

Disturbing the time capsule: Hydrothermal effects on zircon U-Pb ages



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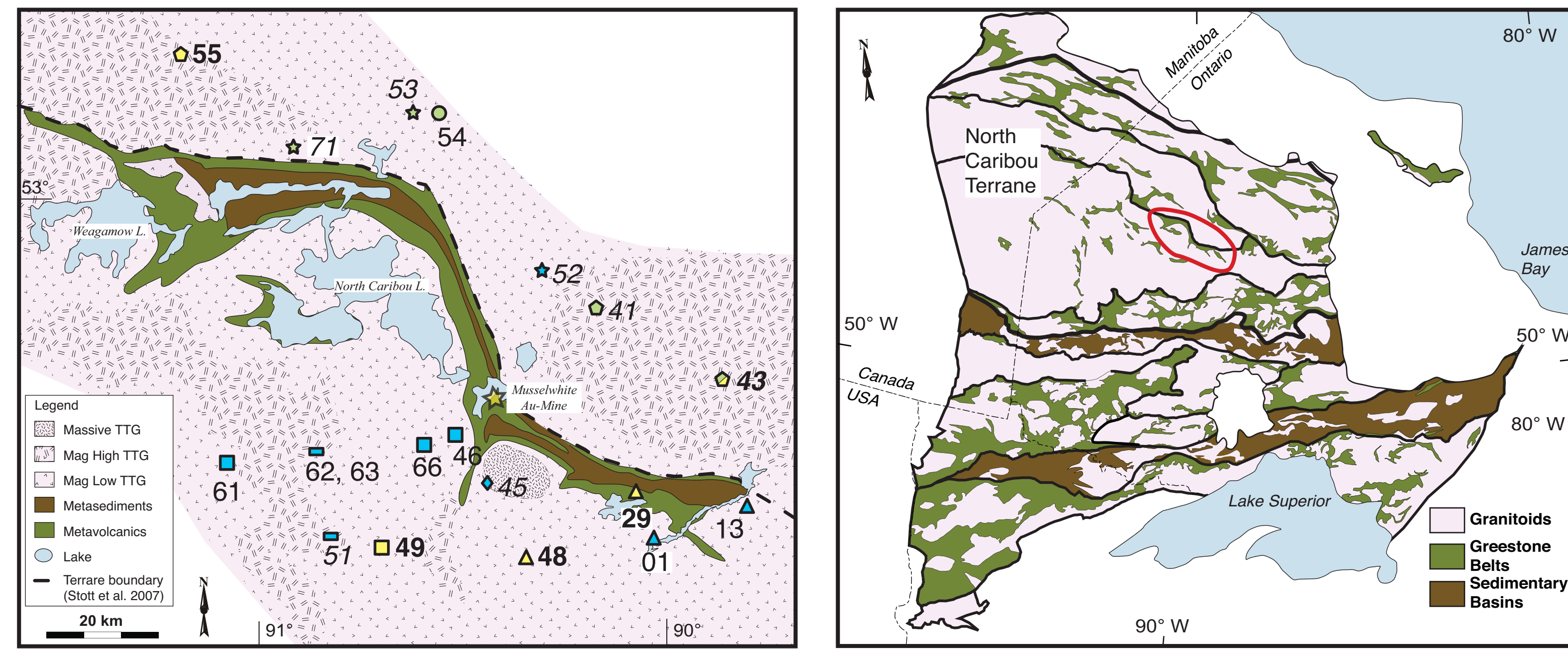
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Introduction:

Zircon is generally considered a robust mineral for geochronology, as it can preserve its ages through high temperature metamorphism, partial melting, and weathering. In this study, we analyze zircons for U/Pb isotopes and trace elements via LA-ICP-MS at the University of New Brunswick. Our results are consistent with several origins of zircon, including crystallization from igneous protoliths, granitoids and pegmatites, and hydrothermal dissolution-precipitation. The textures and occurrence of altered zircon are consistent with other minerals, like monazite, which are susceptible to alteration.

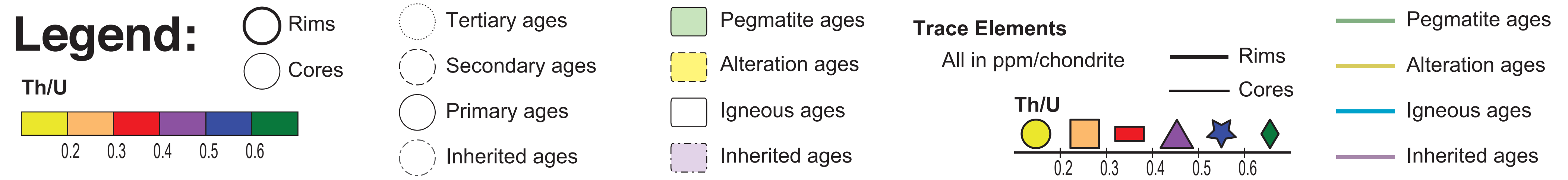
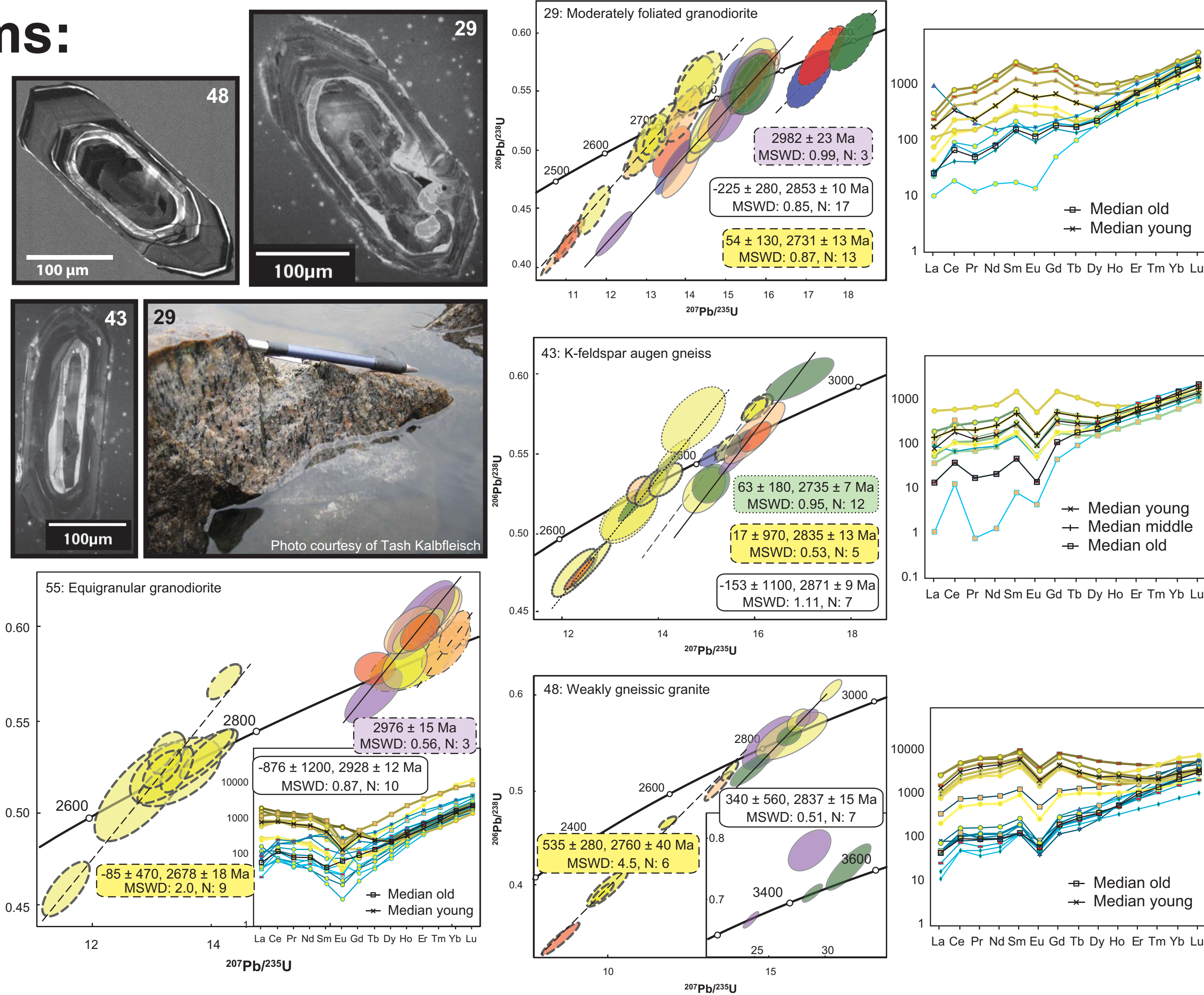
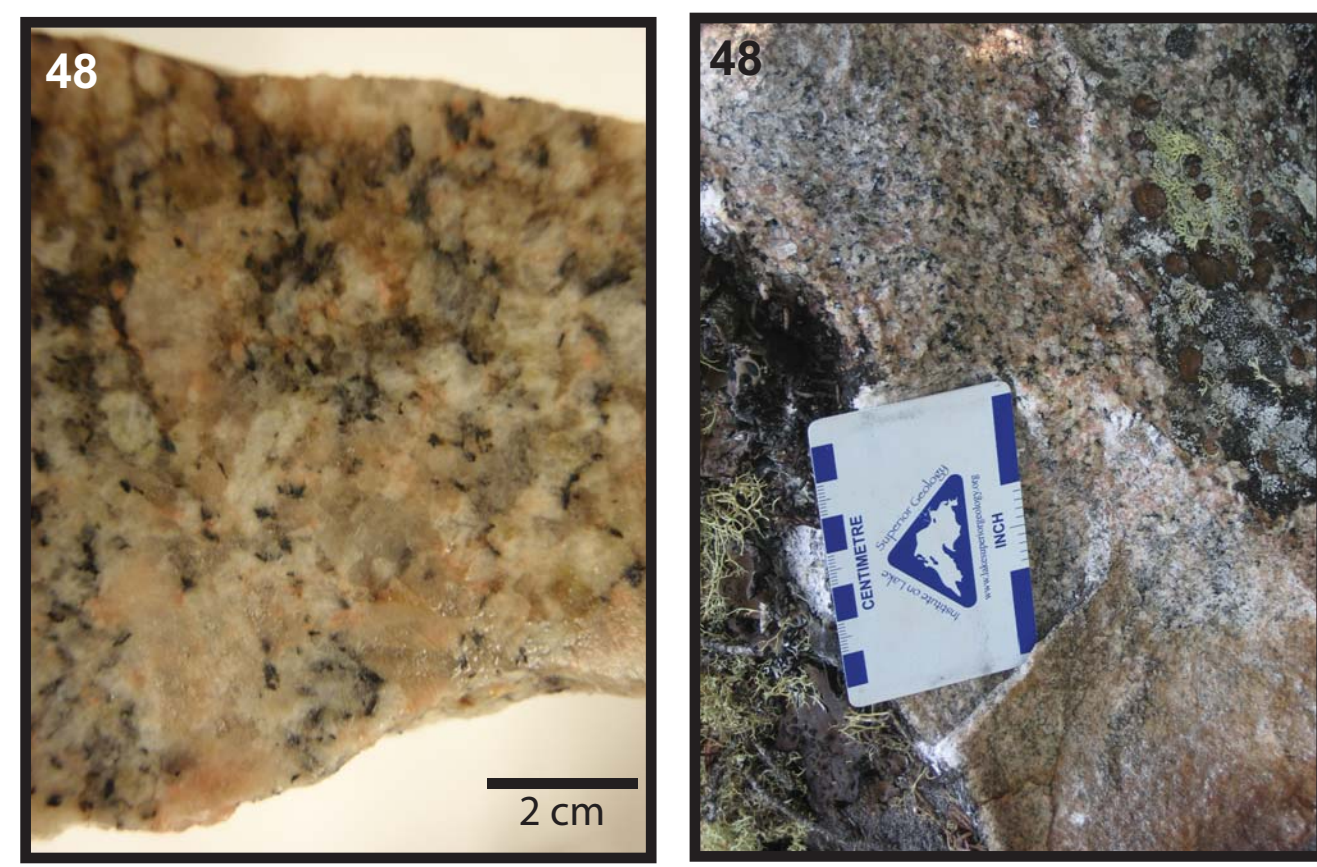
Regional geology:



- North Caribou greenstone belt in North Caribou terrane of Superior Province
- Samples from TTGs surrounding the North Caribou greenstone belt
- Musselwhite (structurally controlled, BIF-hosted, orogenic lode Au deposit) at centre of belt
 - Evidence for fluids include: biotite and chlorite alteration and quartz veining
 - P-T estimates for mineralization from 400-500 °C and 3-9 kbar (Otto, 2002; Hall & Rigg, 1986)
- Ages reflect regional events:
 - 3.0-2.8 Ga formation of North Caribou terrane
 - 2.7-2.6 Ga amalgamation of Superior craton

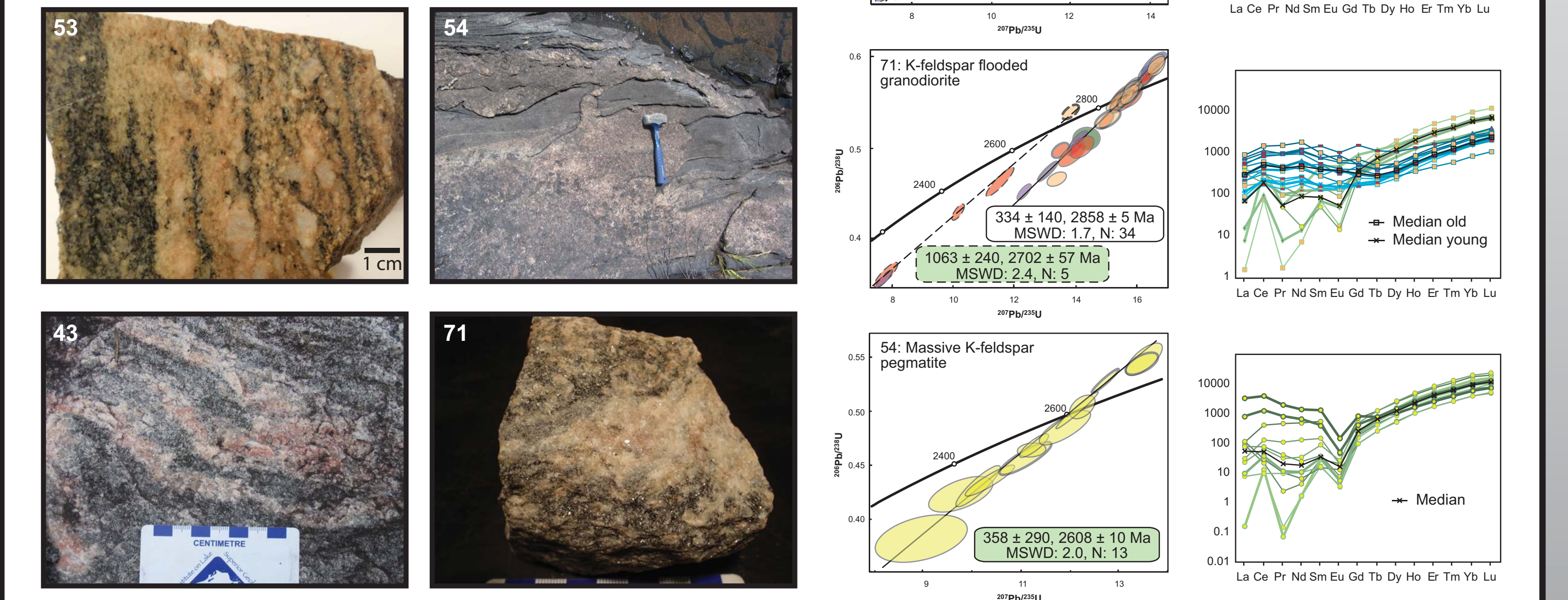
Zircon with altered rims:

- No pegmatite in outcrop
- Multiple age populations
- Young age found only in rims
- Lower Th/U ratios in young zircon
- Enriched LREEs in young zircon
- Old ages in some rims (48)
 - Pb trapped in rims
 - Seen in altered monazite (Seydoux-Guillaume et al., 2003)
- Cloudy resorption rims
 - ~ parallel to zoning
 - crosscut zoning around cracks and inclusions (29)
- Zoning in other minerals (48, 29)
- Typical TTG compositions



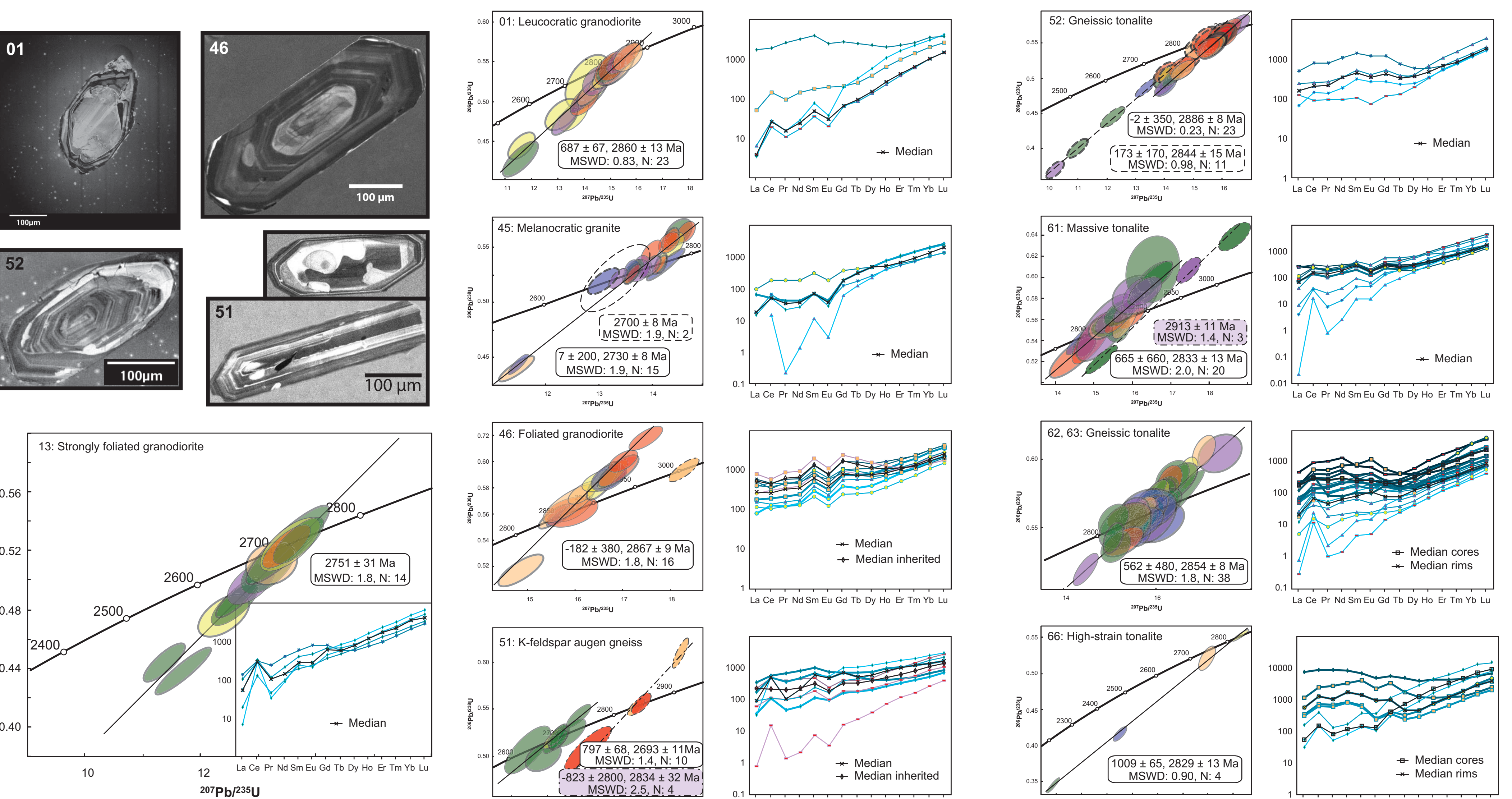
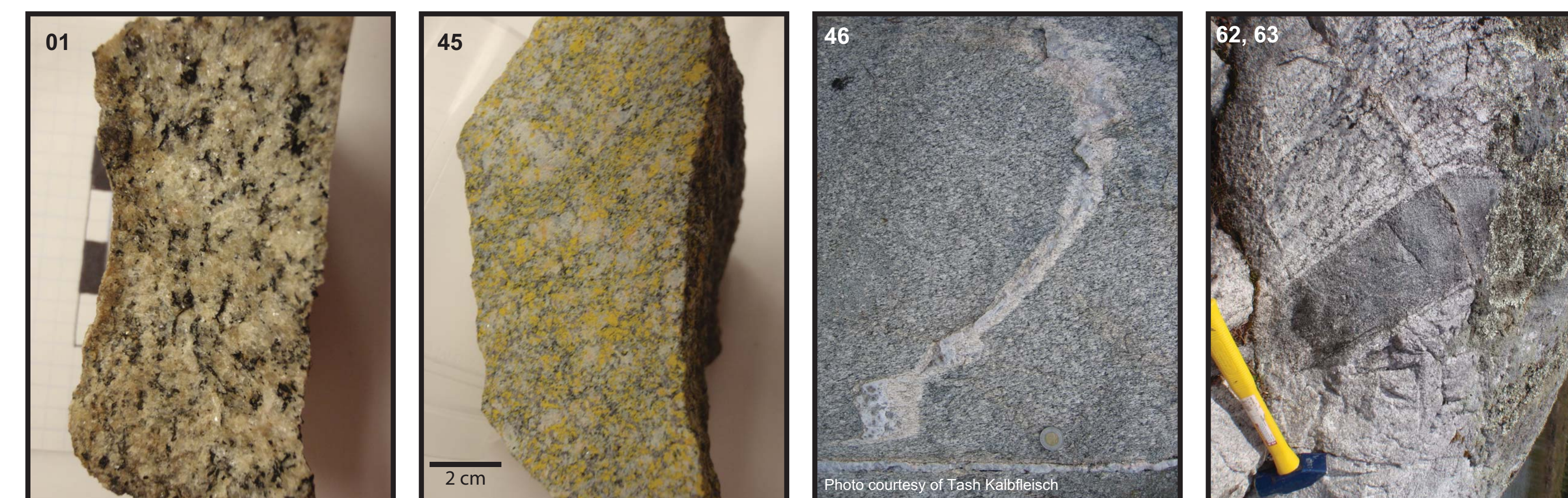
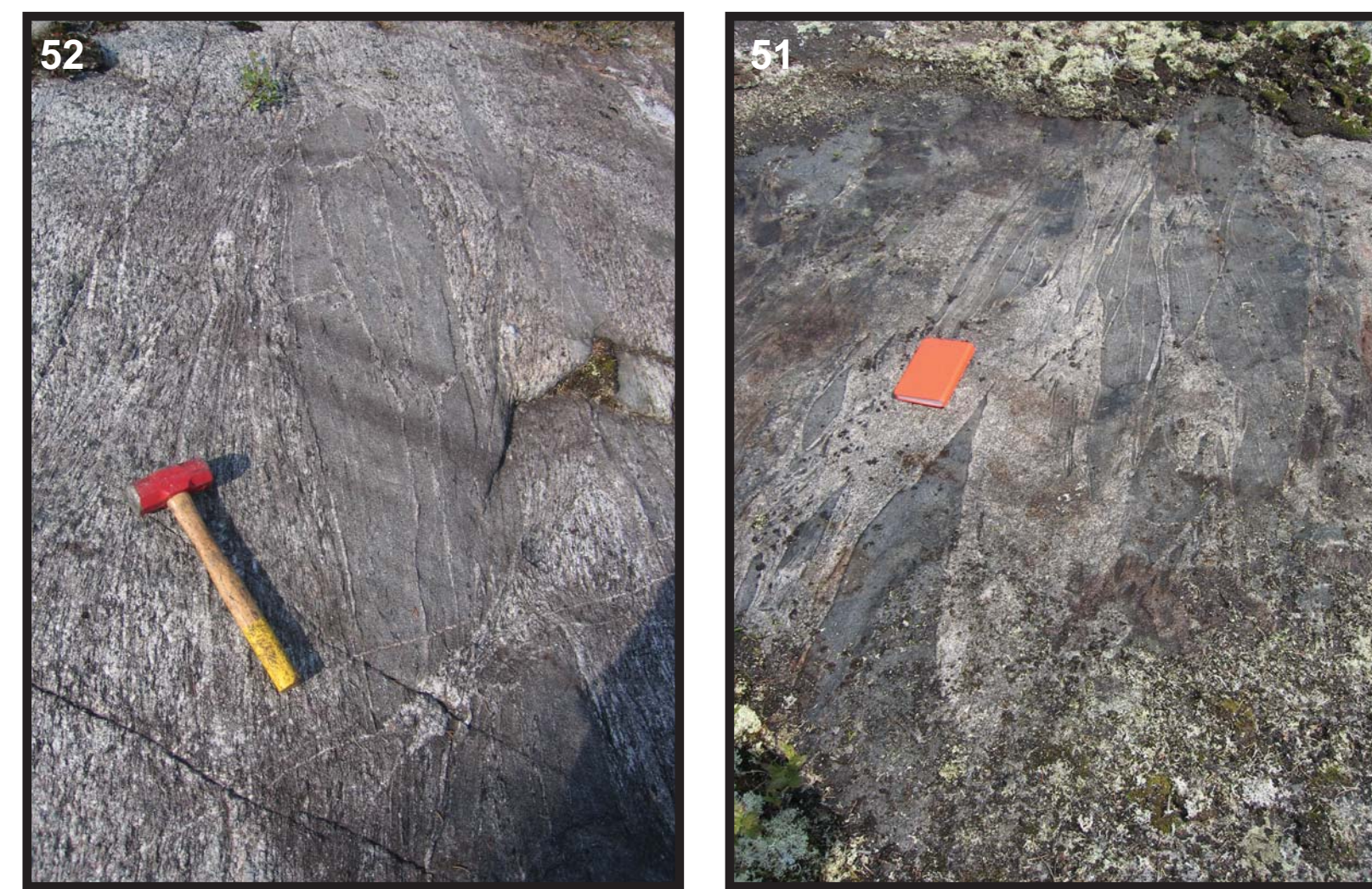
Pegmatite samples:

- Pegmatite intermingled with host rock in outcrop
 - Rocks true granites
- One date from pegmatite (54)
- Multiple age populations
- Lower Th/U ratios in young population
 - Young ages in cores from leucocratic areas (53, 71)
- Depleted and enriched LREEs in young zircon
 - Possible alteration associated with pegmatite intrusion? (54 zircon SEM shows altered cracks)



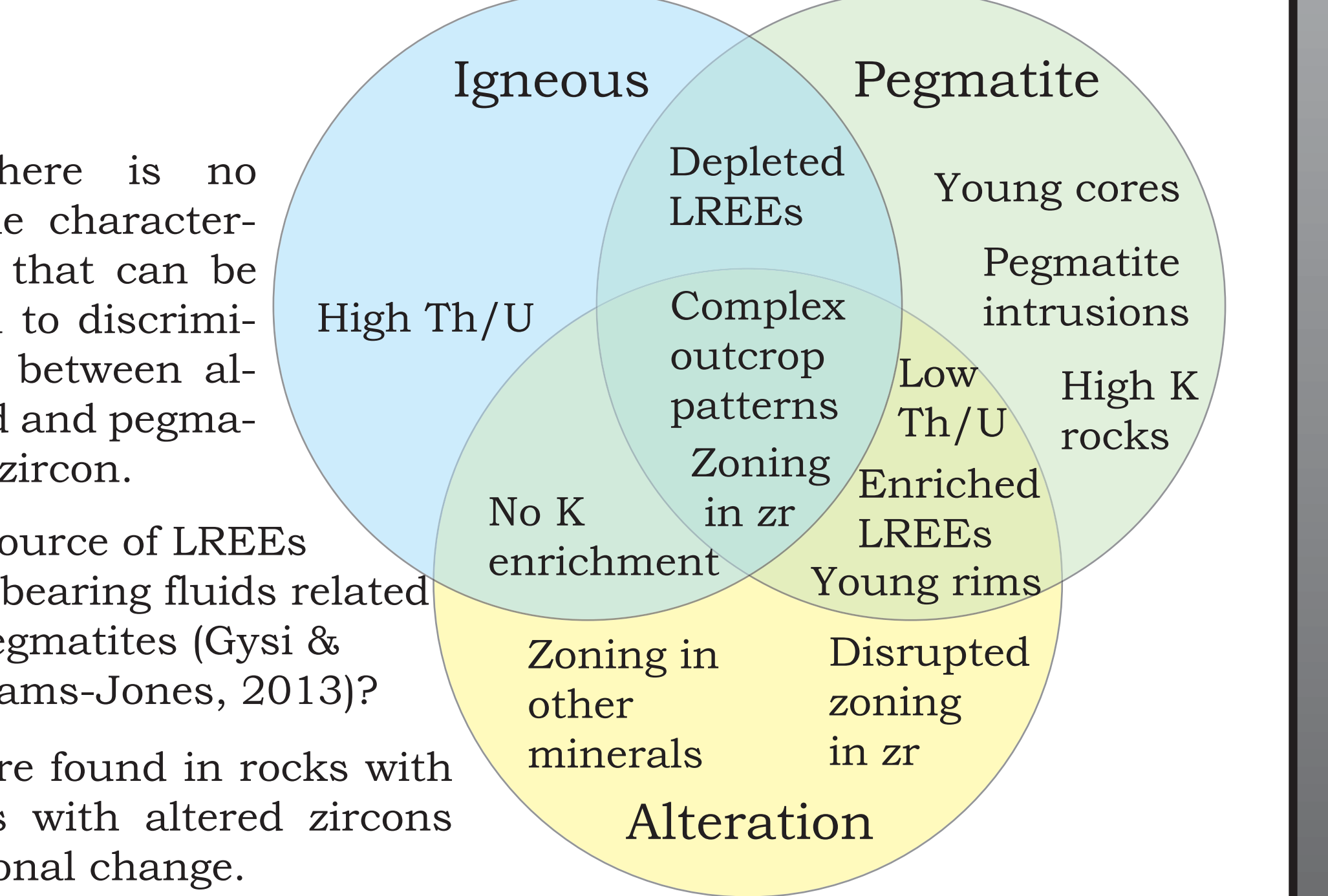
Igneous zircon:

- Outcrops may have complex textures (51,52,62,63)
- Zircon textures
 - Oscillatory zoning
 - May have overgrowths (52)
- Th/U ratios >0.3
- May have many age populations
- LREE depleted
- Typical TTG compositions



Summary:

- There is no single characteristic that can be used to discriminate between altered and pegmatitic zircon.
- Source of LREEs HCl-bearing fluids related to pegmatites (Gysi & Williams-Jones, 2013)?
- Pegmatitic zircons (circles above) are found in rocks with higher K concentrations, while rocks with altered zircons don't show such a dramatic compositional change.



Acknowledgements and works cited:

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Gysi & Williams-Jones, 2013. *Geochem Cosmochim Acta* 122, 324-352; Hall & Rigg, 1986. *Gold* '86, 124-136; Otto, 2002, MSc Thesis; Seydoux-Guillaume, et al., 2003. *Geology* 31, 973-976.