What happened after the High Island super-eruption?

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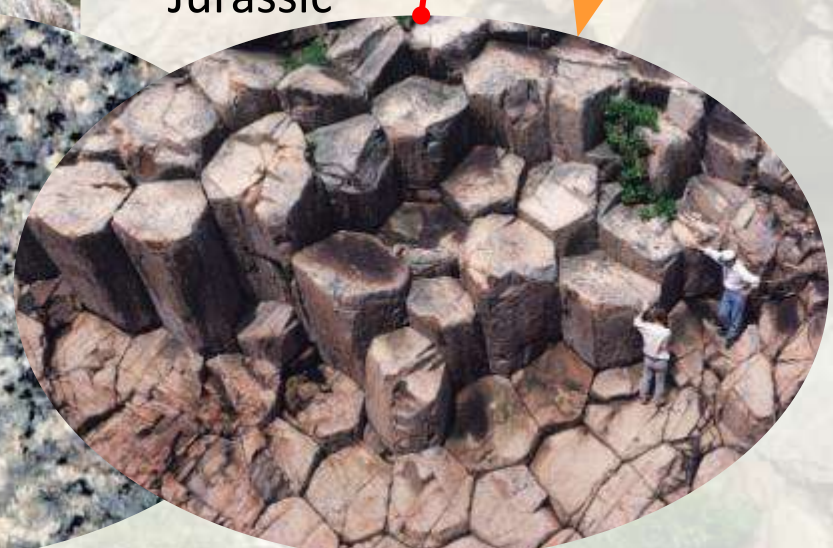
Geological History of Hong Kong

Devonian

Early to Middle Jurassic

Middle Jurassic to Early Cretaceous



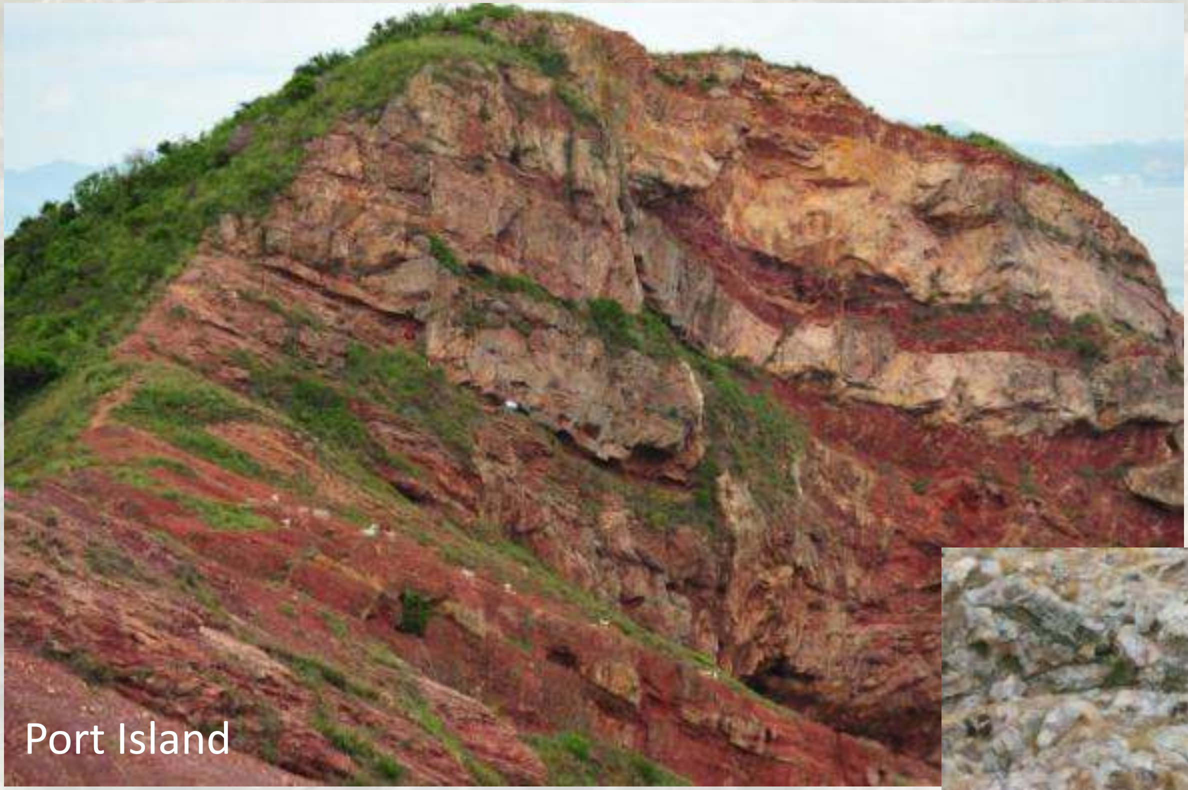
Evidence for Post-volcanism Tectono-thermal Events

Mafic Dykes

Mafic dyke intruding High Island Tuff: 105.3 ± 0.5 Ma ^{40}Ar-^{39}Ar Age (whole rock) (Campbell & Sewell, 2005)

What does this age mean?

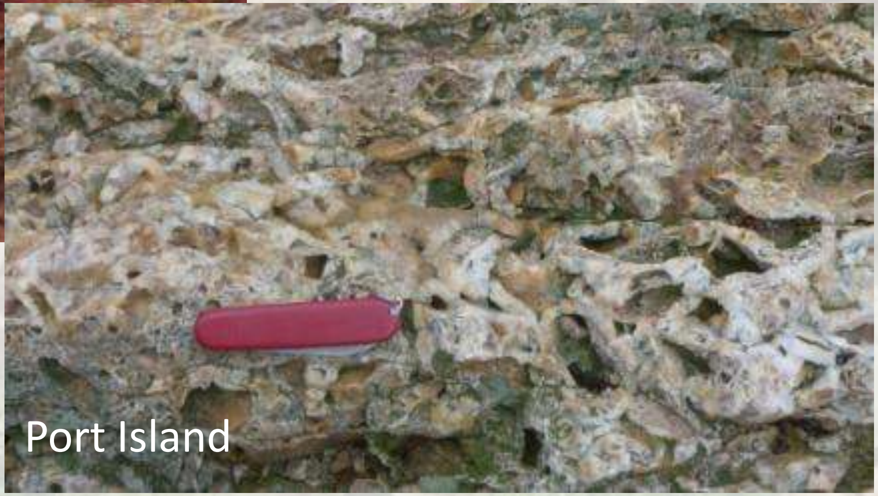
Evidence for Post-volcanism Tectono-thermal Events



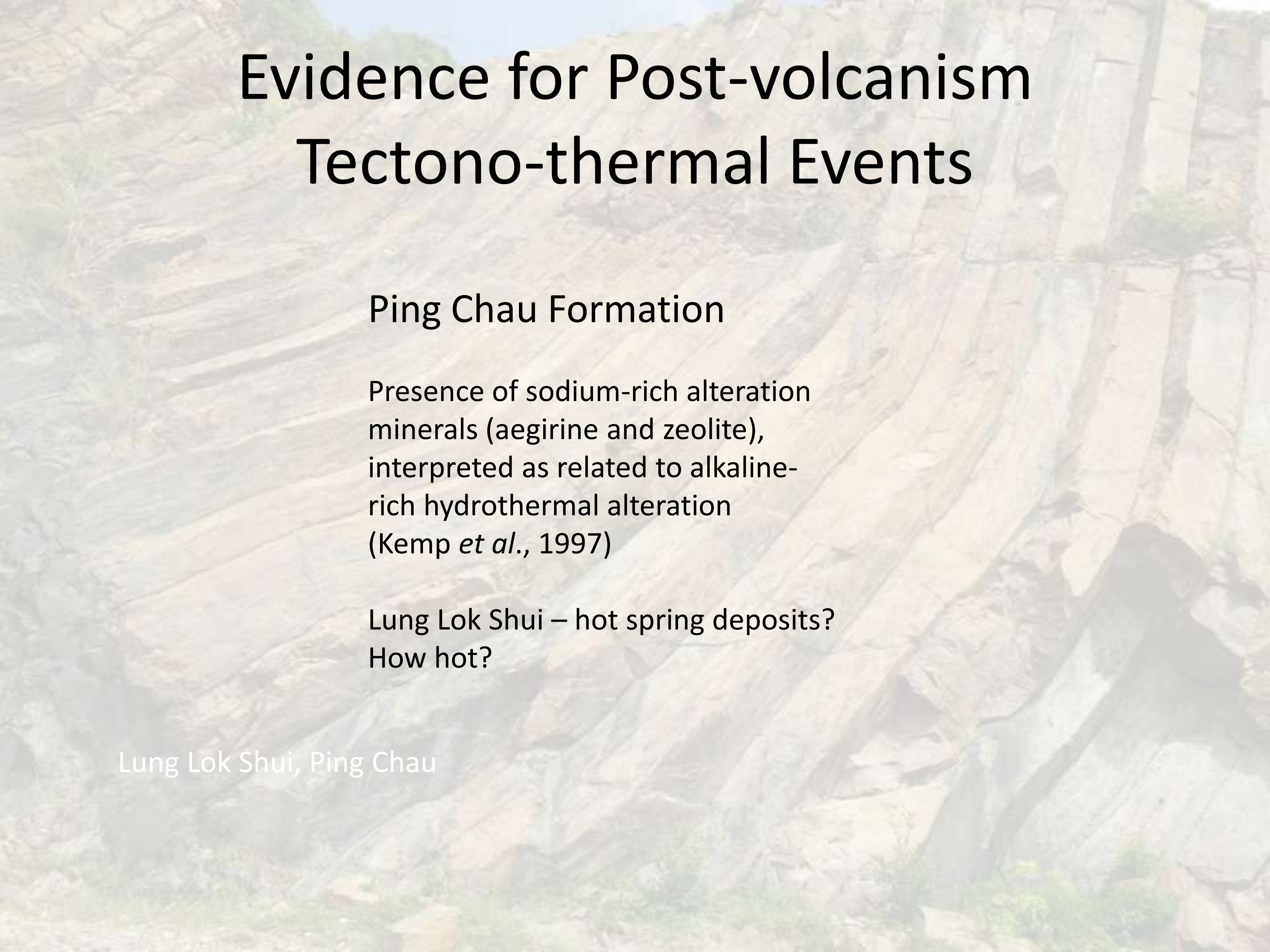
Cretaceous redbeds

Cut by numerous normal fault (Chan et al., 2010)

Presence of quartz stockworks



Evidence for Post-volcanism Tectono-thermal Events



Ping Chau Formation

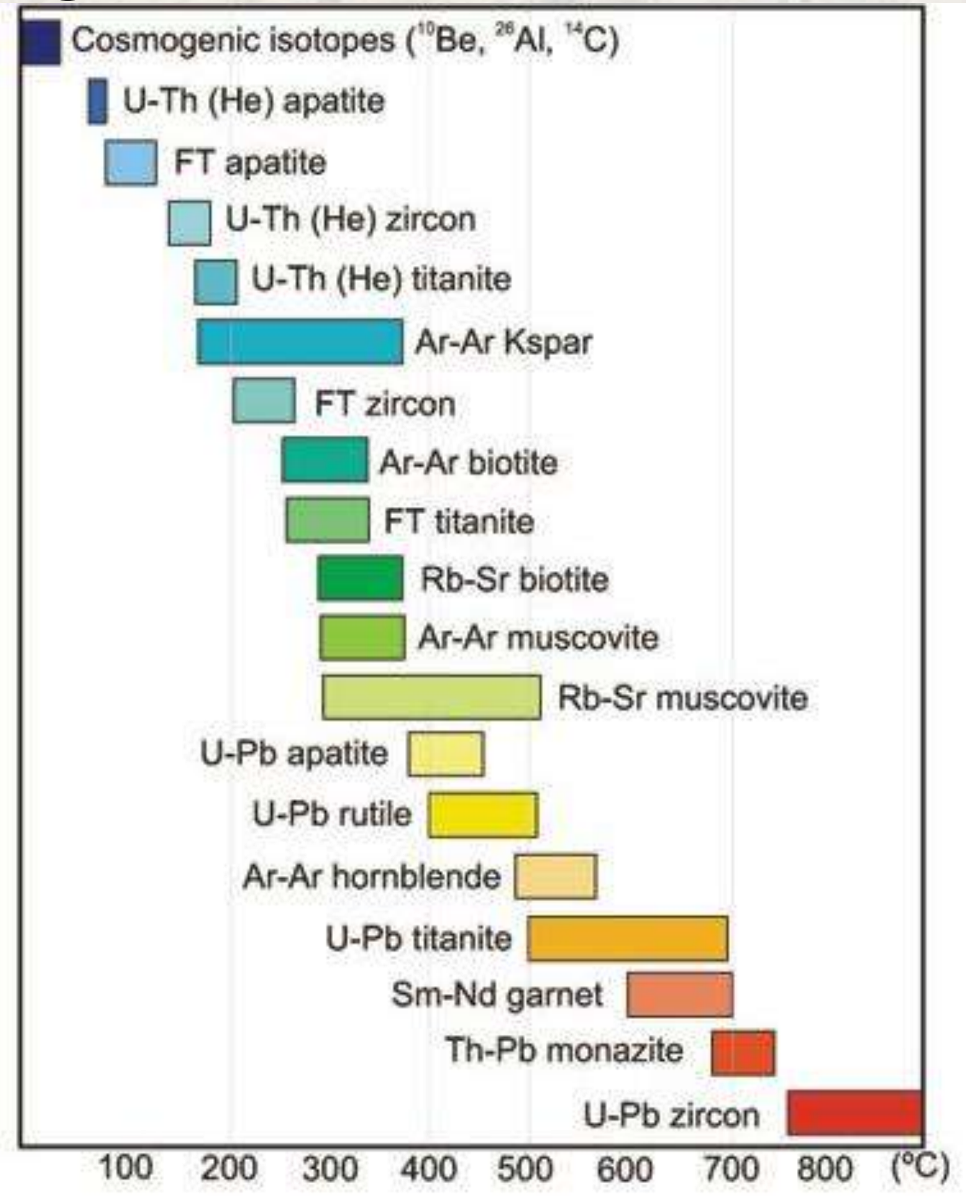
Presence of sodium-rich alteration minerals (aegirine and zeolite), interpreted as related to alkaline-rich hydrothermal alteration (Kemp *et al.*, 1997)

Lung Lok Shui – hot spring deposits? How hot?

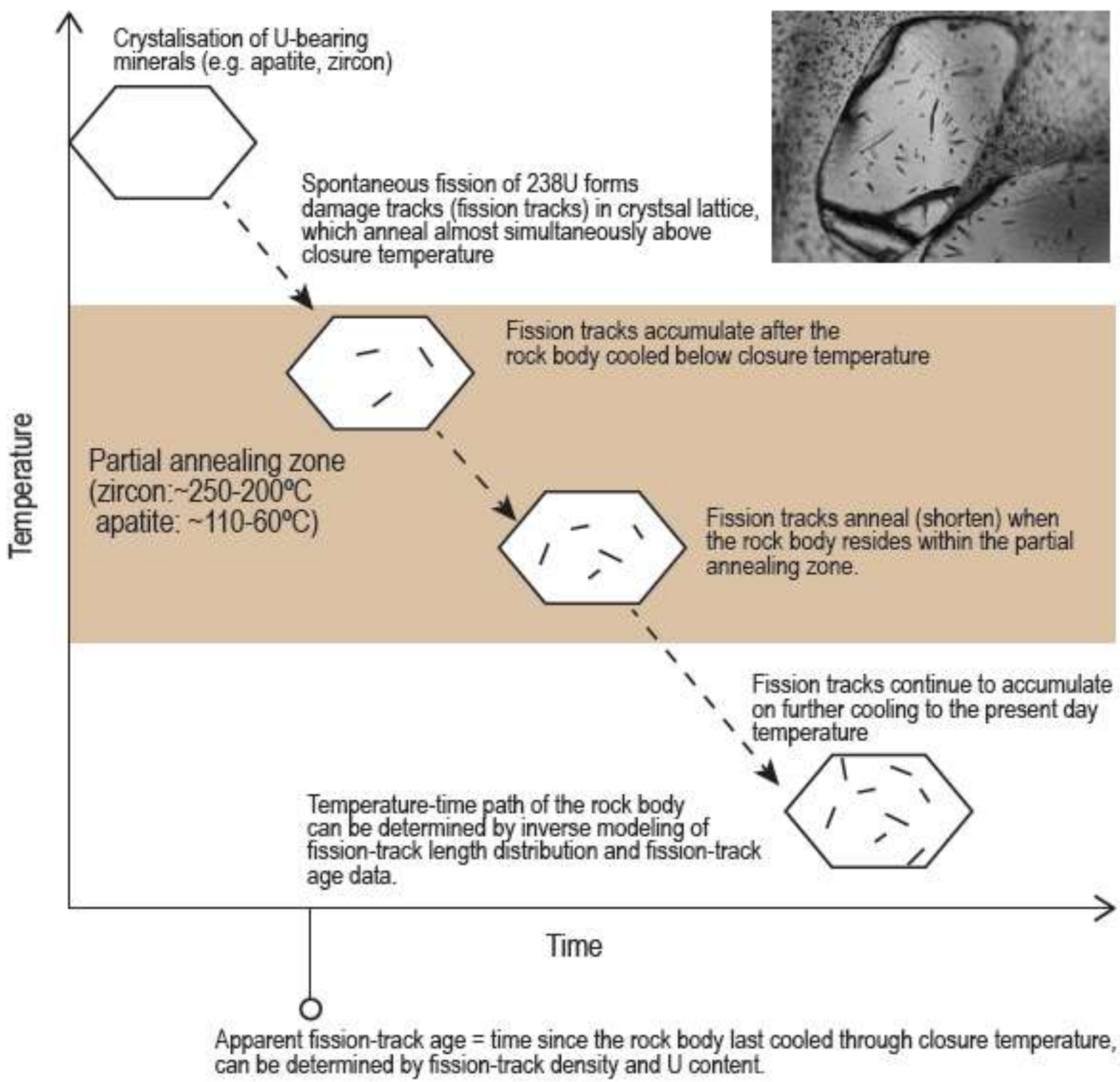
Lung Lok Shui, Ping Chau

Temperature Range of Thermochronometers

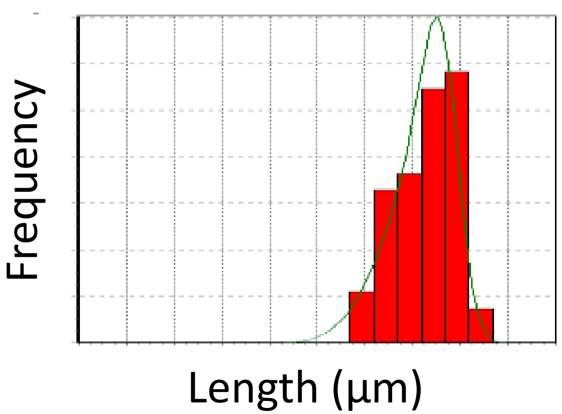
Low temperature thermochronometers



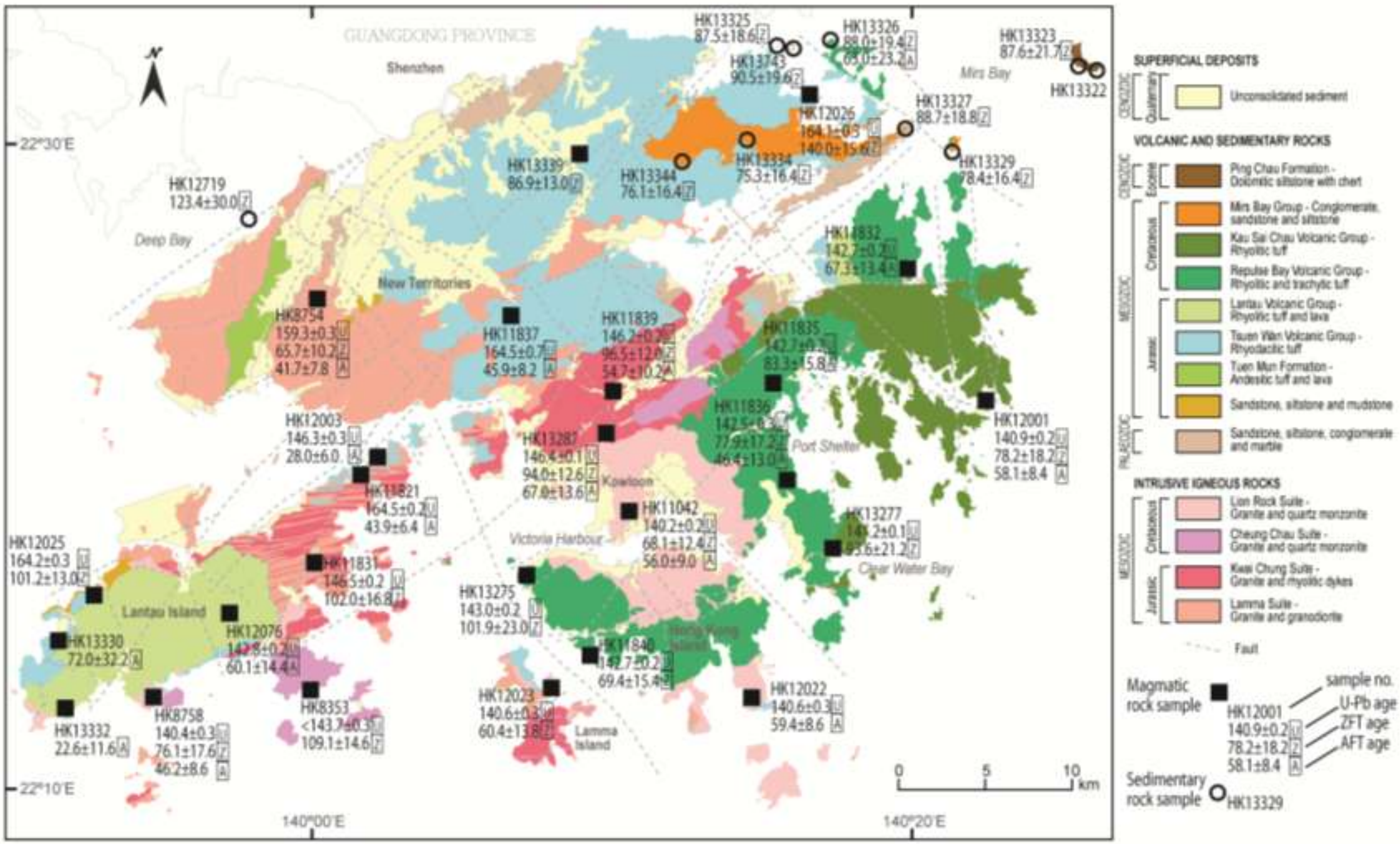
Principle of Fission-track (FT) Thermochronology



Apatite Fission Track: Track Length Distribution

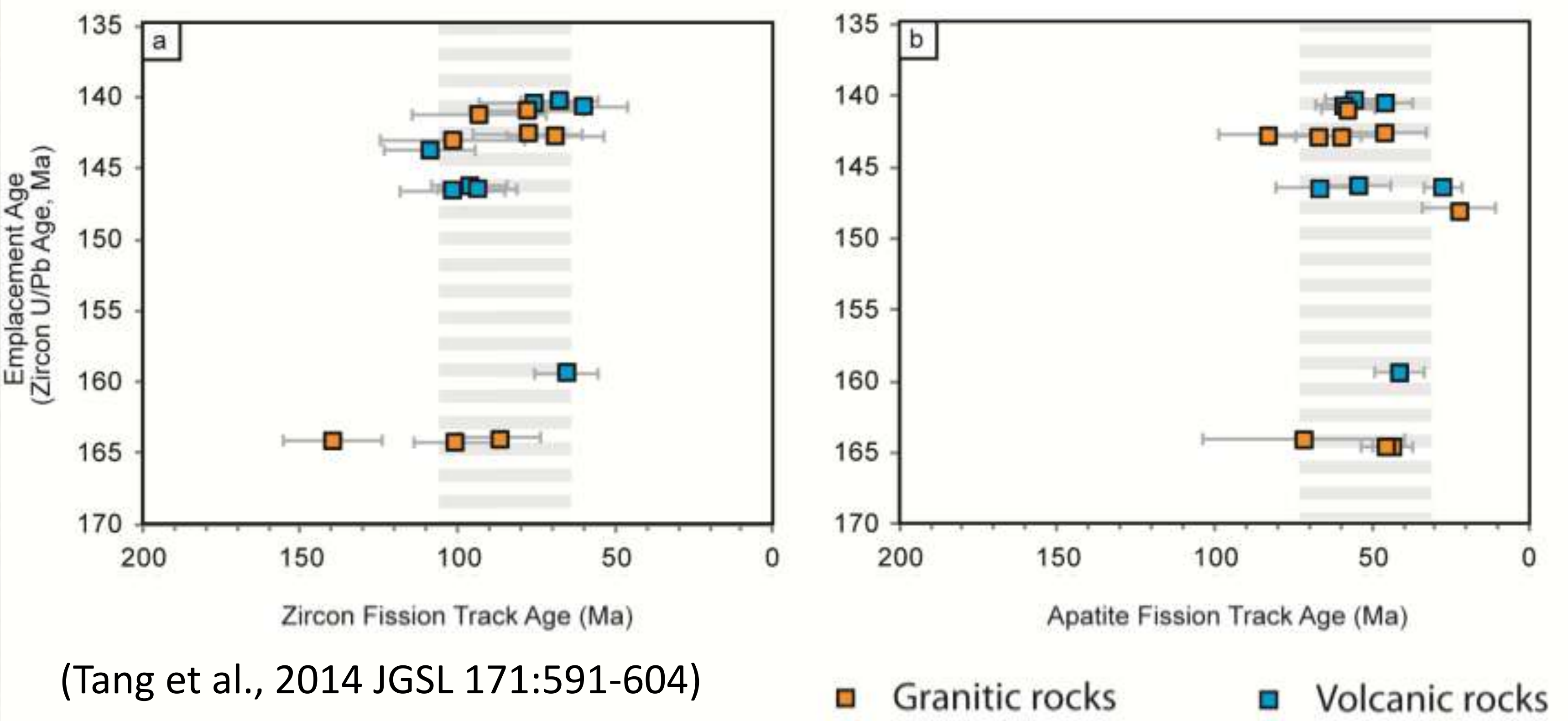


Results of Fission Track Dating



(Tang et al., 2014 JGSL 171:591-604)

Eruption Ages vs Fission Track Ages



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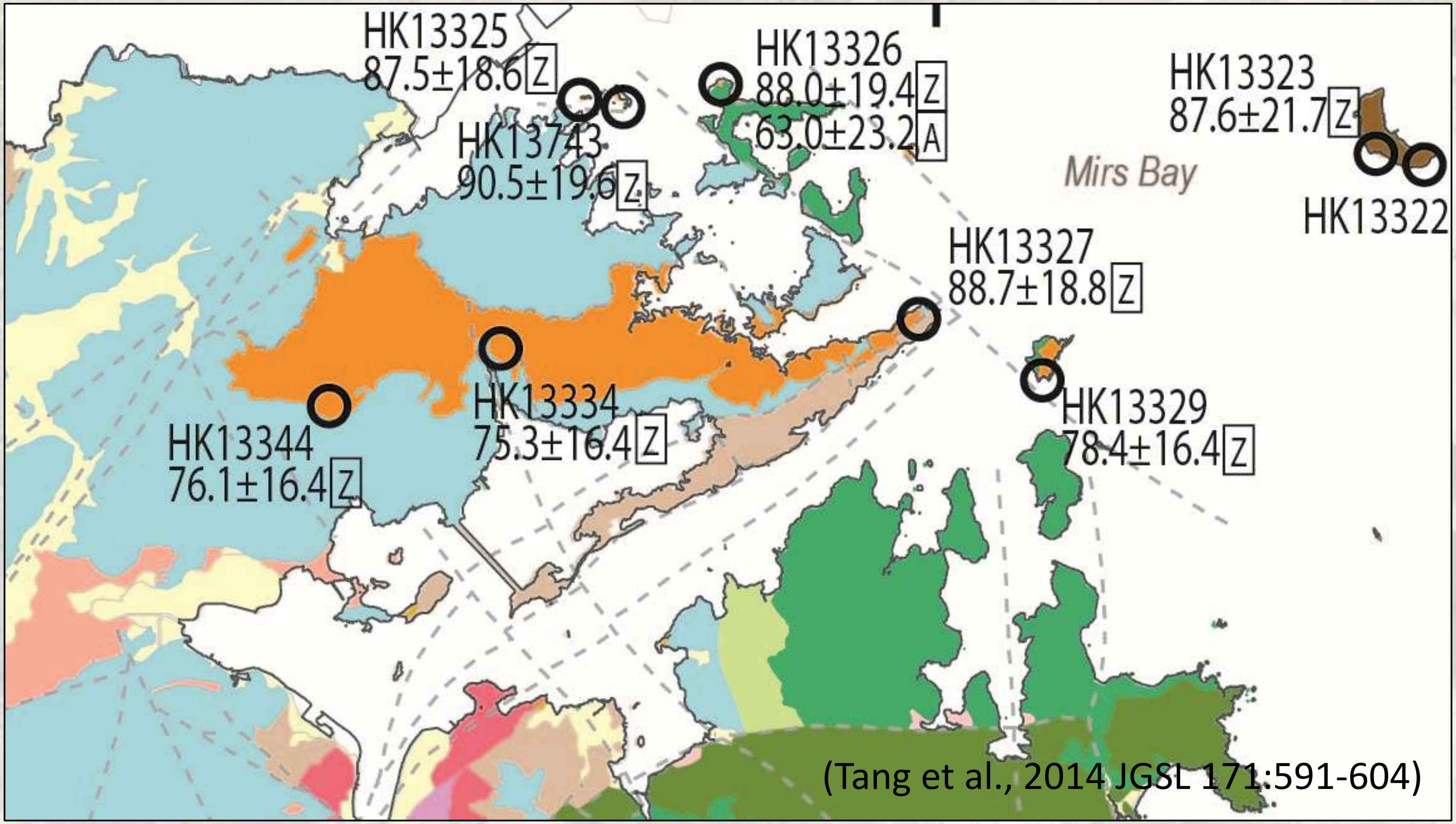
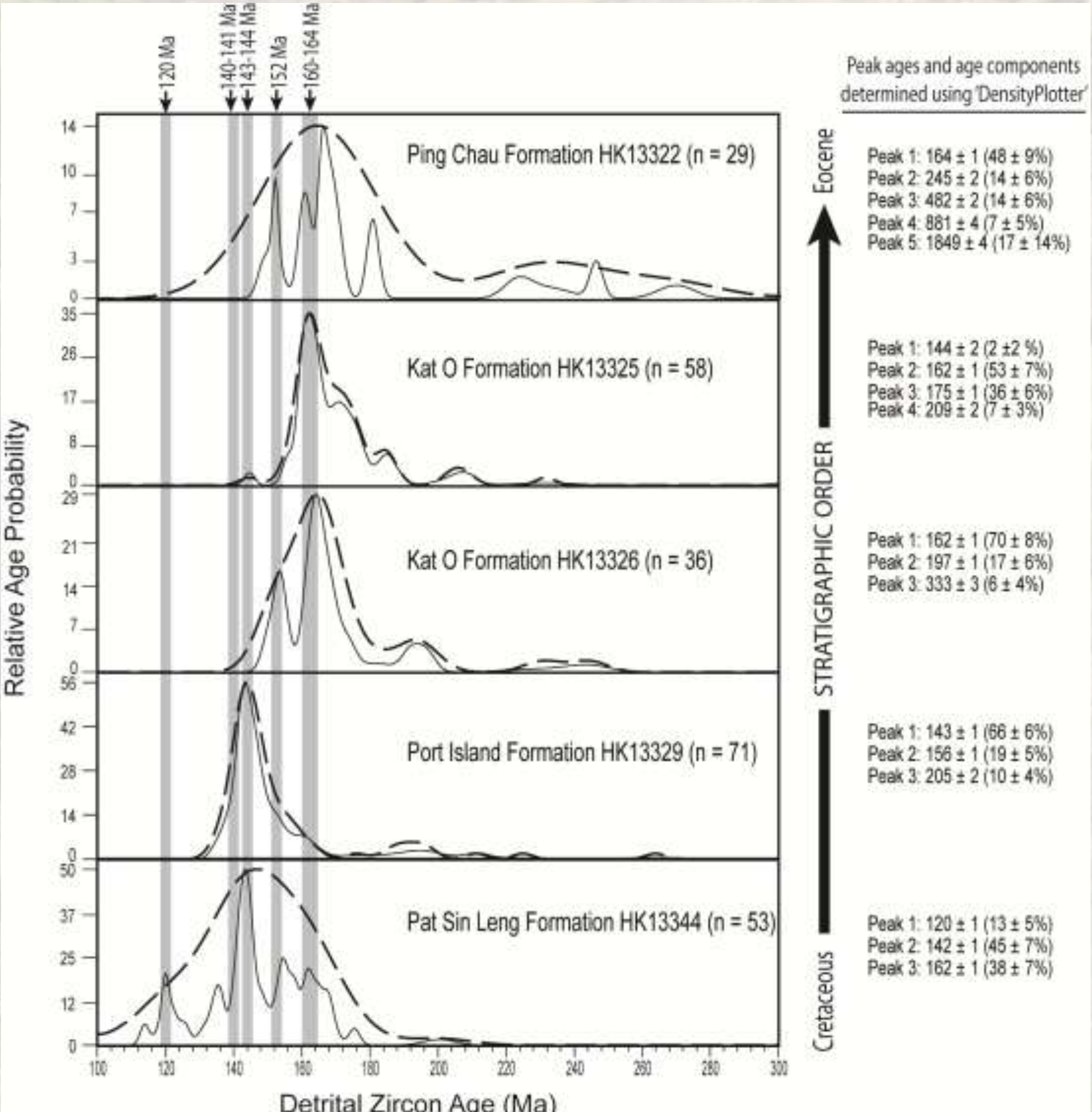
Detrital Zircon Double Dating (FT and LA-ICP-MS U-Pb)



Detrital Zircon U-Pb Dating



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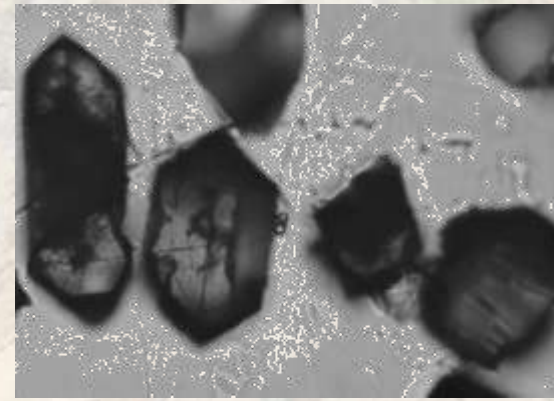
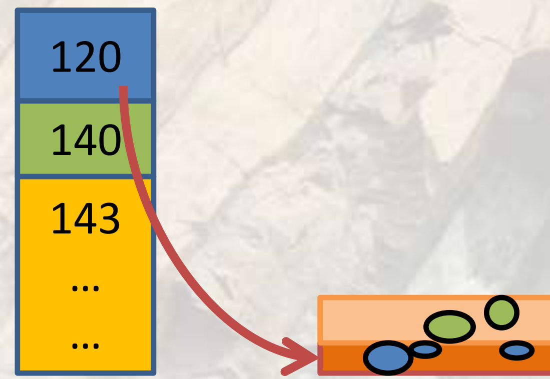




The lowest Cretaceous sediment sequence deposited after 120 Ma, on top of erosion surface of 164 Ma volcanic rocks.

Provenance of Cretaceous Sediments

Local magmatic rocks, eroded from nearby outcrops

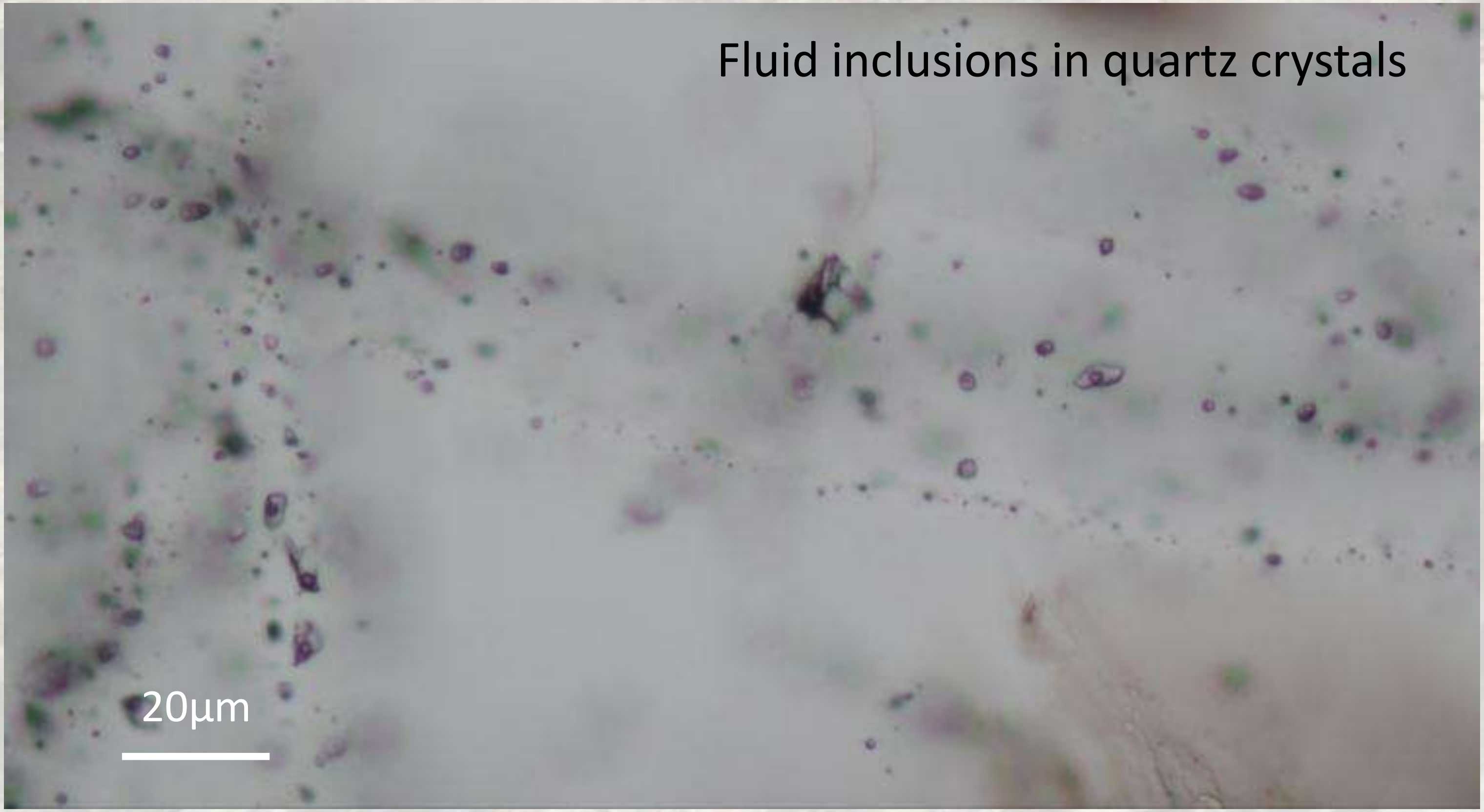
Maximum depositional age of Cretaceous redbeds

Detrital zircon FT ages
→Single age population
→FT system reset

Overprinting of Thermal Events

- Zircon and apatite FT systems in magmatic rocks have been reset
- For Cretaceous redbeds, thermal records of the source rocks in detrital zircon (ZFT) have been erased
- The rock bodies experienced post-emplacement heating to temperature of ≥250 °C

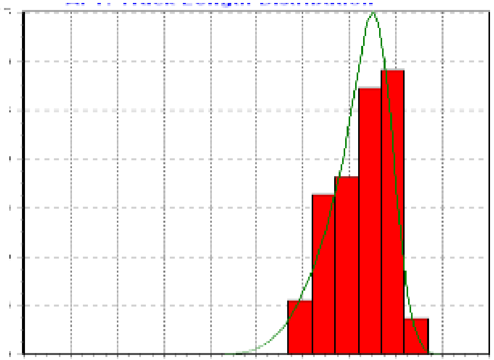
Fluid Inclusion Micro-thermometry



Fluid inclusion micro-thermometry
Kowloon Granite: > 230 °C
Mount Butler Granite: > 290 °C

Inverse Modelling of AFT Age & Track Length Data

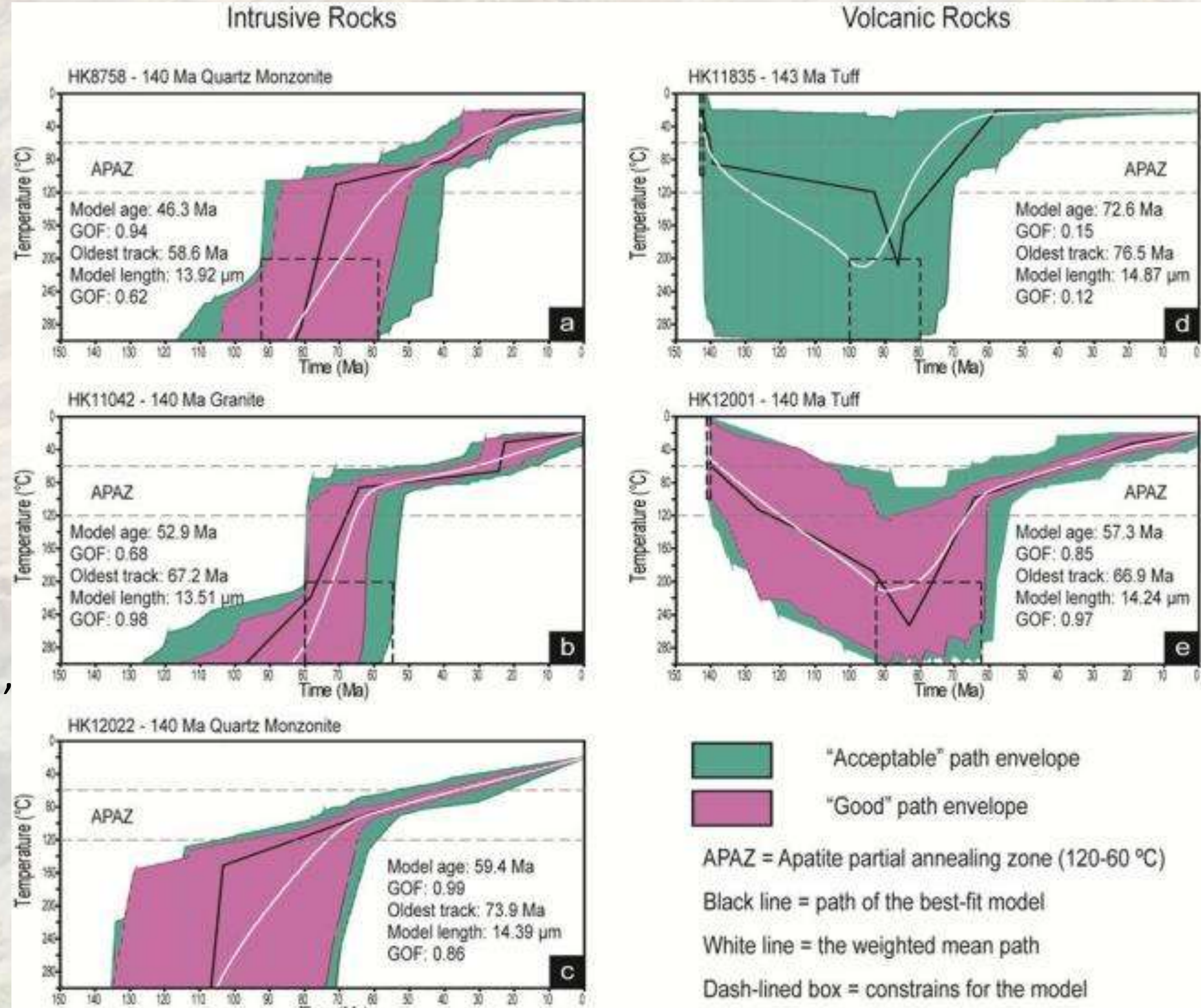
Apatite Fission Track:
Track Length Distribution



Frequency

Length (µm)

Rapid cooling from 100-80 Ma, then slow cooling from 60 Ma



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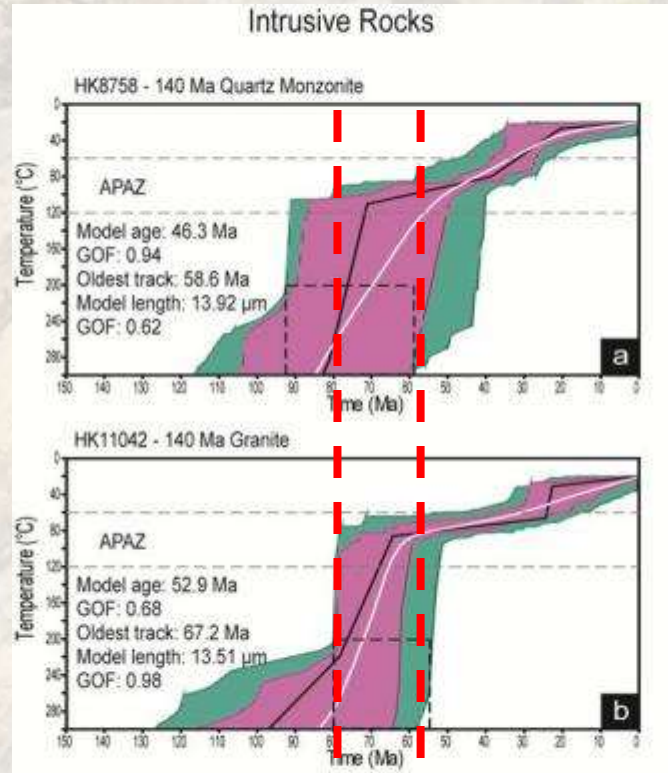
Exhumation of Granitic Plutons



Prior to 100-80 Ma: Thermal event(s)

Geothermal adjustment and unroofing by erosion.

Estimated long-term averaged exhumation rate since 60 Ma: 0.03 mm yr^{-1}

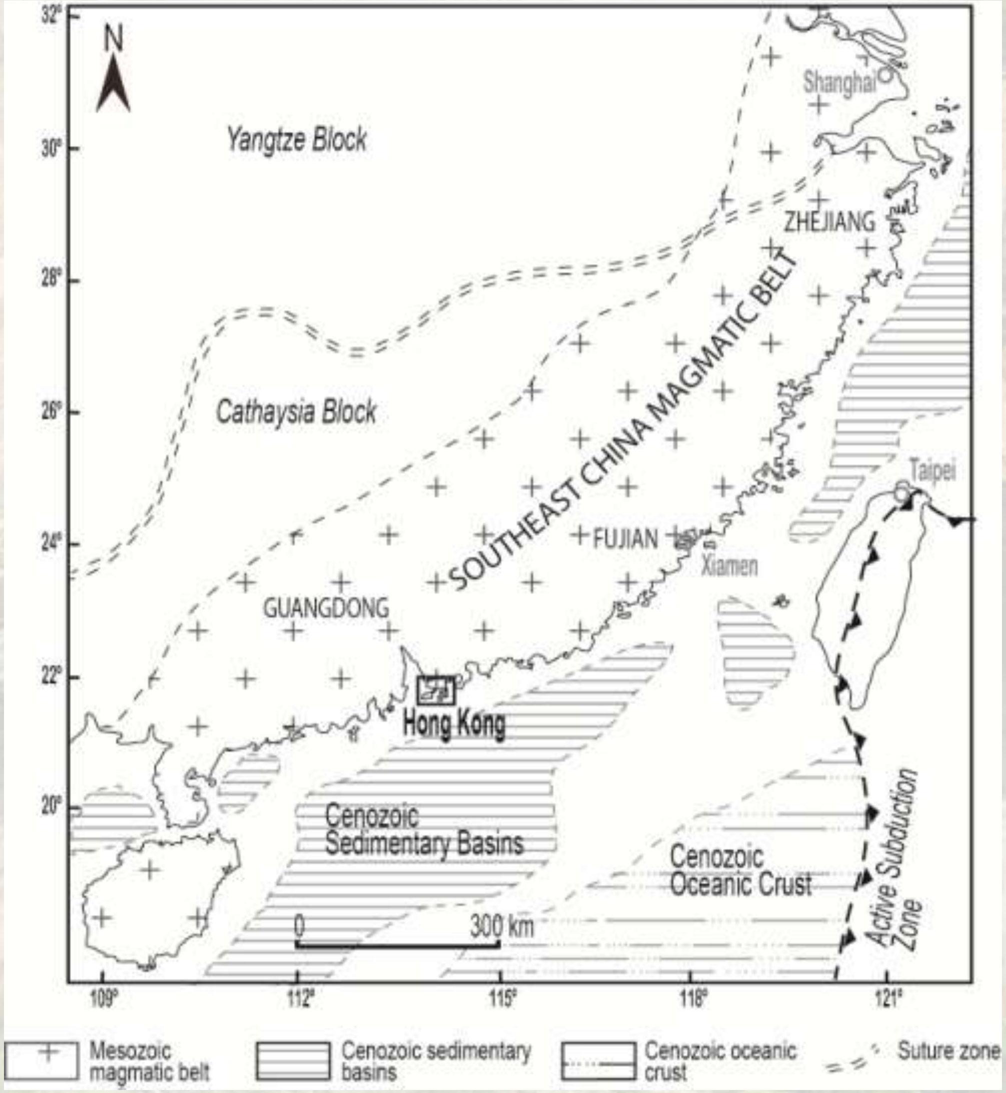
Initial rapid cooling through ZFT closure temperature (250±50 °C) by ~100-80 Ma.

After ~60 Ma: slow cooling to erosion-driven exhumation.

Evolution of SE China Since Late Mesozoic

- An elevated geothermal gradient driven by continuing Yanshanian magmatism in the region till as late as 100-80 Ma

- Crustal extension, rifting, and opening of SCS displaced the original magmatic arc to the southeast, now at Palawan.



Summary

- Volcanic-plutonic assemblages and the Cretaceous sediments behaved as a single package
- The rock bodies experienced post-emplacement heating to temperature of ≥250 °C
- An elevated geothermal gradient driven by continuing Yanshanian magmatism in the region till as late as 100-80 Ma
- After 60 Ma: slow cooling to erosion-driven exhumation, with estimated long-term averaged rate of 0.03 mm yr^{-1}
- Tectono-thermal history of Hong Kong related to cessation of Yanshanian magmatism, crustal extension, rifting and opening of new oceanic basin in South China

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