Deformation structure and peak-metamorphic temperature in Kodiak accretionary complex, Alaska

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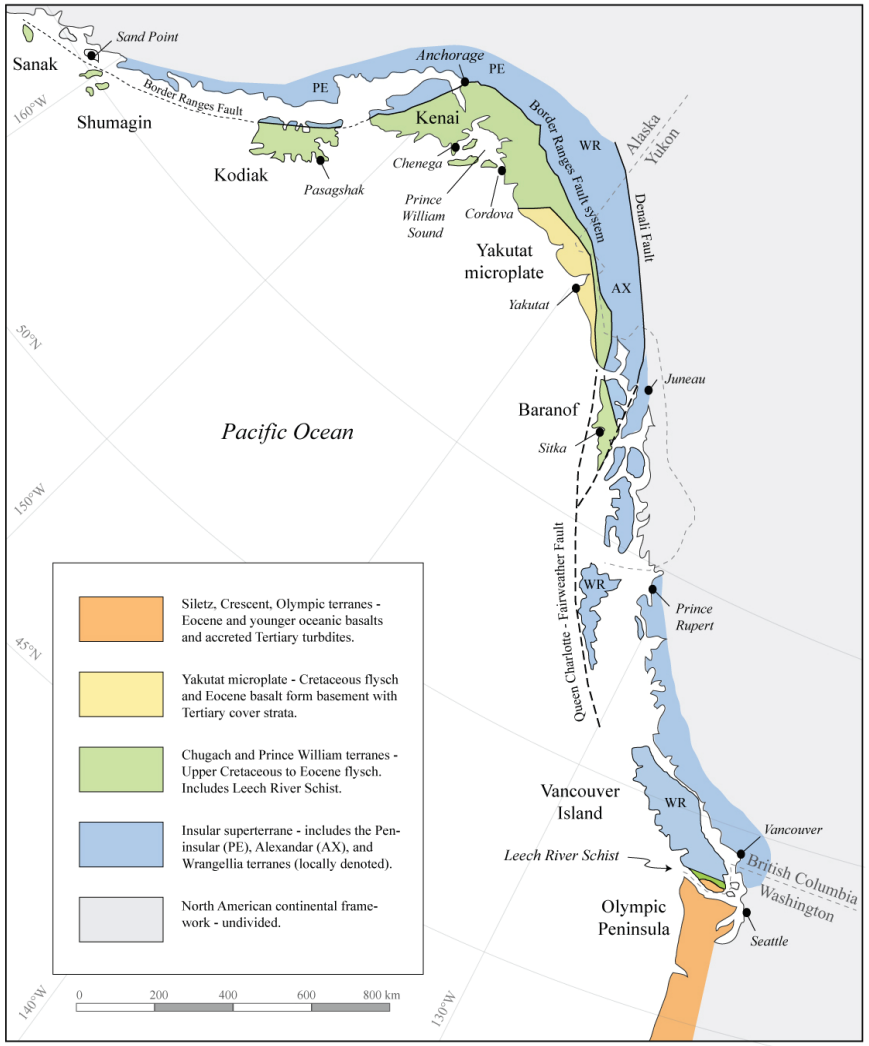
Chugach-Prince William Terrane

- accretionary complex exposed for 2200 km (Plafker et al. 1994)
- metaturbidites and near-trench intrusions

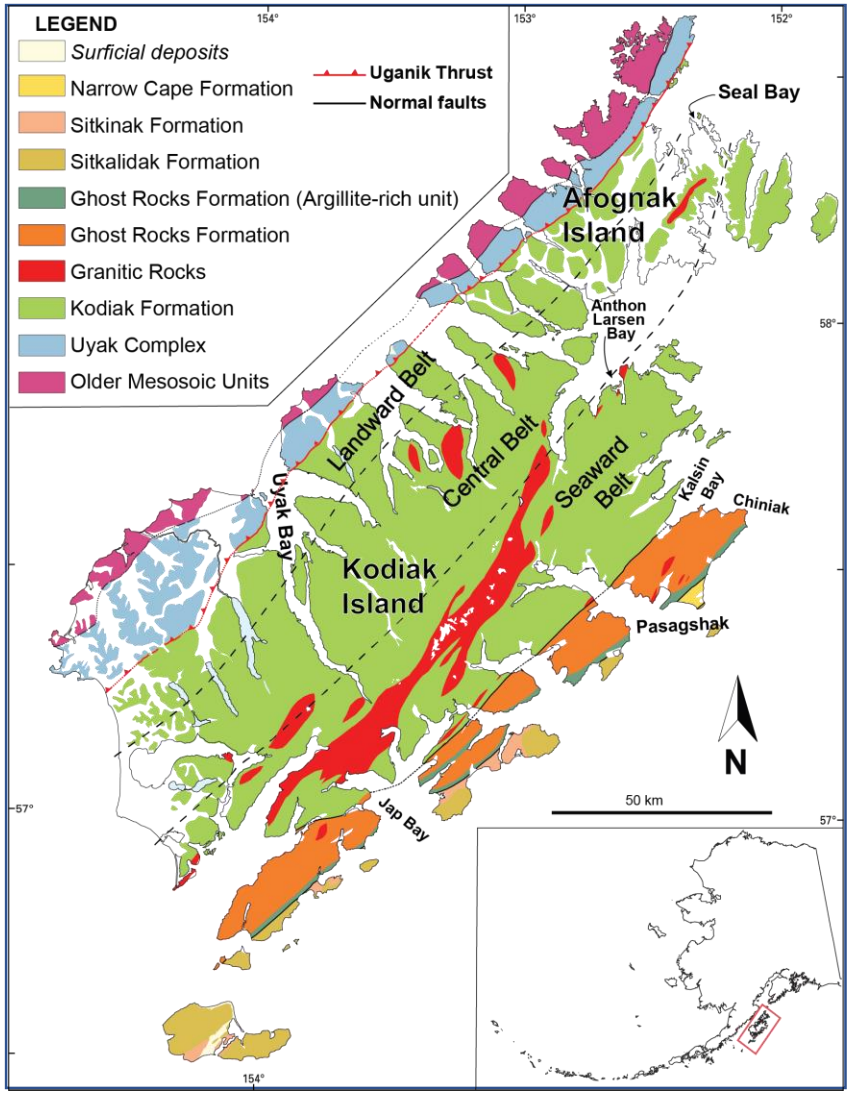
- paleomagnetic results indicate significant northward coast parallel transport for about 2500 km along Border Ranges Fault and other strike-slip faults

  Example: Ghost Rocks Formation 25 ± 7° (recent position ~57°)



Garver & Davidson, 2012

Kodiak accretionary complex



- Uyak Complex – tectonic mélange (Connelly, 1978)

- <u>Accreted units (metaturbidites):</u>

1. Kodiak Formation – Maastrichtian (Byrne & Fisher, 1987)
2. Ghost Rocks Formation – Late Cretaceous to Early Paleogene (Moore et al., 1983)

- <u>Slope sediments (separated by the unconformity with accreted units):</u>
  - Narrow Cape Formation – Middle Miocene (More et al. 1983)

- Kodiak granite 59-58 Ma
  - Younging trend towards SE

The aim of the work

- To characterize:
  - thermal structure of the Kodiak accretionary complex
  - the influence of shearing on recorded temperature
  - the influence of basalt intrusions
- To describe the deformation across the complex
  - The nature of deformation
  - unconformity between accreted units and slope sediments

Methods

- paleostress determination
  - ➢fieldwork
  - ➢for data processing: Win_Tensor

- the peak metamorphic temperature estimation
  - ➢Raman Spectroscopy of Carbonaceous Material (RSCM) – 50 samples analyzed

Following Lahfid et al. (2010):

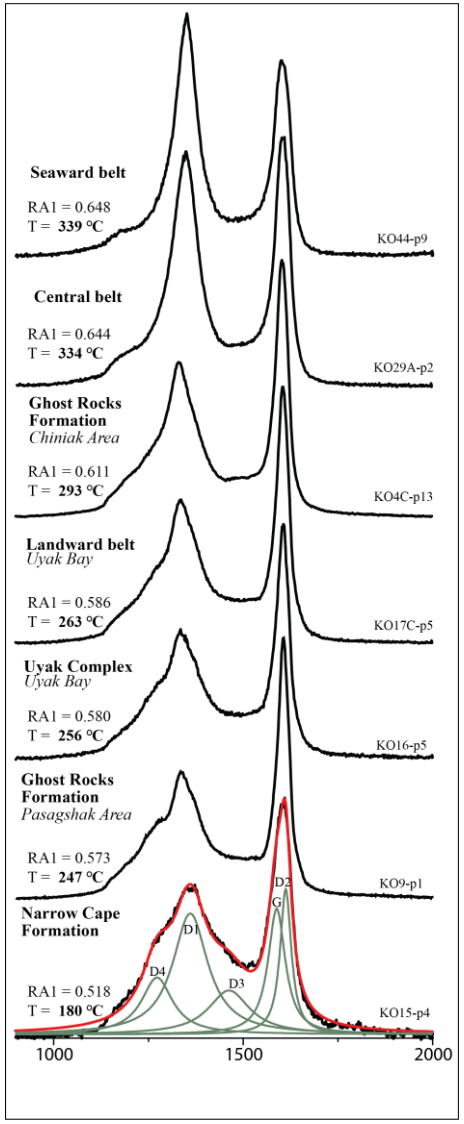
RA1 = ((D1 + D4) / (D1 + D4 + D3 + G + D2))

T°C = 1217.6 ∗ RA1 − 450.66

Temperature structure

- accreted units = 220-350 °C
- Kodiak Formation
  - Kodiak Landward belt = 250-285 °C
  - Kodiak Central belt = 320-340 °C
  - Kodiak Seaward belt = 300-350 °C
- Ghost Rocks Formation
  - Chiniak Area = 280-310 °C
  - Pasagshak Area = 220-260 °C
- Uyak Complex
  - 250-285 °C

- slope sediments of Narrow Cape Formation = 180 °C



RSCM results

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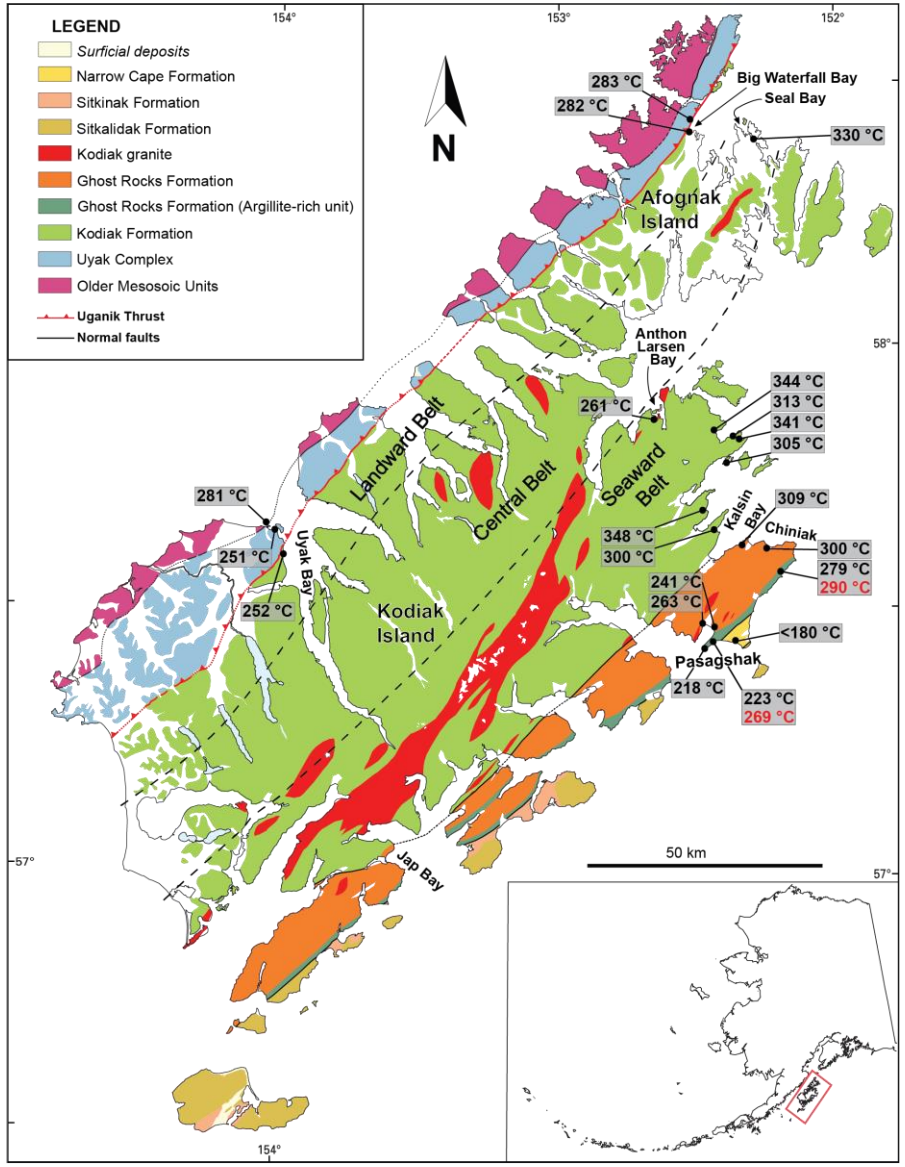
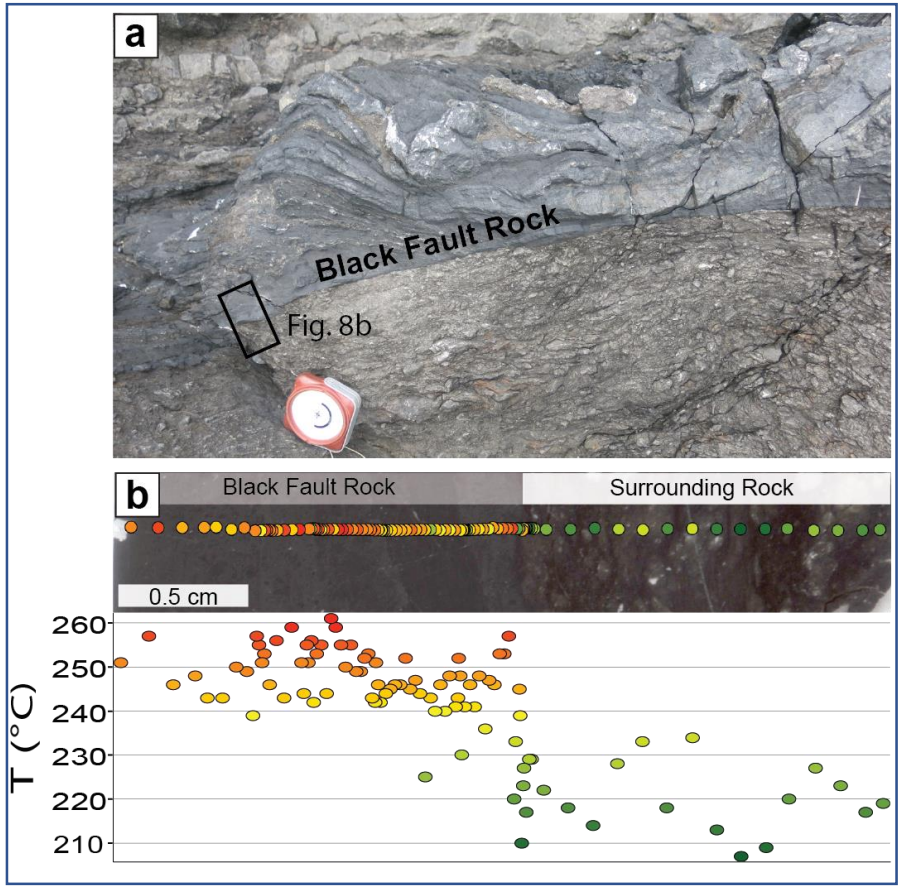
Red Temperatures: analyzed samples in the contact with basalts

More detailed T data for each unit is presented in next several slides

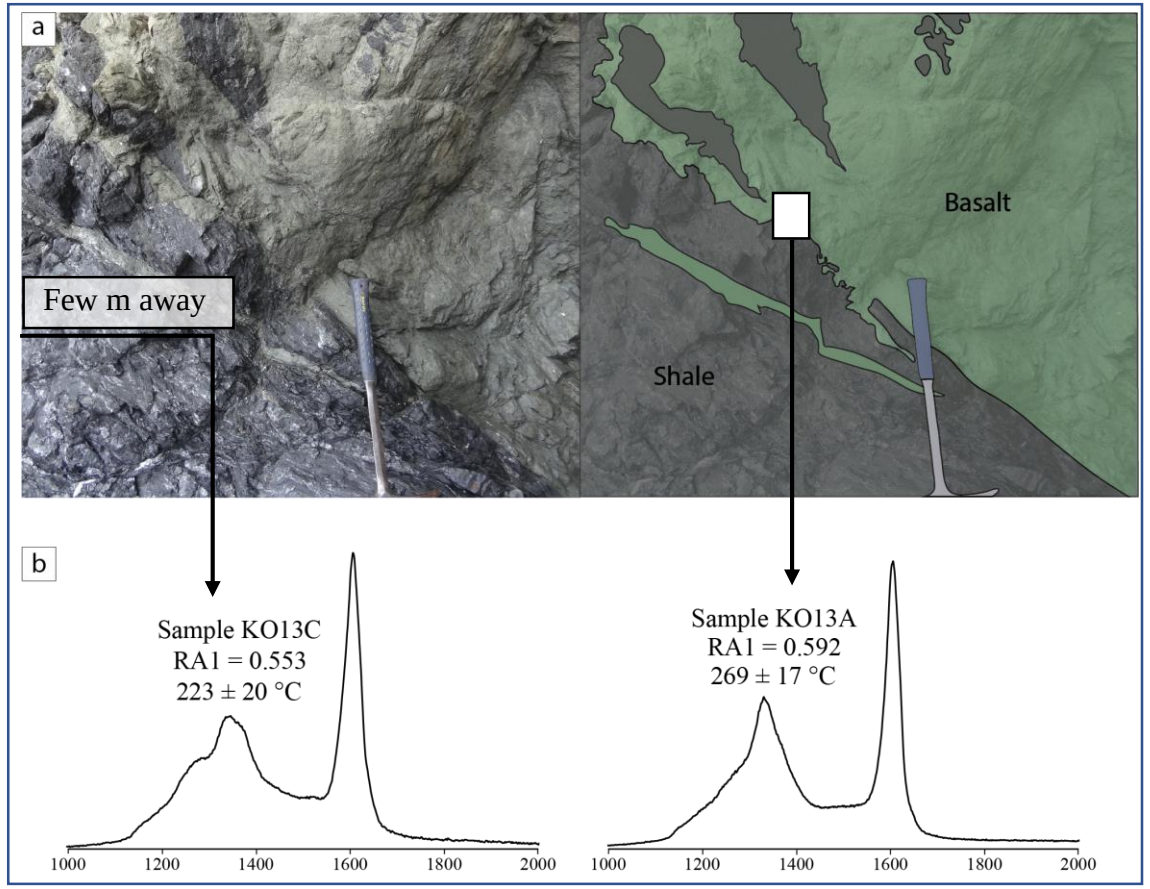


The influence of intrusions and faults

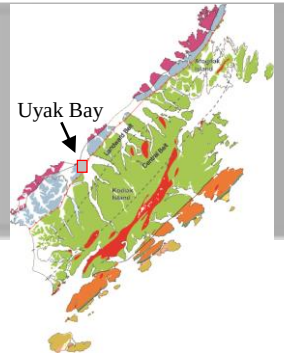
- the RSCM temperature within fault rocks is higher than in surrounding rock



- basalt intrusions affect thermal structure

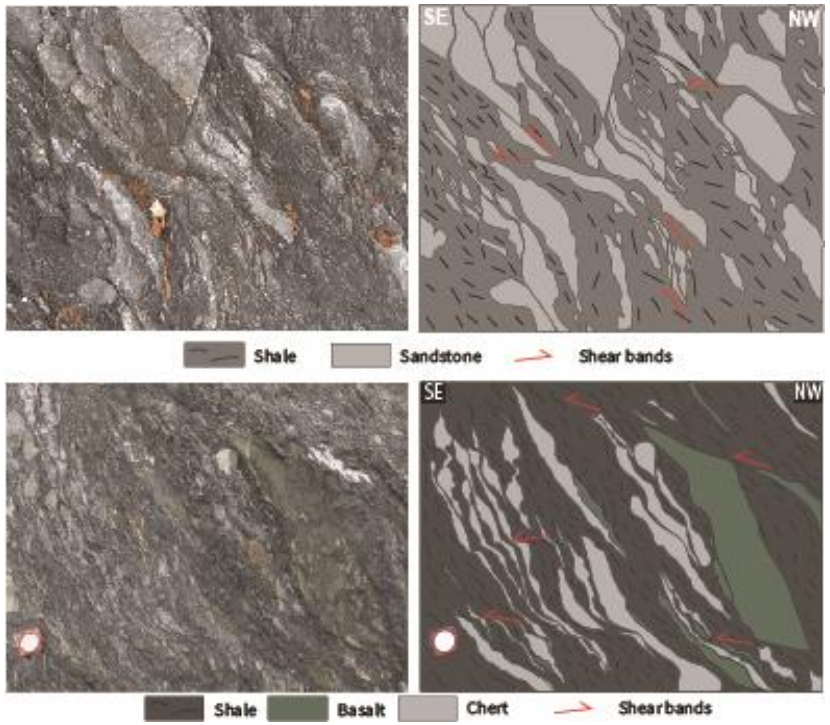


Uyak Complex and Landward belt

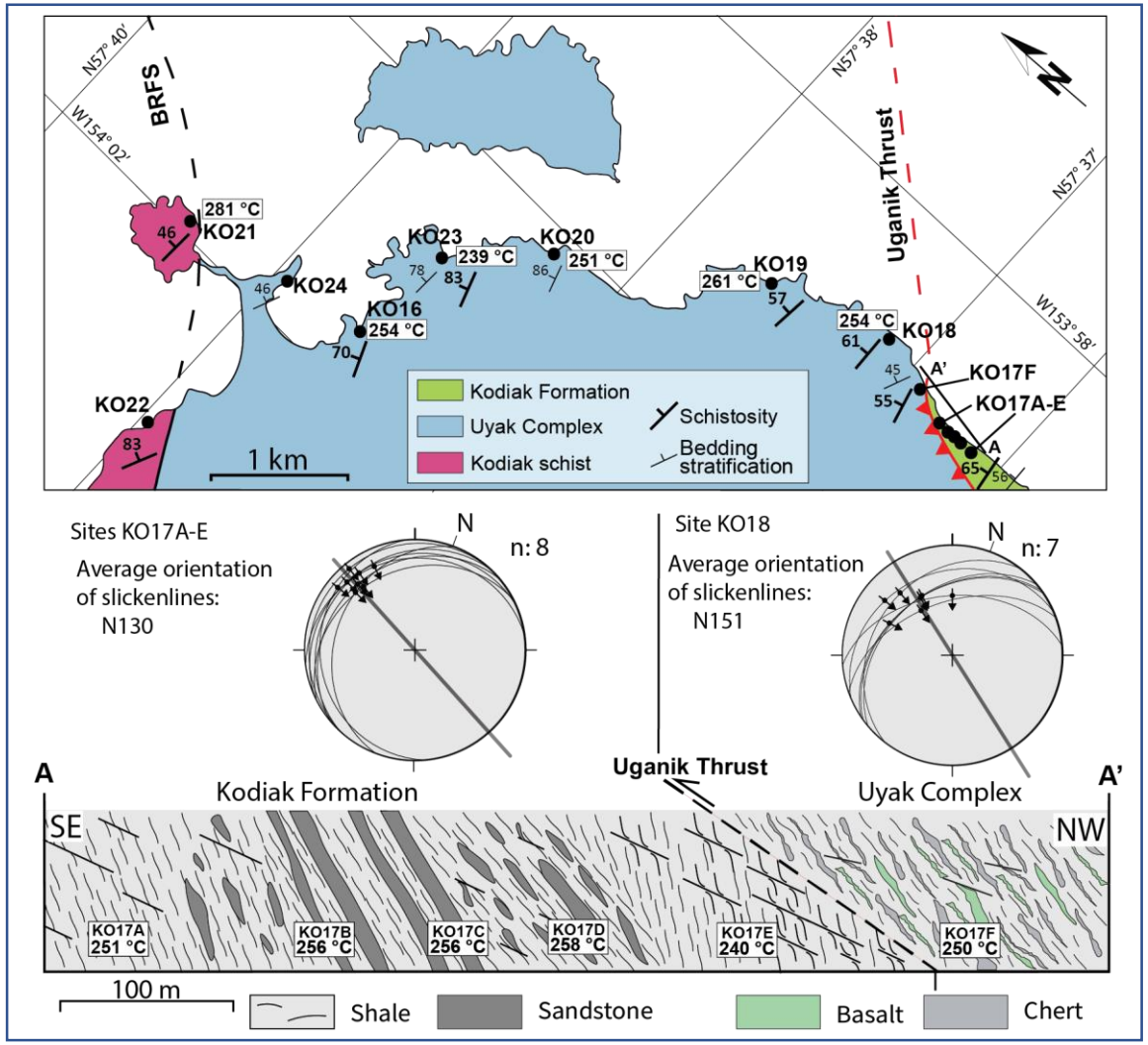


Uyak Bay

- tectonic contact between Uyak Complex and Landward belt – Uganik Thrust
- in both formations: Top-to-the-SE (trench) simple shear

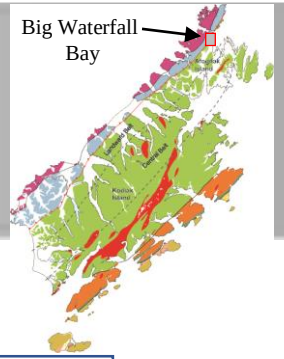


Landward belt (top) and Uyak Complex (bottom)

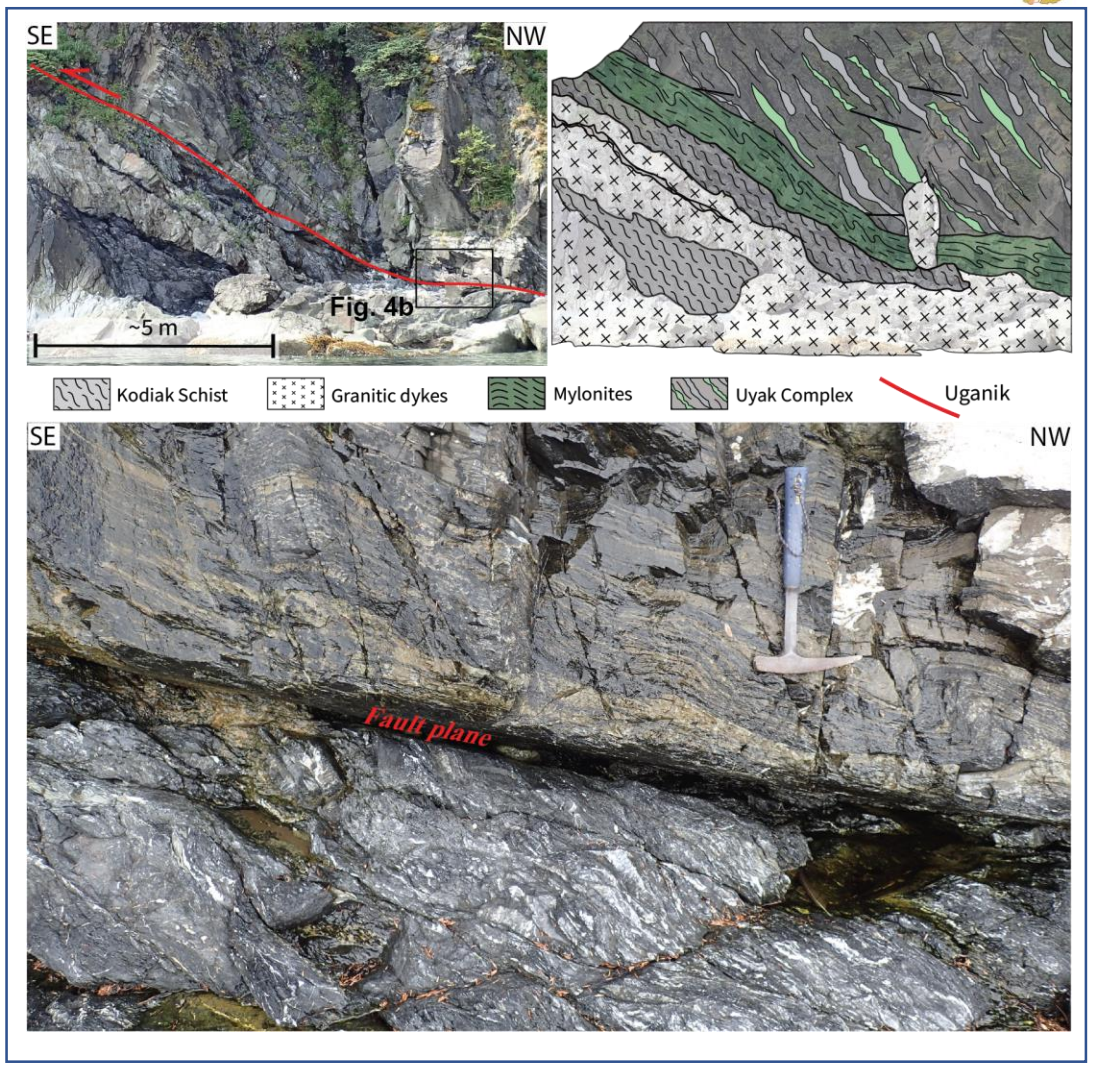


Uyak Complex and Landward belt

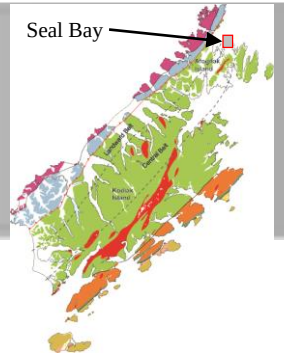
Big Waterfall Bay



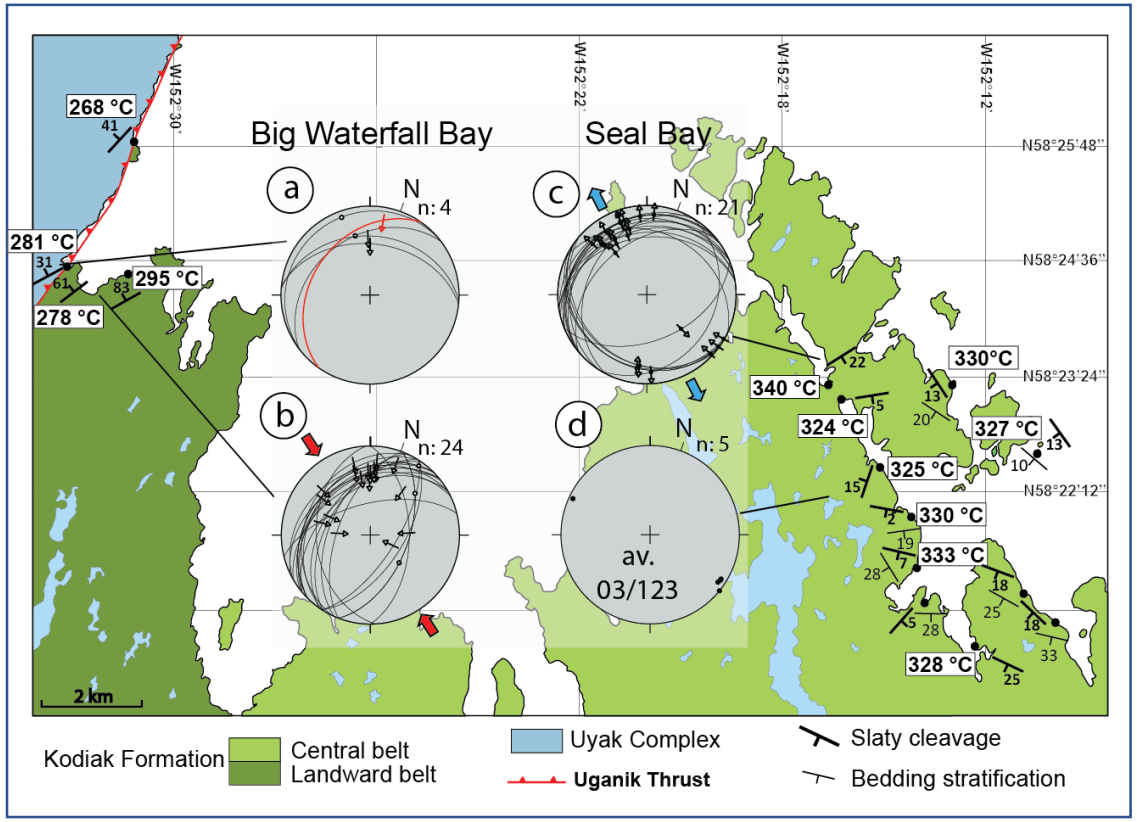
- Temperature is equal in both foot and hanging wall
- Hanging wall (Uyak Complex)
  - Mylonites with asymmetric folds indicating top-to-the-SE
- Foot wall (Kodiak Formation)
  - Top-to-the-SE shear bands
- Like in Uyak Bay, strong deformation in foot wall is presented only close to the Uganik Thrust

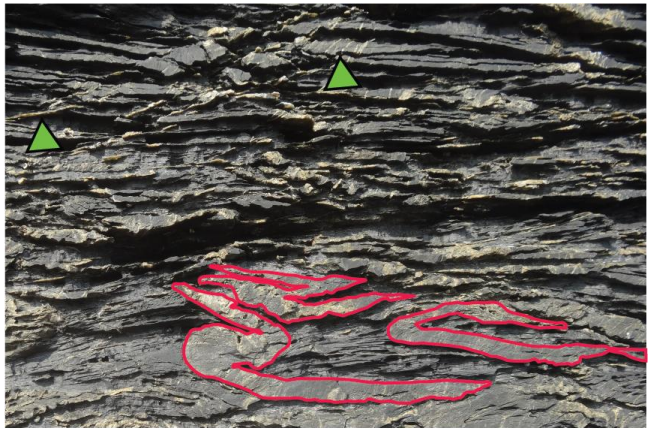


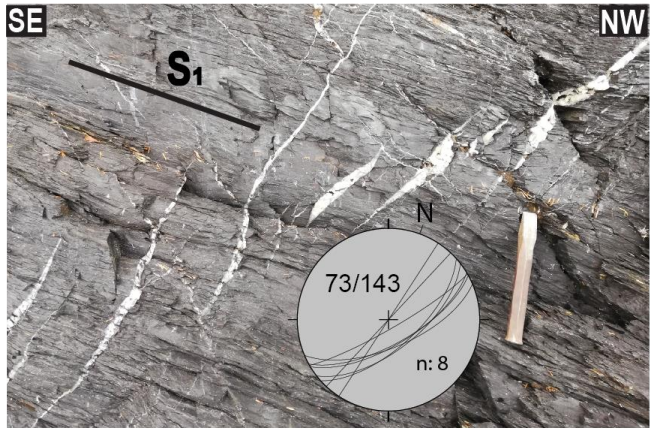
Central belt

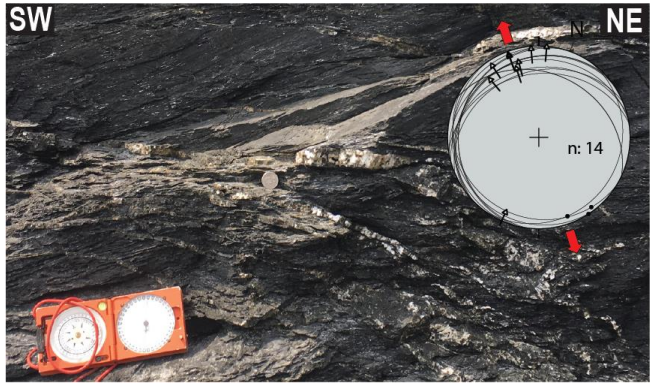


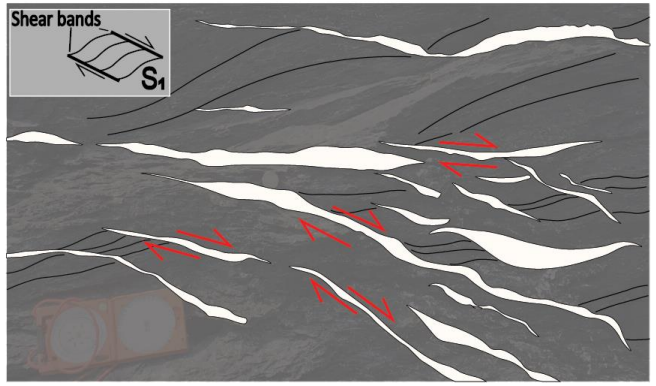
- foliation is close to horizontal
- conjugate extensional shear bands and en echelon arrays (dominantly top-to-the-SE)



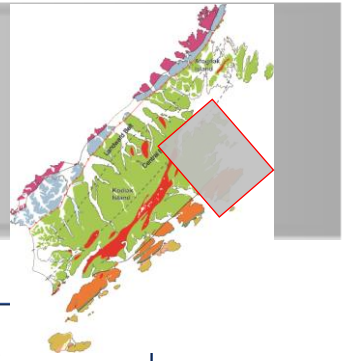






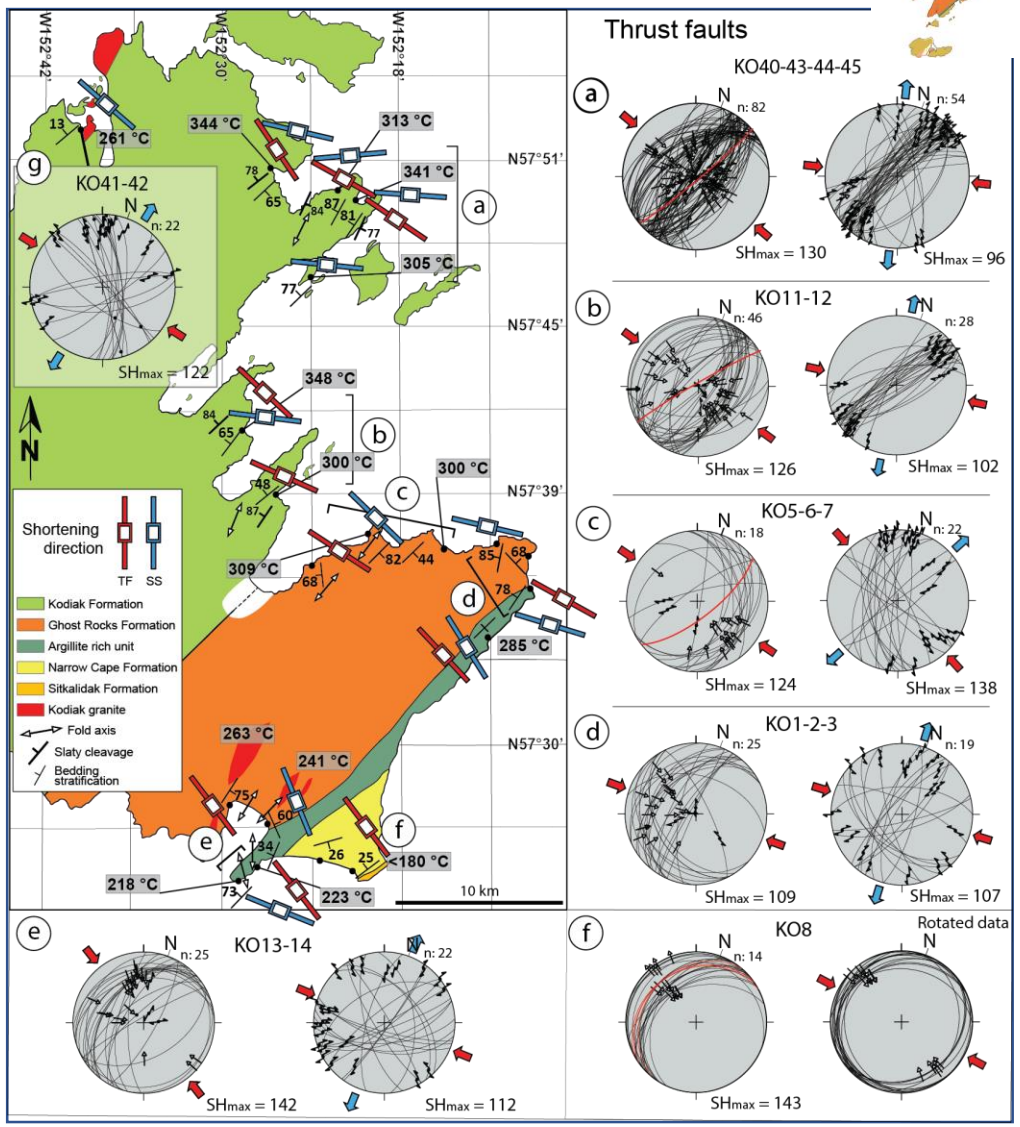


Seaward belt and Ghost Rocks Formation



- sub-vertical foliation
- conjugate thrust faults
  - ➢ indicate SE-NW shortening direction
- strike-slip faults
  - ➢ Late-stage, postdate thrust faults
  - ➢ Also in Kodiak granite (g), previously described as undeformed

- Narrow Cape Formation - (f) on the figure
  - ➢ after rotation S_0 back to horizontal, all measured faults became conjugate thrust faults

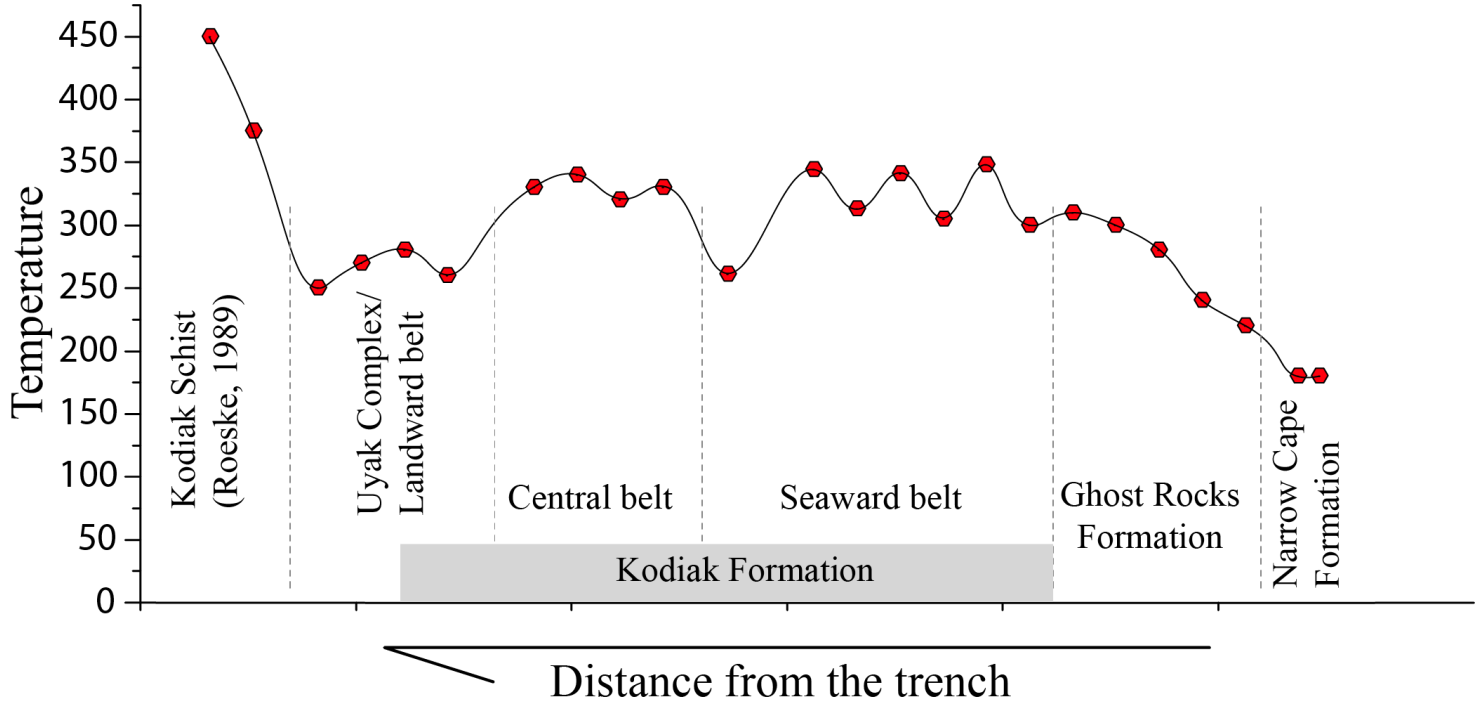


Conclusions

- Central part of the prism (Central and Seaward belt) has experienced the highest metamorphic temperature
- RSCM temperature is equal in both foot wall (Kodiak Formation) and hanging wall (Uyak Complex) of the Uganik Thrust
- Middle Miocene Narrow Cape Formation experienced 180 °C, indicating vigorous vertical motion within frontal part of the prism

Temperature structure along the complex

- No monotonically increase towards the inner part of the wedge



The unconformity

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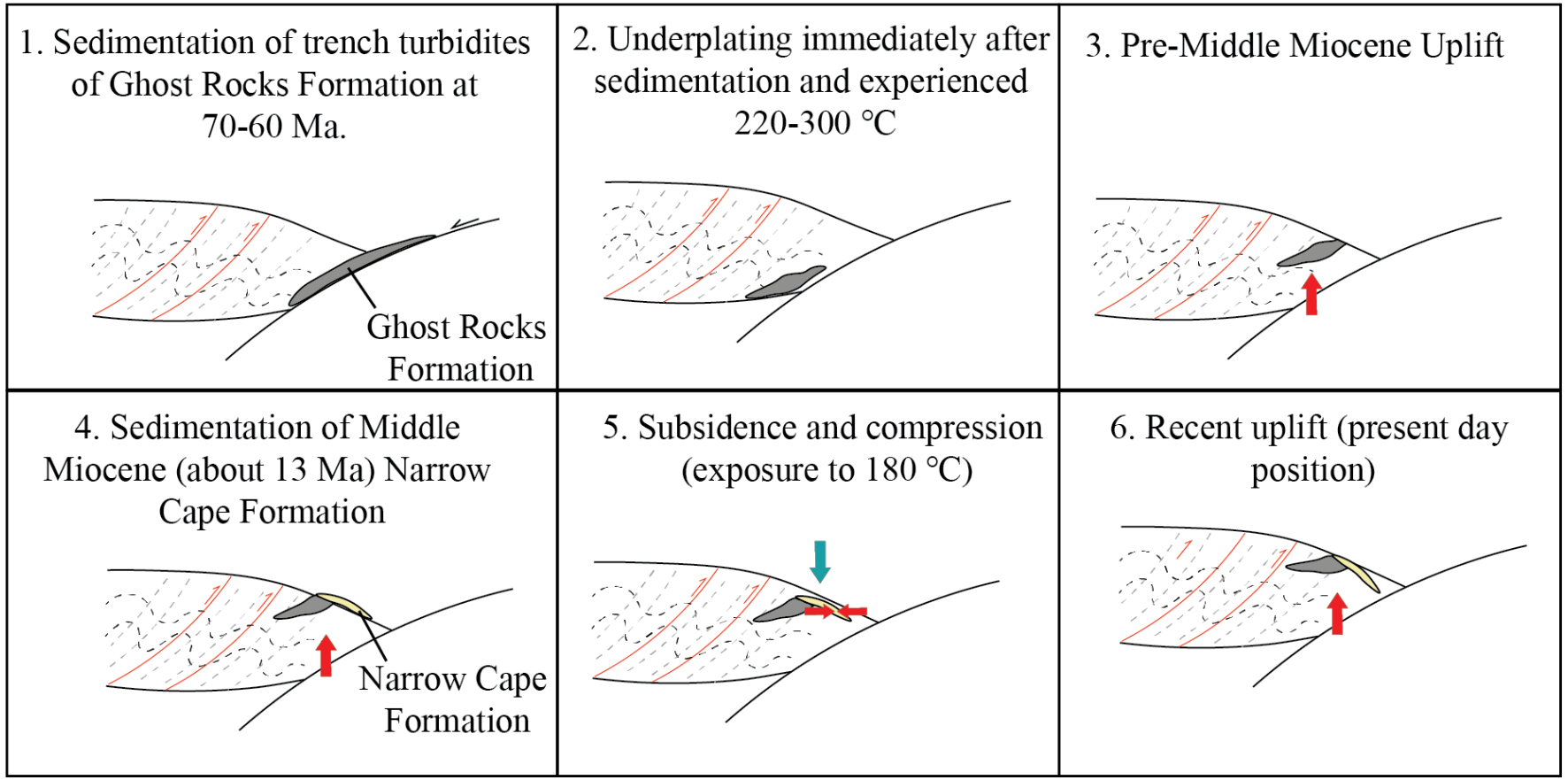
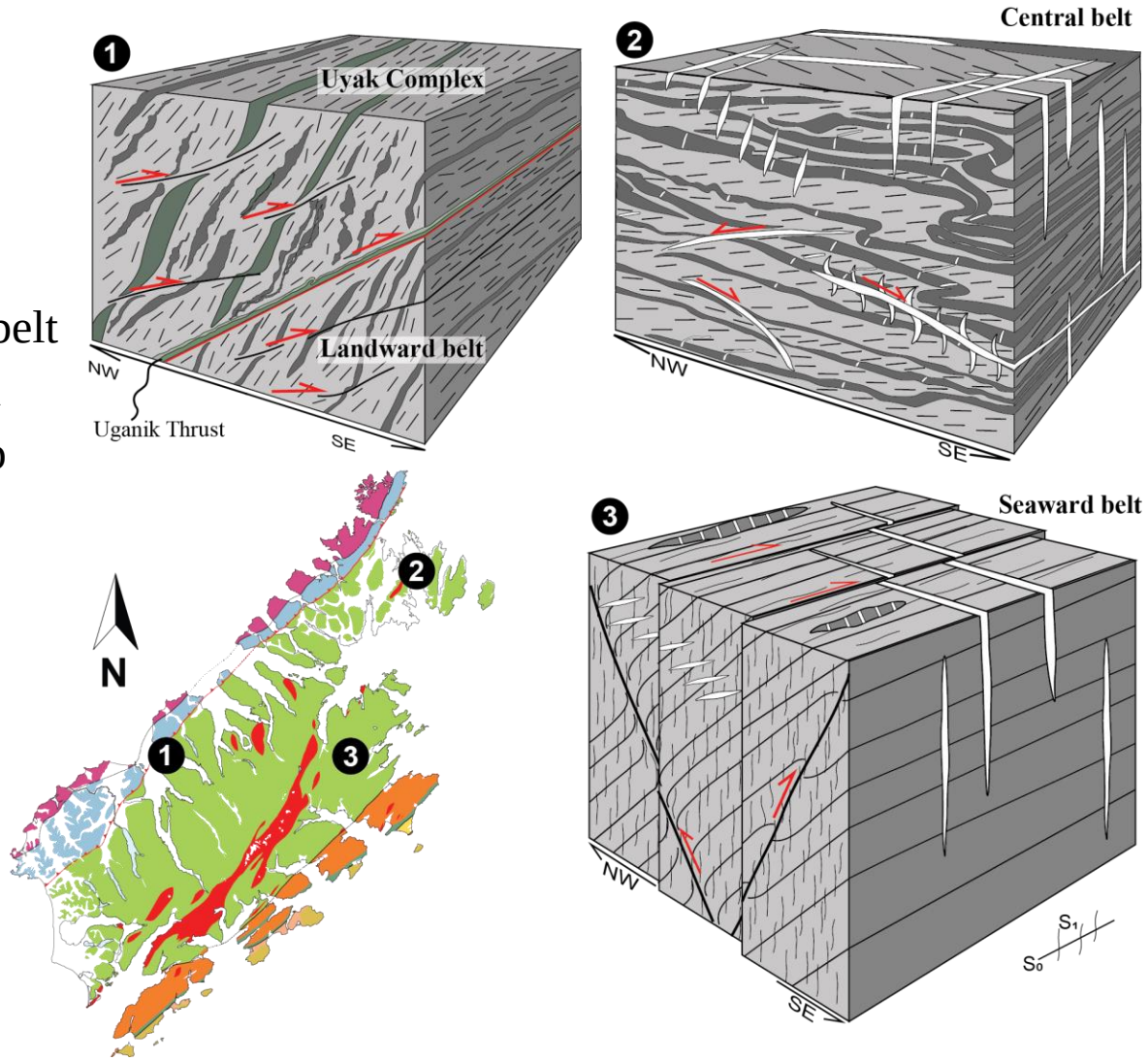


Deformation

- the nature of deformation highly differs across the complex
- from NW to SE (towards the recent trench):
  - ➢ Top-to-the-SE simple shear in Uyak Complex and Landward belt
  - ➢ NW-SE extension in Central belt with sub-horizontal foliation
  - ➢ NW-SE compression in Seaward belt and later E-W strike-slip
- slope sediments of Narrow Cape Formation:
  - ➢ Compression predates tilting