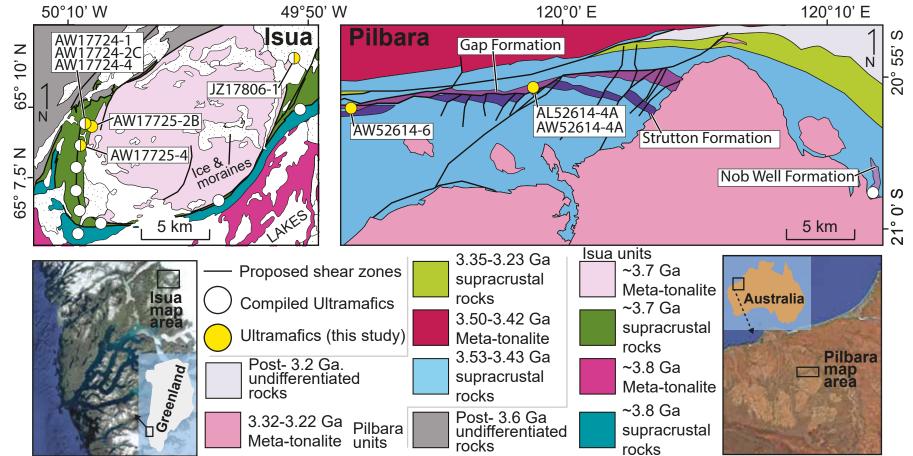


spinel geochemistry from ultramafic rocks of Isua supracrustal belt and East Pilbara Terrane to explore their origins.

If they are not consistent with mantle-origins, or they can be viably interpreted as crustal ultramafic rocks (e.g., cumulates), then plate tectonics is not required to interpret their origins.

Geological maps of the study areas and sample locations



East Pilbara Terrane (~3.5-3.2 Ga, Western Australia) is dominantly interpreted by non-plate tectonic models.

Supracrustal rocks

deposition of volcani-sedimentary supracrustal rocks

downward

advection

n response

to deposition

transition into lower crust and mantle

Tonalite

heat-pipe tectonics

partial convective crustal overturn

transition into lower crust and mantle

sinking as gravitational drips

Tonalite

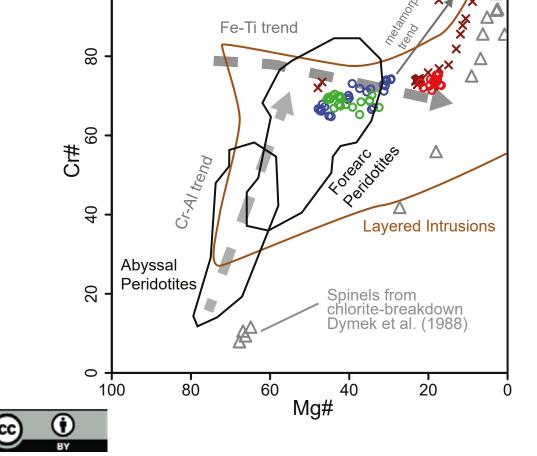
lava and/or

cumulates

Representative thin section photos

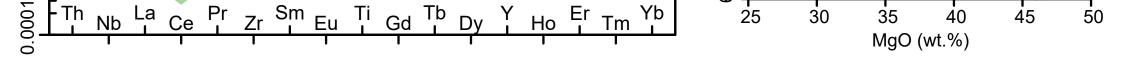
Pilbara: AW52614-6 PPL Pilbara samples Pilbara: AW52614-6 XPL →AW-52614-6 + Primitive ODP Leg 209 abyssal peridotites show cumulate PILBARA mantle Garret Transform abyssal peridotites 0 Oman forearc peridotites - Depleted textures → Pilbara Nobb Jⁱ Well Formation mantle Papua New Guinea forearc peridotites Al₂O₃ (Wt.%) ∞ Carbonated Hyblean abyssal peridotites samples X Isua ultramafics associated with low Al₂O₃/-ဖ ⊕ AW17724-2C TiO₂ basalts Igneous tex-Isua: AW17724-2C PPL Isua: AW17724-2C XPI ⊕ AW17724-4 X Isua ultramafics associated with high tures of Isua Al₂O₃/TiO₂ basalts ↔ Pilbara basaltic andesites - Salgash Subroup samples are al-100 \sim tered beyond 0 recognition 10 0 Х 0 **Comparison of spinel geochemistry** Ö. of Isua & Pilbara samples and depleted mantle rocks TiO₂ (wt.%) 0.6 Primitive mantle Normalized 0.1 O AW-52614-6 O AL-52614-4A 0 4 OAW-52614-4A 」ੋ ਵੋ 0.01 Ô Ö × Isua ultramafics associ-ated with low Al₂O₃/TiO₂ basalts 6 100 \sim Szilas et al. (2015) 0 ▲ Isua peridotites associ-ated with low Al₂O₃/TiO₂ က basalts 0 Dymek et al. (1988) 0 △ Isua peridotites associ-ated with high Al₂O₃/TiO₂ 100 80 basalts \sim Dymek et al. (1988) 16 Spinels from FeOt (wt.%) 4 chlorite-breakdown Dymek et al. (1988) 0.1 Forearc Peridotites mantle Abyssal 2 Peridotites 0.01 0 100 20 60 Cr# ω 100 0.00

Comparison of whole-rock geochemistry of Isua & Pilbara samples and depleted mantle rocks



(%

TiO₂ (wt.



G

Findings:

- 1) geochemistry of Isua and Pilbara ultramafic samples are similar, and are more enriched in incompatible trace elements than most of the depleted mantle rocks;
- 2) spinels of Isua and Pilbara ultramafic rocks show moderate to high Cr# and low to moderate Mg#, which are inconsistent with the depleted manlte rocks;
- 3) Pilbara samples show cumulate textures;
- 4) Isua and Pilbara ultramafic samples show co-genetic relationships with local supracrustal rocks. These findings indicate a cumulate origin, and are incompatible with a mantle origin. Therefore, plate tectonics is not required to explain these rocks.

Future targets: geochemical modeling to check whether refertilization to depleted mantle rocks could produce the whole-rock and spinel geochemical patterns observed in Pilbara and Isua samples.