

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

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Géosciences pour une Terre durable

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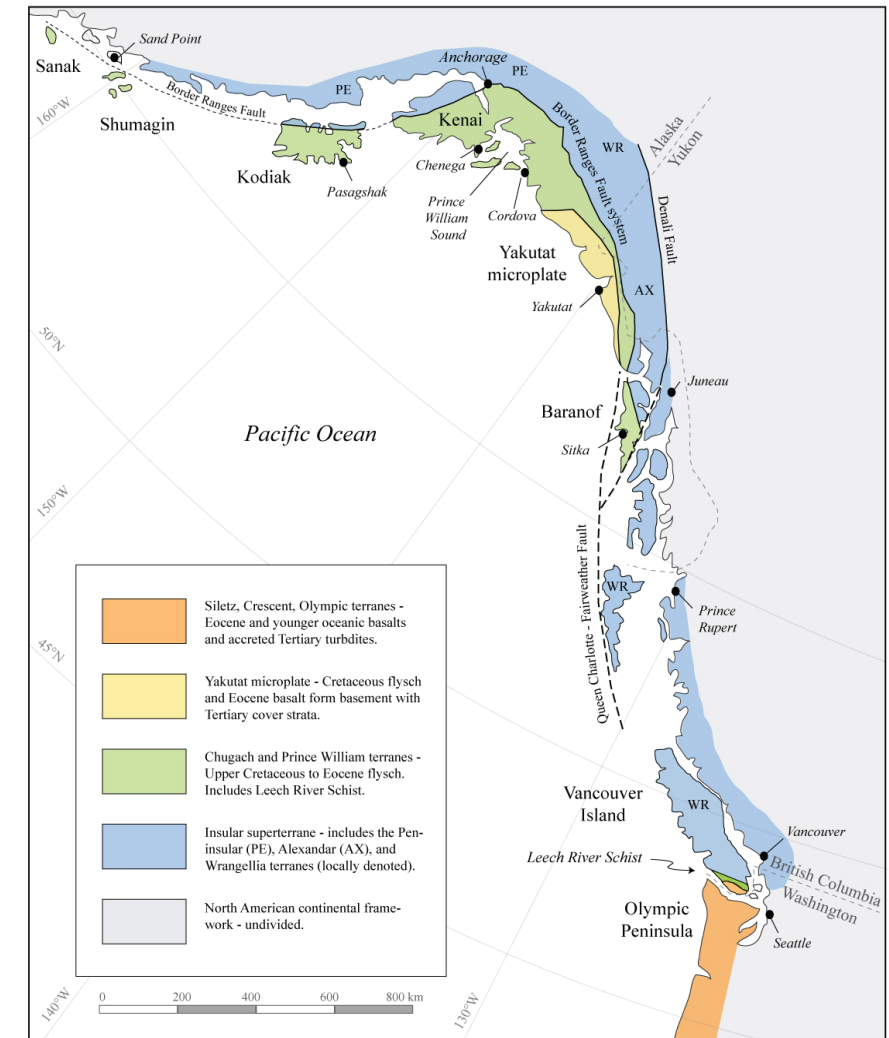
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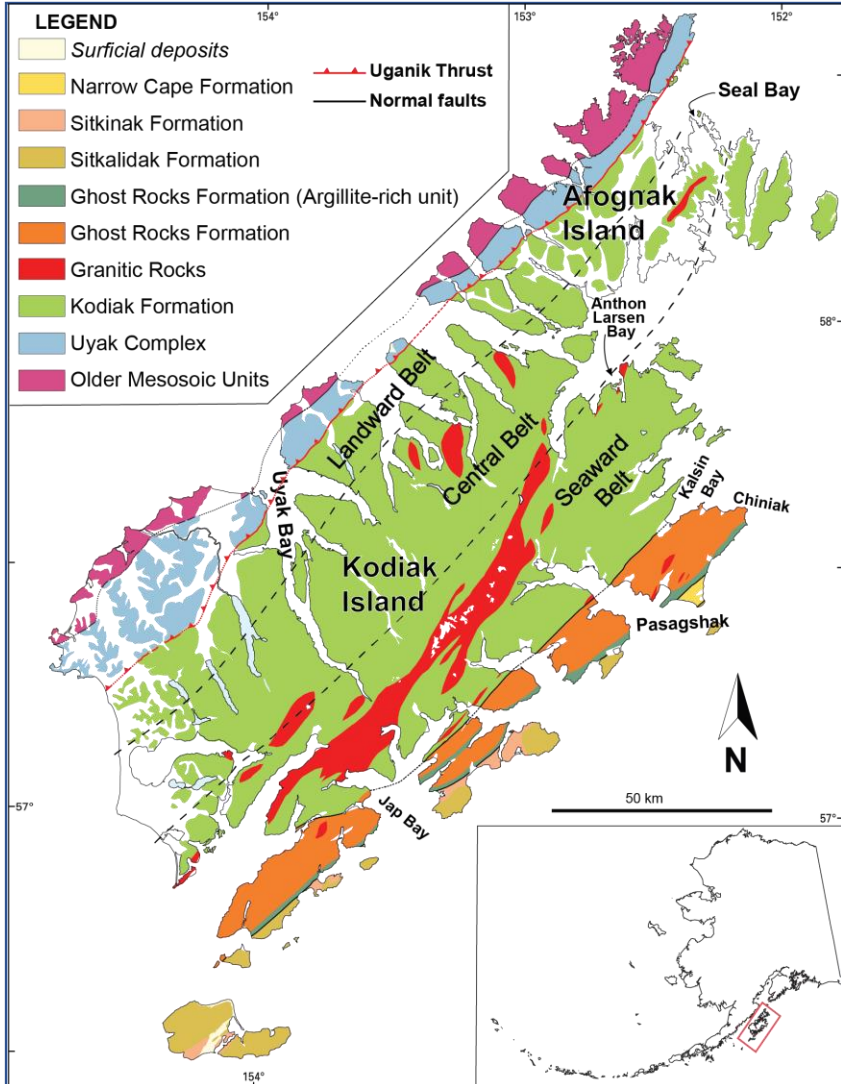
Chugach-Prince William Terrane

- 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 $25 \pm 7^\circ$ (recent position $\sim 57^\circ$)



Kodiak accretionary complex



- Uyak Complex – tectonic mélange (Connelly, 1978)
- Accreted units (metaturbidites):
 1. Kodiak Formation – Maastrichtian (Byrne & Fisher, 1987)
 2. Ghost Rocks Formation – Late Cretaceous to Early Paleogene (Moore et al., 1983)
- Slope sediments (separated by the unconformity with accreted units):
 - 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

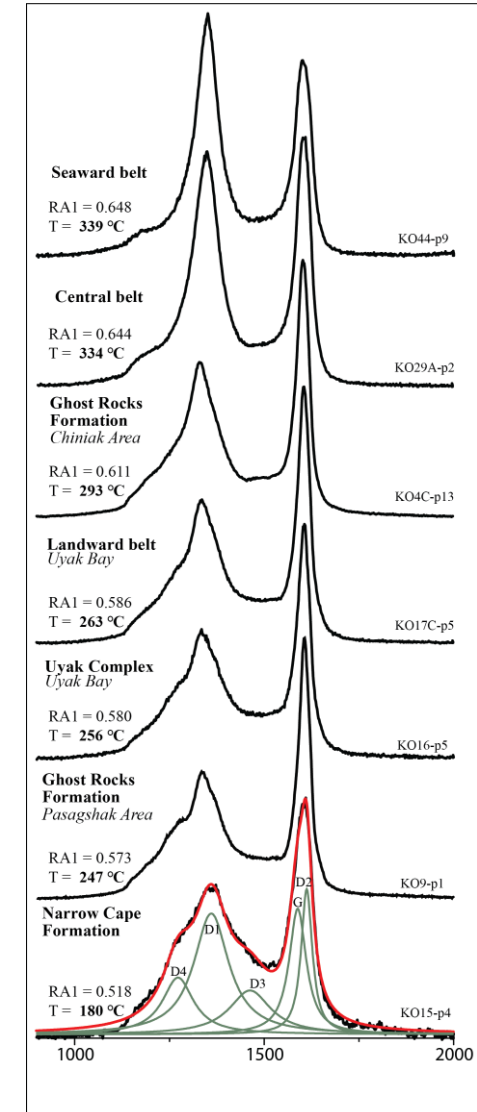
Following Lahfid et al. (2010):

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

$$T^{\circ}C = 1217.6 * RA1 - 450.66$$

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

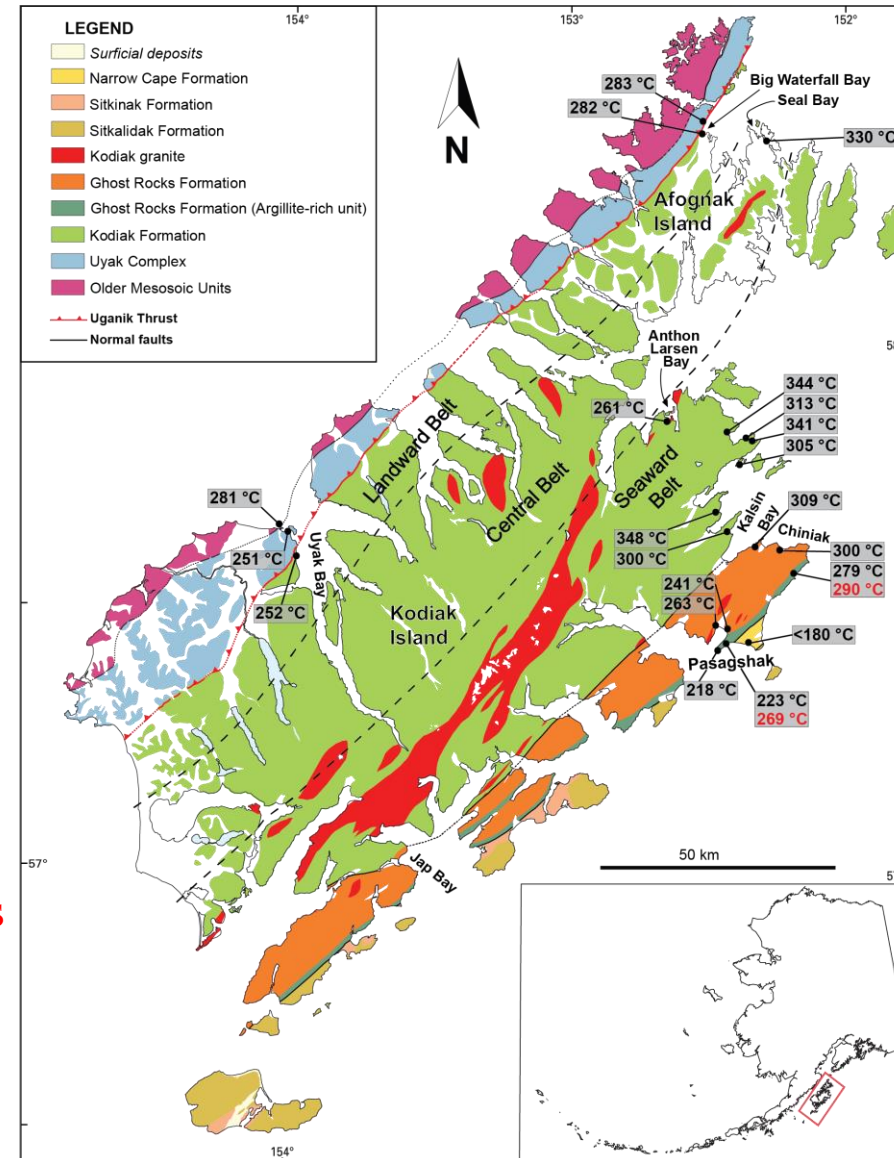


RSCM results

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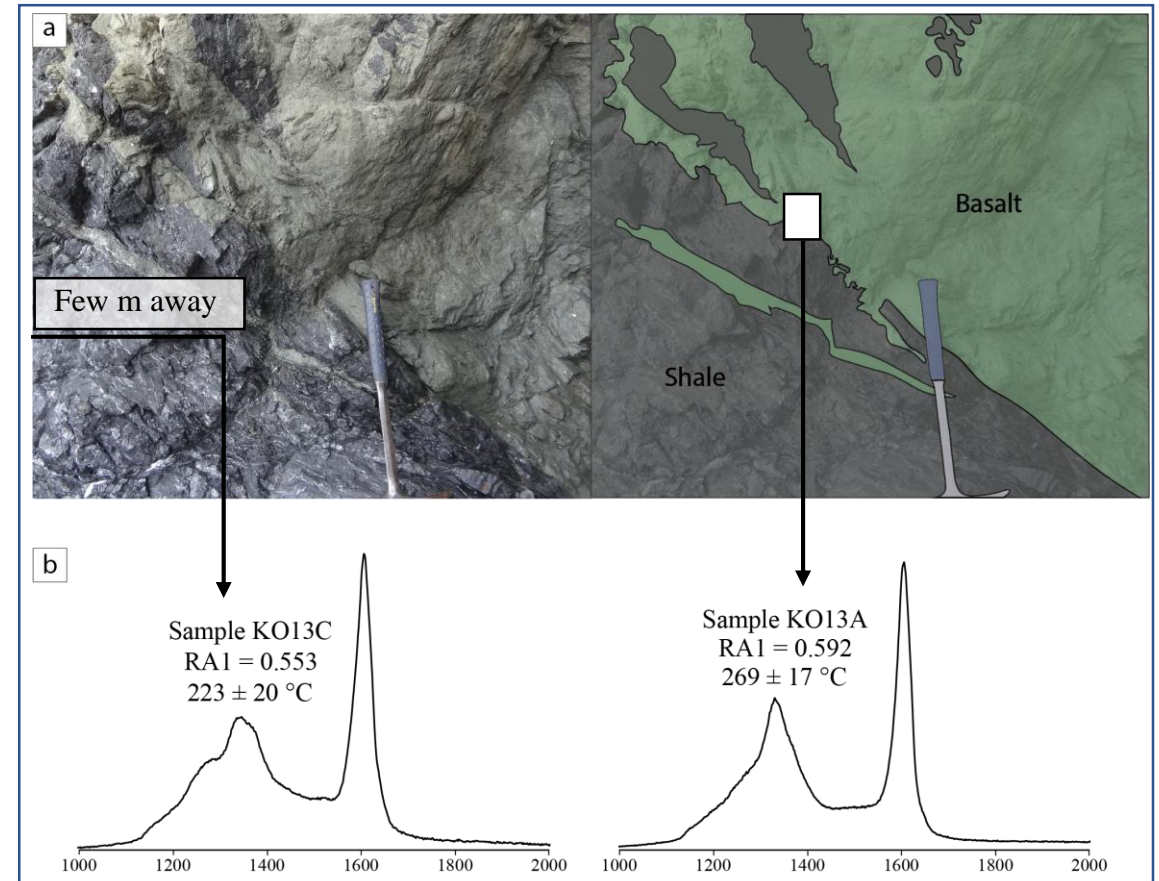
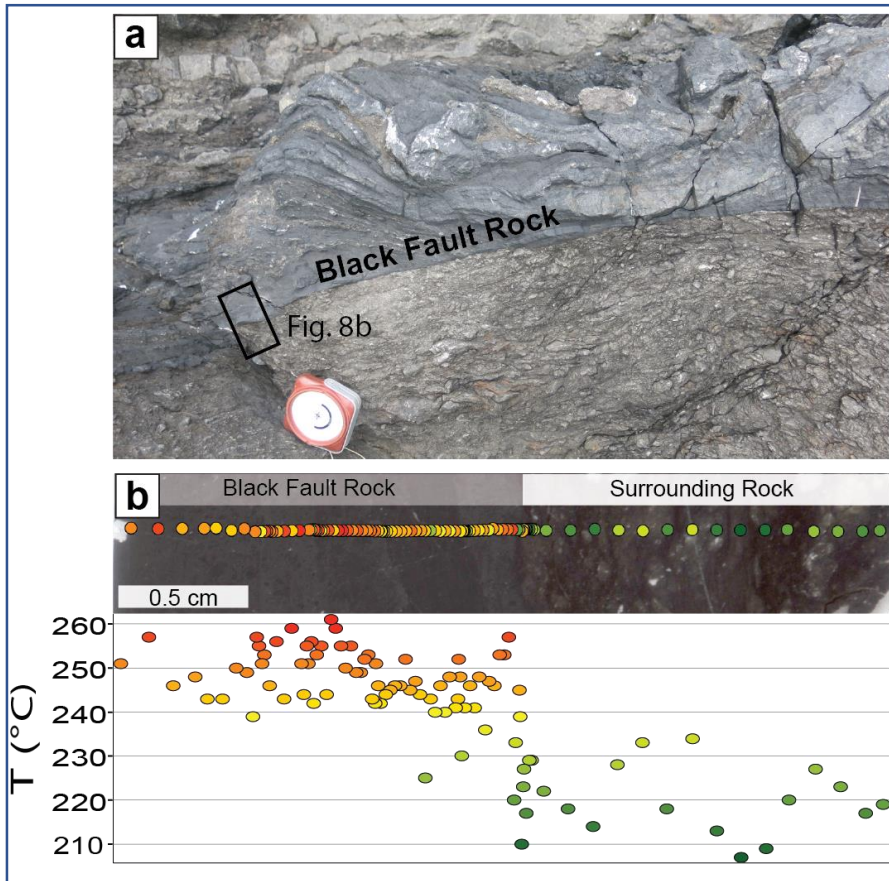
Red Temperatures: analyzed samples in the contact with basalts

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



The influence of intrusions and faults

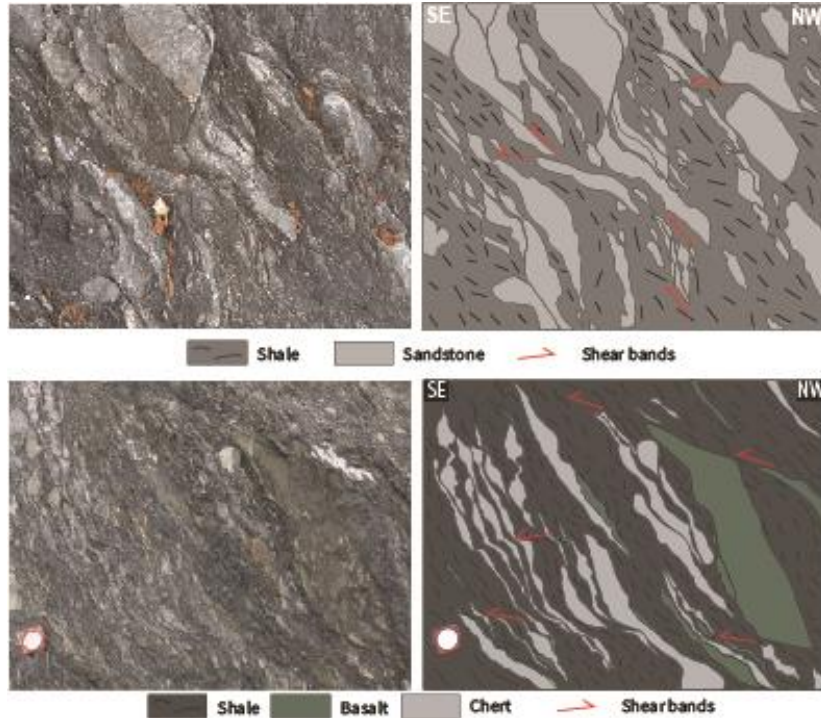
- the RSCM temperature within fault rocks is higher than in surrounding rock
- basalt intrusions affect thermal structure



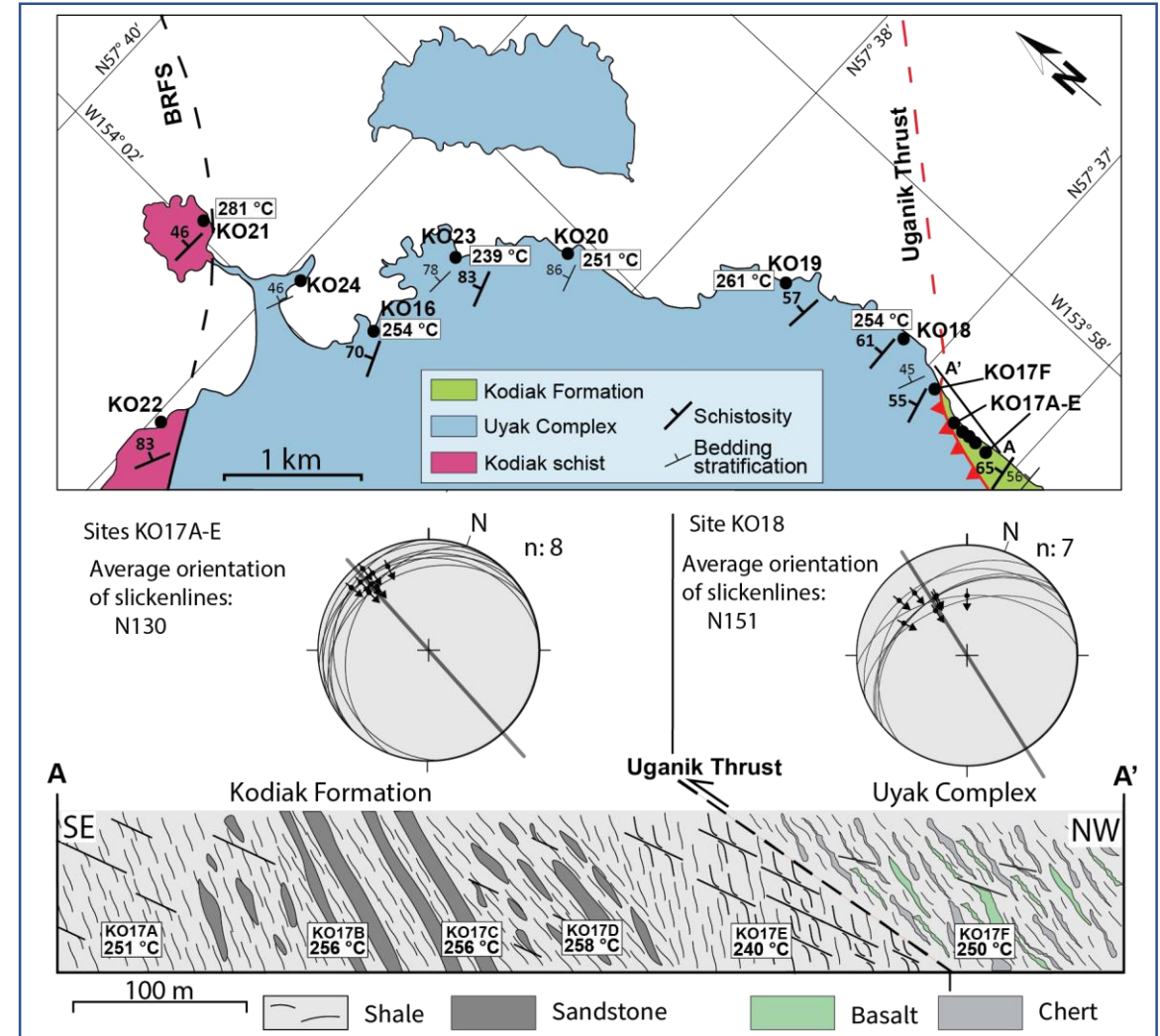
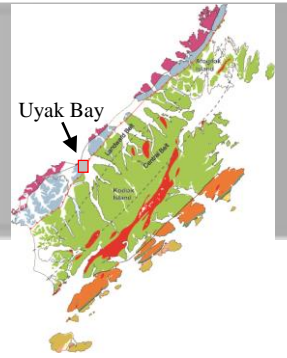
Uyak Complex and Landward belt

Uyak Bay

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

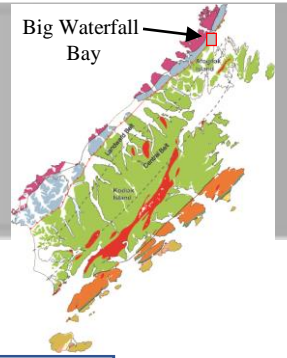


Landward belt (top) and Uyak Complex (bottom)

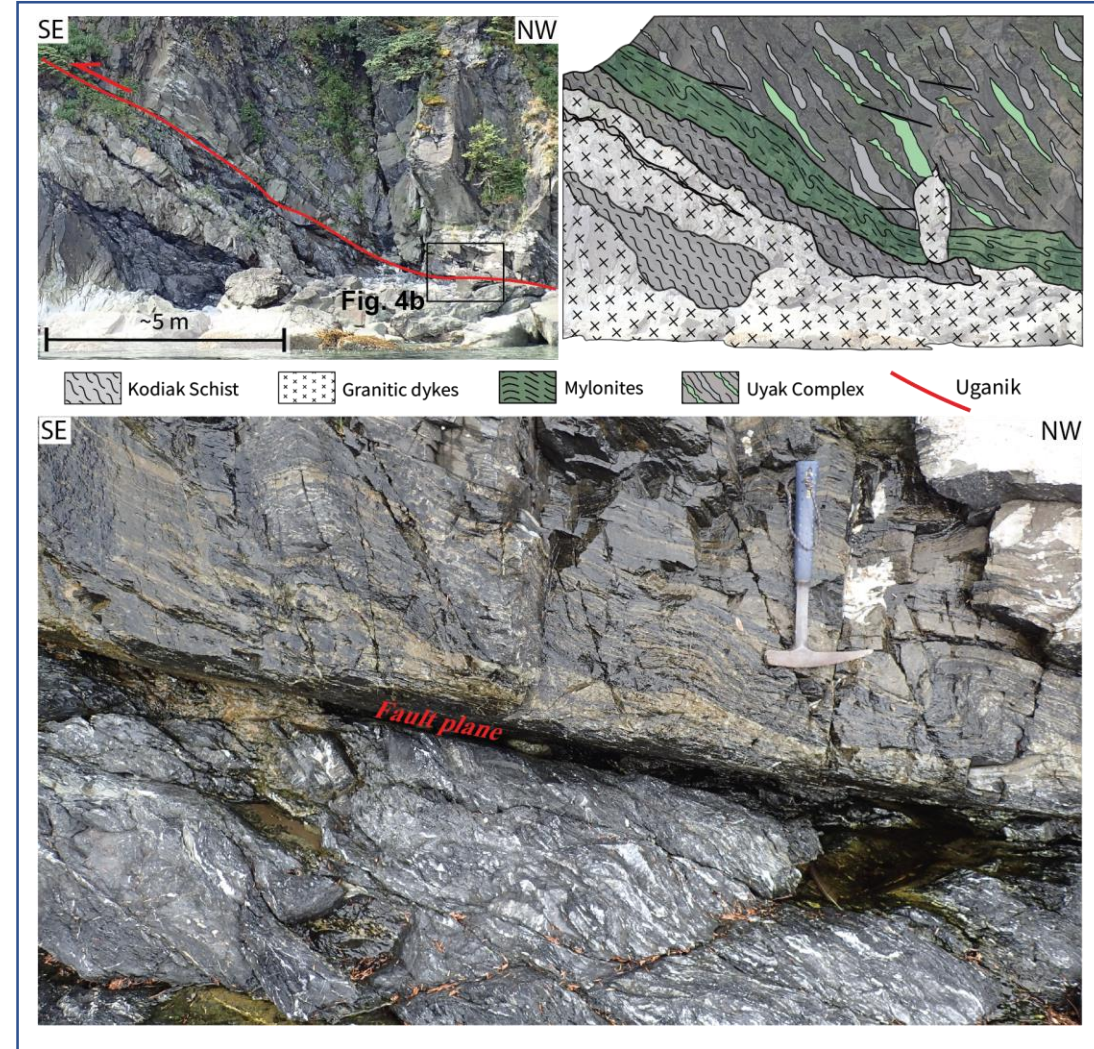


Uyak Complex and Landward belt

Big Waterfall Bay

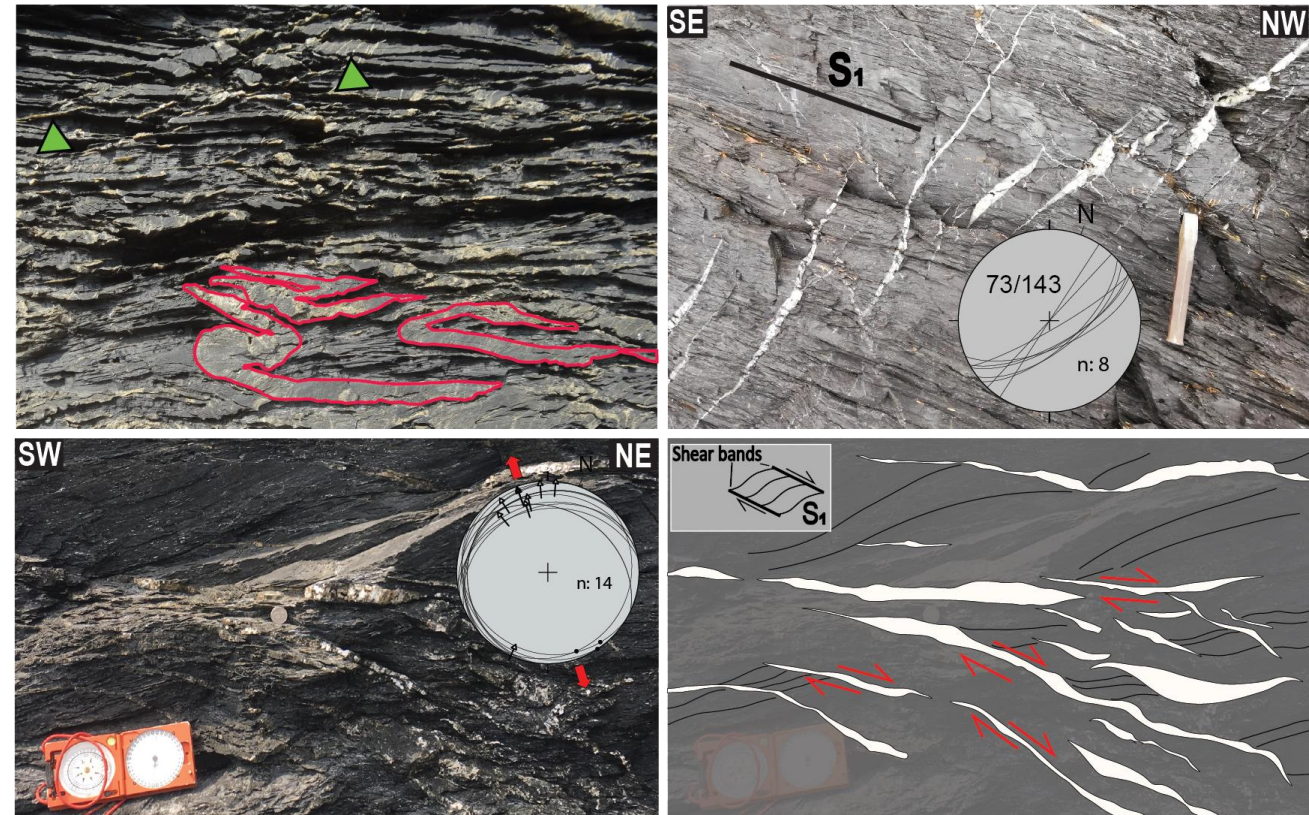


- Temperature is equal in both foot and hanging wall
- Hanging wall (Uyak Complex)
 - Mylonites with asymmetric folds indicating top-to-the-SE
- Foot wall (Kodiak Formation)
 - Top-to-the-SE shear bands
- Like in Uyak Bay, strong deformation in foot wall is presented only close to the Uganik Thrust

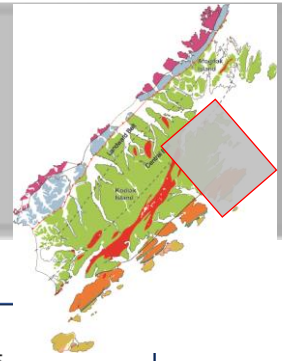


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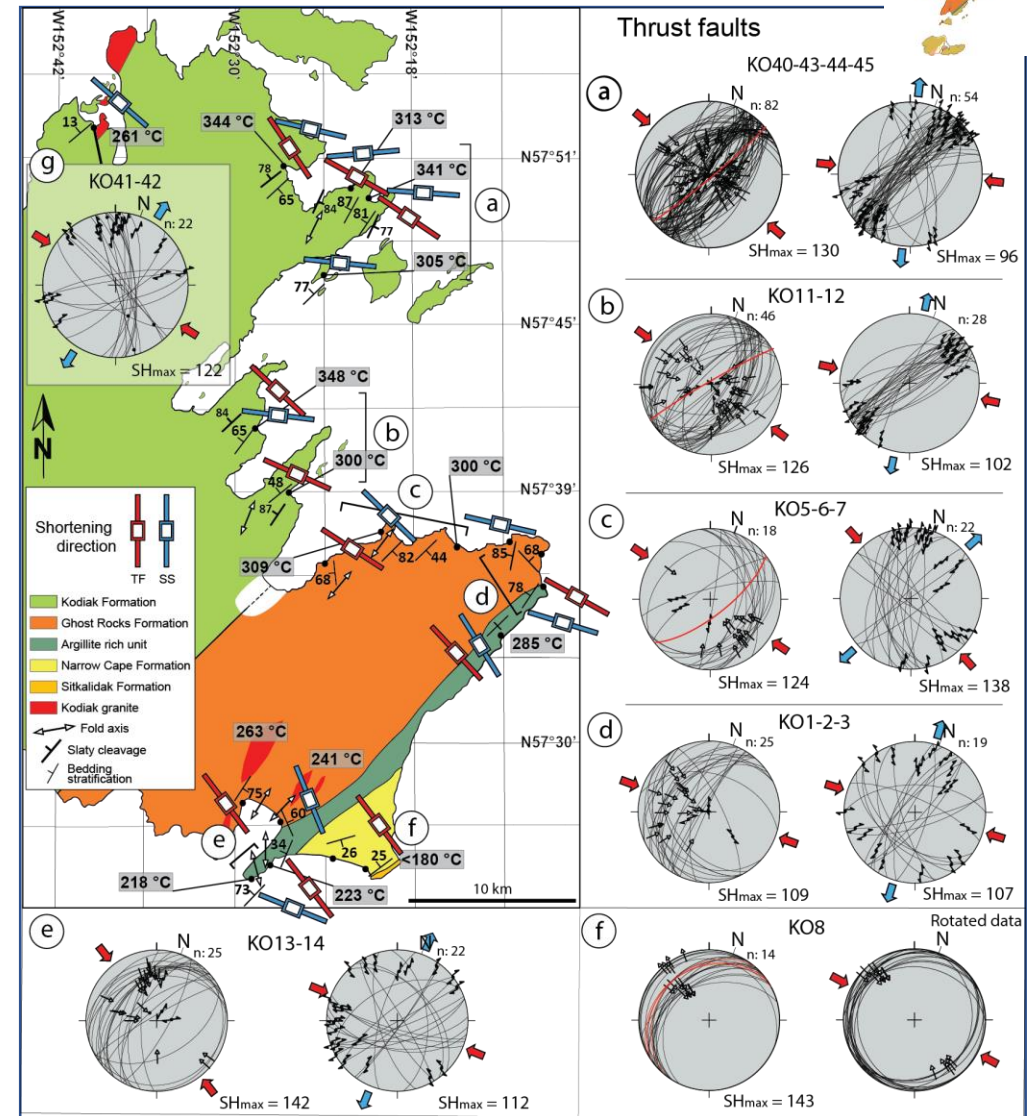
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- The figure is a geological map of the Uyak Complex and surrounding areas, including Kodiak Formation, Central belt, and Landward belt. The map displays structural features, temperature data, and structural analysis diagrams.
- Map Features:**
- Geological Units:** Kodiak Formation (light green), Central belt (medium green), Landward belt (dark green).
 - Structural Features:** Uyak Complex (blue), Uganik Thrust (red line with triangles), Slaty cleavage (black line with 'X'), Bedding stratification (black line with 'V').
 - Temperature Data:** Various temperature points are marked, including 268 °C, 281 °C, 278 °C, 295 °C, 300 °C, 324 °C, 325 °C, 327 °C, 328 °C, 330 °C, 333 °C, and 340 °C.
 - Structural Analysis Diagrams:** Four diagrams (a, b, c, d) show structural analysis results. Diagram (a) shows N: 4, (b) shows N: 24, (c) shows N: 21, and (d) shows N: 5. Diagram (d) also includes 'av. 03/123'.
- Map Labels:**
- Big Waterfall Bay**
 - Seal Bay**
 - W452°22**, **W452°18**, **W452°12**
 - N58°25'48"**, **N58°24'36"**, **N58°23'24"**, **N58°22'12"**
 - 2 km**



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

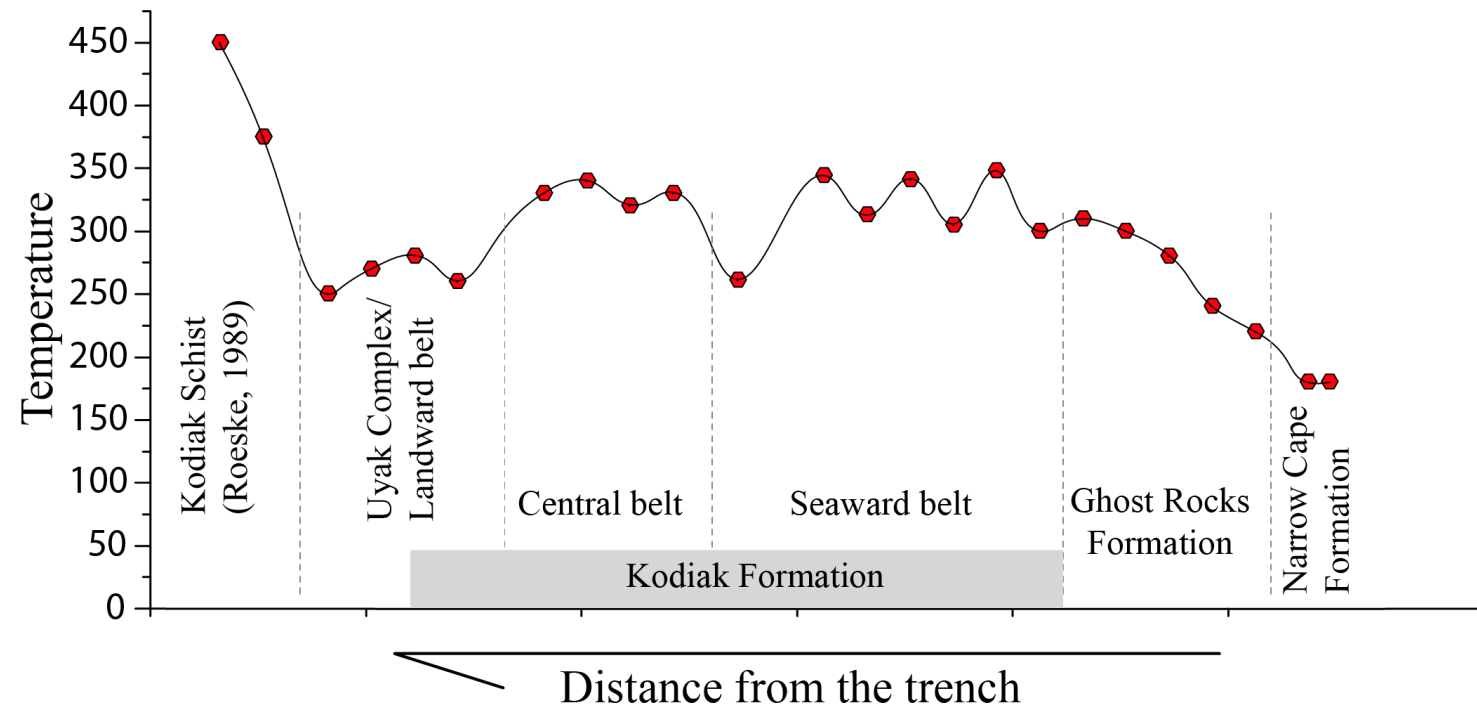


Conclusions

- 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

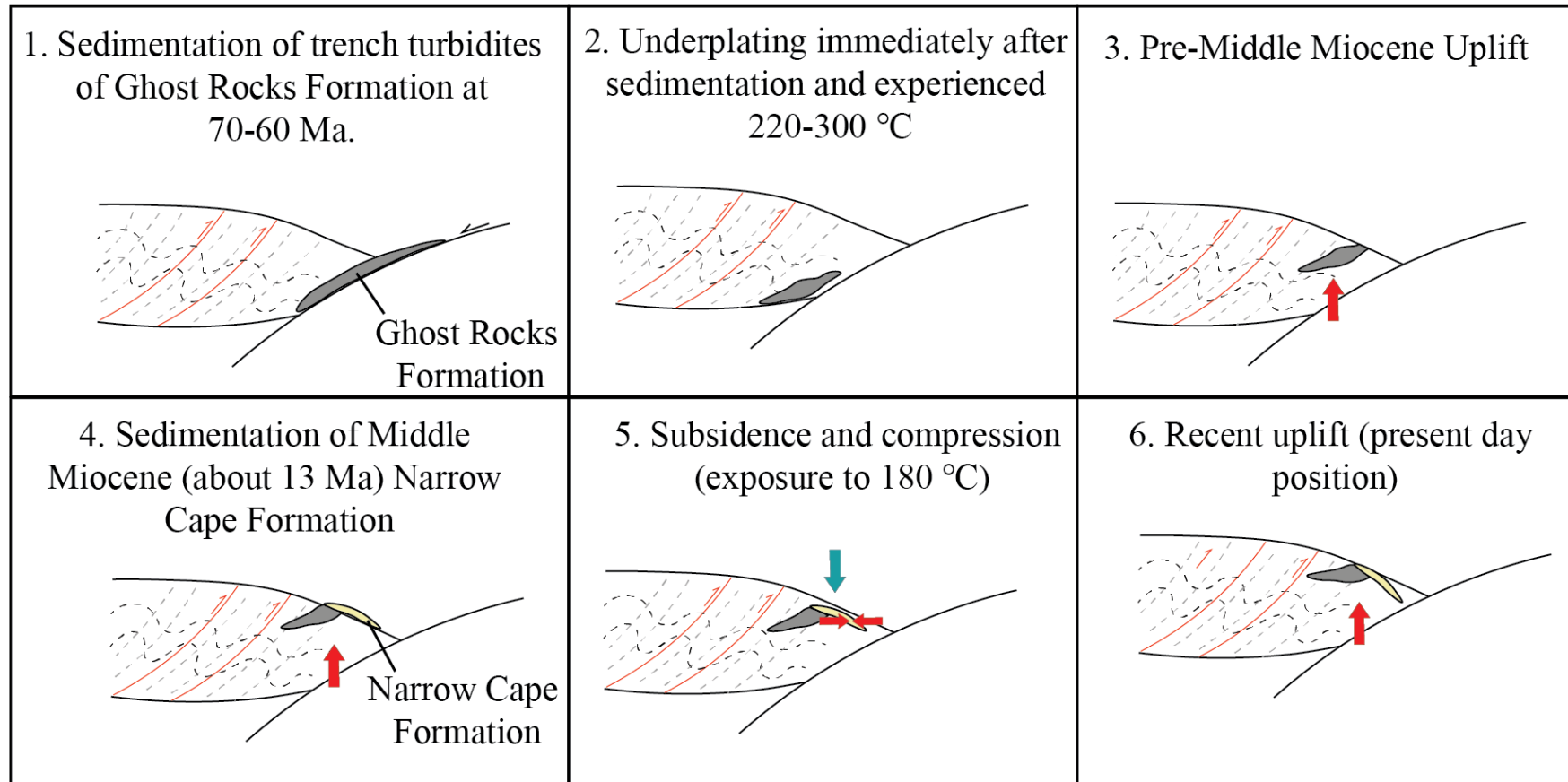
Temperature structure along the complex

- No monotonically increase towards the inner part of the wedge



The unconformity

- Middle Miocene Narrow Cape Formation experienced 180 °C, indicating vigorous vertical motion within frontal part of the prism



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

