An interpretation of surface displacements associated with the 2008 Iwate-Miyagi Nairiku Earthquake detected by ALOS/PALSAR

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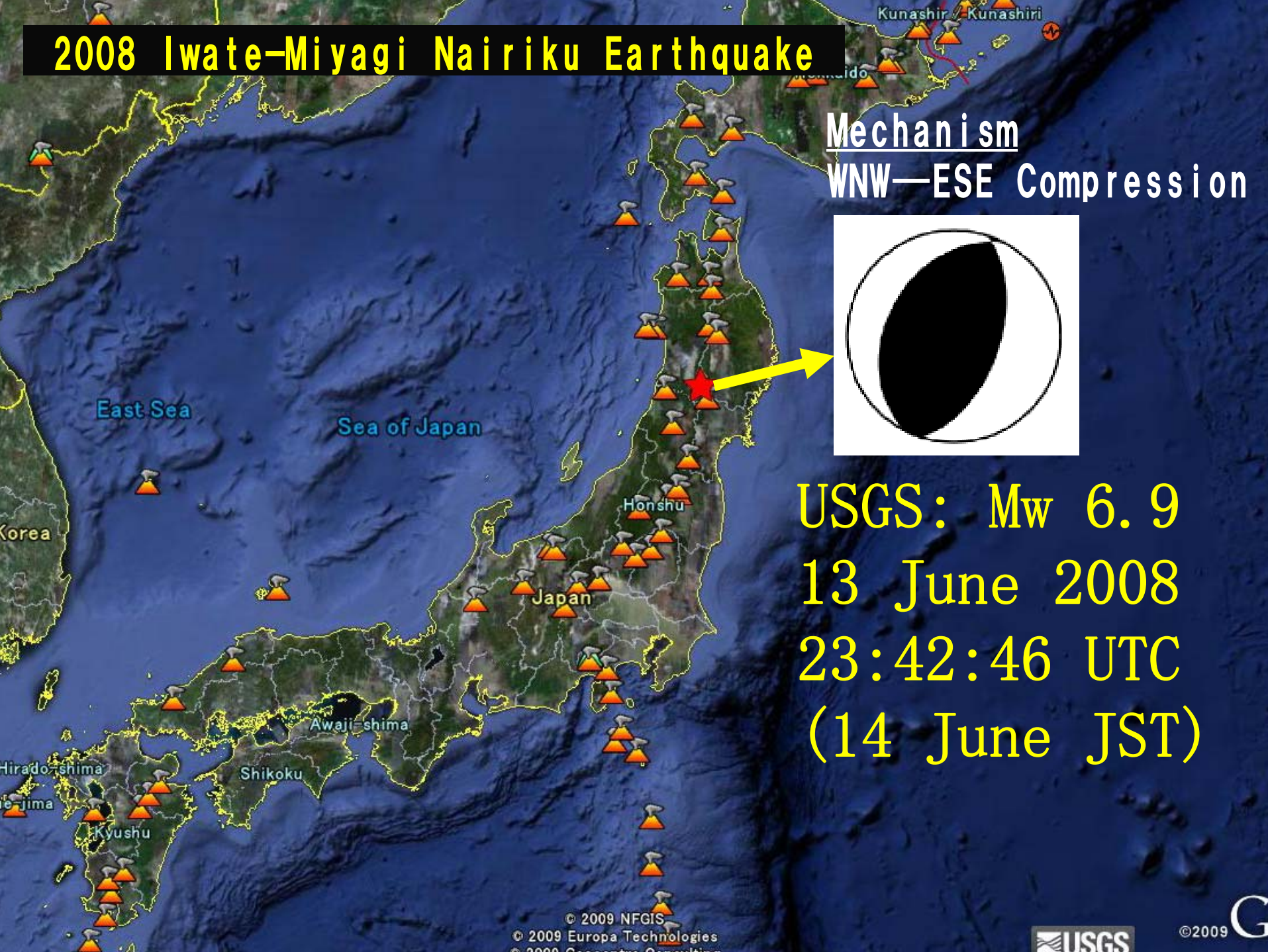
2008 Iwate-Miyagi Nairiku Earthquake



Mechanism

WNW—ESE Compression

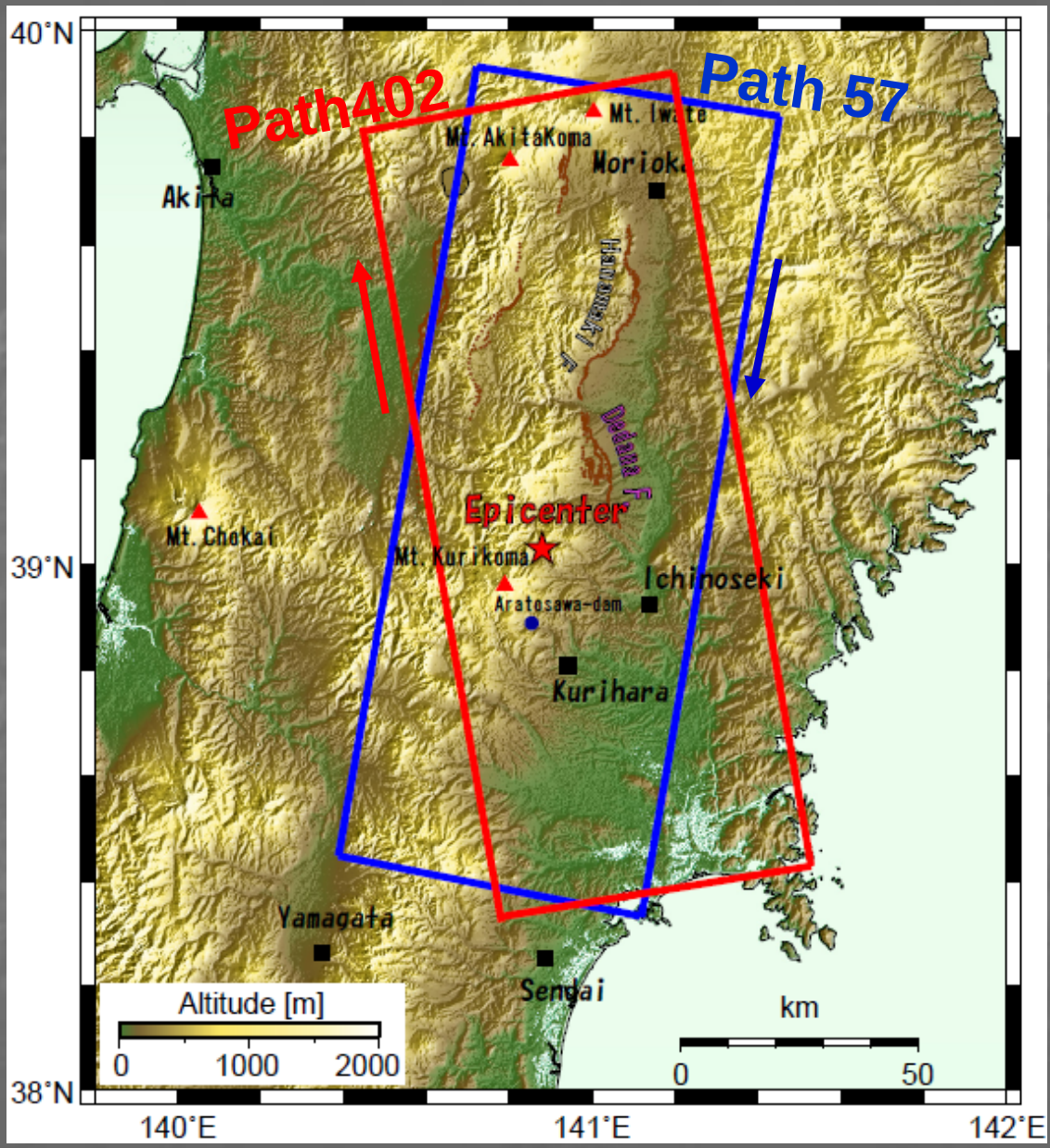
USGS: Mw 6.9

13 June 2008

23:42:46 UTC

(14 June JST)

ALOS/PALSAR Data Acquisition

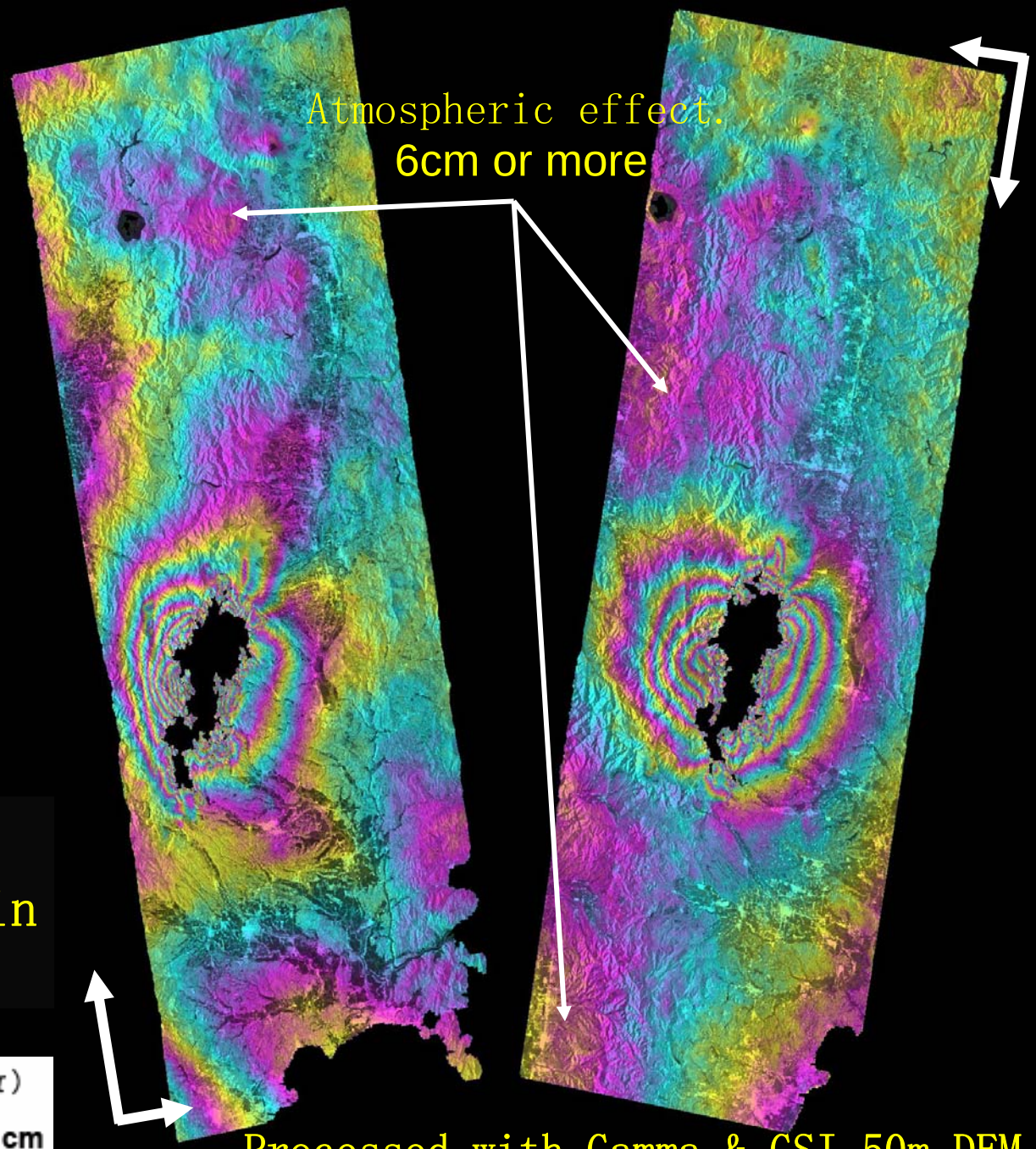


InSAR

Left : Ascending
Path402 (760-780)
2007/06/21 (FBD)
2008/06/23 (FBS)
Bperp=-330m

Right : Descending
Path57 (2820-2840)
2007/08/29 (FBS)
2008/06/23 (FBS)
Bperp=-774m

Clear fringes.
Coherence loss in epicentral area.



For the 2008 Iwate-Miyagi Nairiku EQ.,

Is single fault model good approximation?

No.

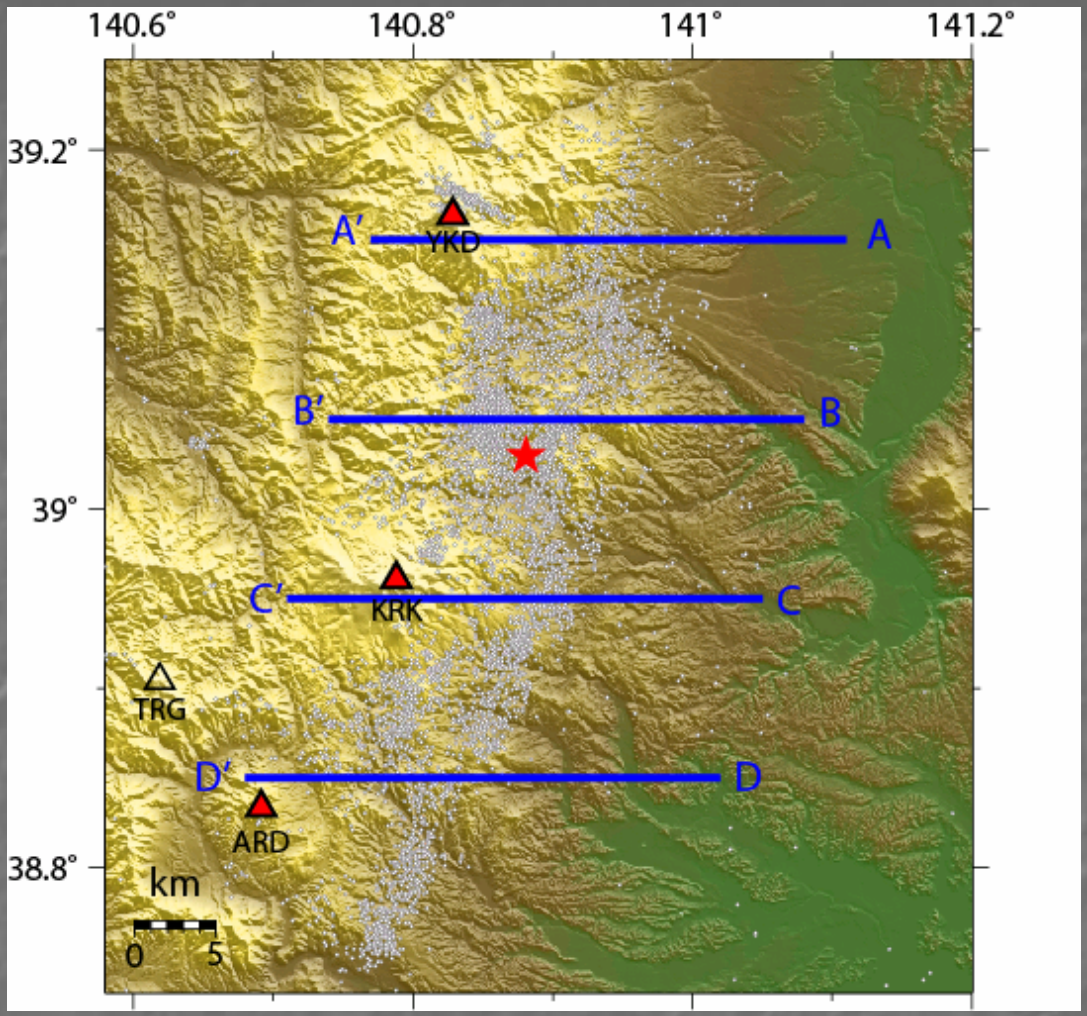
Is there any known active fault?

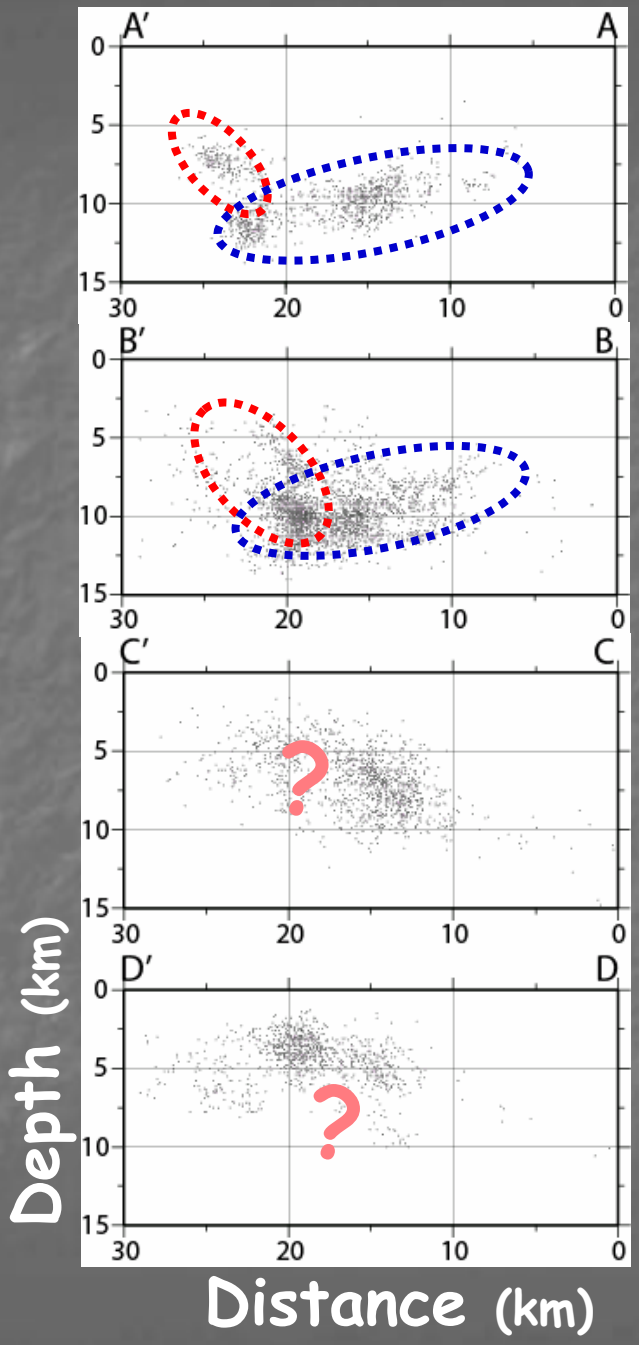
Only around the northern edge.

Is forward modeling wrong?

No, absolutely not.

Seismicity (JMA)





Complex Geometry with
Conjugate Faulting

Fault modeling

Forward modeling by Okada (1992)

→ Modifying fault parameters (Trial & Error, & Grid Search)
rectangular shape、uniform slip

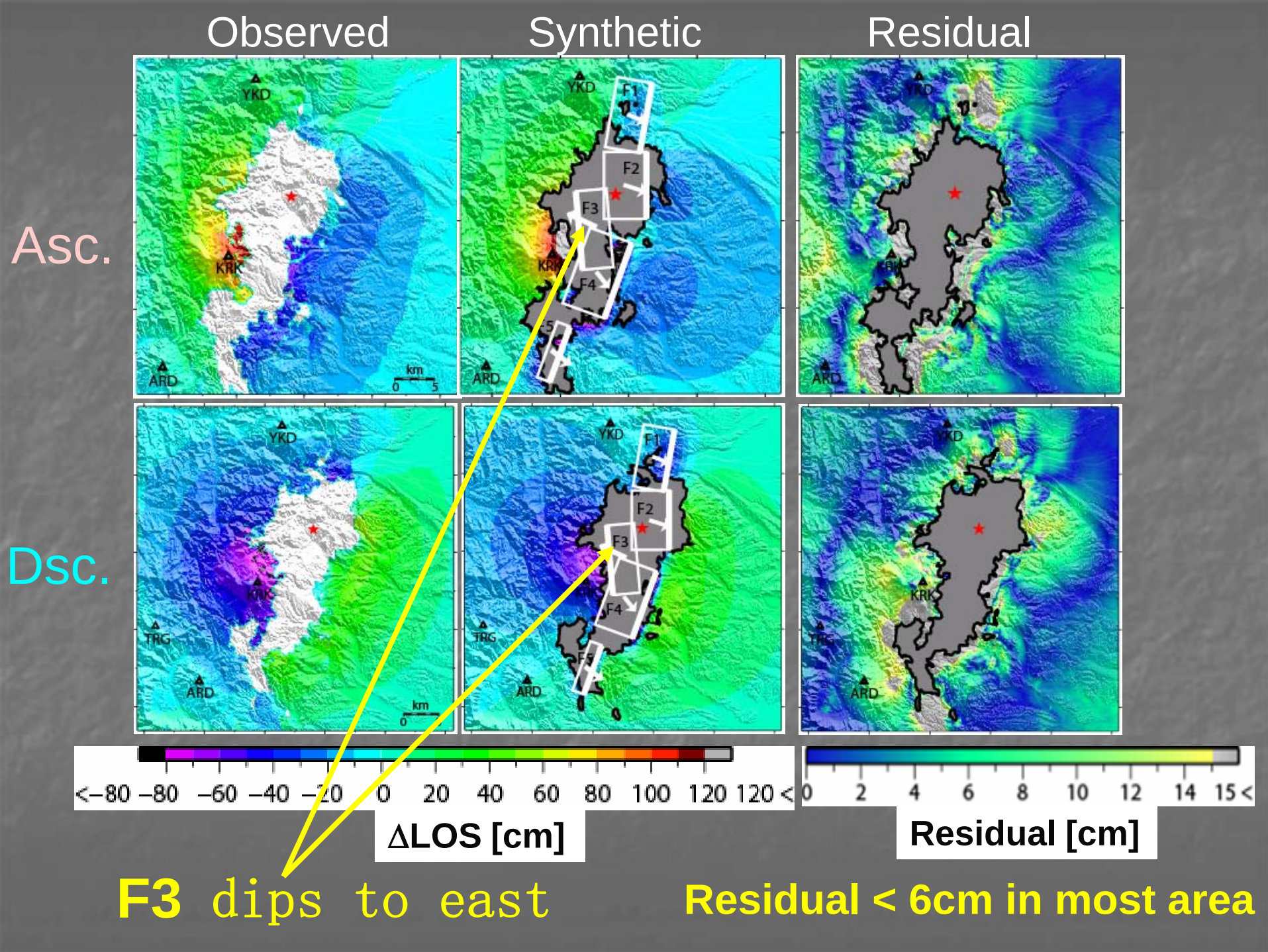
Preferred Model

	Latitude,	Longitude,	Length,	Width,	Depth,	Dip,	Strike,	Slip angle,	Slip(m),	Mw
F1:	140.90	39.12	9.0	5.0	4.0	27.0	190	80	1.5	6.1
F2:	140.895	39.04	8.5	6.8	2.3	37.5	180	76	3.0	6.4
F3:	140.85	38.99	10.0	6.5	2.6	53.0	355	71	2.1	6.3
F4:	140.854	38.94	10.2	6.5	2.2	30.0	200	62	6.4	6.7
F5:	140.79	38.85	7.5	3.0	2.3	55.0	200	80	2.0	6.0

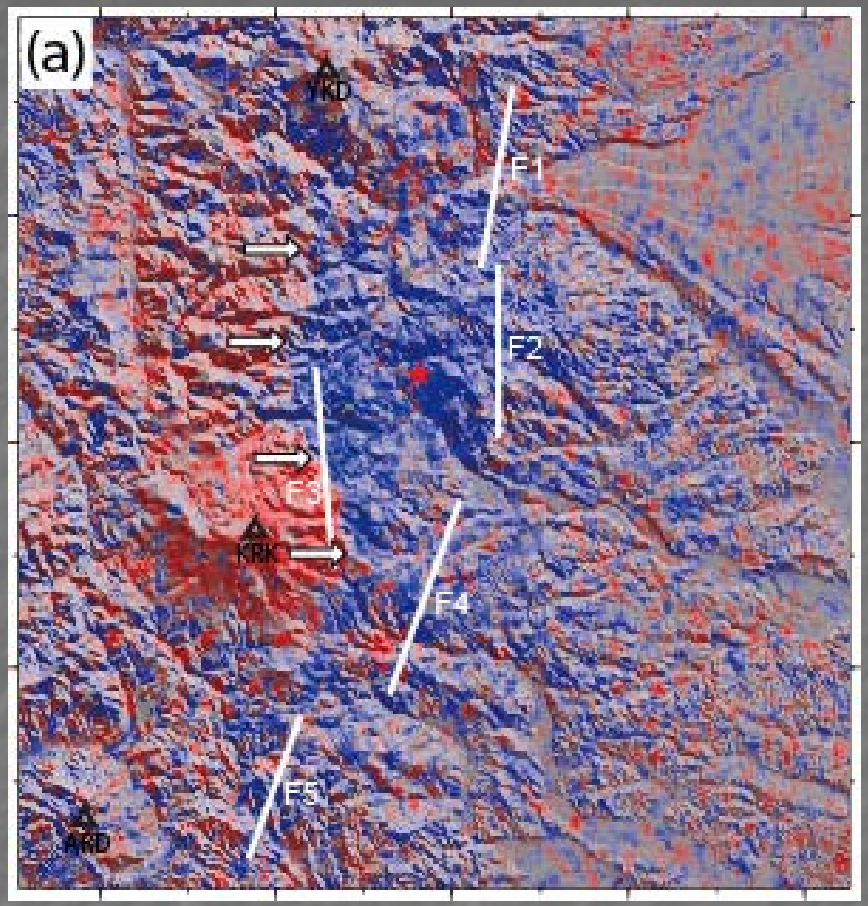
Conjugate Faulting

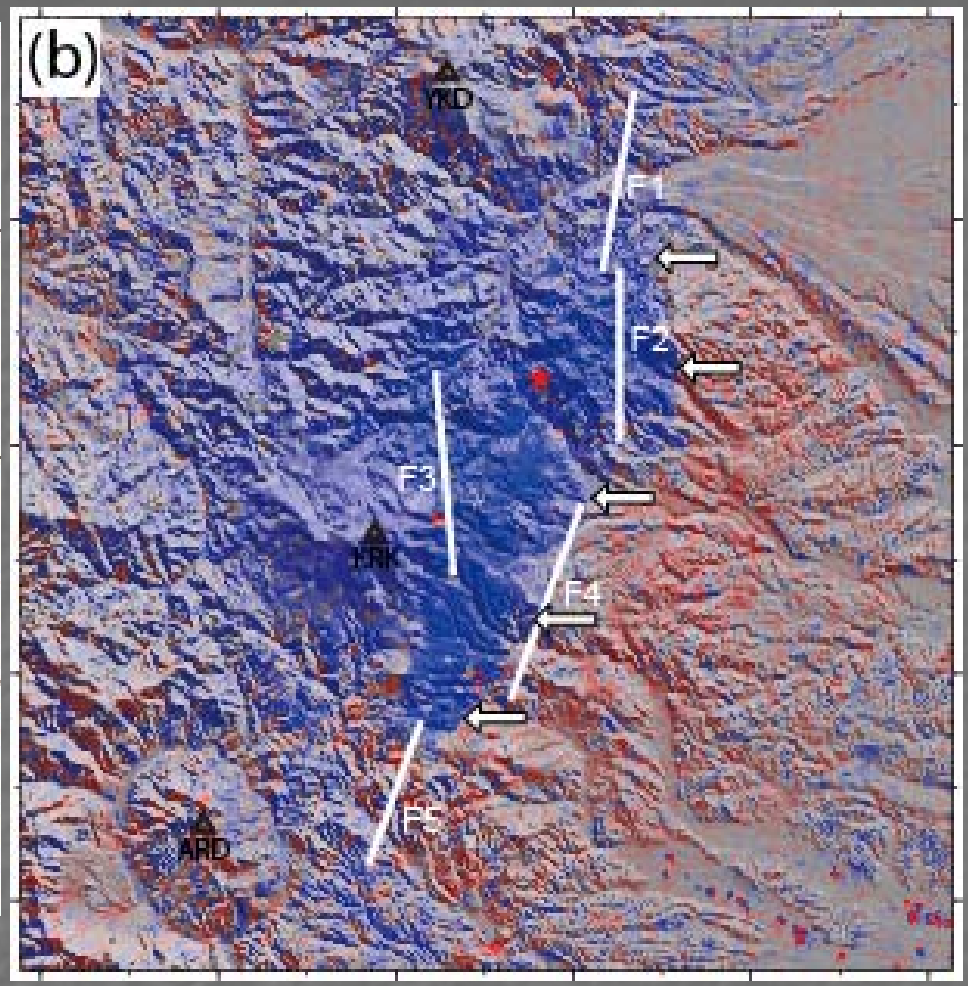
ESE dip: F3

WNW dip: F1, F2, F4, F5

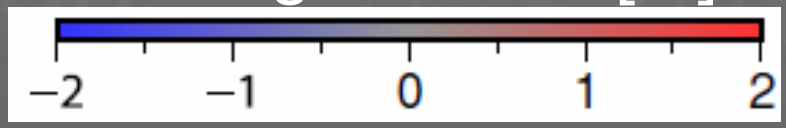

Observed
Synthetic
Residual
Asc.
Dsc.
YKD
KRK
ARD
TRG
F1
F2
F3
F4
km
0
5
<–80 –80 –60 –40 –20 0 20 40 60 80 100 120 120 <
ΔLOS [cm]
0 2 4 6 8 10 12 14 15 <
Residual [cm]
F3 dips to east
Residual < 6cm in most area

Consistency with Range Offsets

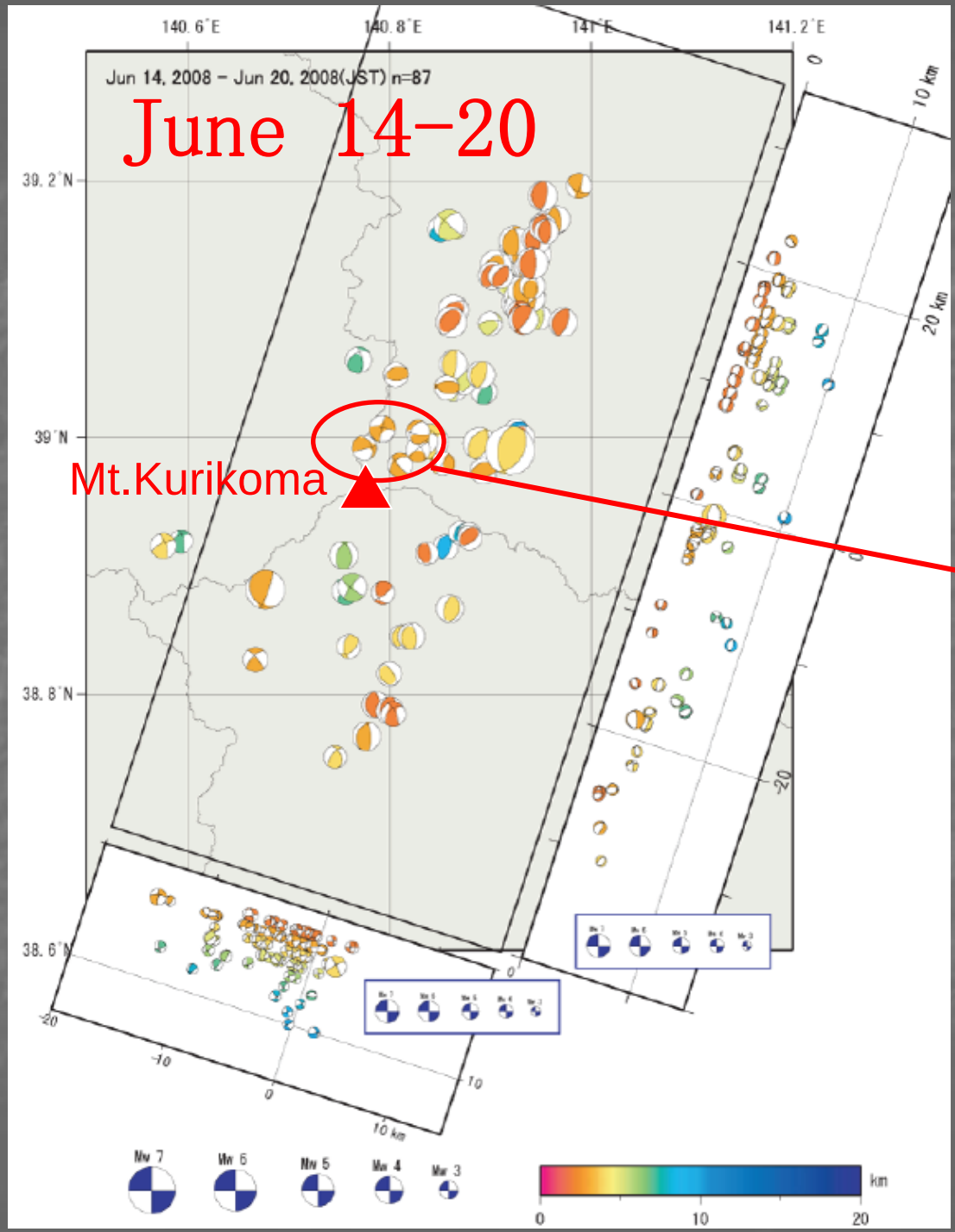




Range offsets [m]



Takada et al. 2009



NIED F-net Moment solutions

(Velocity given by JMA)

http://www.hinet.bosai.go.jp/topics/iwate-miyagi080614/

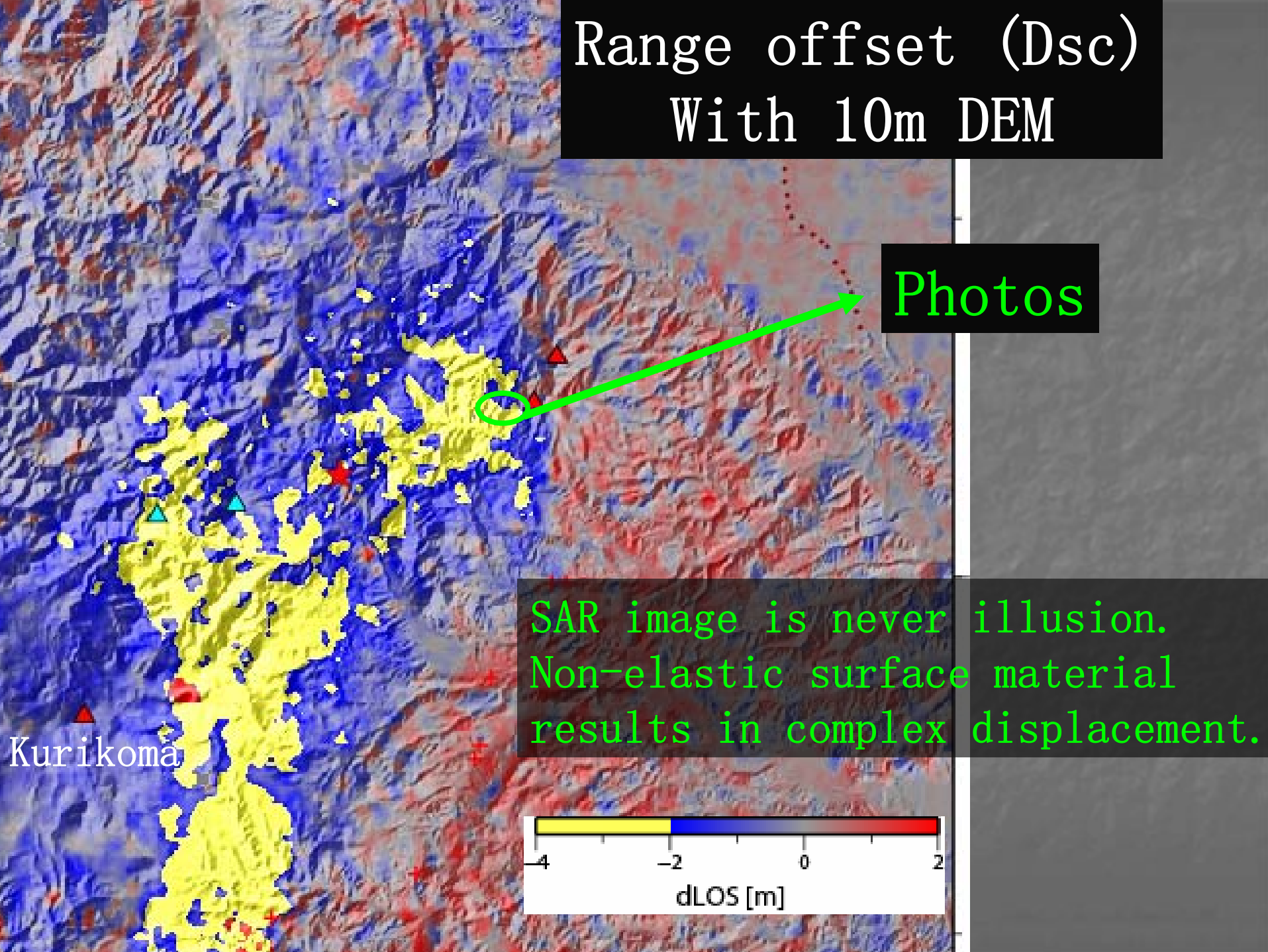
Strike Slip is dominant!!

↓

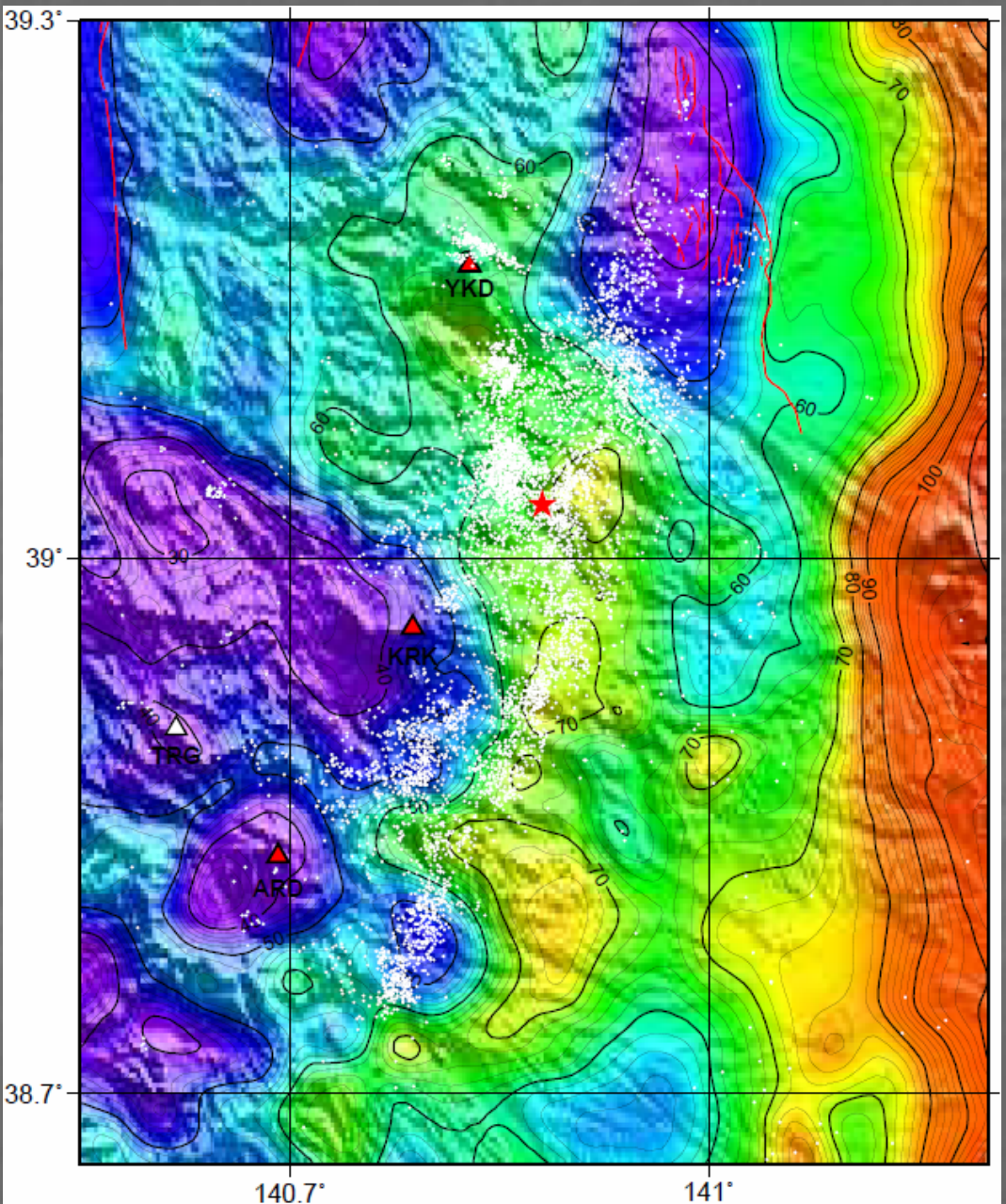
East dipping fault is not very long.


Newly found this year.
Valley side
Hill side
Never landslide!


Left lateral motion
Bamboo grass is draged


Range offset (Dsc)
With 10m DEM
Photos
SAR image is never illusion.
Non-elastic surface material
results in complex displacement.
Kurikoma
−4
−2
0
2
dLOS [m]

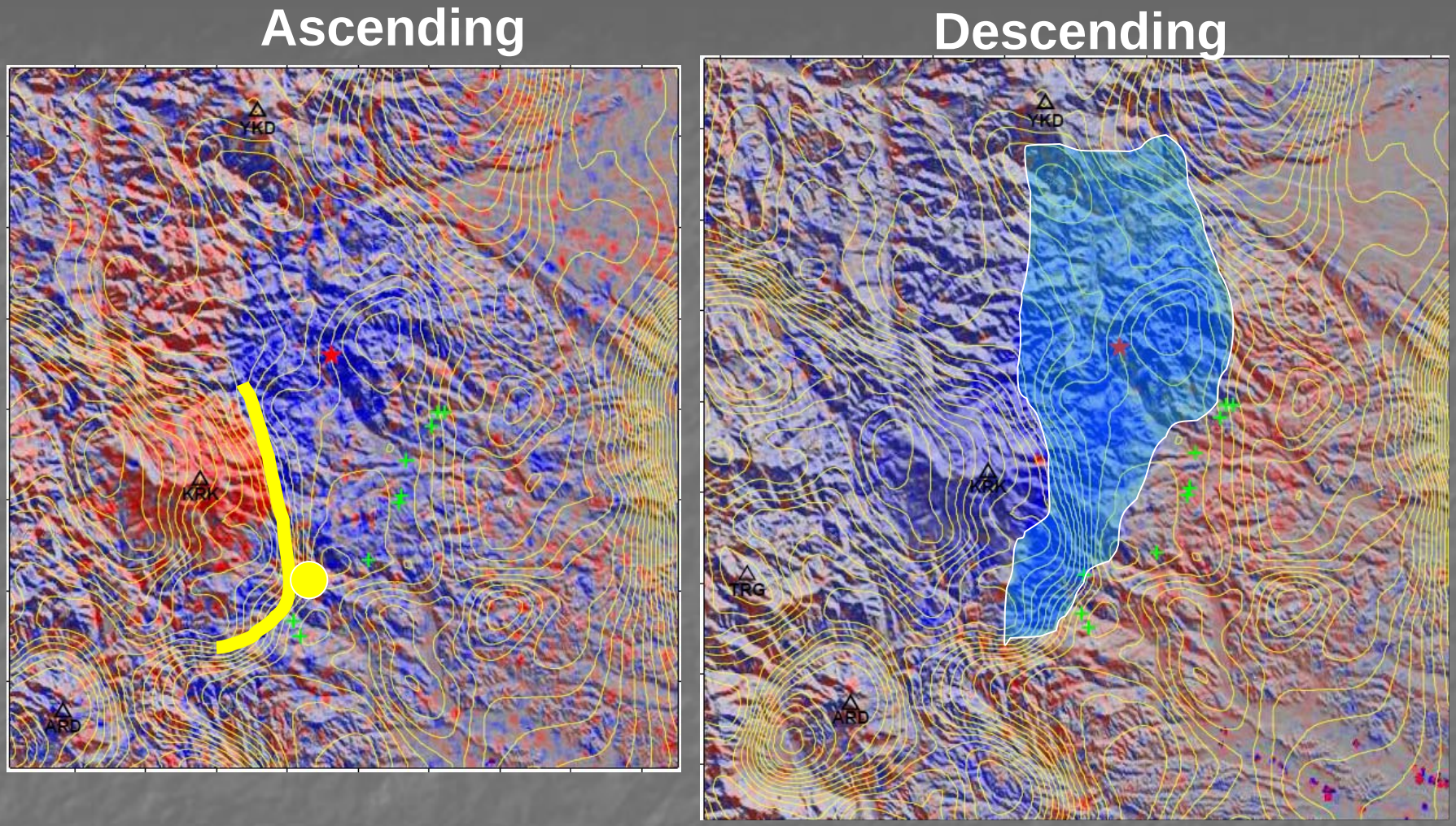
Bouguer Gravity Anomaly



★Very complex crustal structure due to calderas!!

Komazawa et al.(2004)
2.67g/cm^3 grid data
Imaizumi and Nakata (2002)
Active fault data

Pixel Offset and Bouguer Anomaly



Uplifted area matches Bouguer high.

Large gradient in Bouguer anomaly

→ displacement discontinuity

Map of buried calderas in the NE Japan

After Yoshida (2001)

Many calderas in the NE Japan would cause very complex crustal deformation.

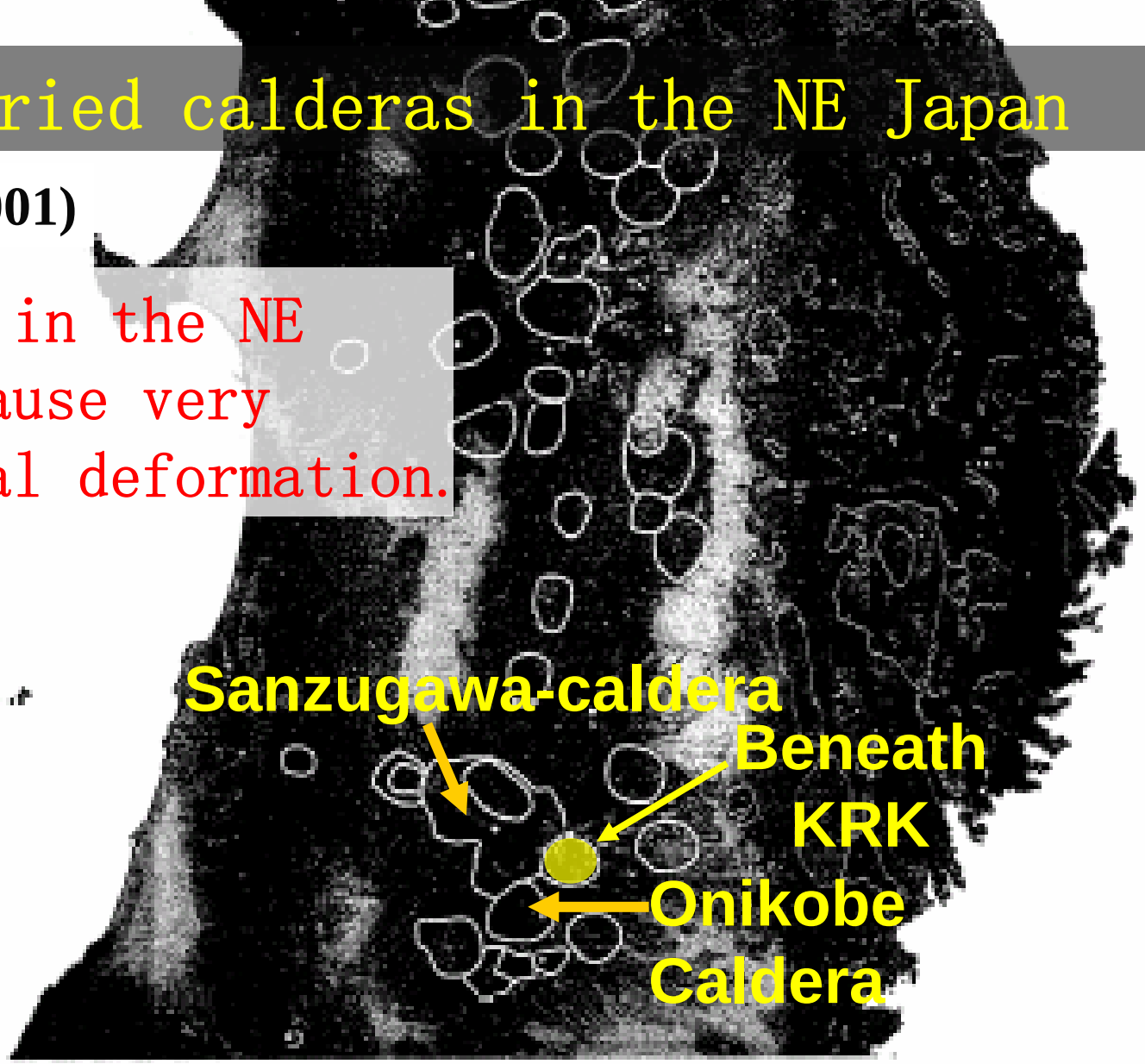


Fig. 8. Topographic and morphological features of late Cenozoic calderas an
Cretaceous Kitakami granitic plutons. (Adapted from Yoshida *et al*., 1999c an
Yokoyama *et al*., 1999, 2000.)

Summary

- At least five faults are required to account for the 2008 Iwate-Miyagi Nairiku Earthquake. Precisely determined hypocenter data are consistent with our fault model, but further improvements are possible.

- Uplifted area fits Bouguer high, and notable displacement discontinuity occurred along large gradients in the anomaly. Complexities in the SAR data results from buried calderas.

- Pixel offset analysis was confirmed by the field survey. Very complex displacements in the epicentral area is due to non-elastic responses of weak surface materials.

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END