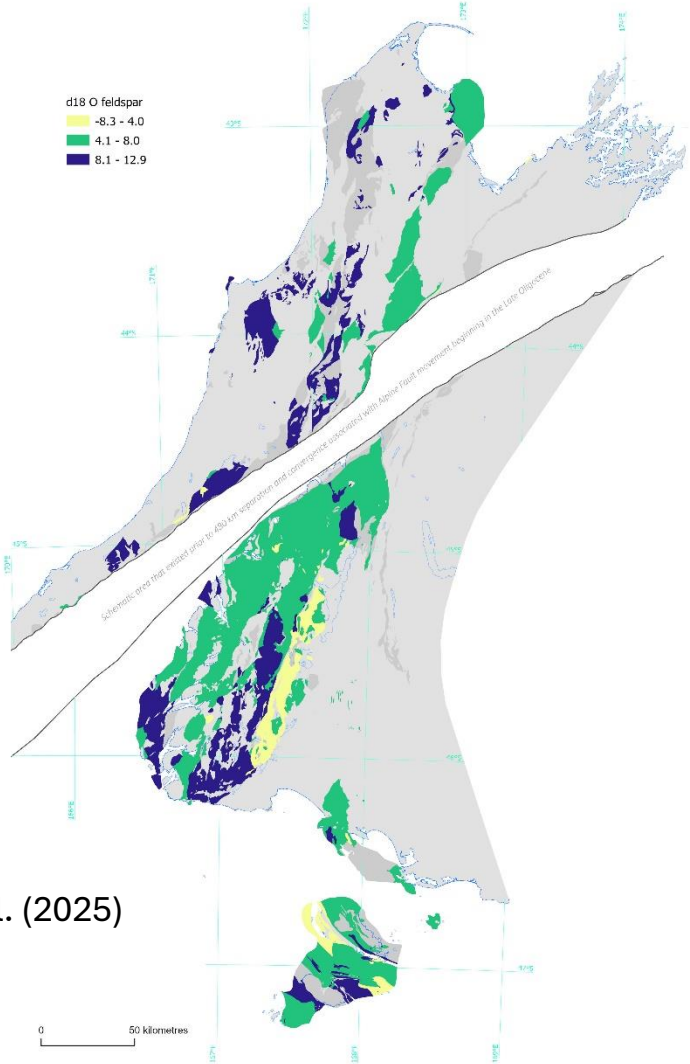
Pluton Map Atlas: examples of numeric properties



Emplacement age



Copper concentrations



δ18 O feldspar

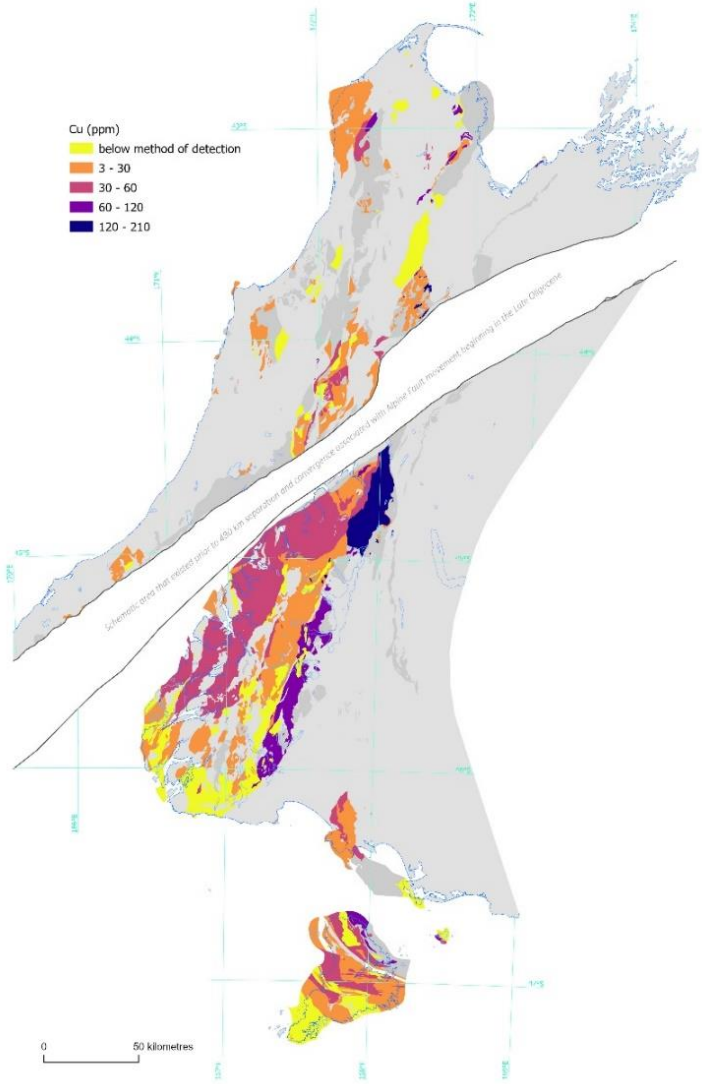
from Sagar et al. (2025)

Pluton Map products

Atlas of pluton properties (PDF, freely downloadable)

Sagar MW, Rattenbury MS, Faure K, Tulloch AJ, Turnbull RE. 2025. Atlas of pluton properties for Aotearoa New Zealand. GNS Science Report 2025.

GIS dataset (freely downloadable GIS data, web map application and streamable web service)



Pluton Map next steps?

Sampling, dating and geochemistry of remaining plutons

Consistent trace element geochemistry (ICP-MS/AES, fire assay) of all plutons, including REEs, Ag, Au, Cd, Co, Cu, Li, Mo, Sn and Ta

Mineralisation-specific fertility parameters such as Fe oxidation state, zircon and apatite trace elements

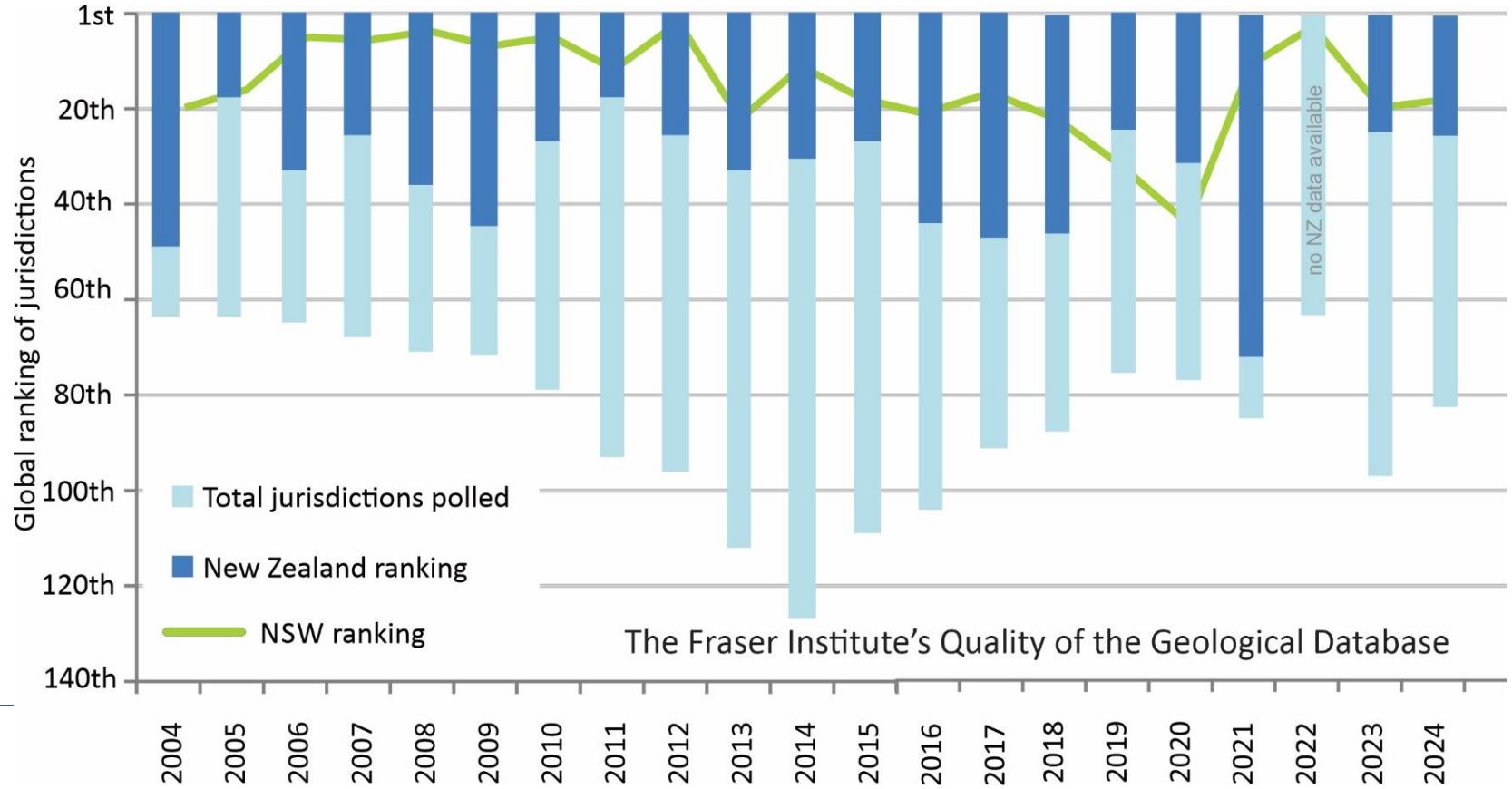
Geoscience data for mineral exploration

Public domain geoscience data relevant to mineral exploration comes from, amongst others, Earth Sciences New Zealand, NZ Petroleum & Minerals and exploration companies via their permit obligations

Good quality, accessible geoscience data assists exploration targeting

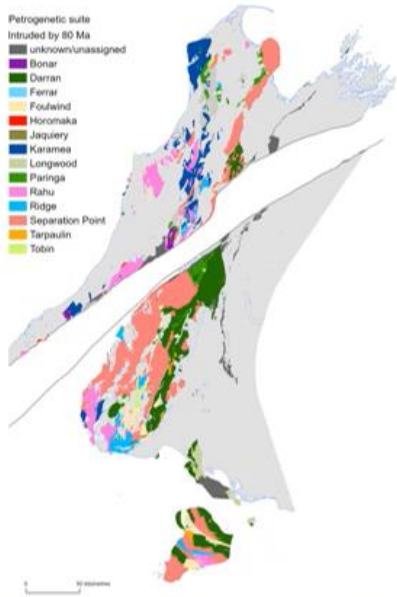
Continued acquisition of public domain geoscience data (and its promotion) will maintain or enhance New Zealand's attractiveness for mineral exploration

Where and what are the key geoscience data gaps?



Earth Sciences New Zealand

A time-lapse history of pluton emplacement across southern Aotearoa New Zealand




West Arm Leucogranite dikes cutting Refrigerator Orthogneiss tonalite, Delta Burn, eastern Fiordland