Australian Government
Geoscience Australia

Uranium mineral systems: ore-forming processes and relationships among deposit types

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Topics

1. Relationships among U deposit types: A revised framework for deposit classification

2. Application of process-based mineral systems models to regional-scale targeting of U mineralisation (part of Energy Security Program)

Uranium deposit classification

Most widely used: IAEA 'RED BOOK'

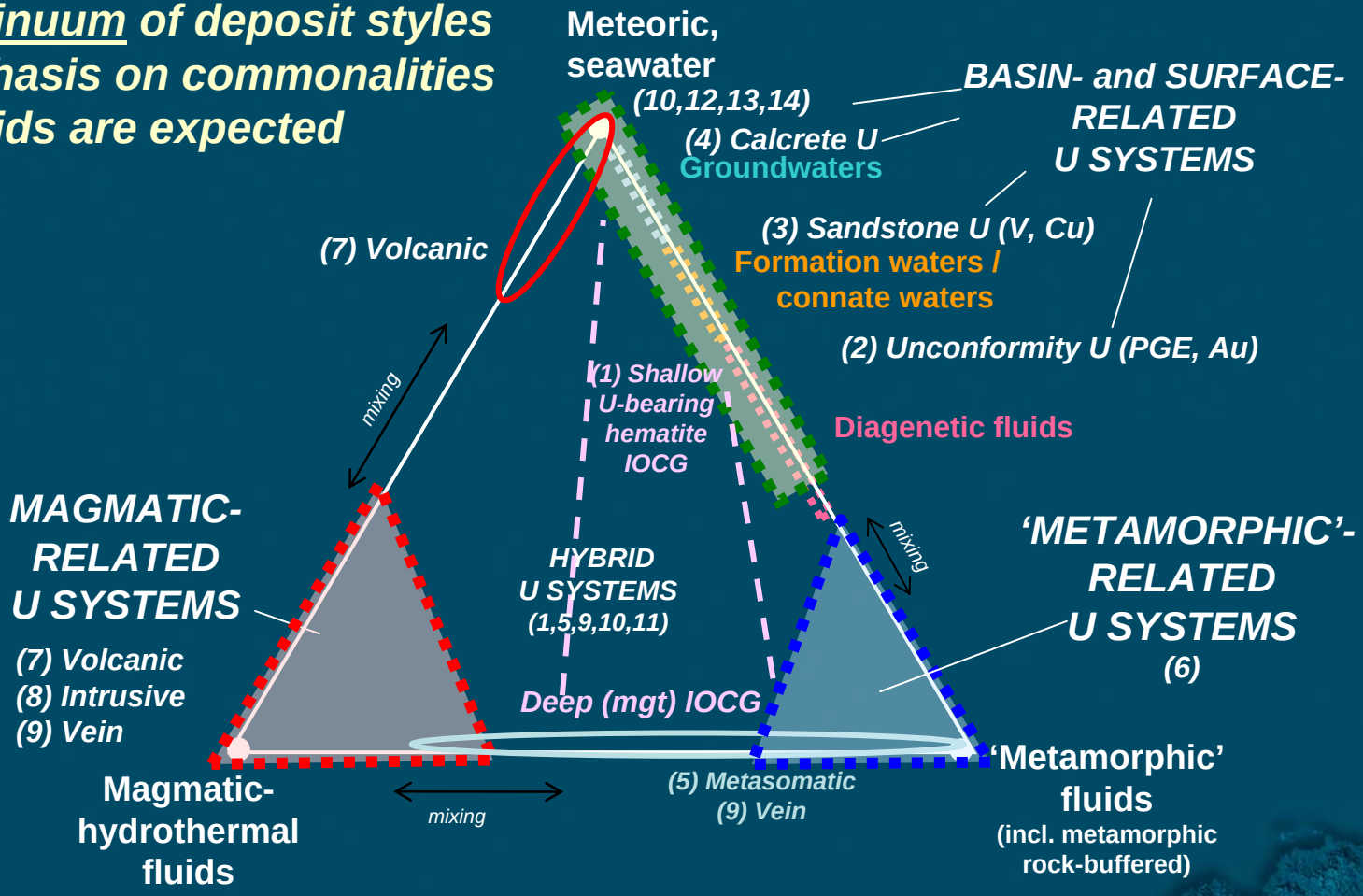
In order of economic importance in Australia:

1. Breccia complex (Iron Oxide Cu-Au)
2. Unconformity-related
3. Sandstone
4. Surficial
5. Metasomatite
6. Metamorphic
7. Volcanic
8. Intrusive
9. Vein
10. Quartz-pebble conglomerate
11. Collapse breccia pipe
12. Phosphorite
13. Lignite
14. Black shale

- ***Based on host-rock or deposit morphology***
- ***Relationships between deposit types not clear***

An alternative view: 3 families of uranium mineral systems

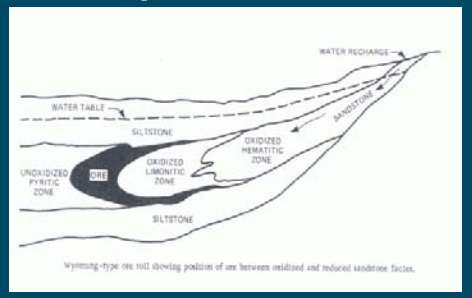
- *Three end-member fluids*
- *<u>Continuum</u> of deposit styles*
- *Emphasis on commonalities*
- *Hybrids are expected*



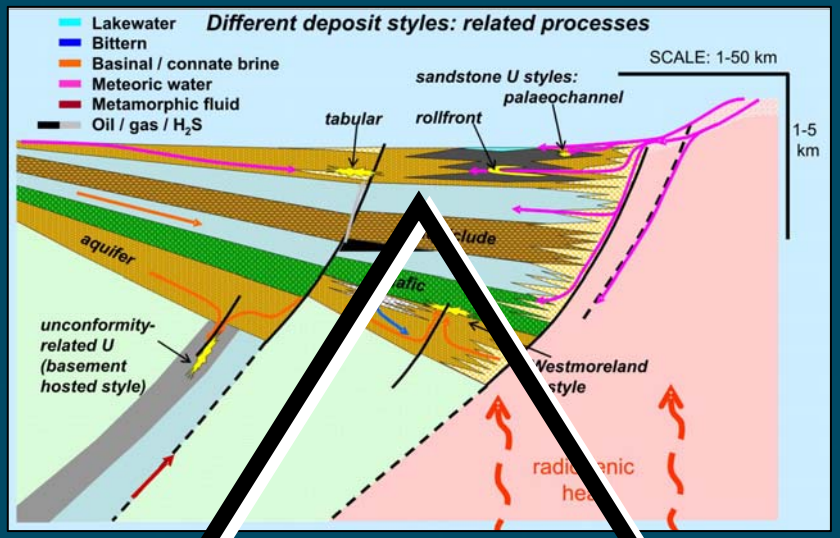
(#) represent deposit types from IAEA Red Book & Dahlkamp (1990)

Mineral systems models (cf. deposit models)

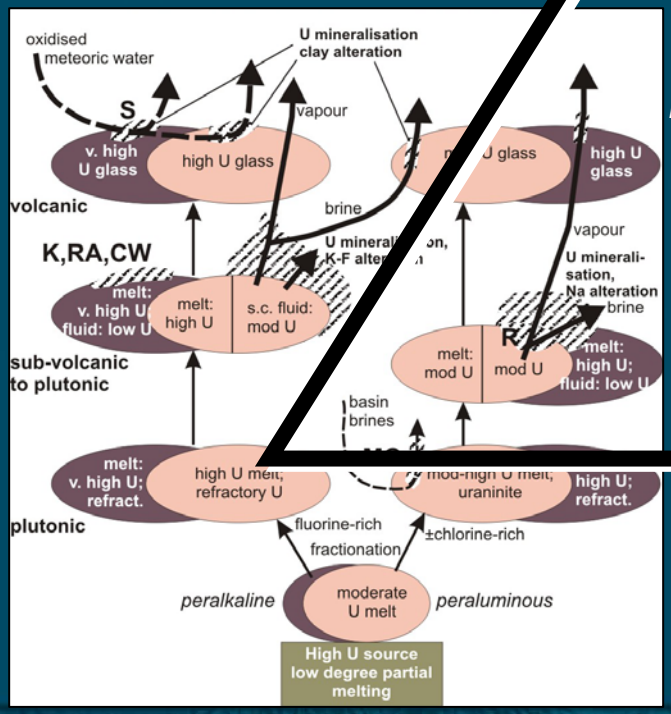
Deposit model



BASIN- and SURFACE-RELATED

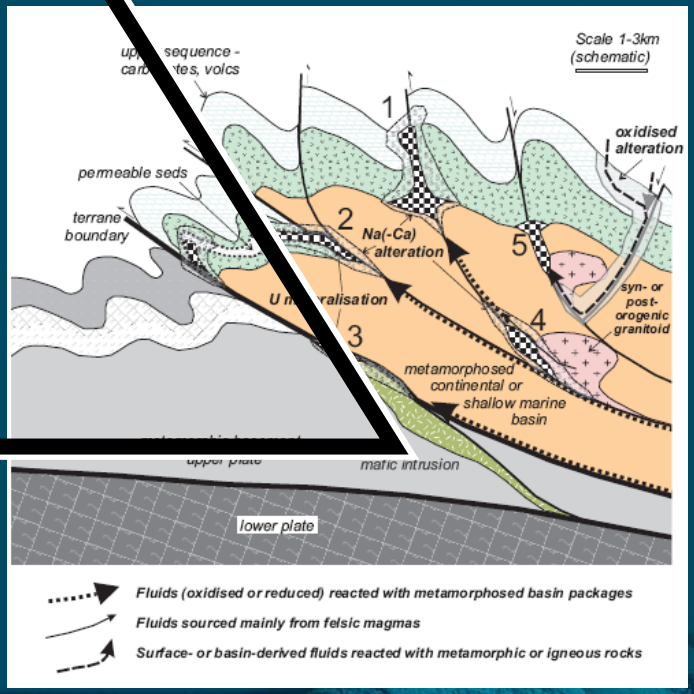


MAGMATIC-RELATED



HYBRIDS (IOCGU, etc)

METAMORPHIC-RELATED



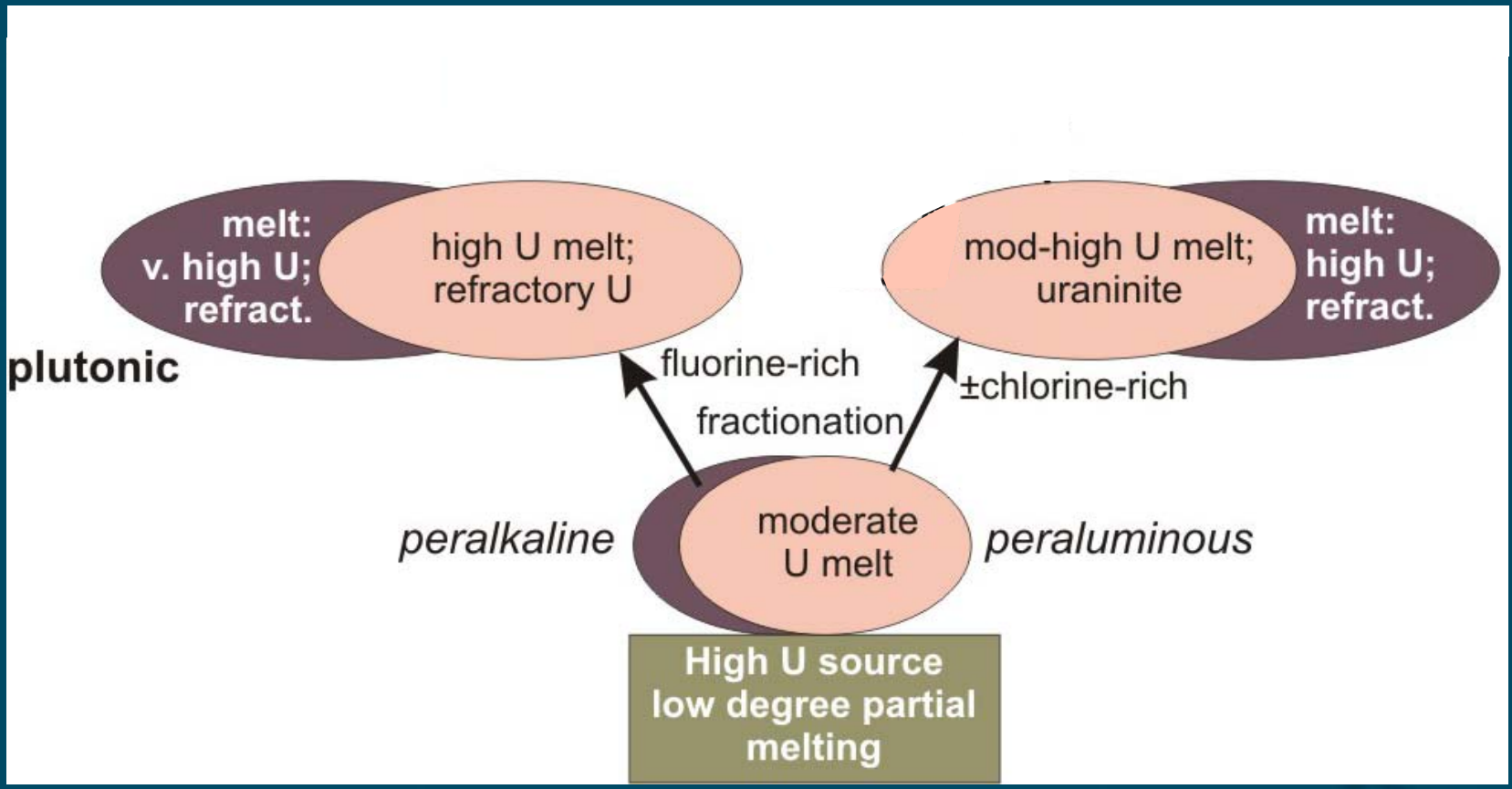
Application of the U systems conceptual framework to exploration targeting

1. Identify critical mineralising processes for each family of U mineral systems
2. Translate into mappable criteria
3. Build GIS layers; assign weightings
4. Produce regional and national scale maps of uranium potential for each system

(Wyborn et al., 1994; Barnicoat et al., 2007; McCuaig & Beresford, 2009)

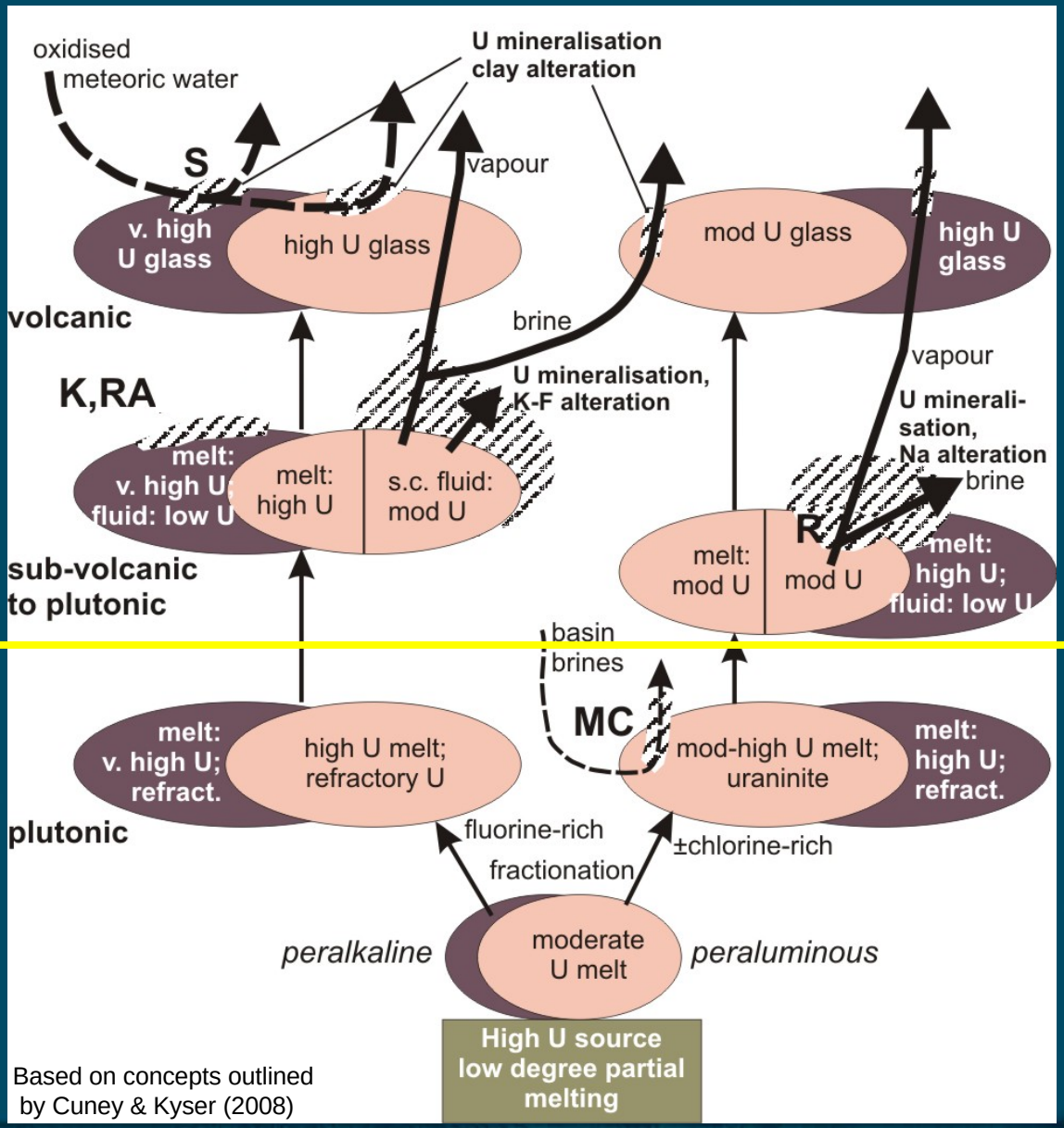
Magmatic-related uranium systems:

critical mineralising processes



Based on concepts outlined by Cuney & Kyser (2008)

Magmatic-related uranium systems

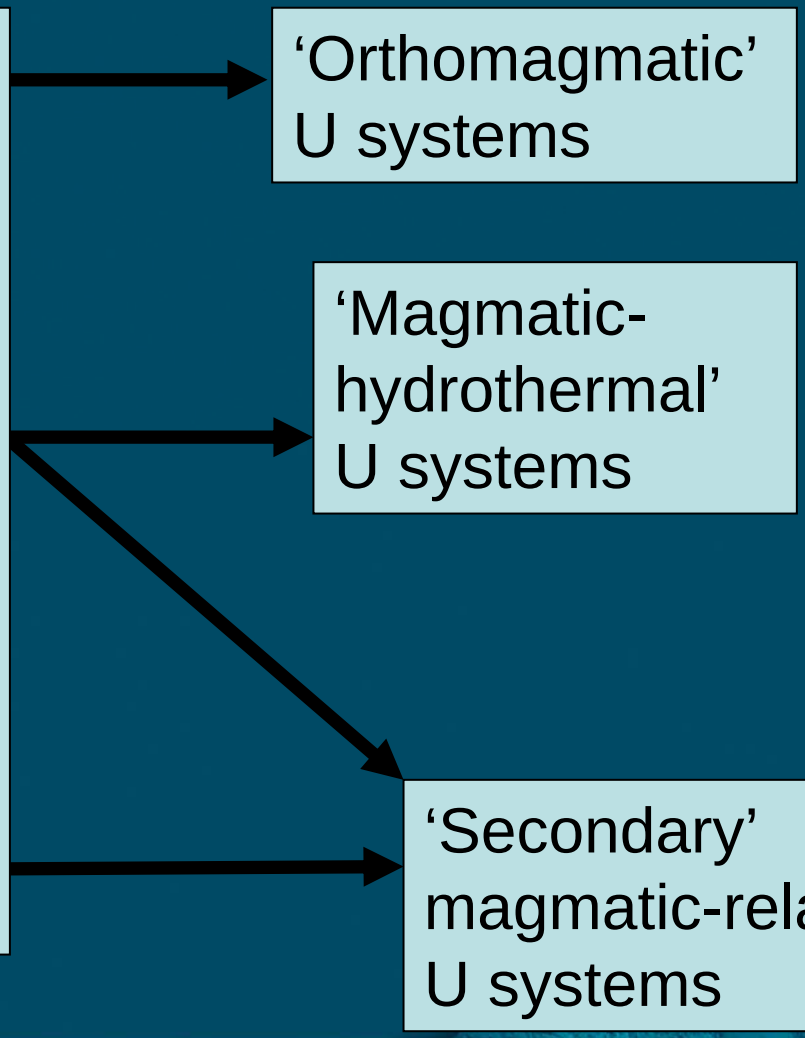


S = Streltsovka
K = Kvanefjeld
RA = Ross Adams
R = Rossing
MC = Massif Central

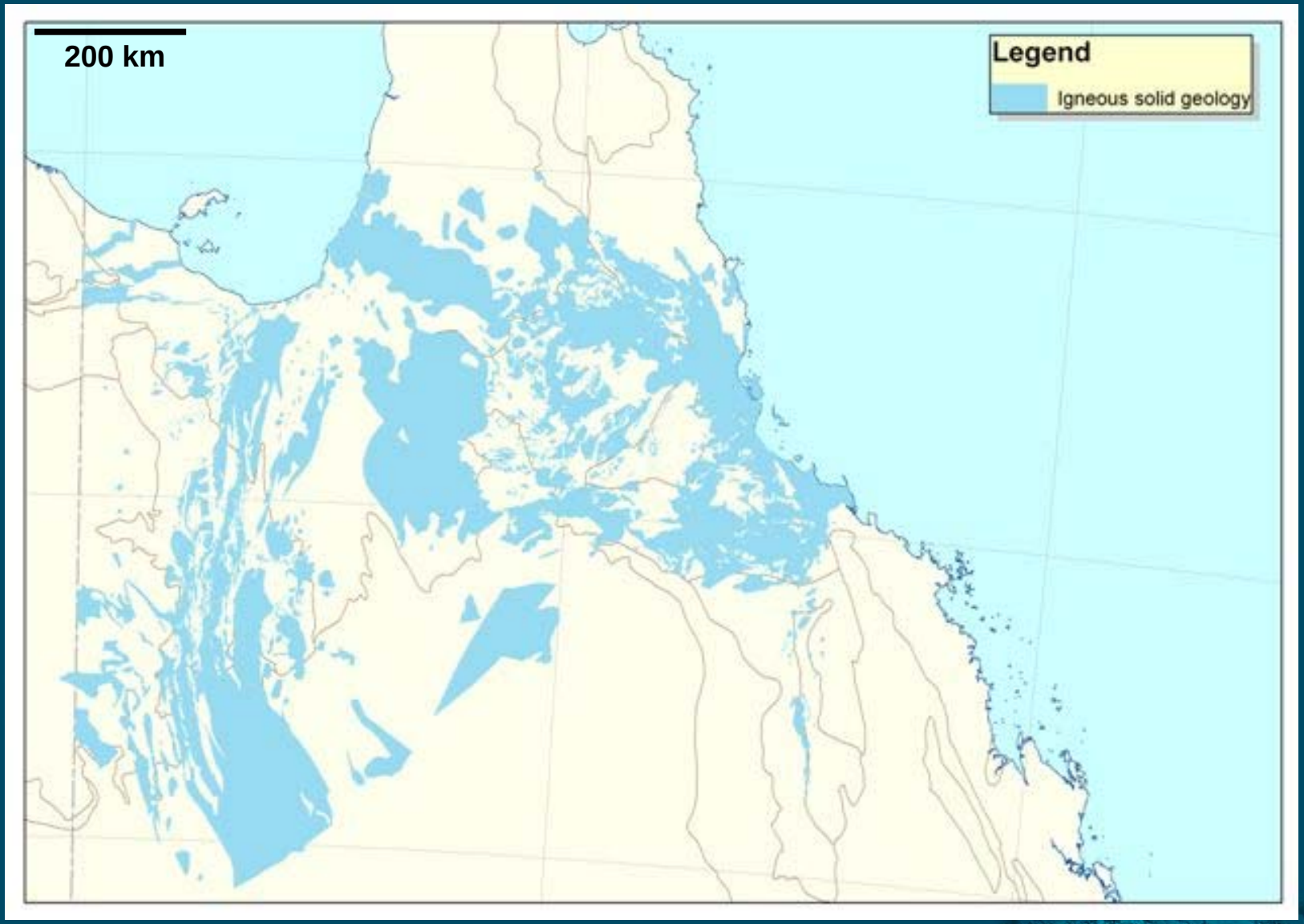
Previous image

Magmatic-related U systems: Key mappable criteria ('ingredients'):

- Peralum, peralk, A-type, high-T I-type
- High temp melting
- Highly fractionated (Rb/Sr)
- High U solubility (peralkaline, Cl, F)
- Volcanic vs plutonic
- High U content
- etc



Nth Queensland magmatic-related U potential



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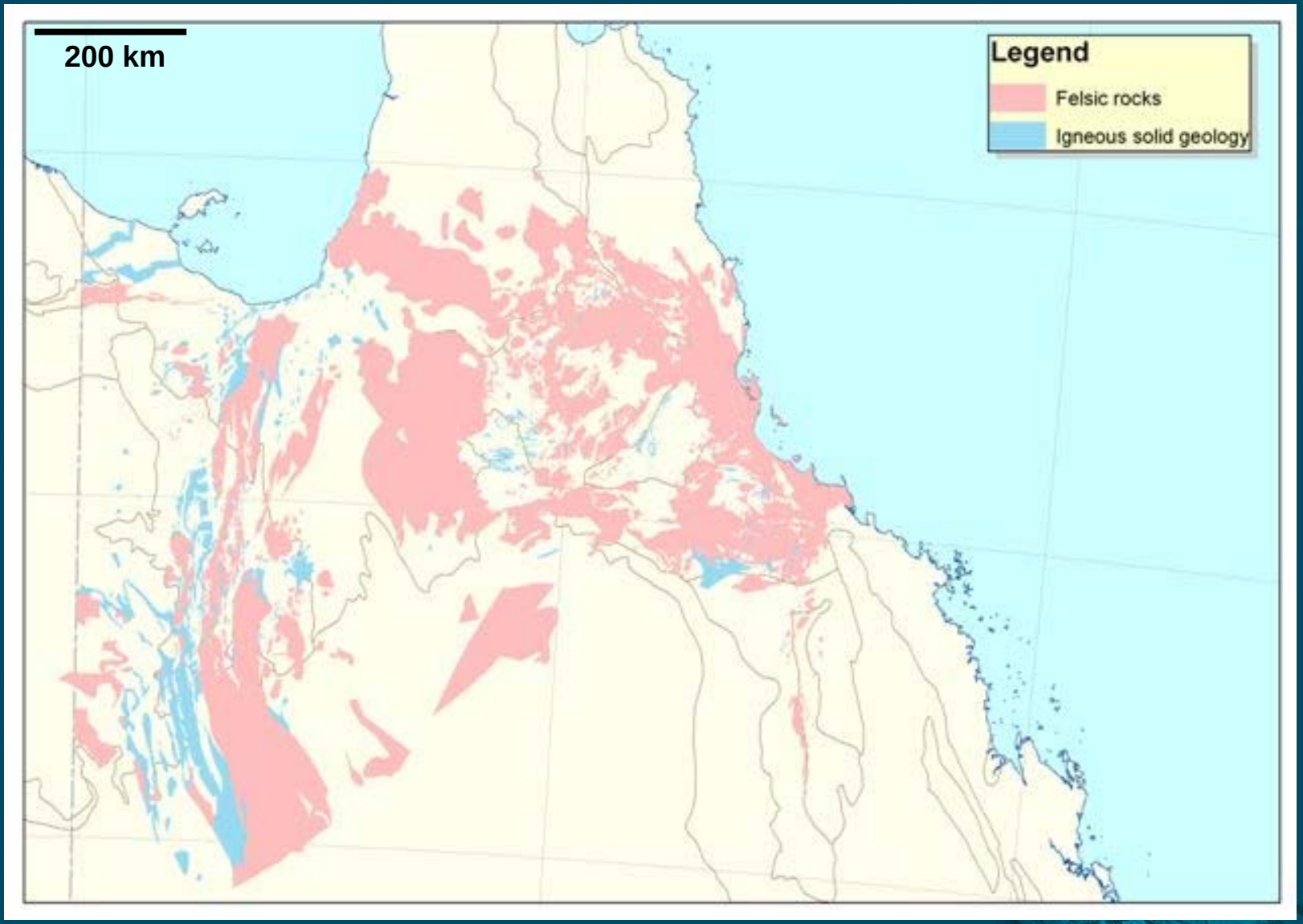

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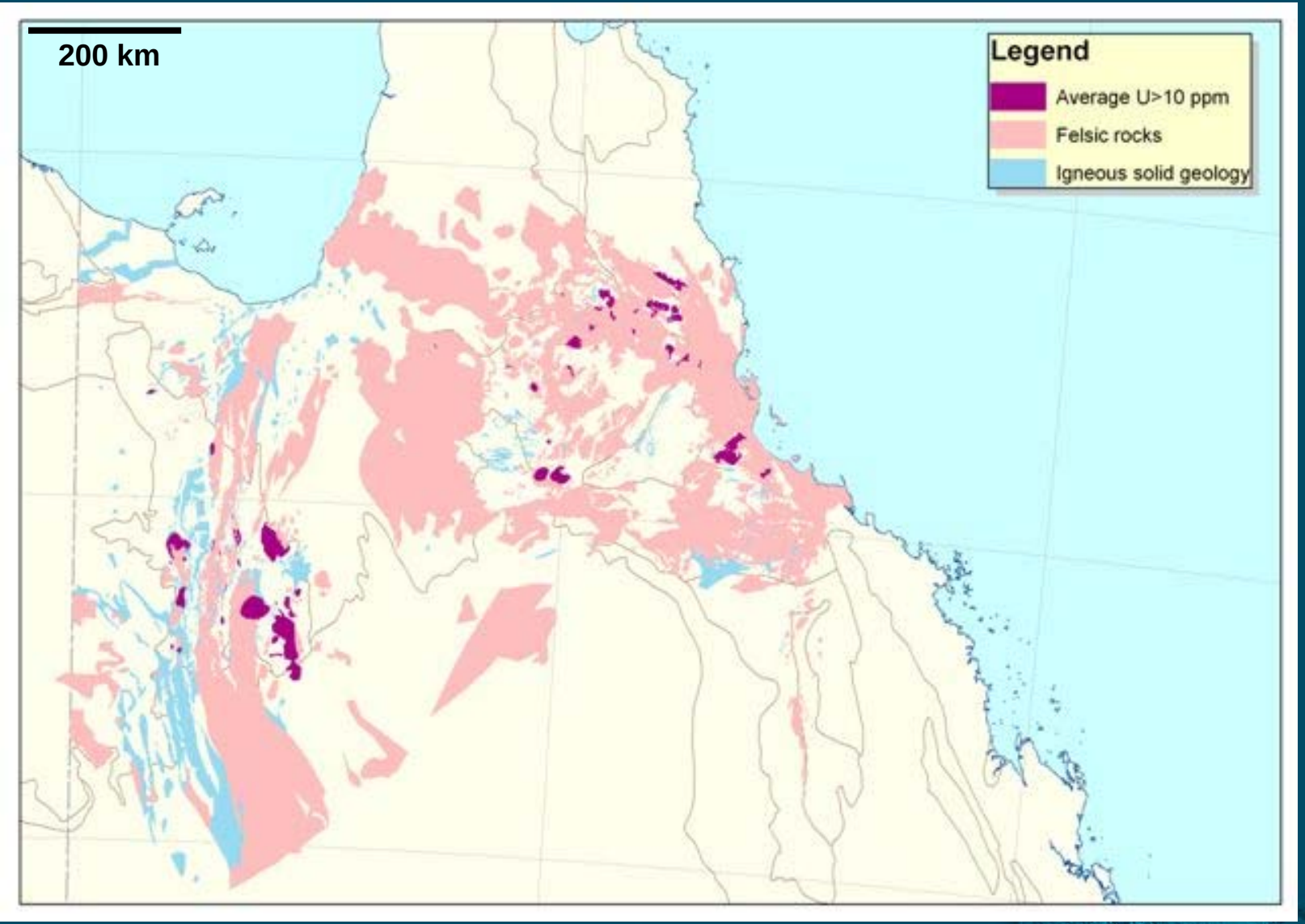

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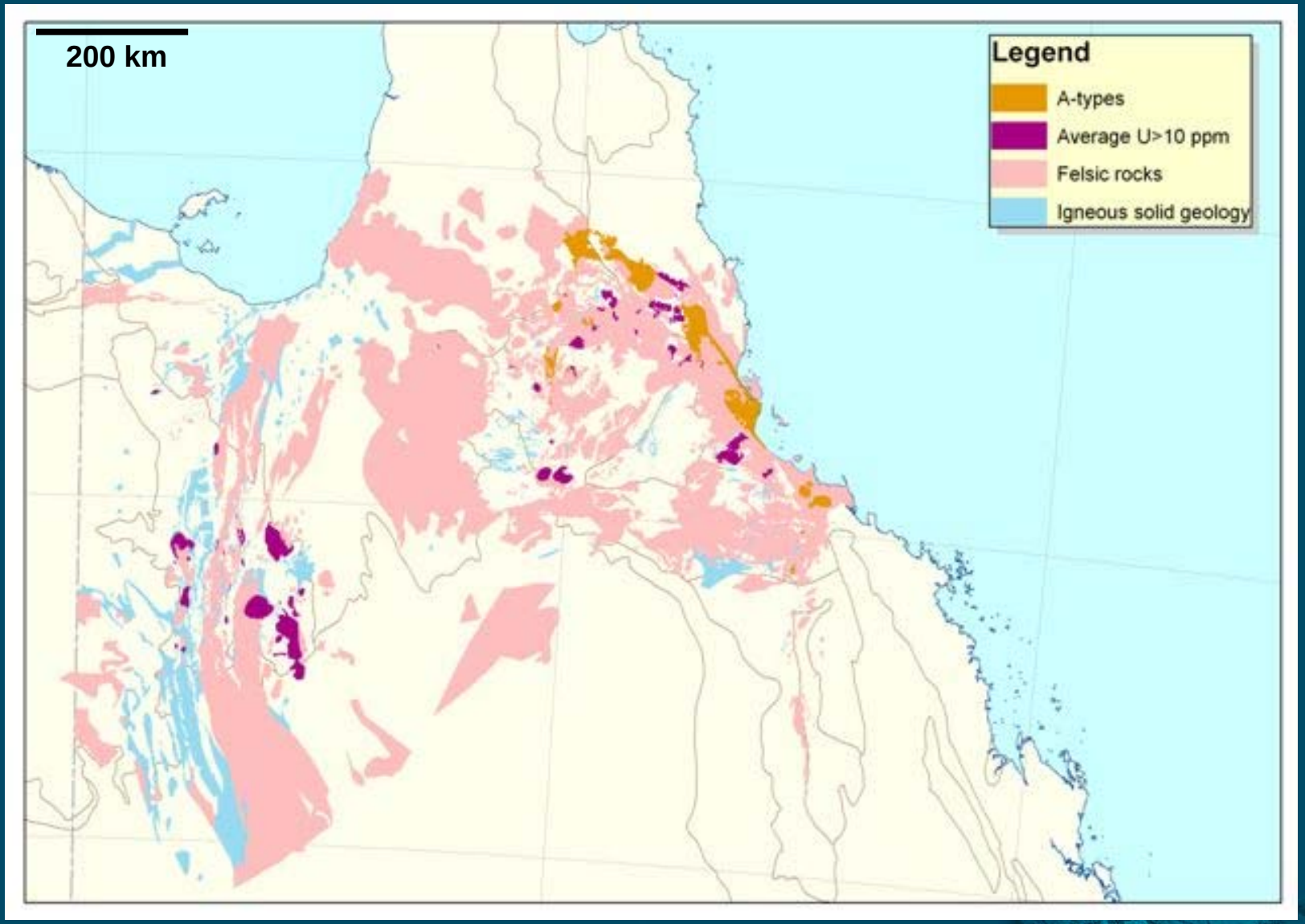

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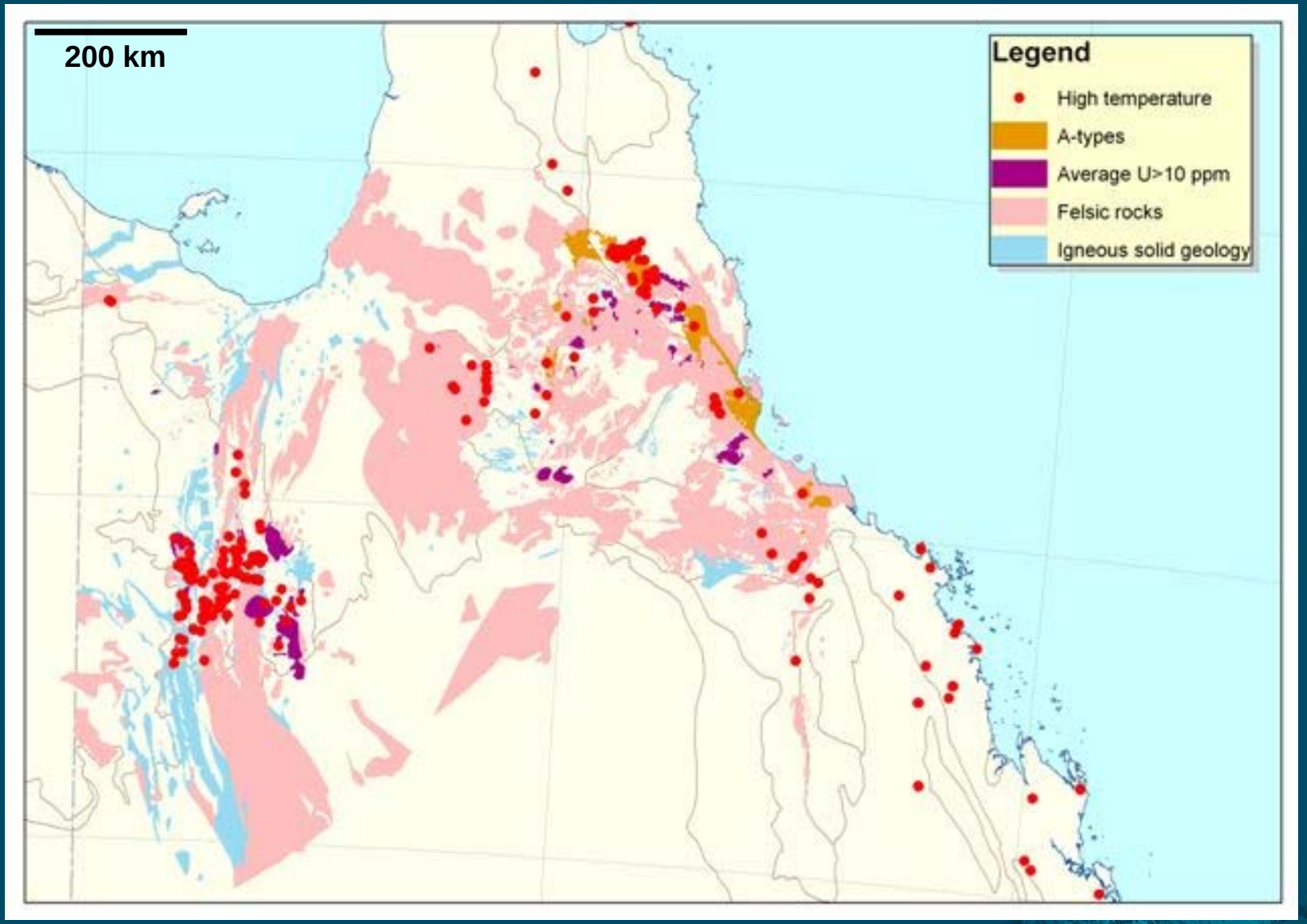

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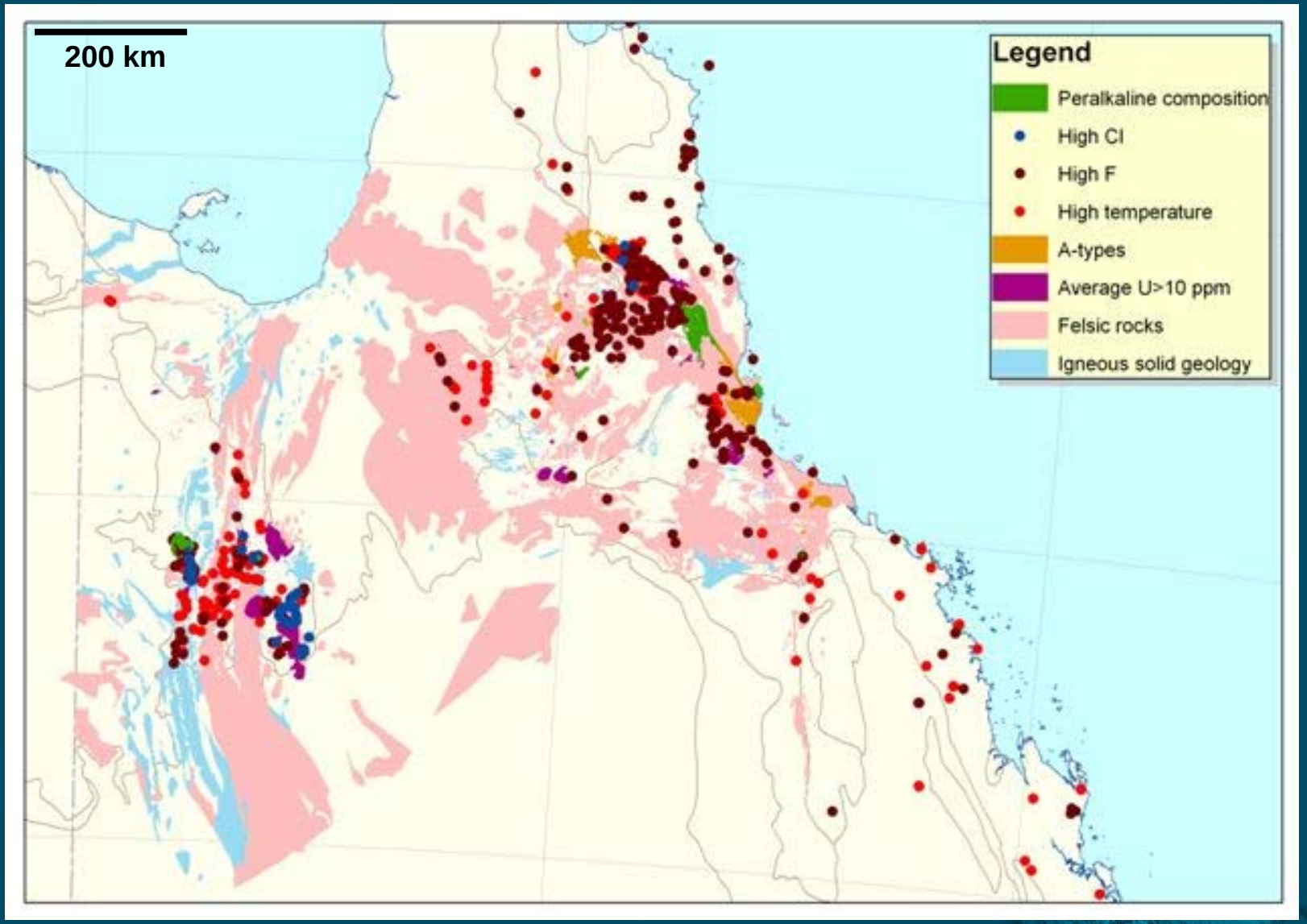

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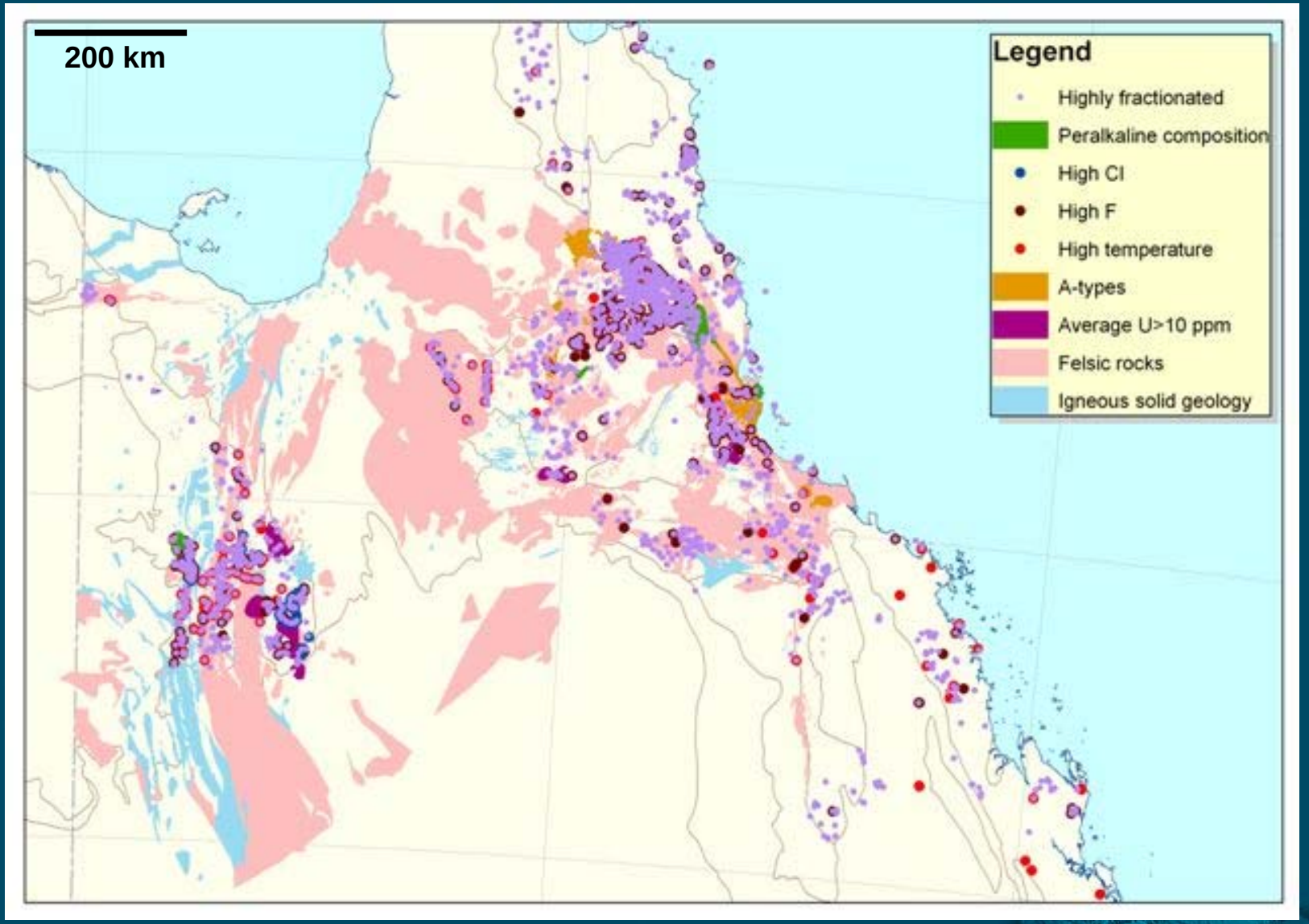

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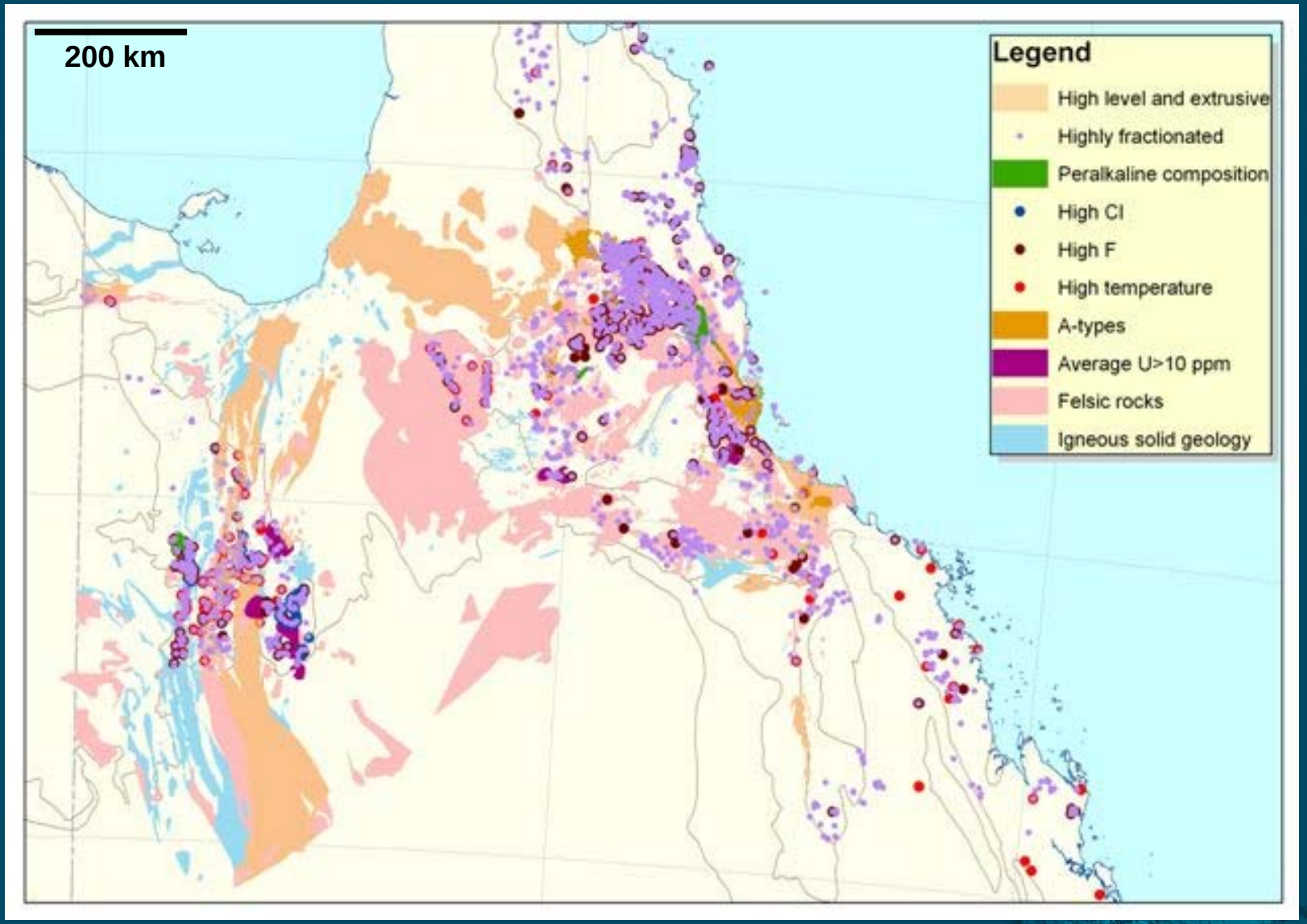

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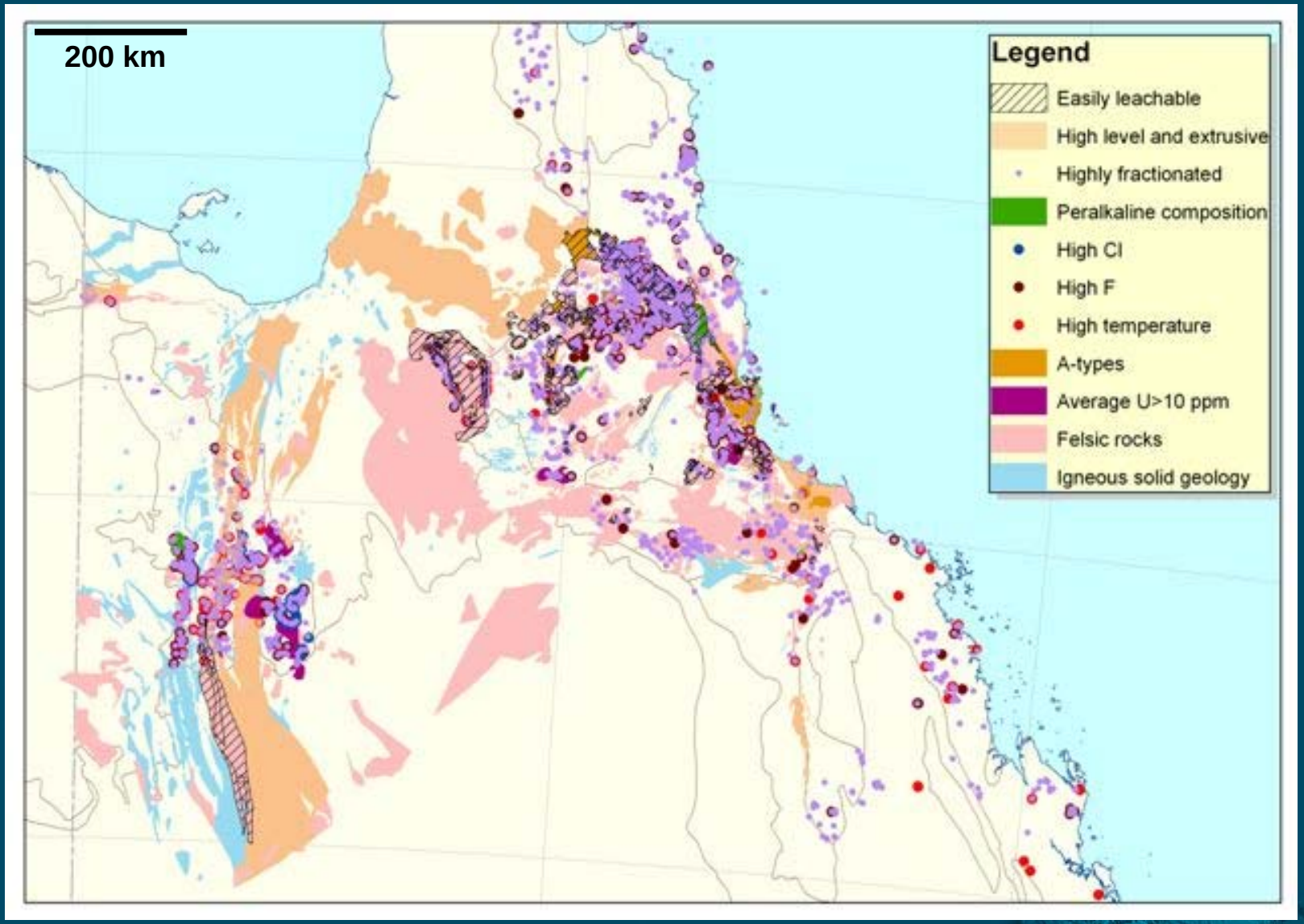

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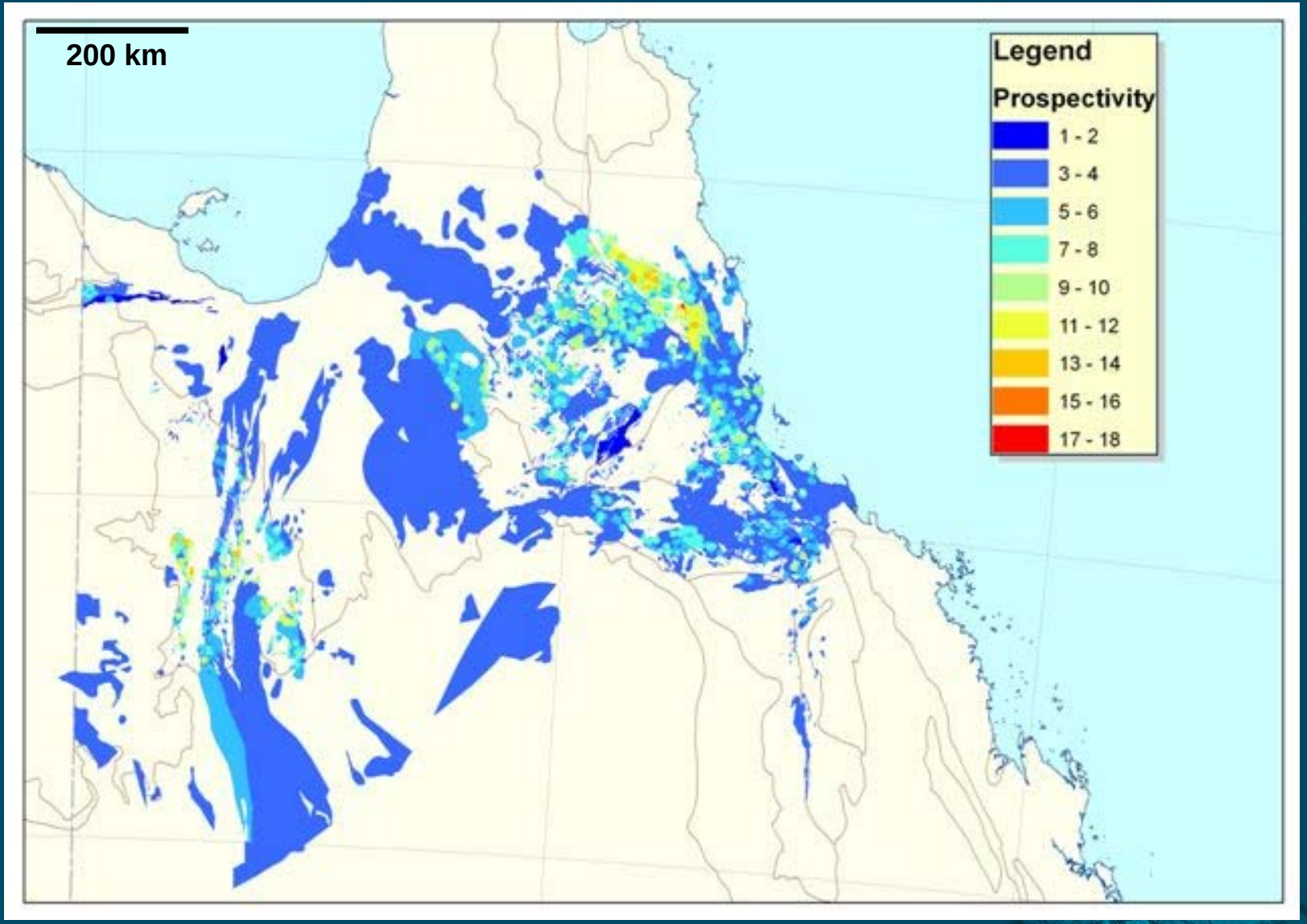

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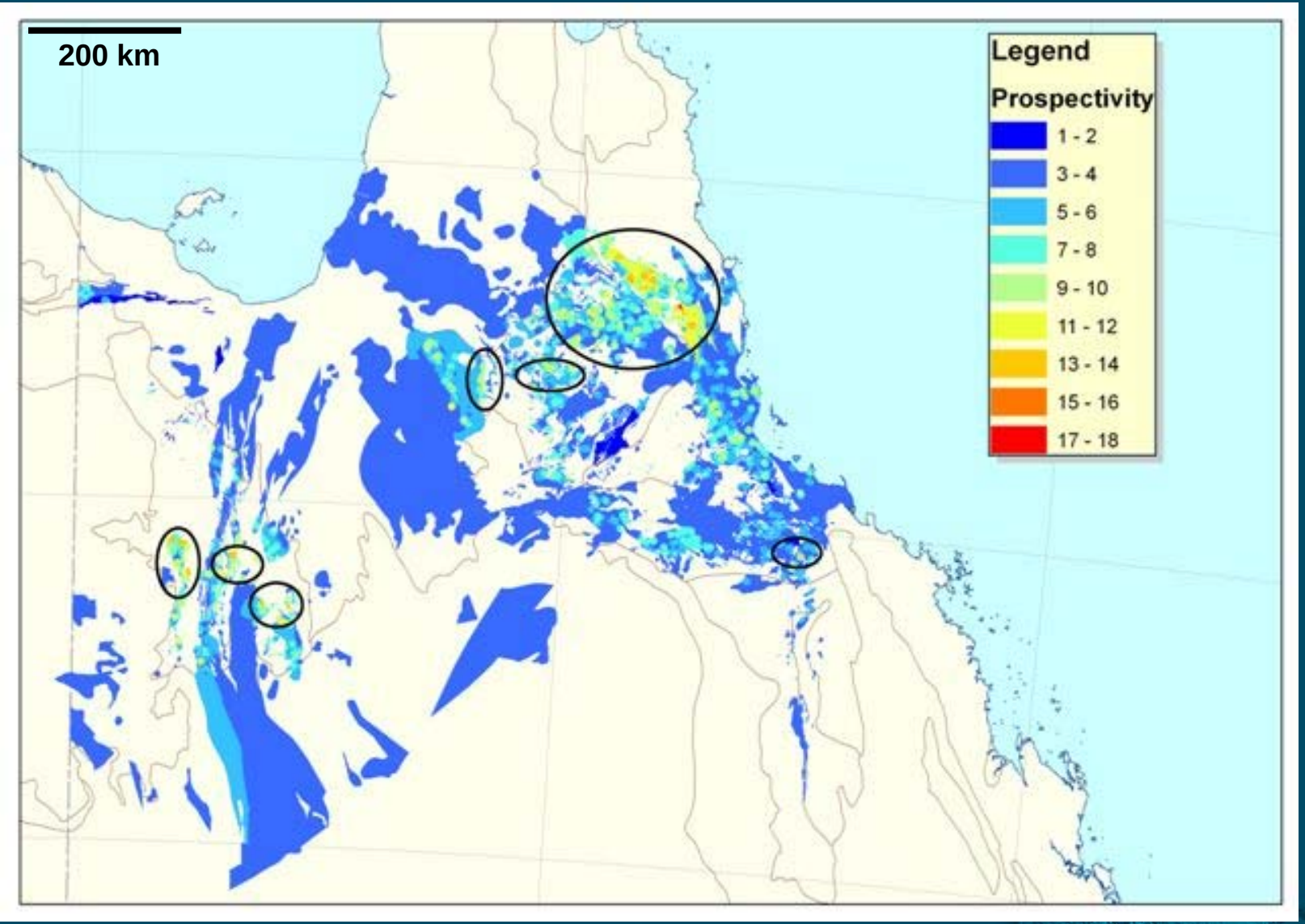
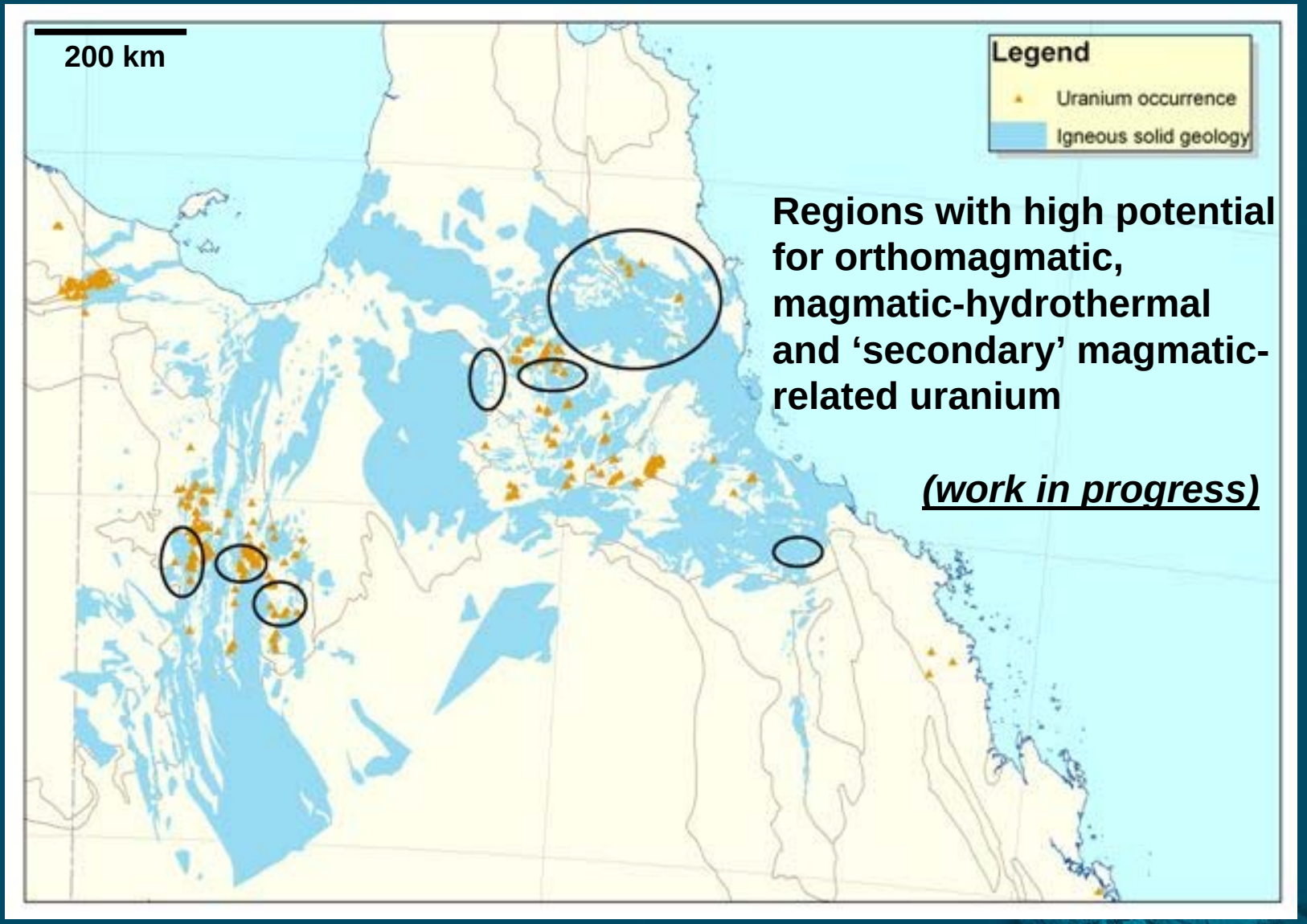
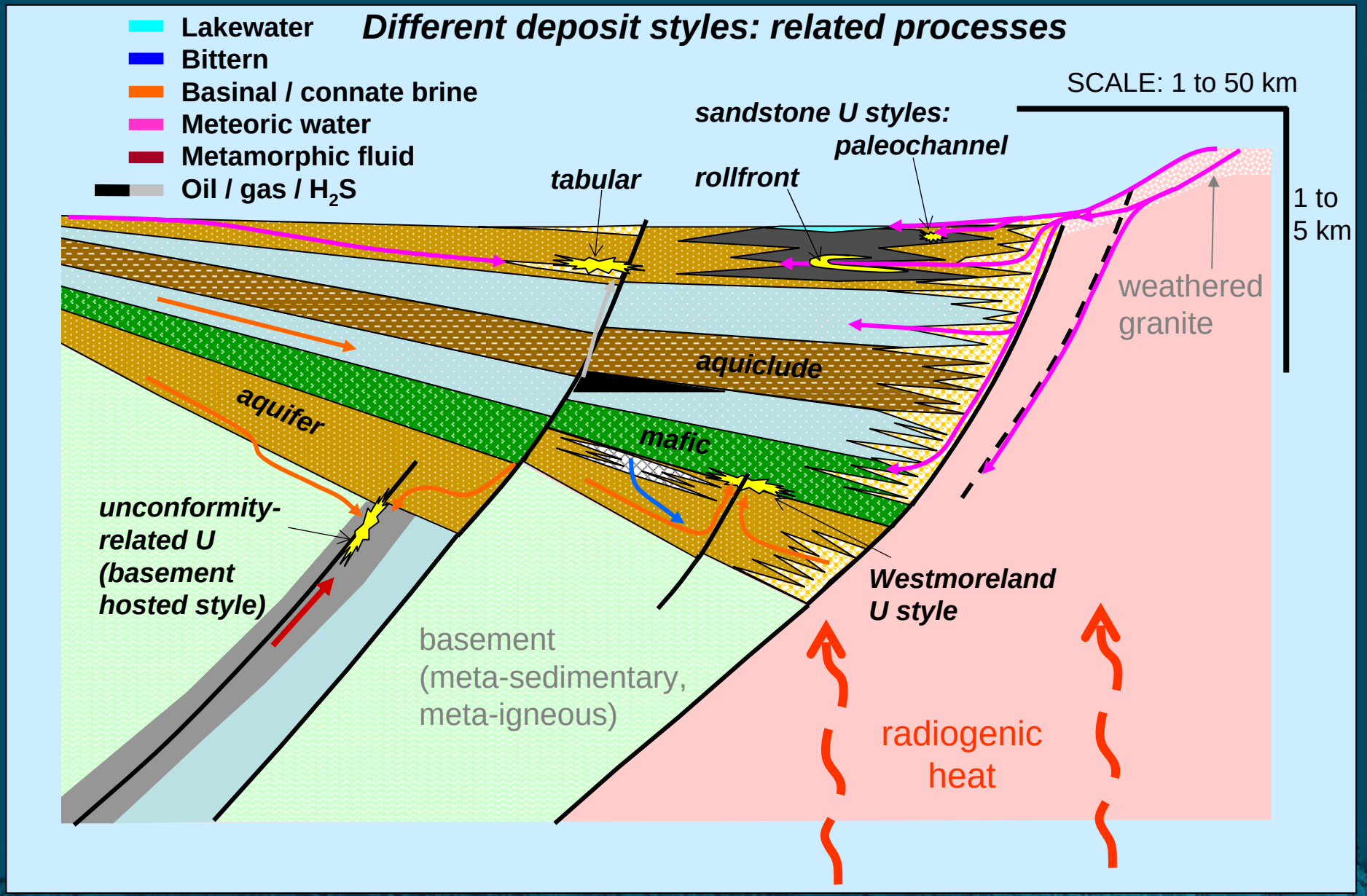


Nth Queensland magmatic-related U potential

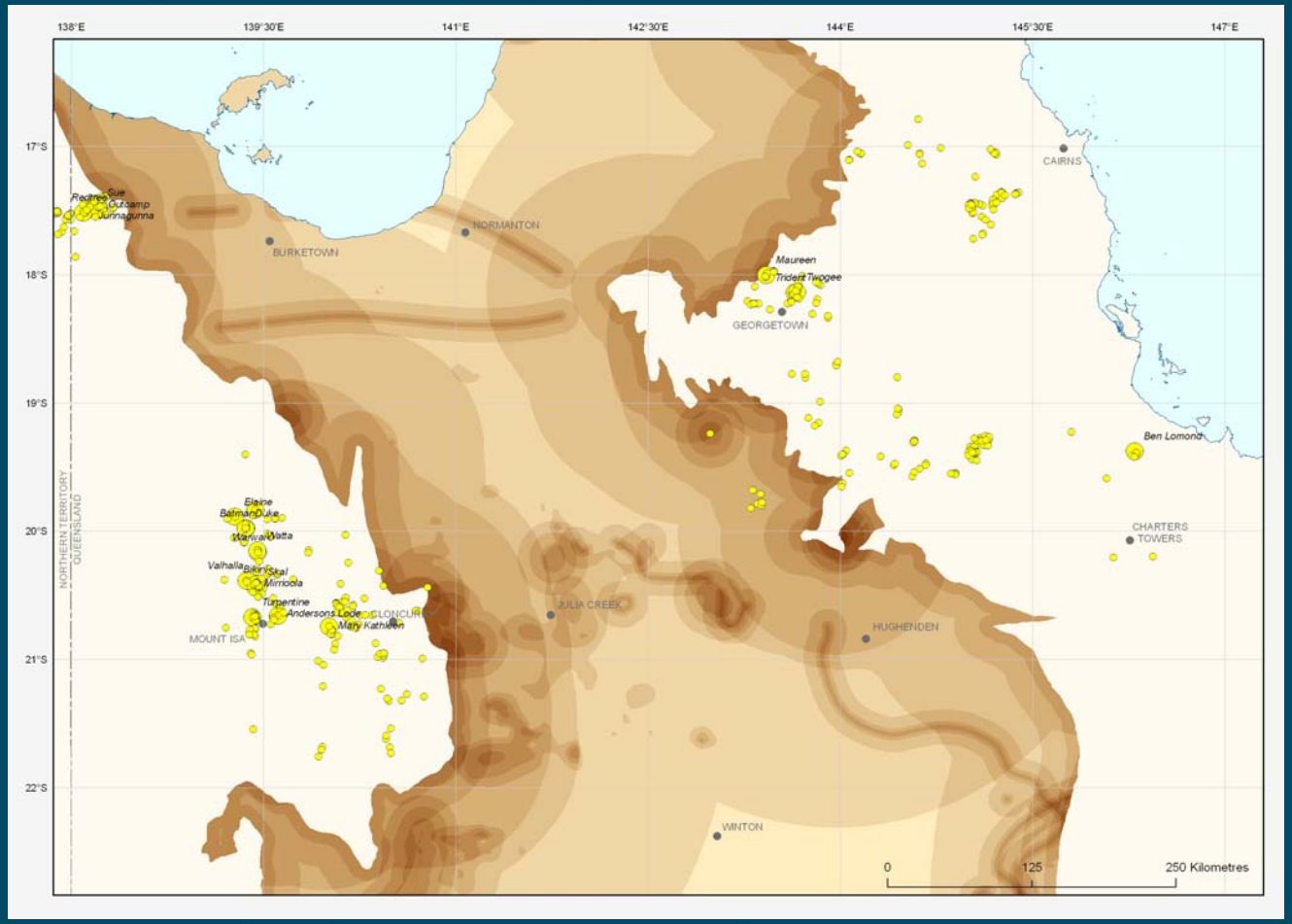


Basin-related uranium systems



Basin-related uranium potential of north Queensland

Uranium potential in Mesozoic basins

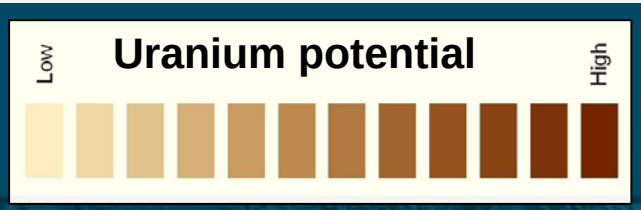


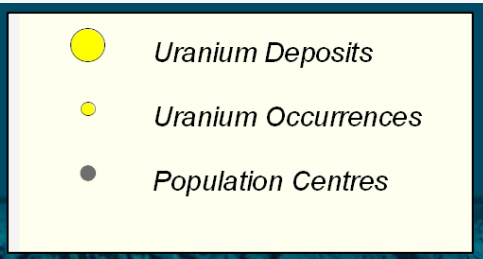
Criteria ranked by distance from:

- High-U source (from radiometric data)
- U anomalies in basin (from radiometric data)
- Groundwater pH gradient (at pH 7)
- Groundwater eH gradient (at eH 0mV)
- Mesozoic basin margin

Plus

- Gamma-ray anomalism in drill holes (contours)

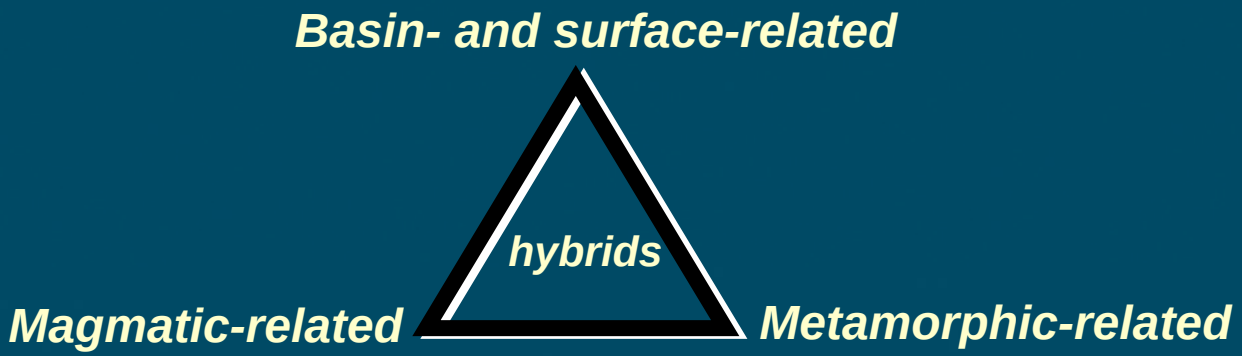




SGA, Townsville 2009

Conclusions

- **3 families of U mineral systems in ternary scheme, based on fundamental fluid types and settings:**



- **Hybrids exist in continuum; new discoveries may not look like known deposit styles.**
- **Application of 'systems' approach: new areas identified with high potential for uranium mineralisation.**