Structural Linkage of Major Tectonic Elements

Ugashik Lakes – Becharof Lake Region

Northeastern Alaska Peninsula

Author(s) and affiliations:

Paul L. Decker[1], Rocky R. Reifenstuhl[2] , and Robert J. Gillis[2]

[1] Alaska Division of Oil and Gas

[2] Alaska Division of Geological & Geophysical Surveys

Date presented:

March 27, 2008

Presentation Forum:

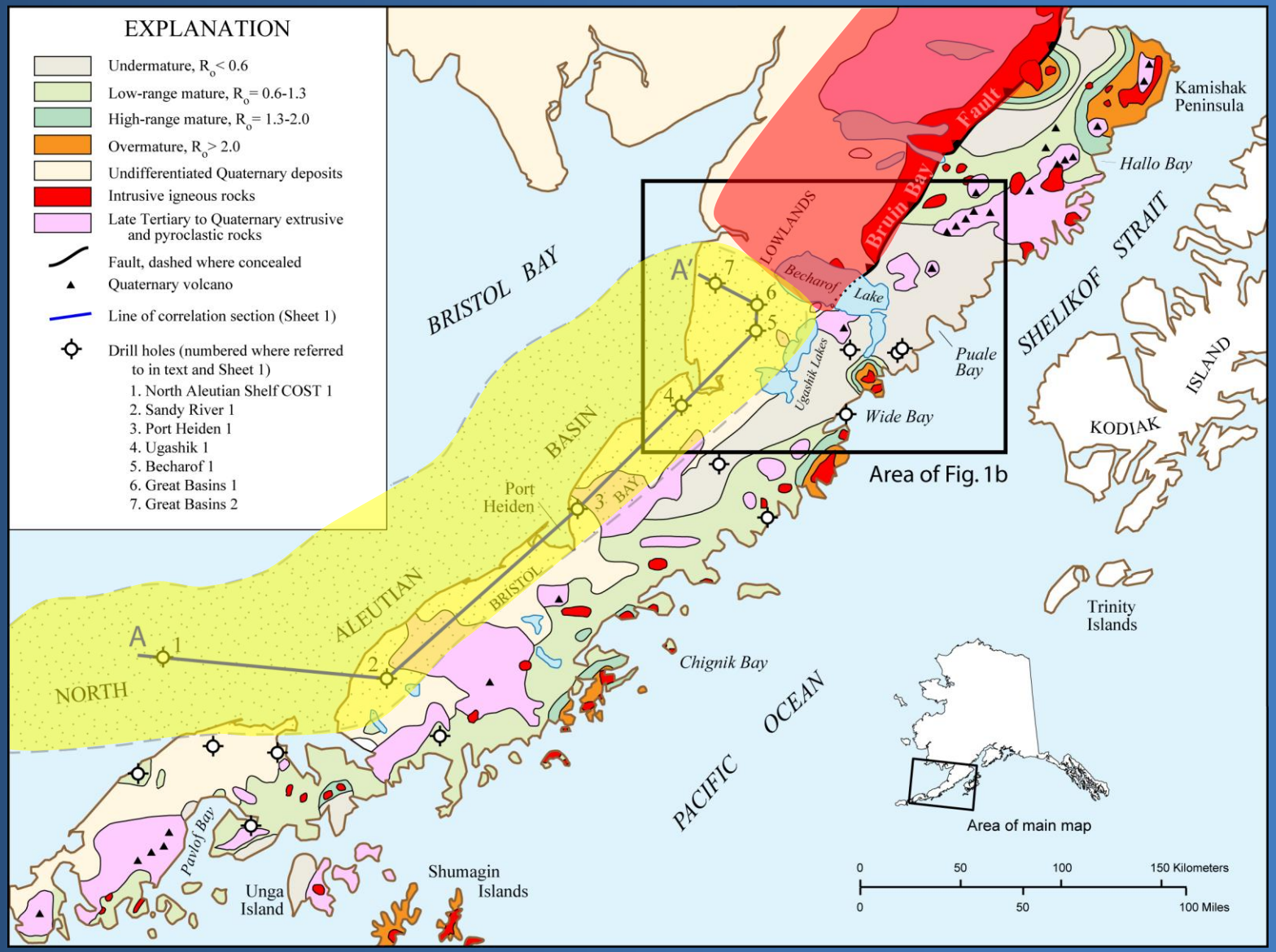
DNR Spring Technical Review Meeting, BP Energy Center

Acknowledgments of any external funding sources and in-kind contributors:

Field studies during 2007 were funded by the Alaska Division of Oil and Gas and the Alaska Division of Geological & Geophysical Surveys. The authors appreciate logistical assistance from Katmai National Park and the U.S. Fish and Wildlife Service management in King Salmon, Alaska. Robert Blodgett (consulting geologist) helped confirm the presence of Jurassic Shelikof Formation based on its molluscan fauna assemblage in hand specimens. The ideas presented here benefitted from written communications with Chris Nye, DGGS/Alaska Volcano Observatory, and Natalia Ruppert, Alaska Earthquake Information Center.

Alaska Peninsula – North Aleutian Basin

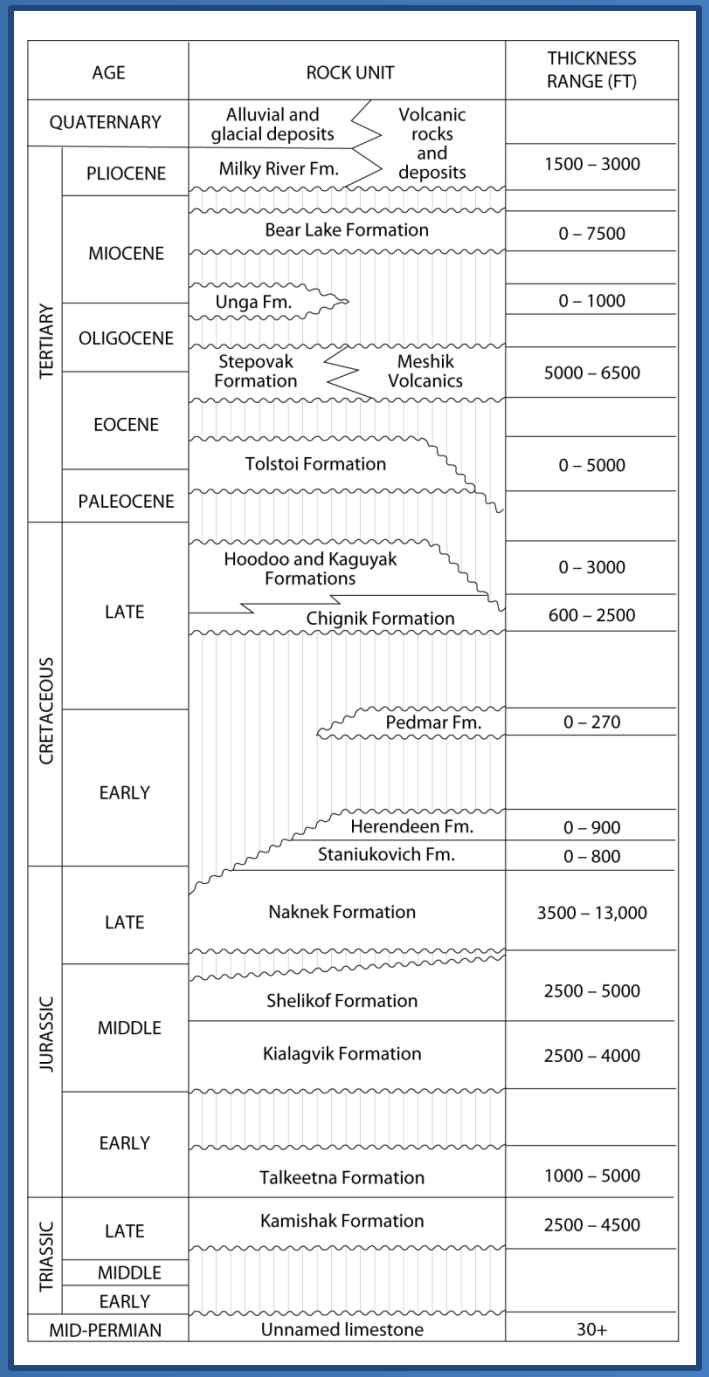
Surface Thermal Maturity (Molenaar, 1996)



Alaska Peninsula Stratigraphic Column

Key Map Units:

- Miocene Bear Lake Fm
- Upper Jurassic Naknek Fm
- Middle Jurassic Shelikof Fm

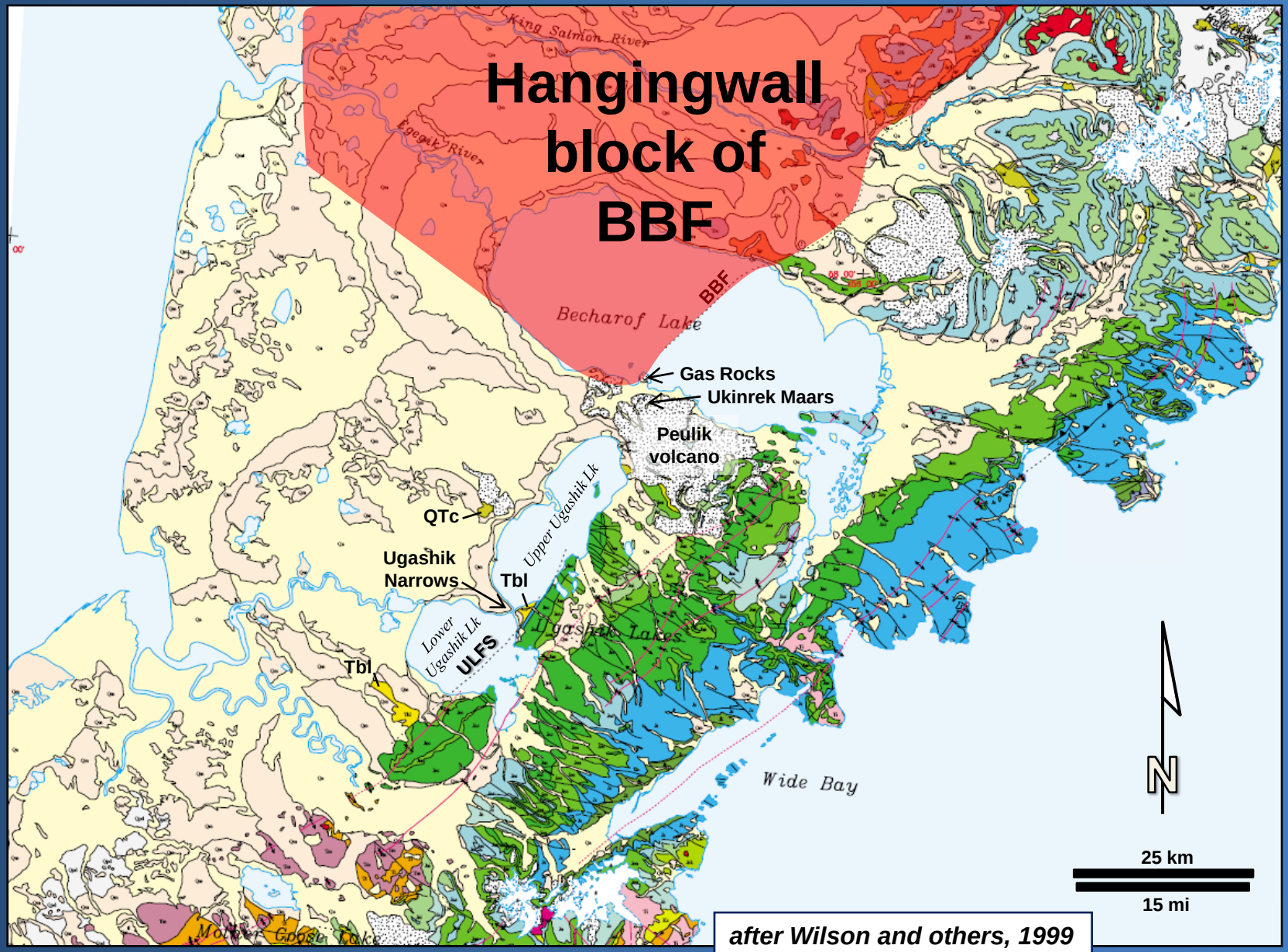


Tectonic Elements

- Bruin Bay Fault
  - Regional up-to-west reverse separation
  - Probable sinistral component (Detterman)
  - North of the southern shore of Becharof Lake
  - Tertiary (as old as Late Jurassic?) movement
- Ugashik Lakes Fault System *
  - Down-to-west relative throw – but which way do faults dip?
  - Miocene deposits to west
  - Closely associated with short-wavelength magnetic anomaly
  - South of southern shore of Becharof Lake
- Ugashik Sub-basin *
  - Separated from main back-arc depocenter by Meshik volcanic center
  - Later subsidence than main back-arc (Neogene vs Paleogene)
- Becharof Discontinuity *
  - Major magnetic contrast between subsided basin and uplifted BBF
  - Seismically-mappable fault zone
  - Modern seismicity, volcanism

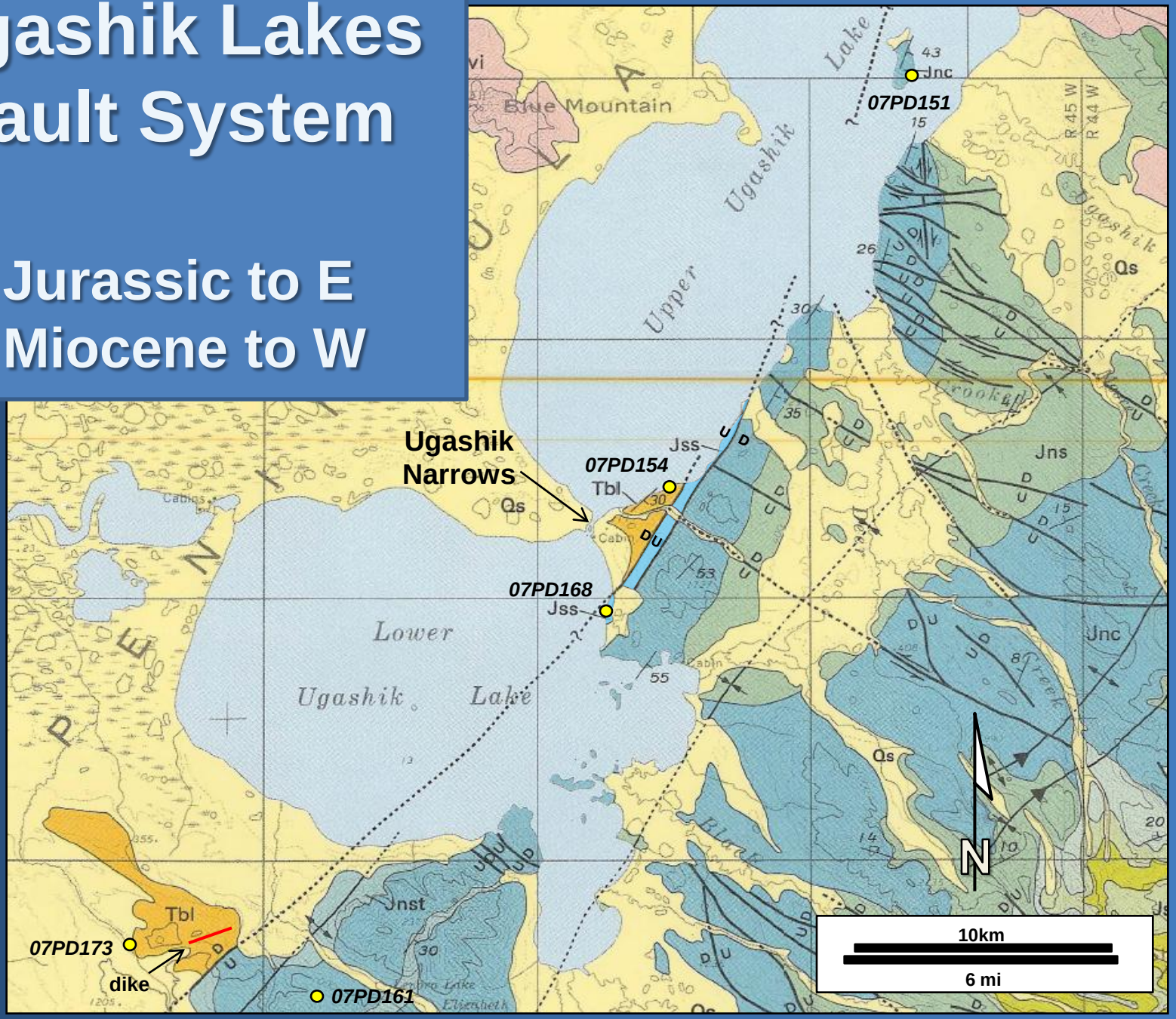
** new name, this study*

Ugashik – Becharof Lakes Area Geology



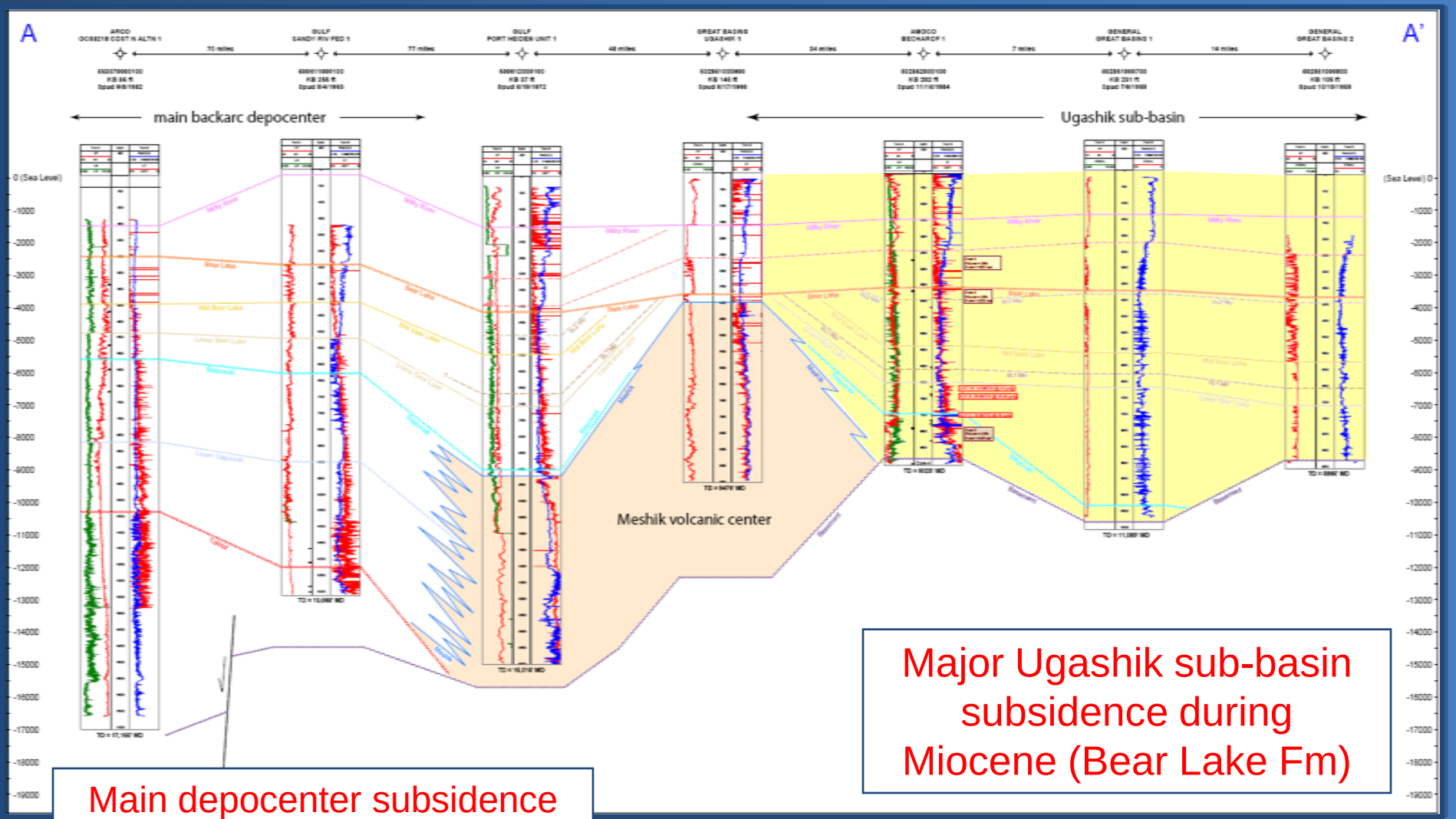
Ugashik Lakes Fault System

- Jurassic to E
- Miocene to W



Ugashik Sub-basin

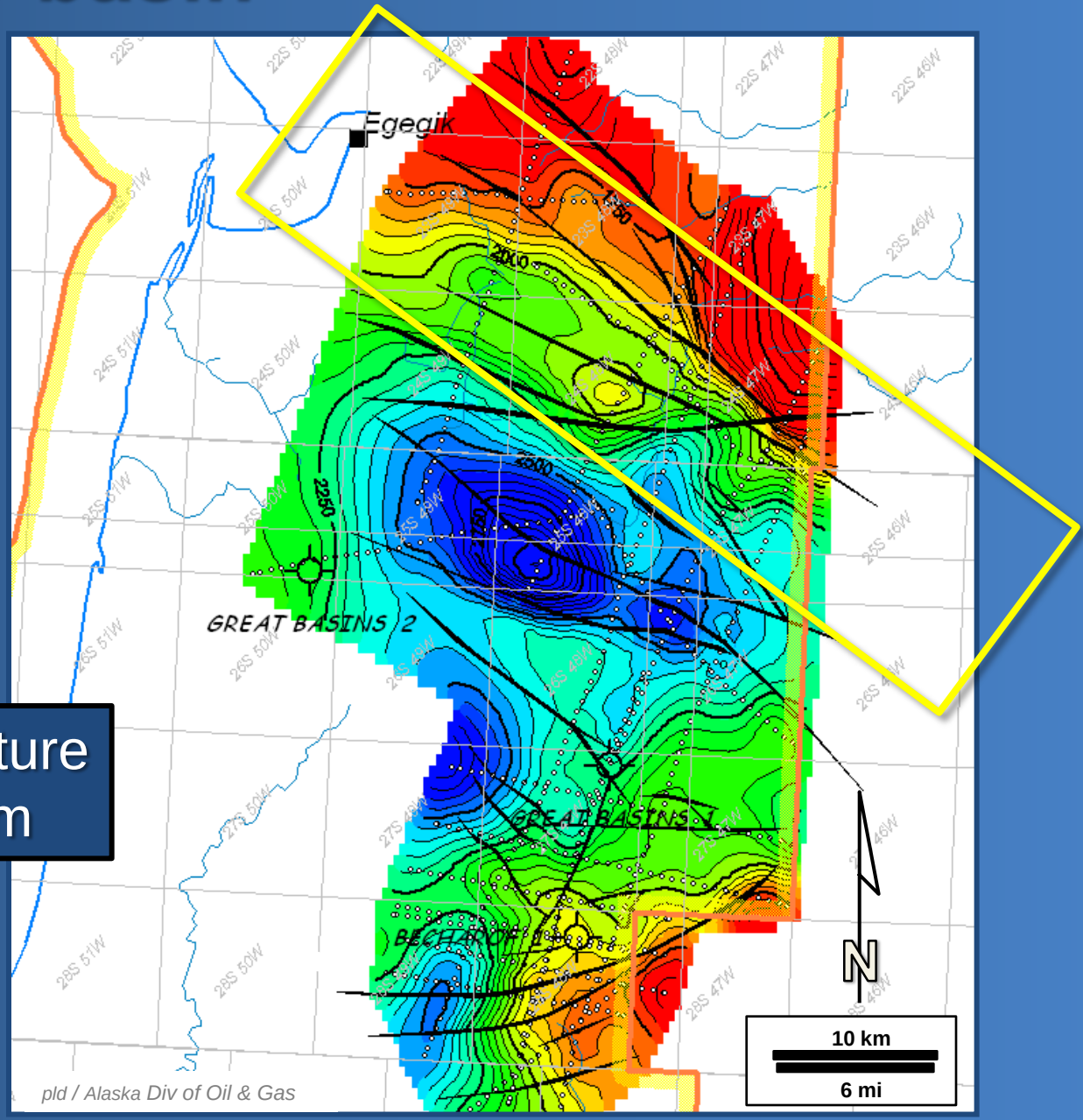
Distinct subsidence history



Main depocenter subsidence during Eocene-Oligocene (Tolstoi, Stepovak Fms)

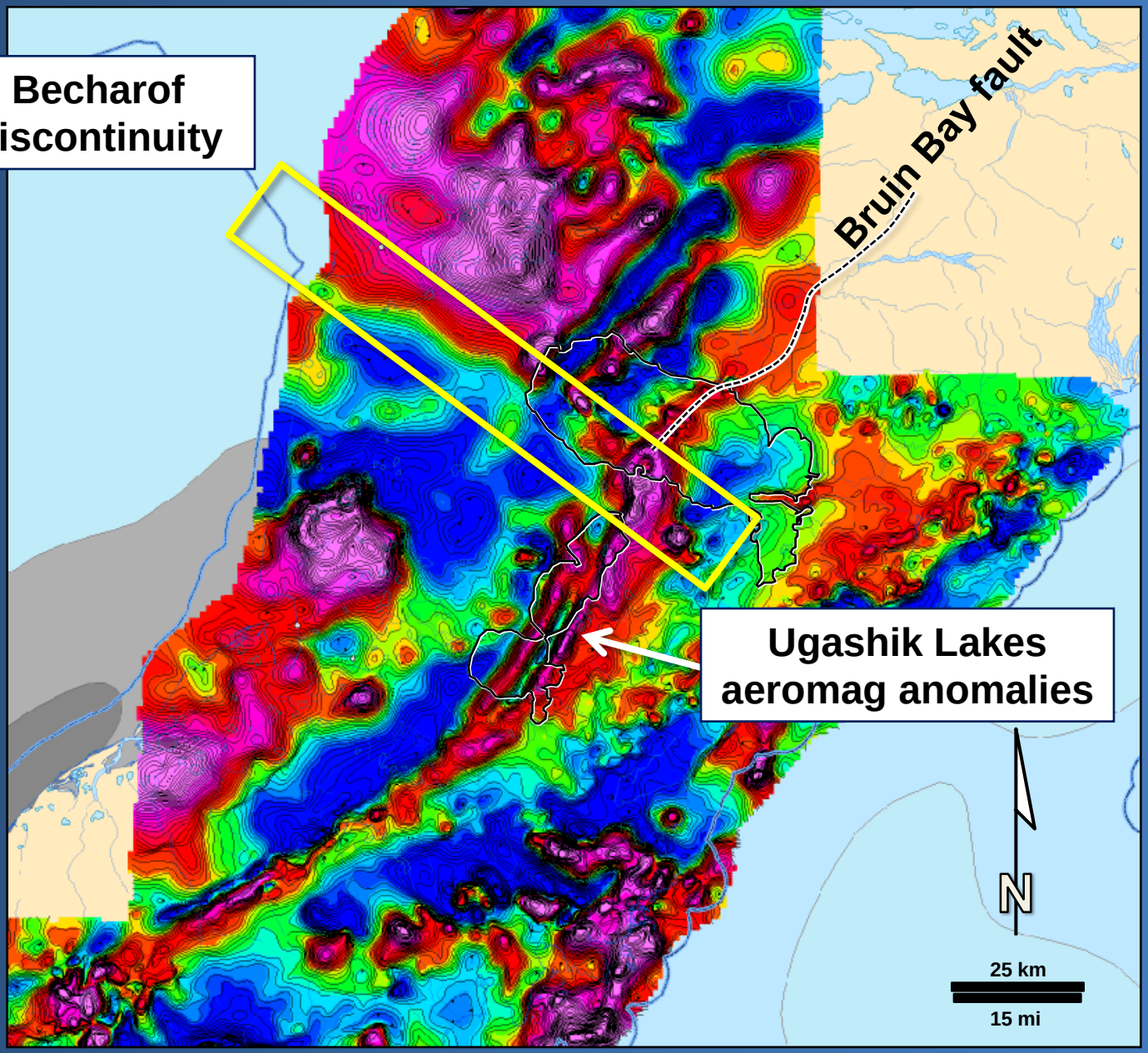
Major Ugashik sub-basin subsidence during Miocene (Bear Lake Fm)

Ugashik Sub-basin



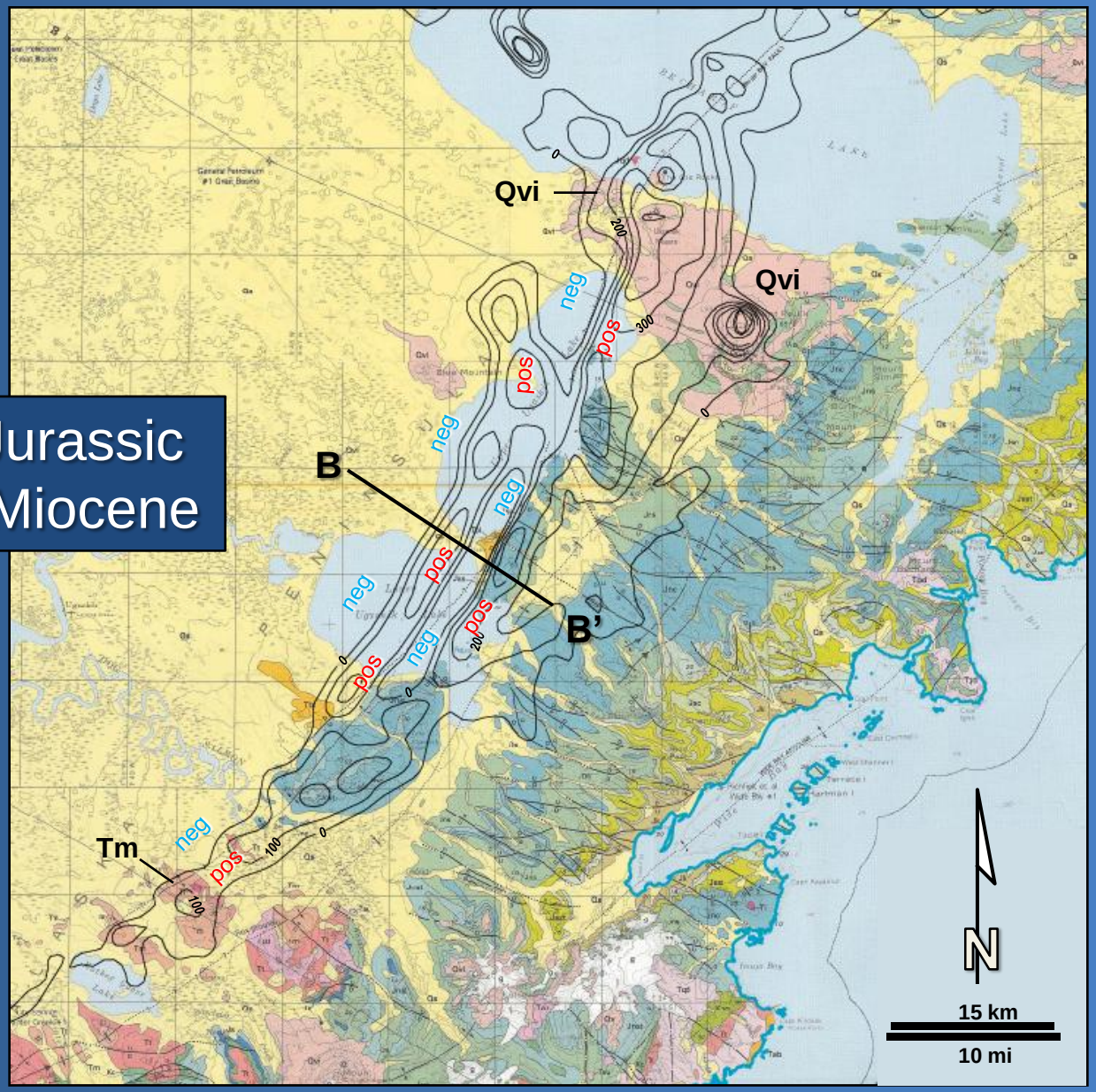
Seismic time structure
Base Bear Lake Fm

Ugashik – Becharof Region Aeromagnetics



Ugashik Lakes Magnetic Anomaly vs. Geology

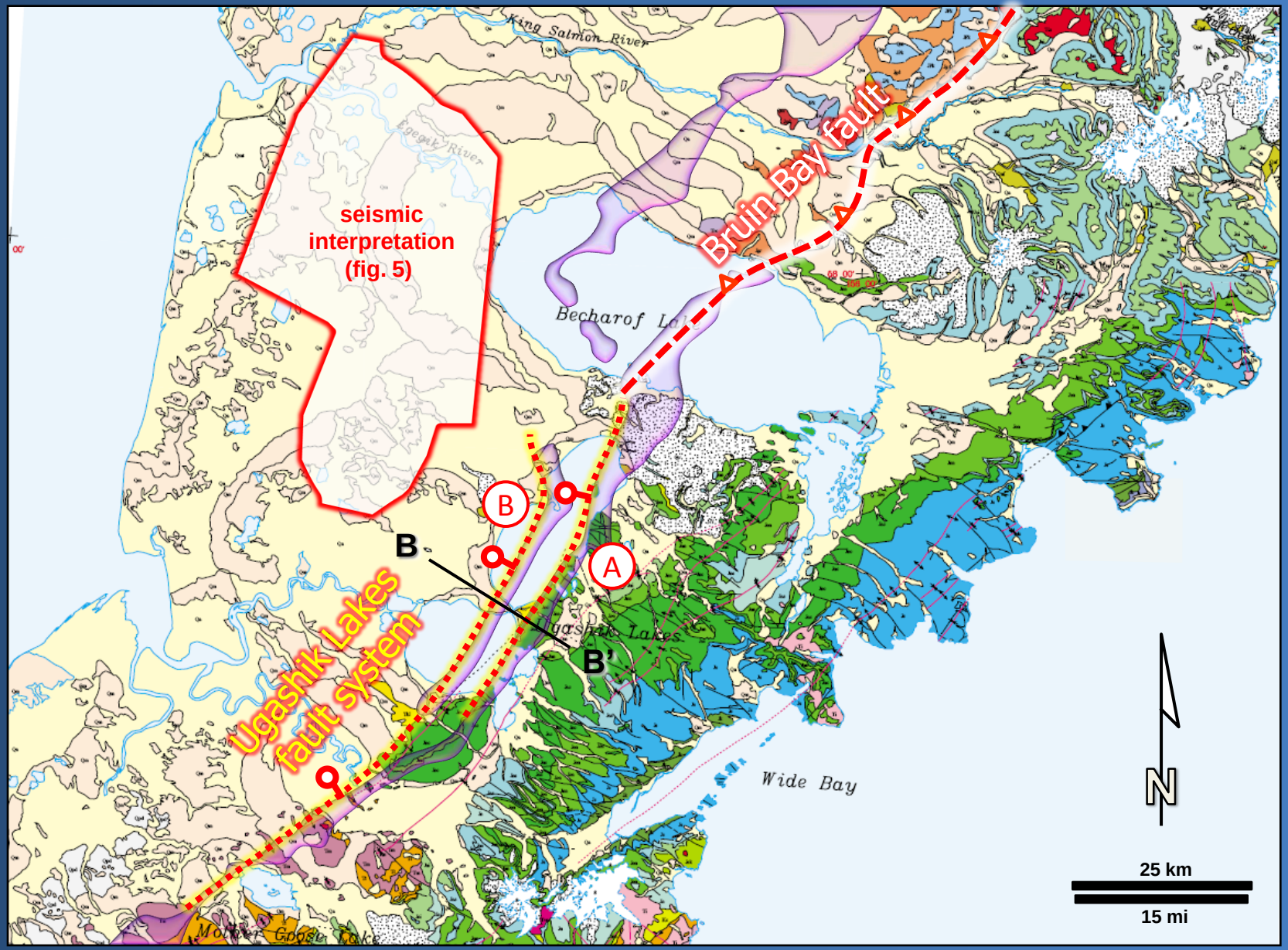
Positive anomaly → Jurassic
Negative anomaly→ Miocene



High Magnetic-susceptibility Jurassic Units

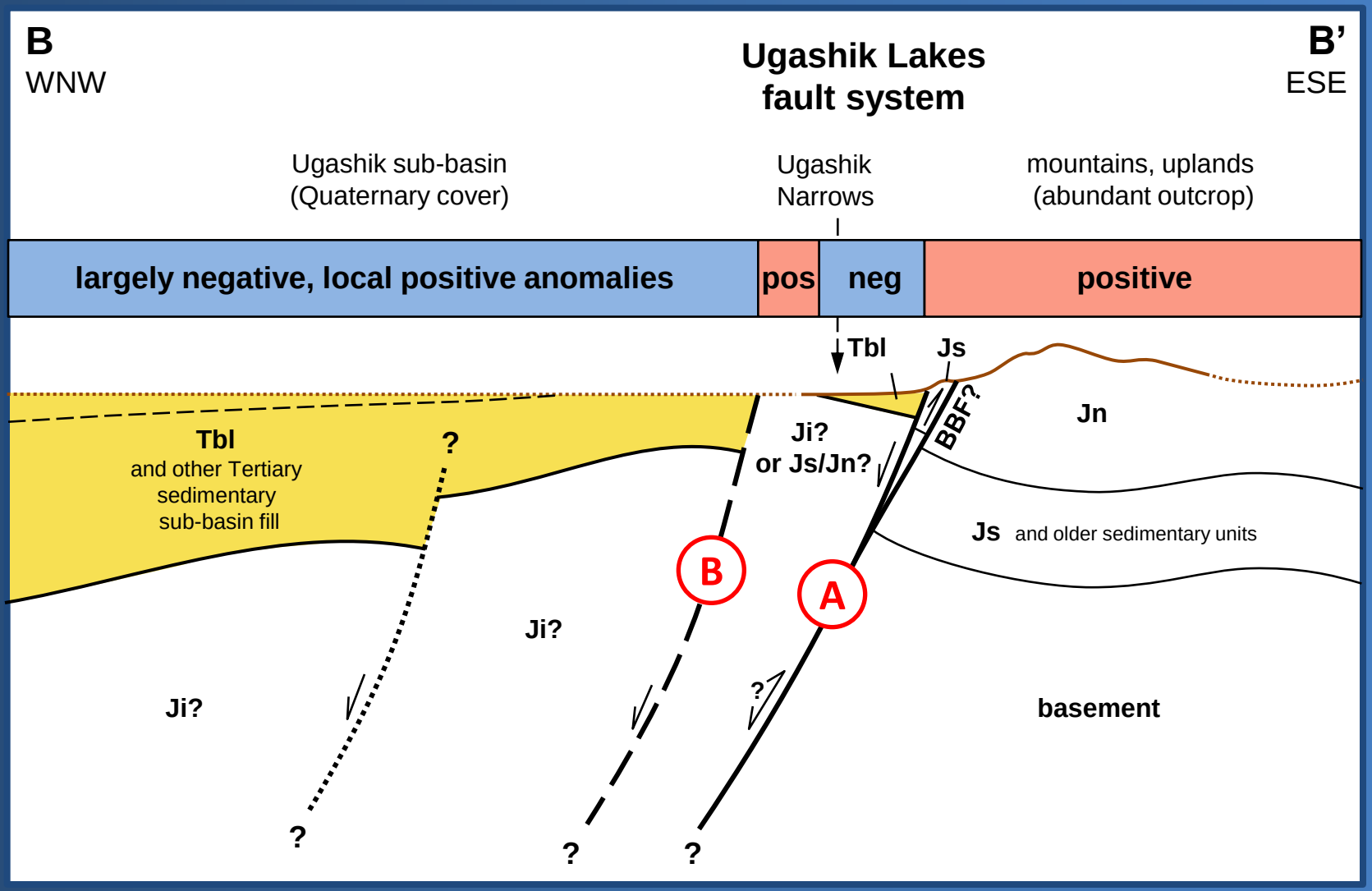
Naknek Fm conglomerates
rich in plutonic cobbles & boulders,
island in Upper Ugashik Lake

Shelikof Fm conglomerates
rich in basaltic pebbles, east shore
of Upper Ugashik Lake


King Salmon River
Egegik River
seismic interpretation (fig. 5)
Becharof Lake
Bruin Bay fault
B
B
A
Ugashik Lake
B'
Ugashik Lakes fault system
Wide Bay
Mother Goose Lake
N
25 km
15 mi

Ugashik Lakes Fault System

Conceptual Magnetic-Structural Model



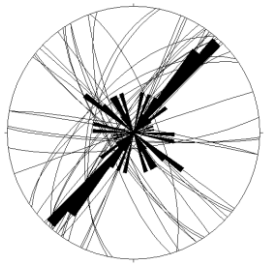
Fault-fracture fabrics

Ugashik Lakes Fault System

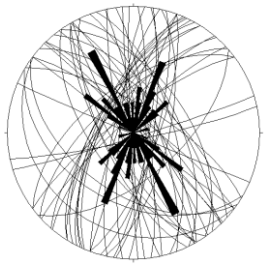
Notable subpopulations with NNE-SSW strike, steep NW dip

Interpreted as parallel to controlling faults of Ugashik Lakes Fault System

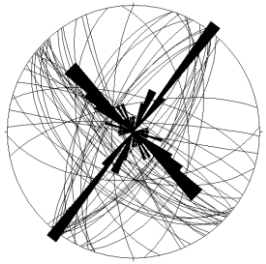
i.e., ULFS = NW-dipping faults with normal offset



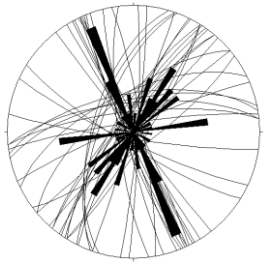
07PD151
Naknek Fm
n = 41



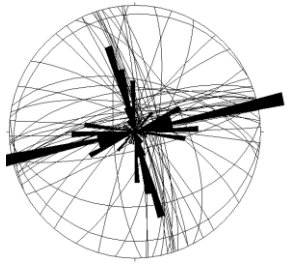
07PD154
Bear Lake Fm
n = 55



07PD168
Shelikof Fm
n = 56

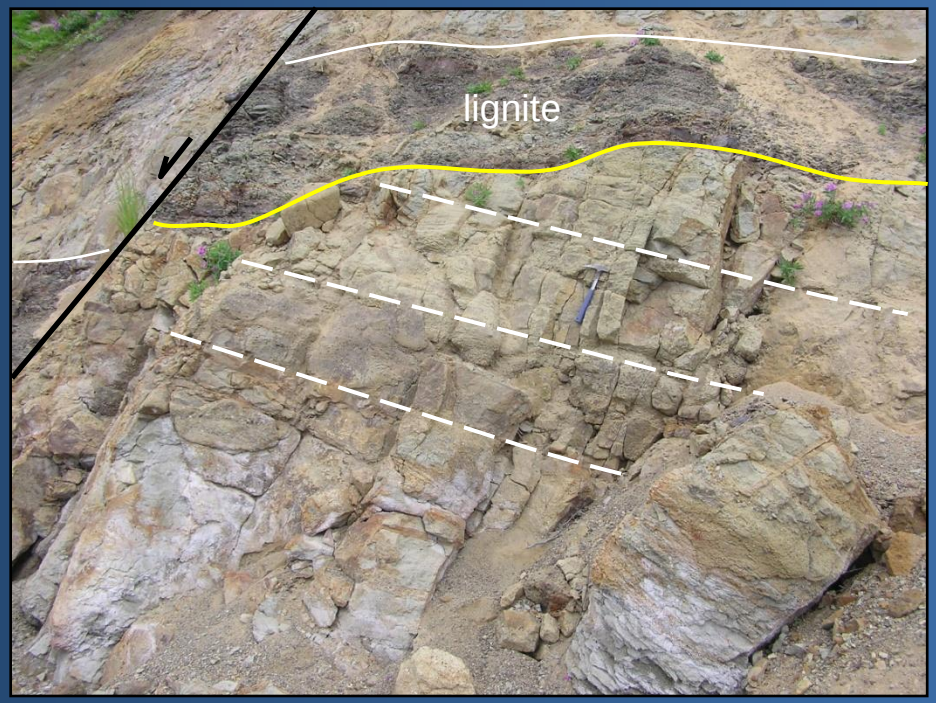


07PD161
Naknek Fm
n = 45

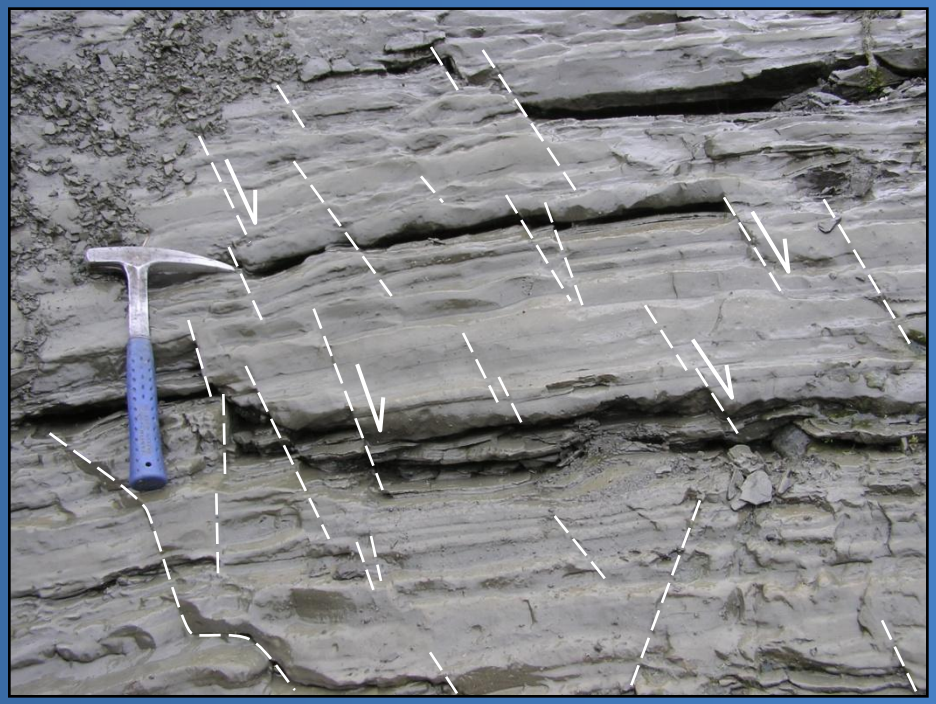


07PD173
Bear Lake Fm
n = 66

Extensional fabric in Bear Lake Formation



Syndepositional fault rotation and local intraformational truncation in Bear Lake Fm, east shore of Upper Ugashik Lake

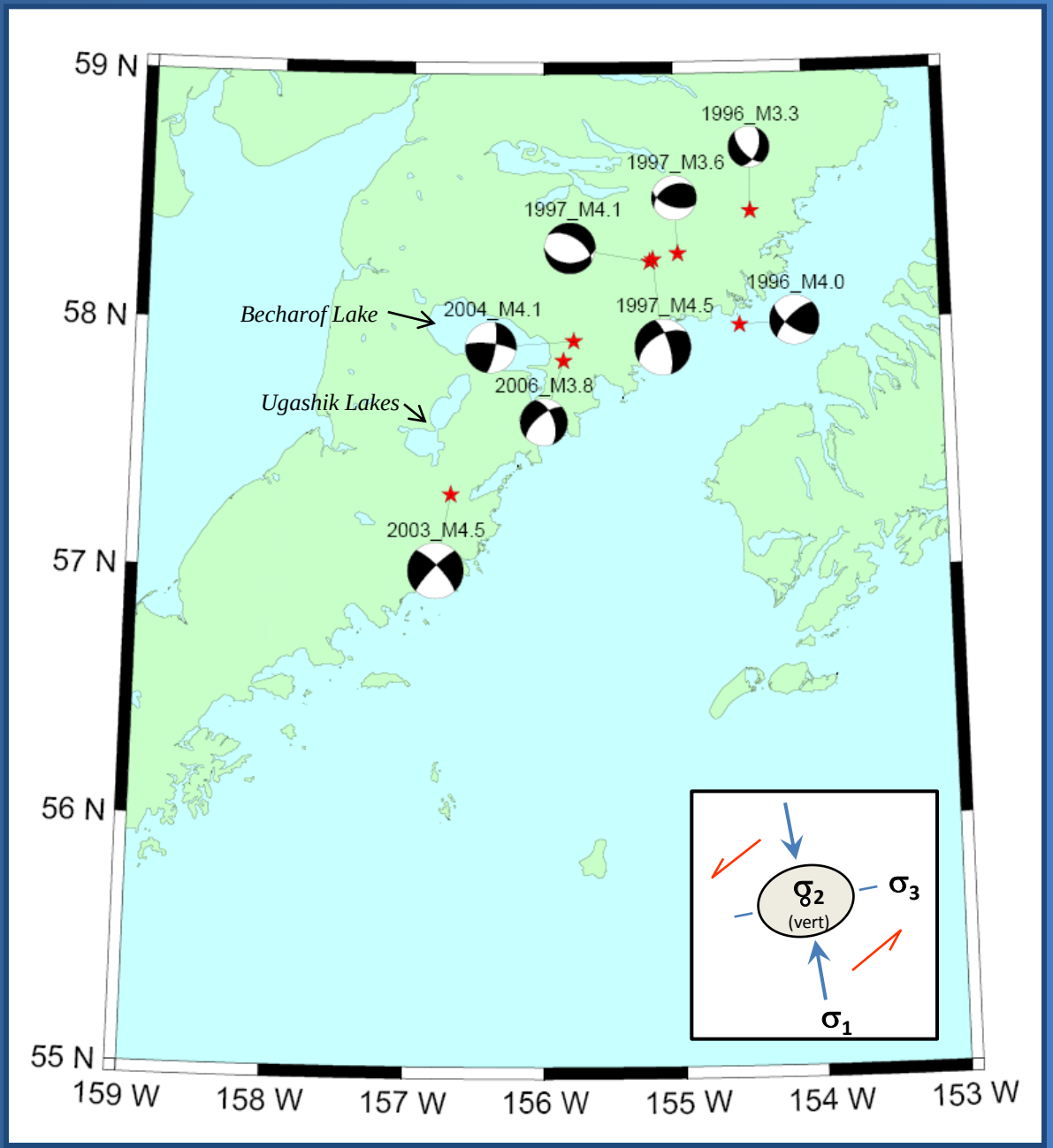


Penecontemporaneous microfaults and shear fractures in lacustrine(?) silts of Bear Lake Fm, S of Lower Ugashik Lake

Focal Mechanisms
1996-2006

Most events consistent with ~north-south maximum horizontal compressive stress

→ component of sinistral strike slip



Focal Mechanism map courtesy of Natalia Ruppert, Alaska Earthquake Information Center.

Kinematic Linkage of Tectonic Elements