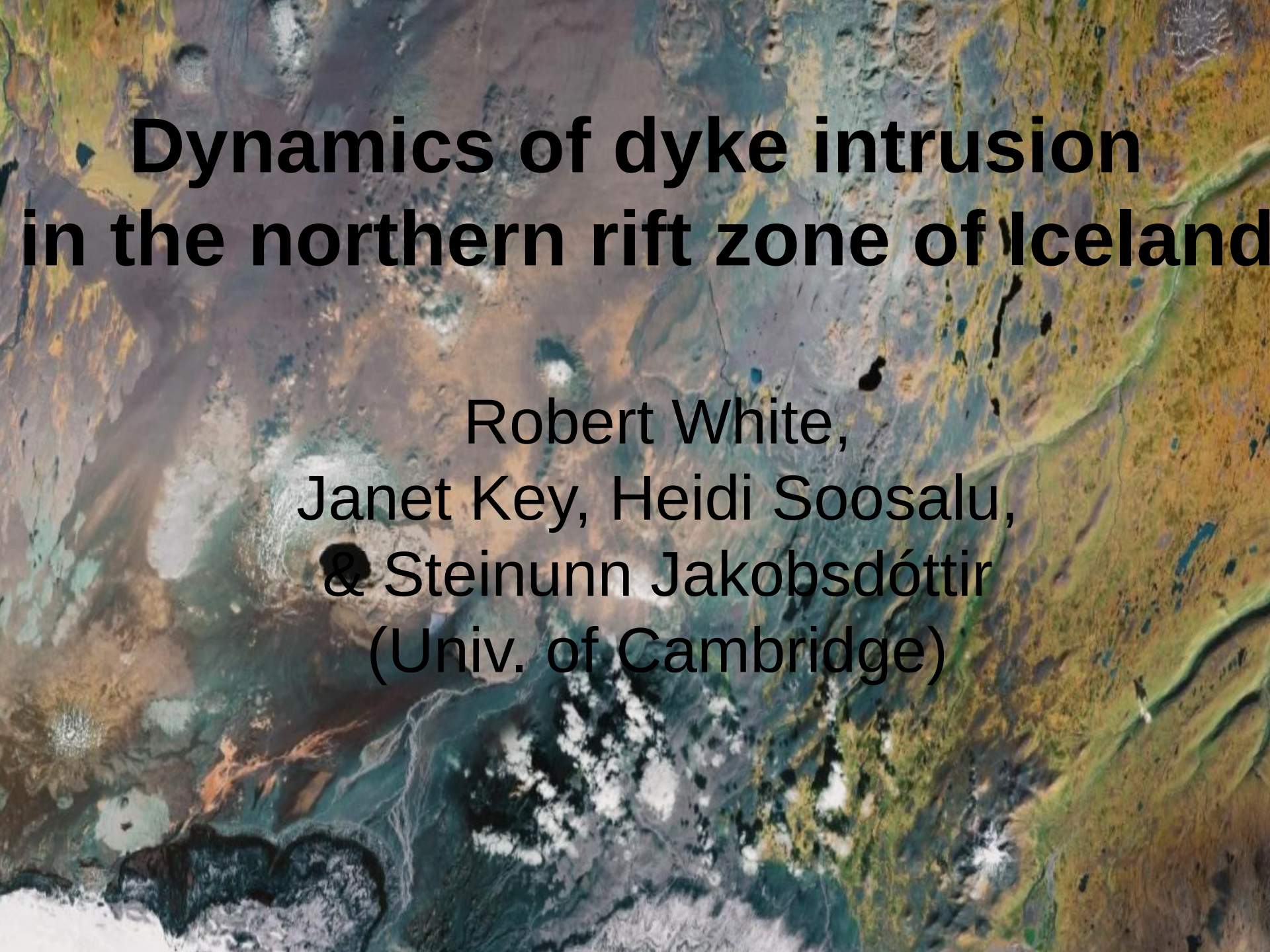


Dynamics of dyke intrusion in the northern rift zone of Iceland

Robert White,
Janet Key, Heidi Soosalu,
& Steinunn Jakobsdóttir
(Univ. of Cambridge)

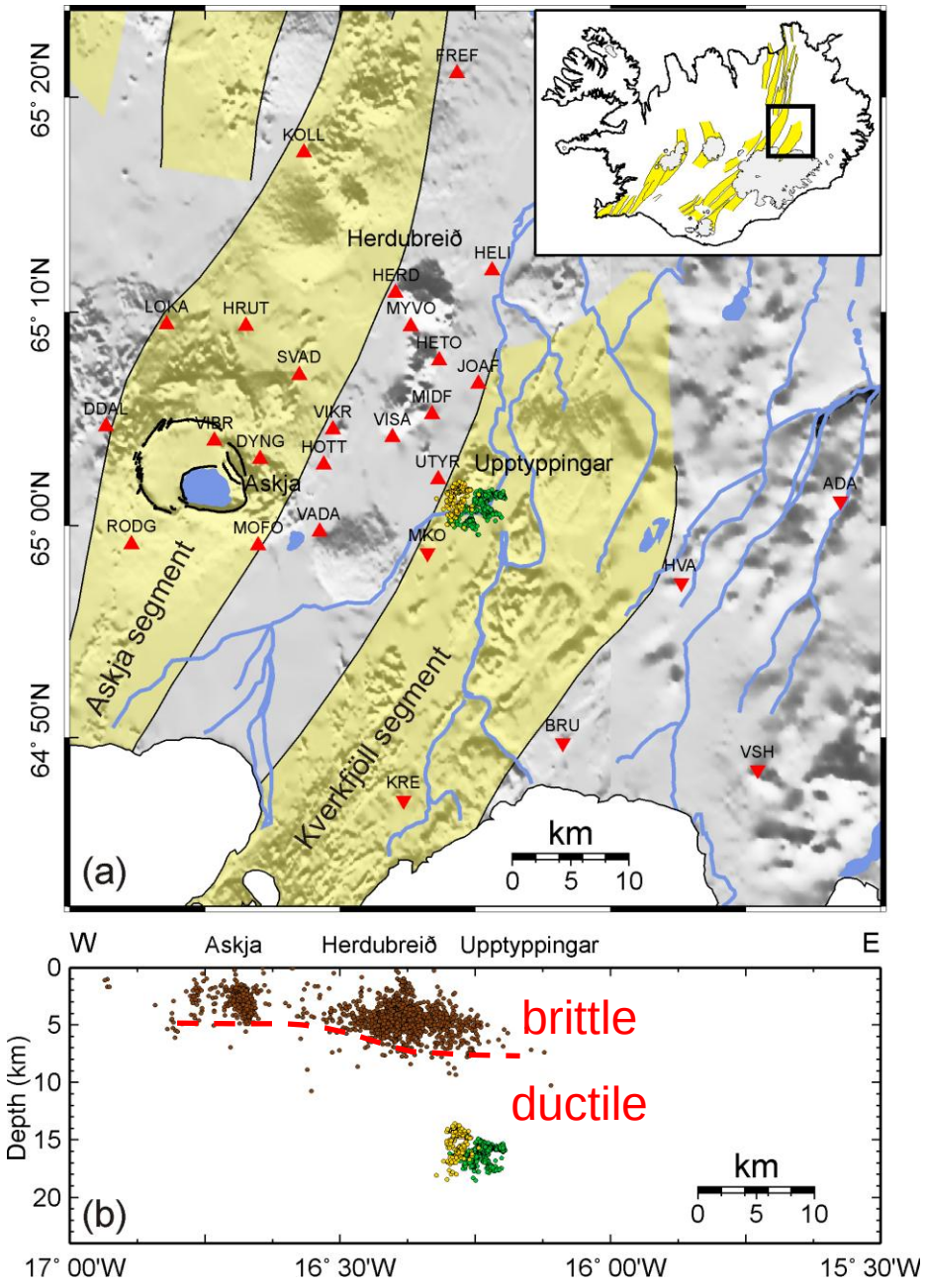
Further details of the data in this presentation are in

White, R. S., Drew, J., Martens, H. K., Key, A. J., Soosalu, H. & Jakobsdóttir, S. S. (2011). Dynamics of dyke intrusion in the mid-crust of Iceland, *Earth and Planetary Science Letters*, **304**, 300–312, doi: 10.1016/j.epsl.2011.02.038

with

Online animations available at: doi:10.1016/j.epsl.2011.02.038.

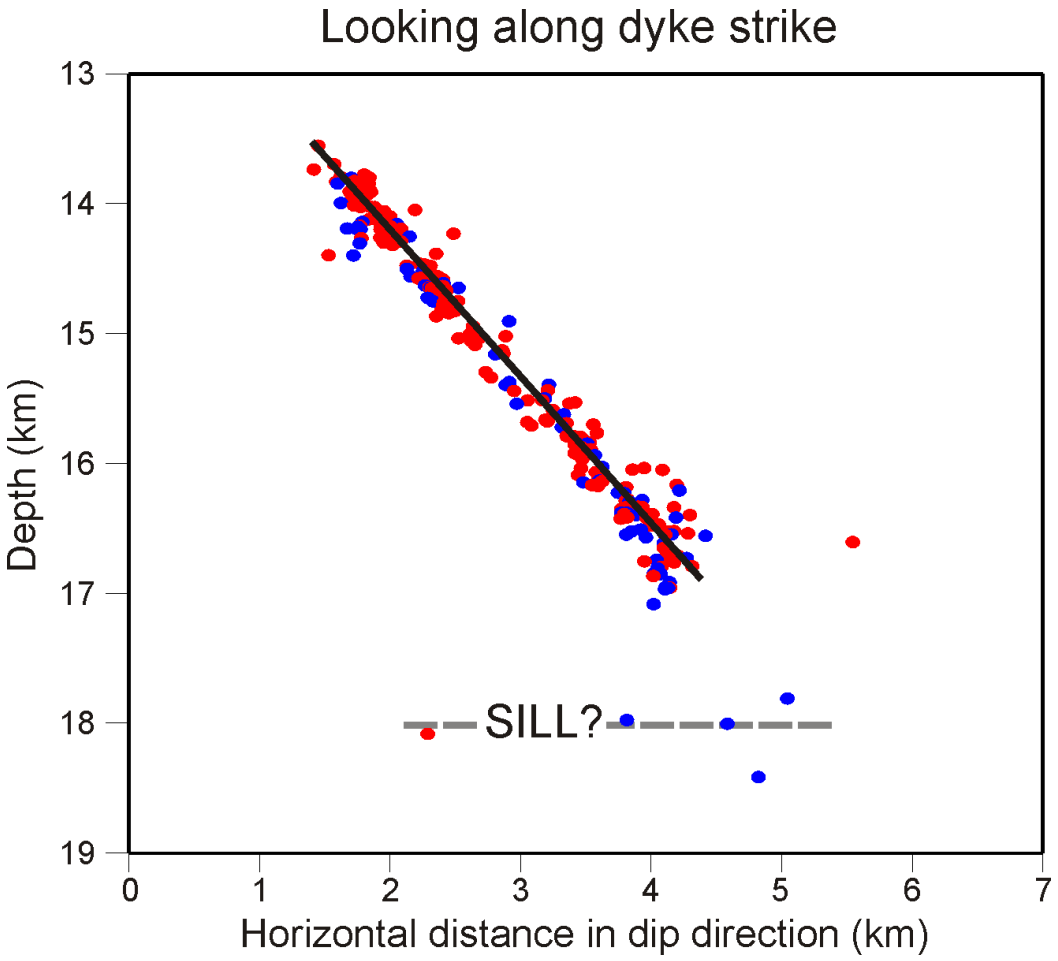
Martens, Hilary R., White, Robert S., Key, Janet, Drew, Julian, Soosalu, Heidi & Jakobsdóttir, Steinunn (2010). Dense seismic network provides new insight into the 2007 Upptyppingar dyke intrusion, *Jokull*, **60**, 47–66.

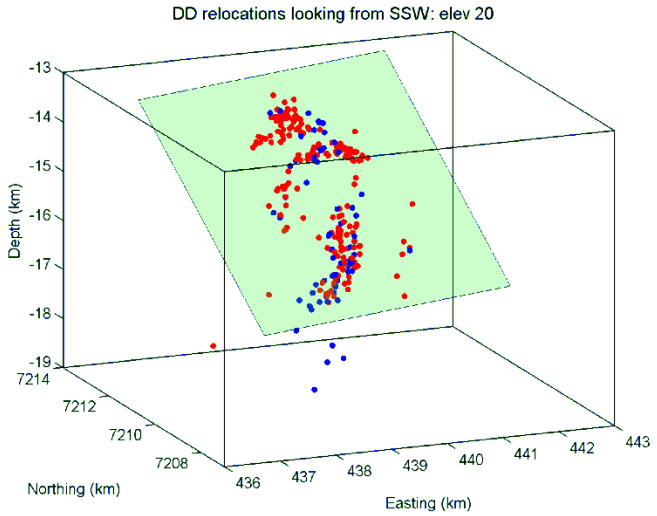

65° 20'N
65° 10'N
65° 00'N
64° 50'N
FREF
KOLL
Herdubreið
HELI
HERD
LOKA
HRUT
MYVO
HETO
SVAD
JOAF
MIDF
DDAL
VIBR
VIKR
VISA
DYNG
HOTT
UTYR
Upptyppingar
Askja
ADA
RODG
MOFO
VADA
MKO
HVA
Askja segment
Kverkfjöll segment
BRU
VSH
KRE
km
0 5 10
(a)
W
Askja
Herdubreið
Upptyppingar
E
Depth (km)
0
5
10
15
20
brittle
ductile
km
0 5 10
(b)
17° 00'W
16° 30'W
16° 00'W
15° 30'W

Upptyppingar earthquakes
(July-Aug 2007)

red – reverse faults

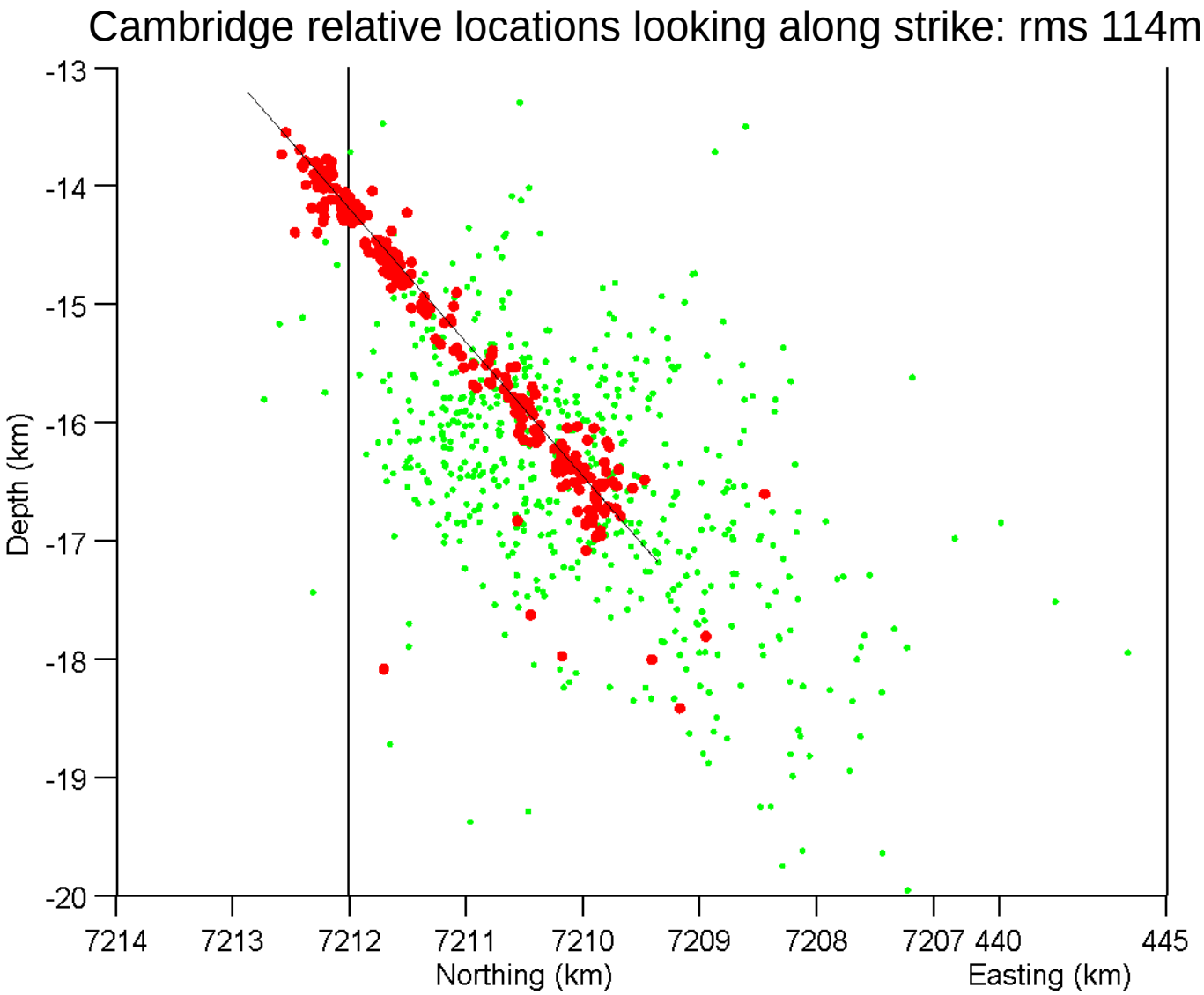
blue – normal faults

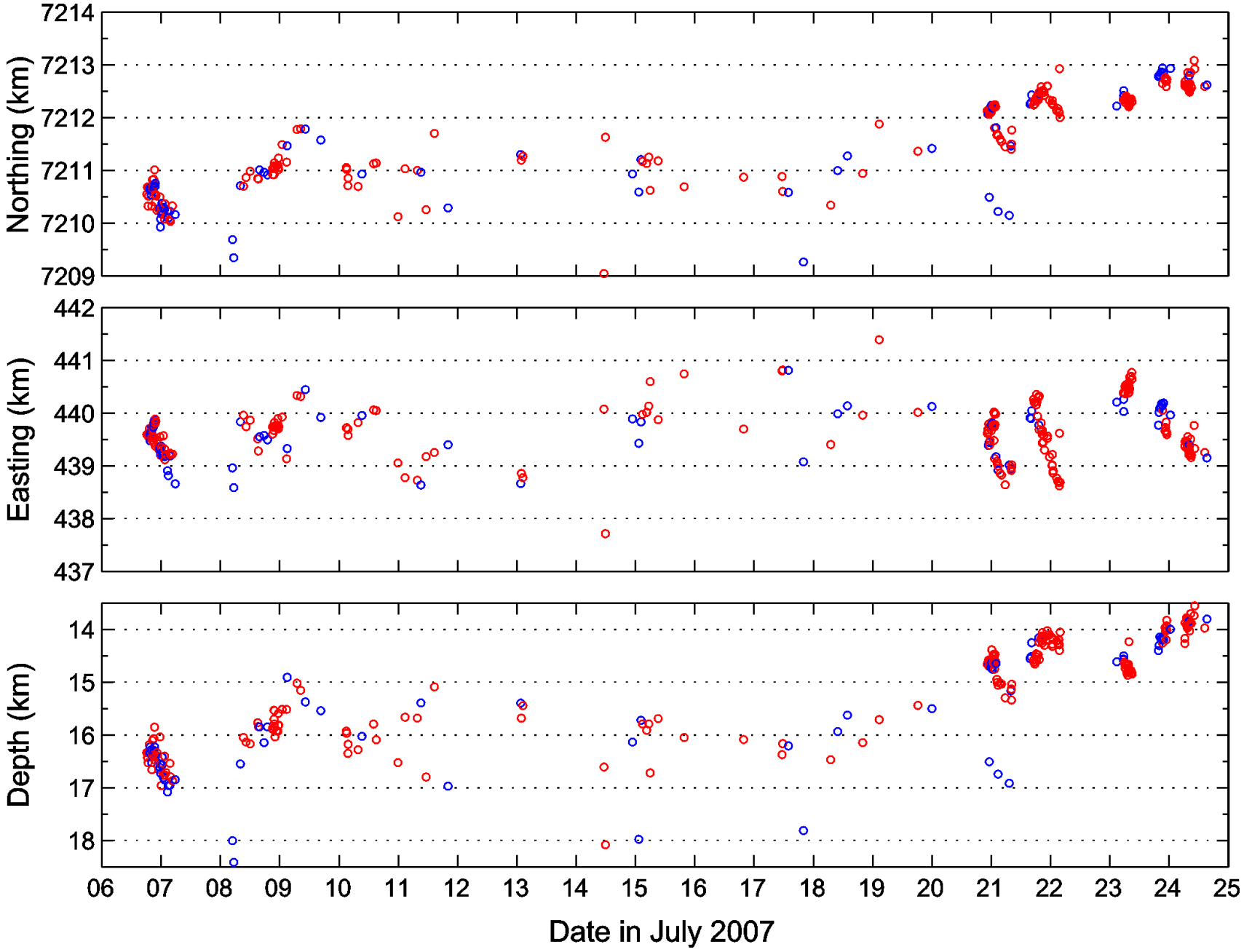




rms fit to plane:114m


Location, Location …


Cambridge relative locations looking along strike: rms 114m
-13
-14
-15
-16
-17
-18
-19
-20
Depth (km)
7214
7213
7212
7211
7210
7209
7208
7207
Northing (km)
440
445
Easting (km)


Northing (km)
7214
7213
7212
7211
7210
7209
Easting (km)
442
441
440
439
438
437
Depth (km)
14
15
16
17
18
06
07
08
09
10
11
12
13
14
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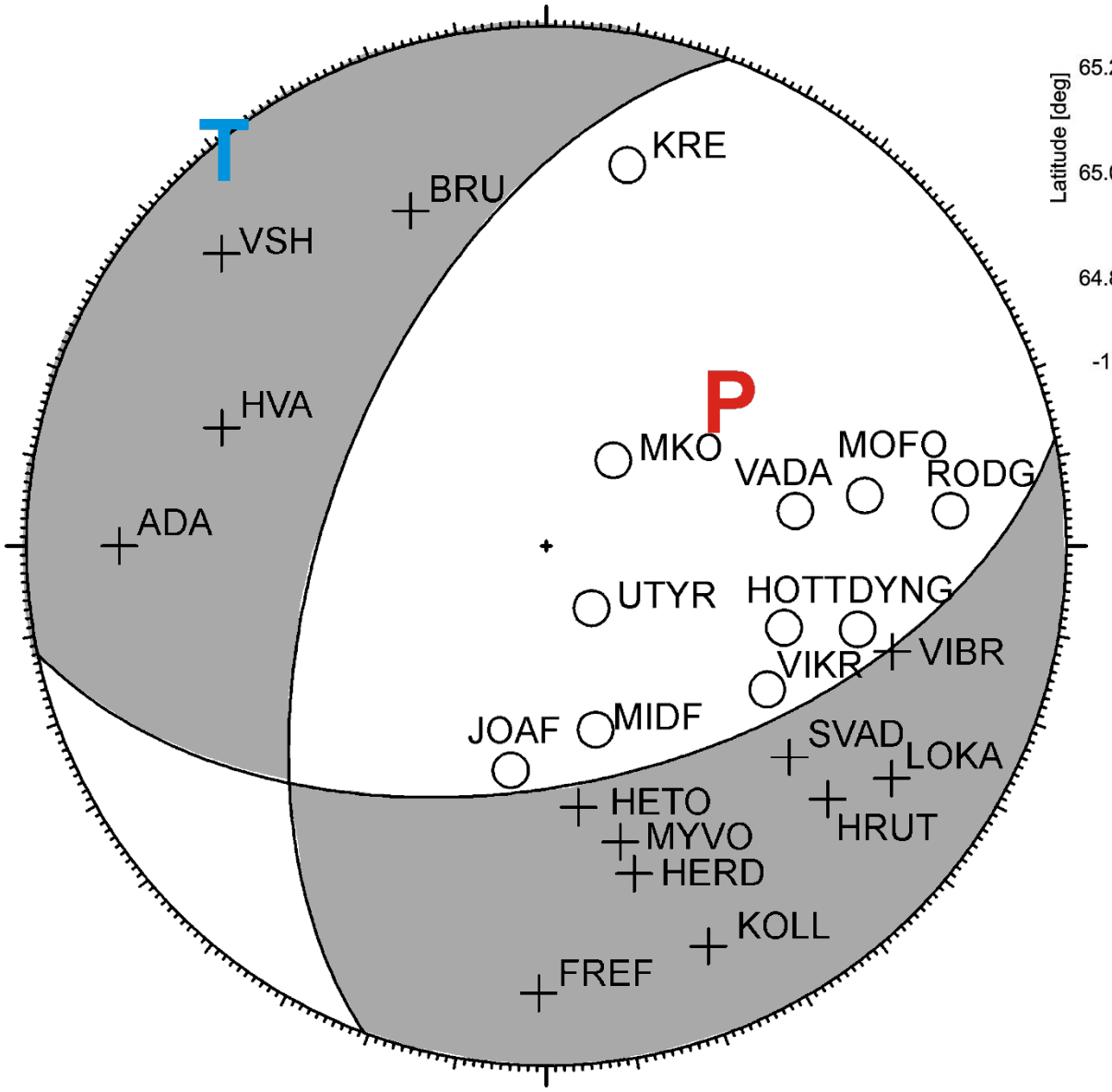
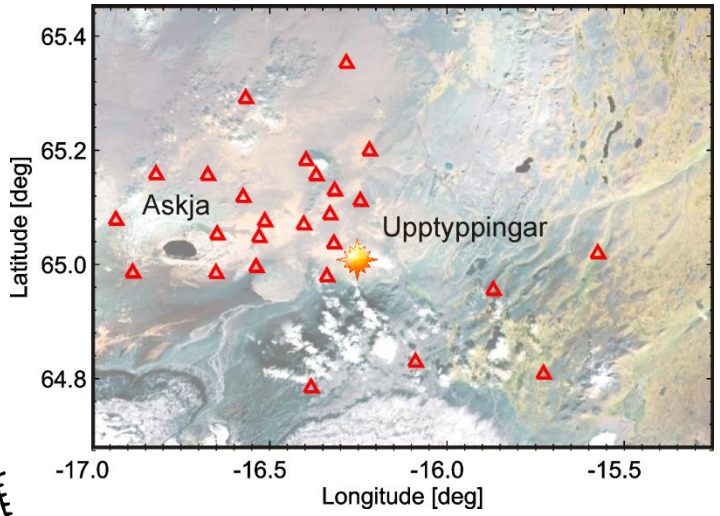
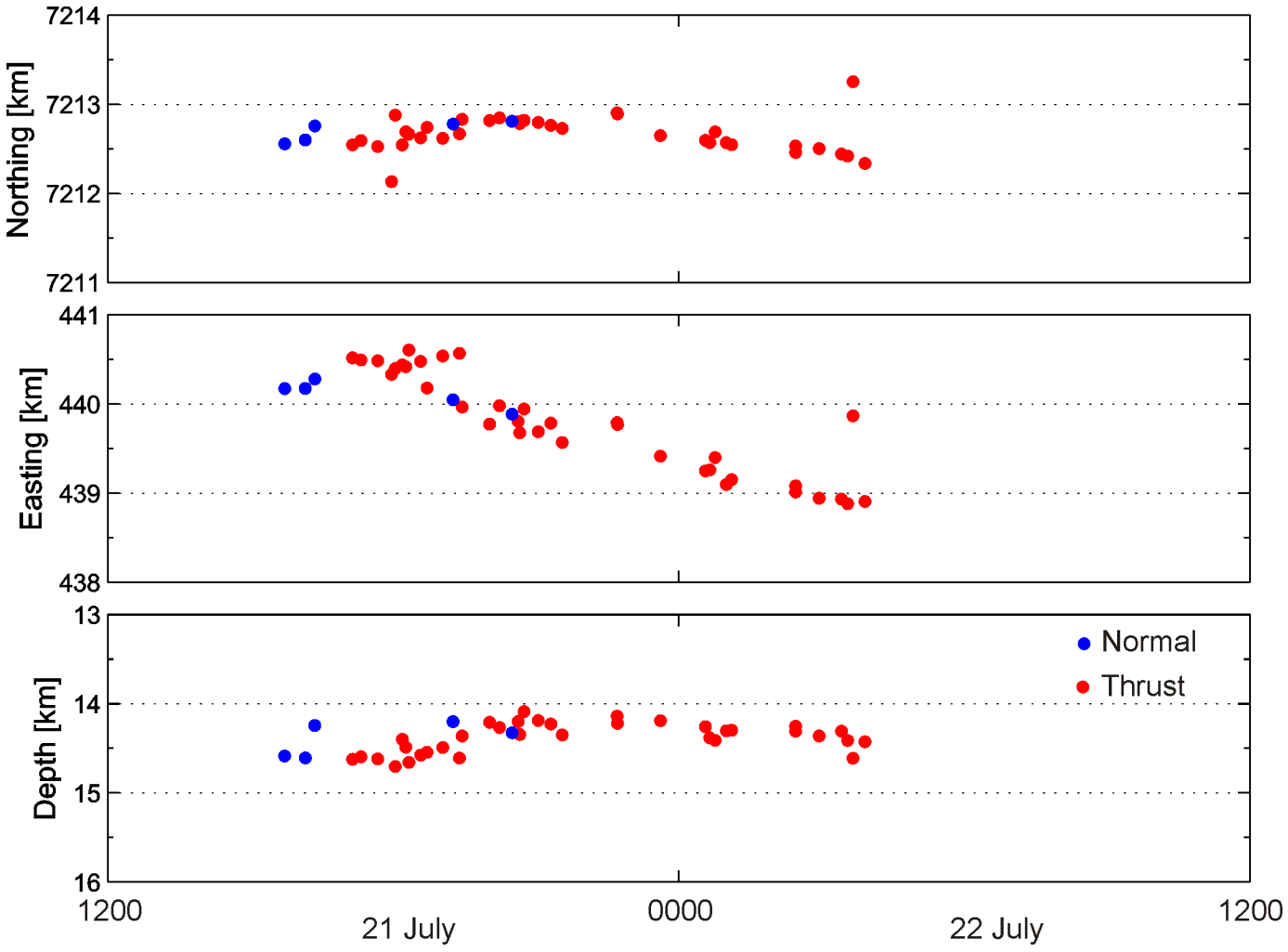
19
20
21
22
23
24
25
Date in July 2007


Moment tensor solutions

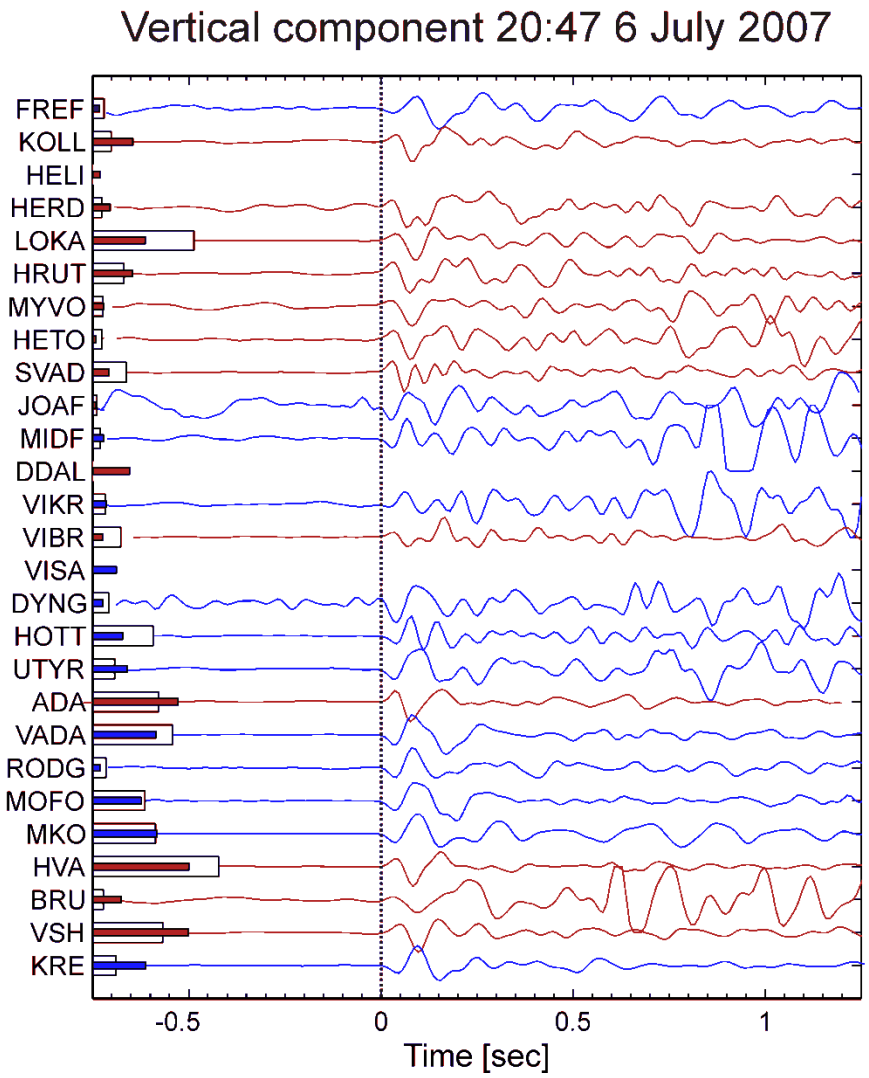
Normal fault



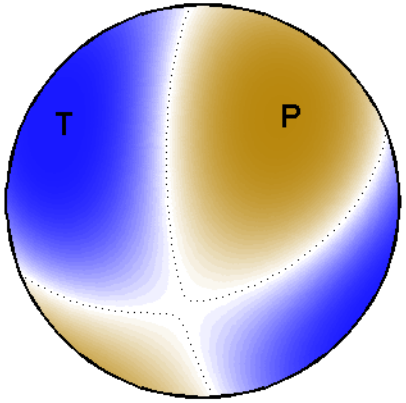



Northing [km]
7214
7213
7212
7211
Easting [km]
441
440
439
438
Depth [km]
13
14
15
16
Normal
Thrust
1200
21 July
0000
22 July
1200

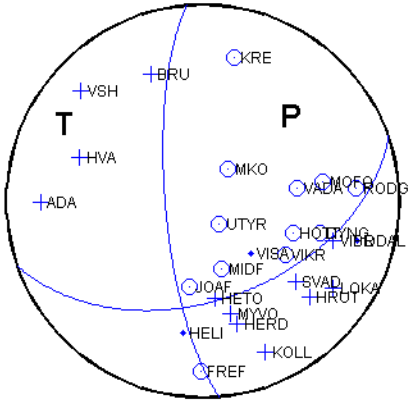
Normal Fault



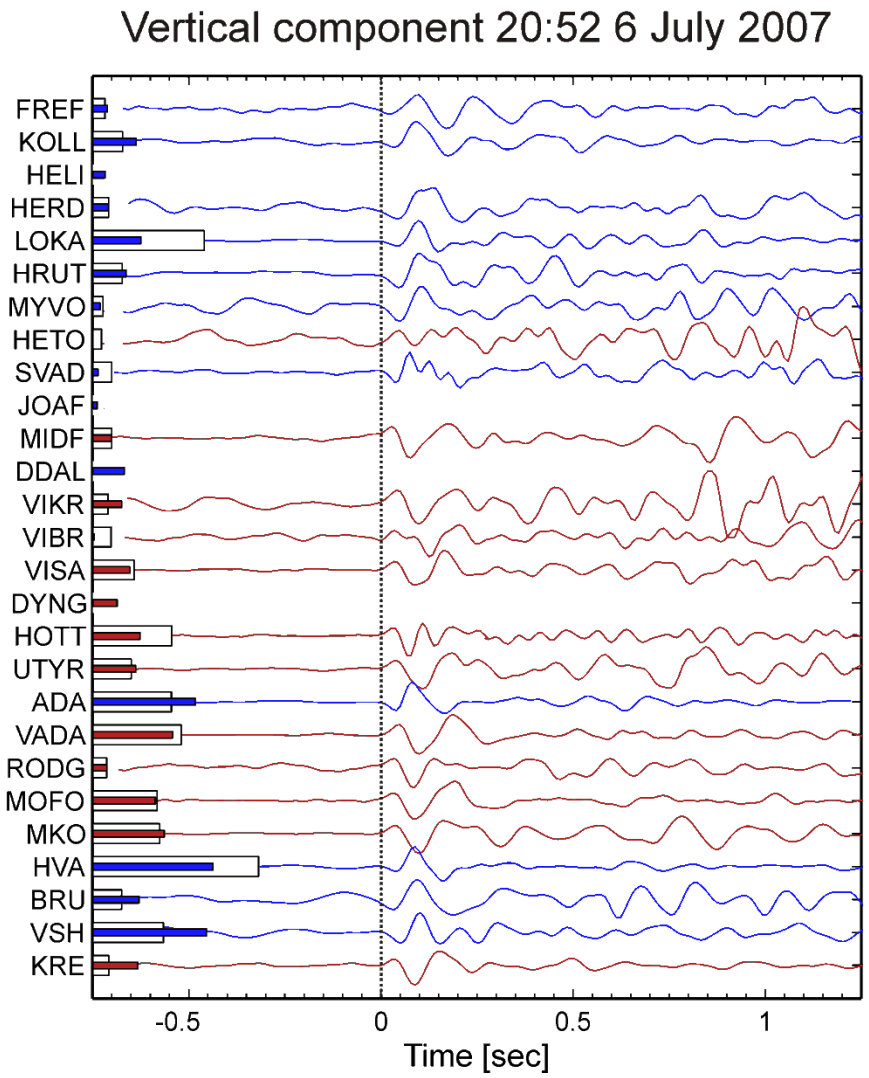
Moment tensor



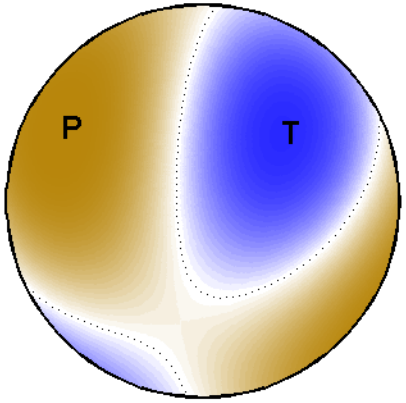
Double couple



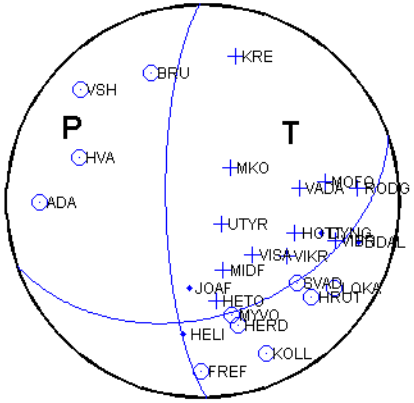
Reverse Fault



Moment tensor



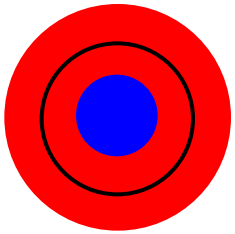
Double couple



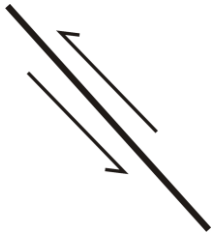
Decomposition of moment tensors

Moment tensor = Isotropic + Deviatoric

explosion
or
implosion



double couple

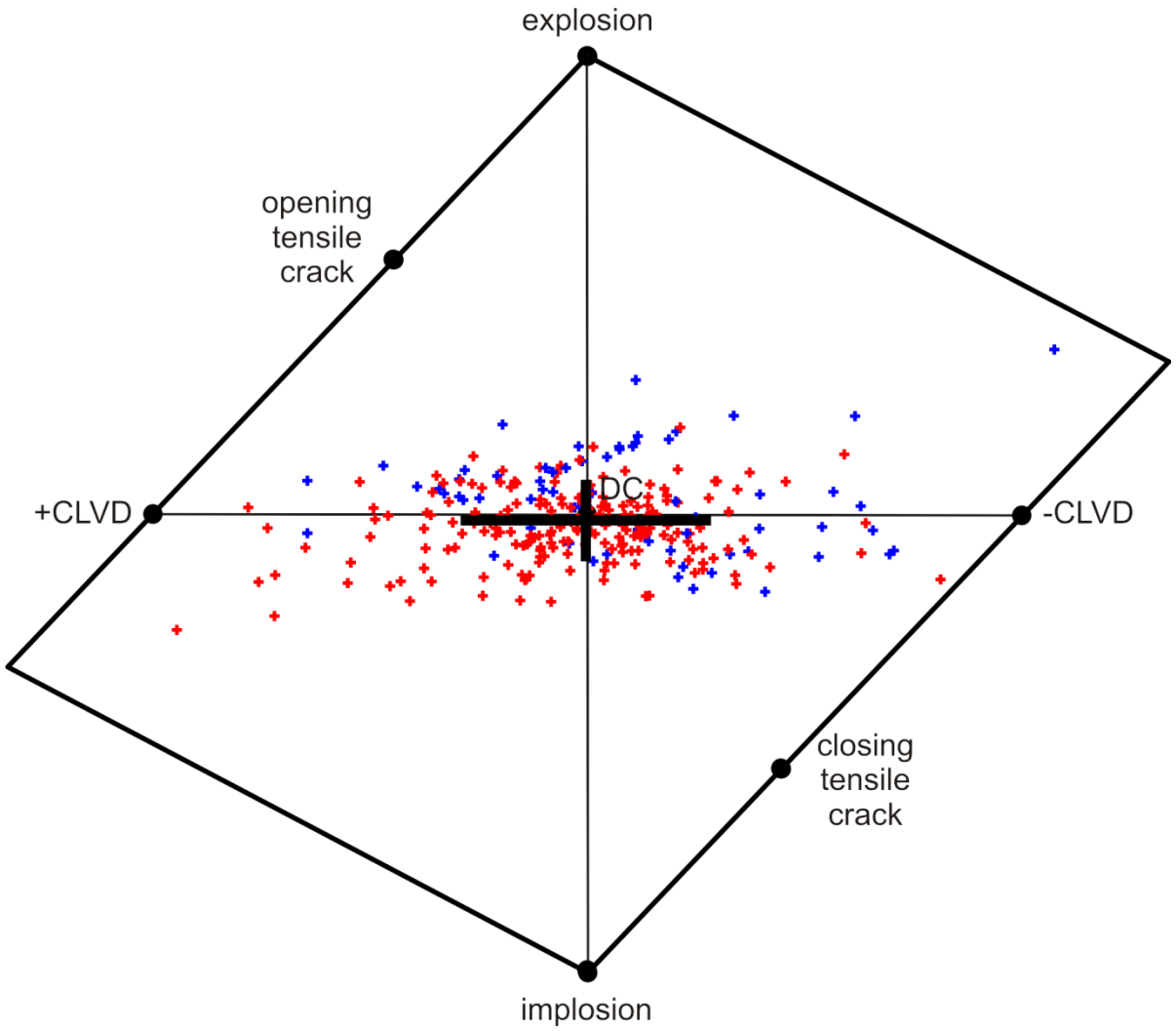


+

compensated linear
vector dipole (CLVD)

zero net force
zero net moment
zero volume change

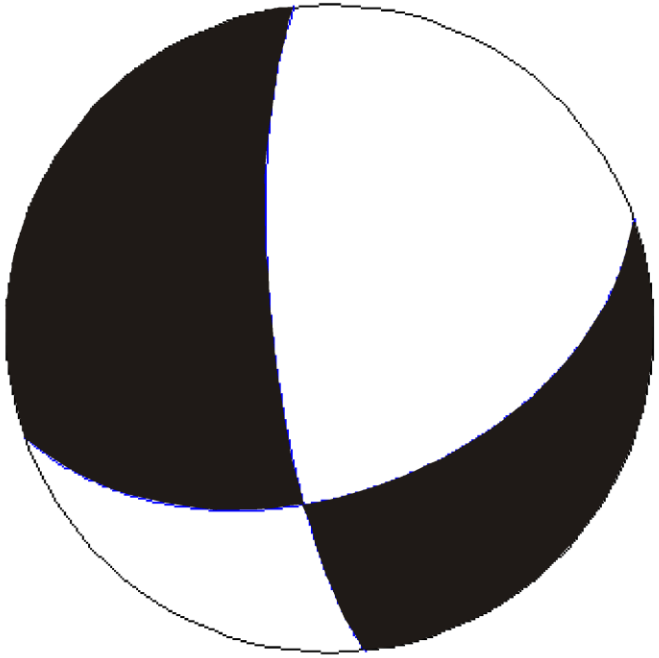
Upptyppingar




Which of the nodal planes is the fault plane?

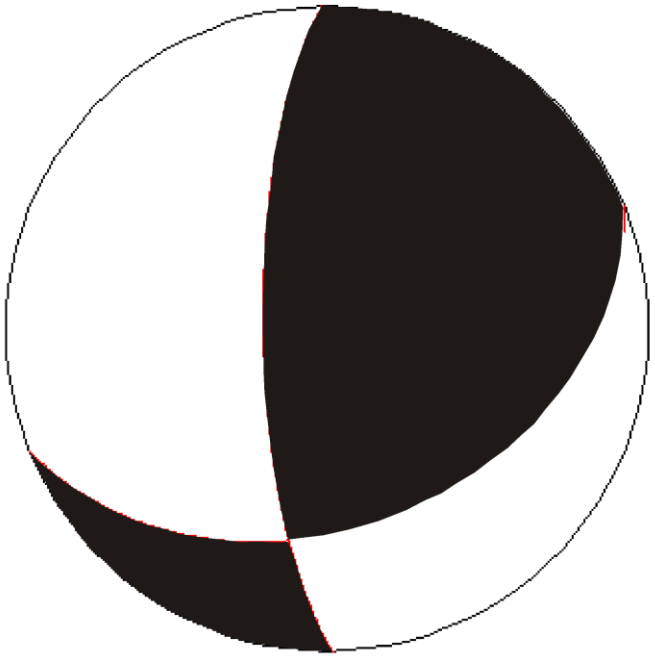
Normal

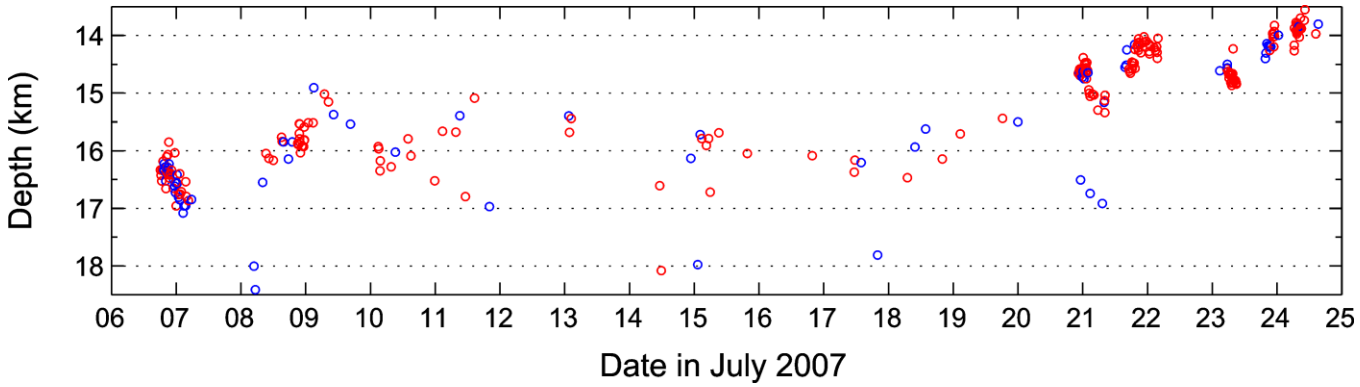
July 06 2047



Reverse

July 06 2052



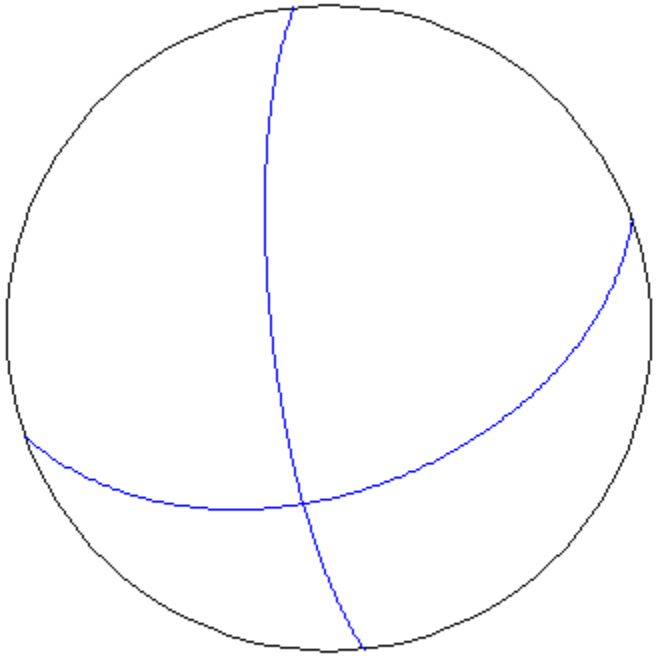


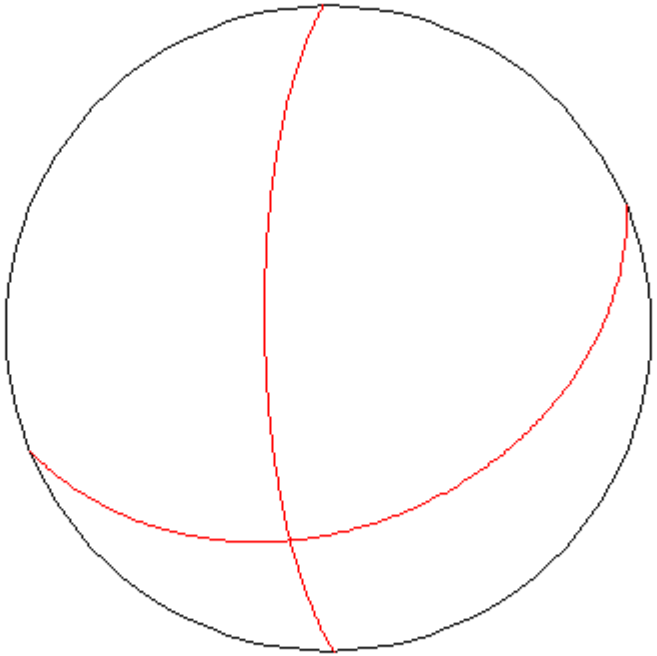
Normal

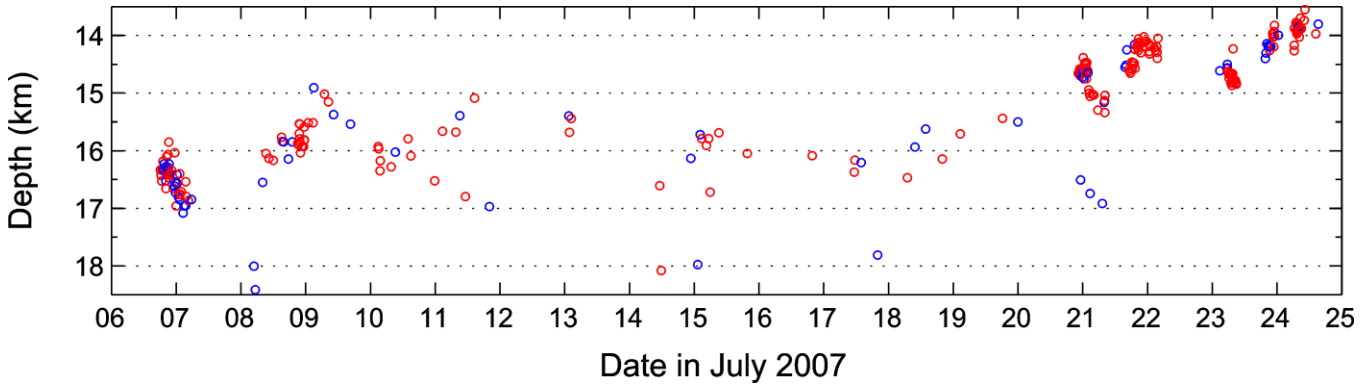
July 06 2047

Reverse

July 06 2052

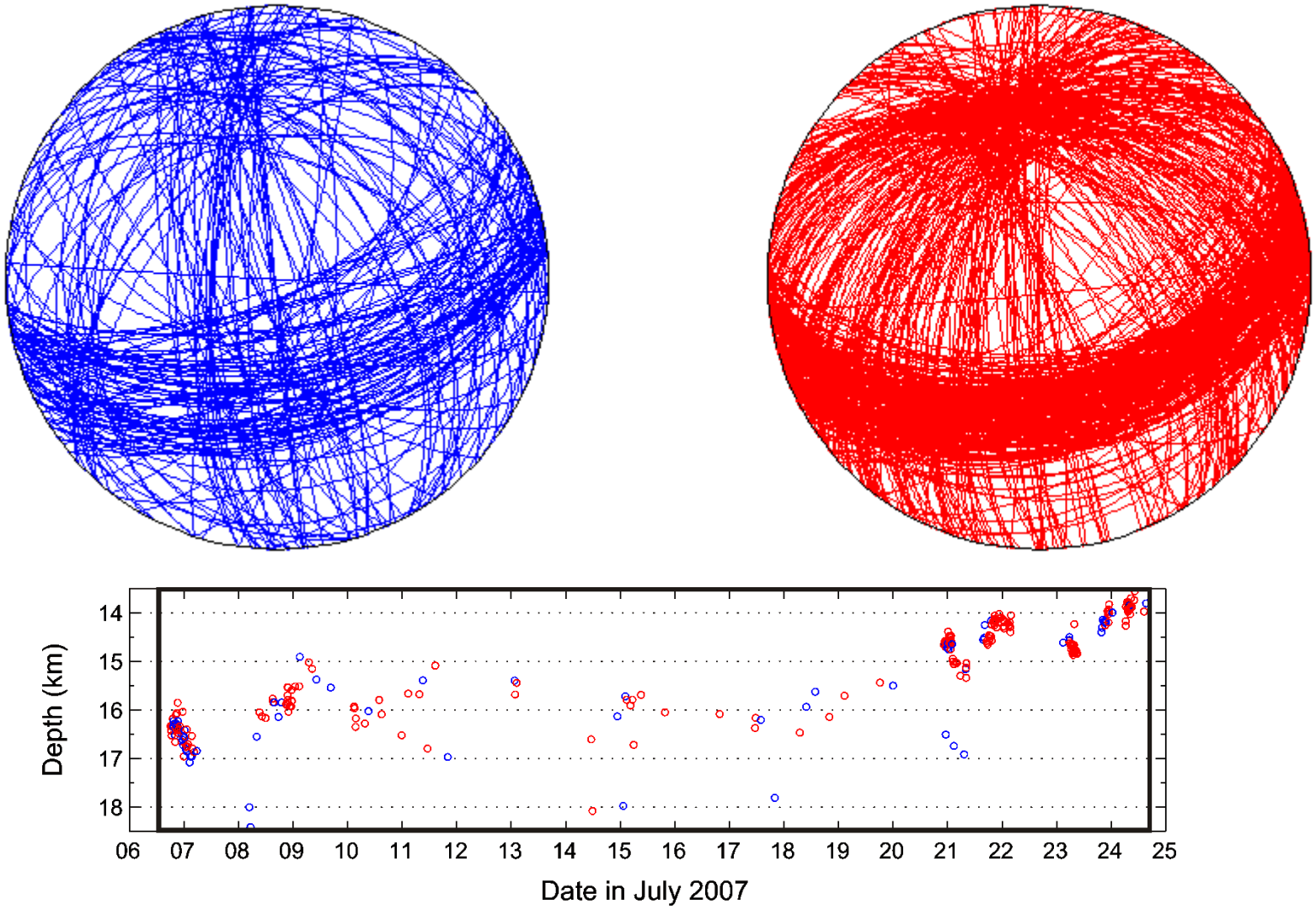




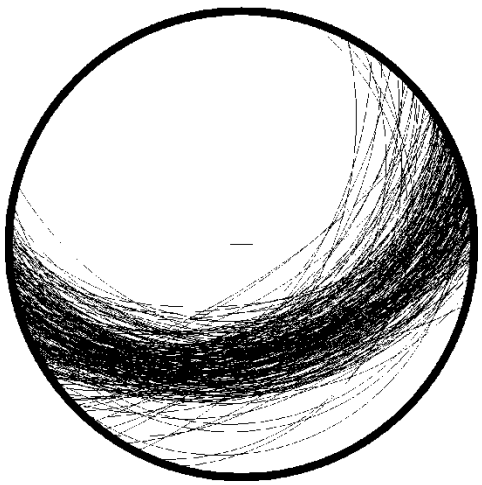


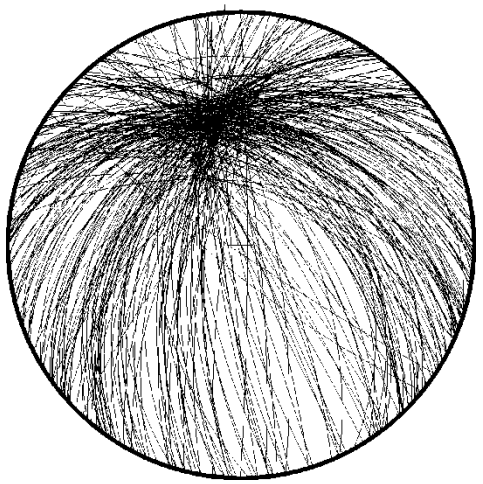
Normal

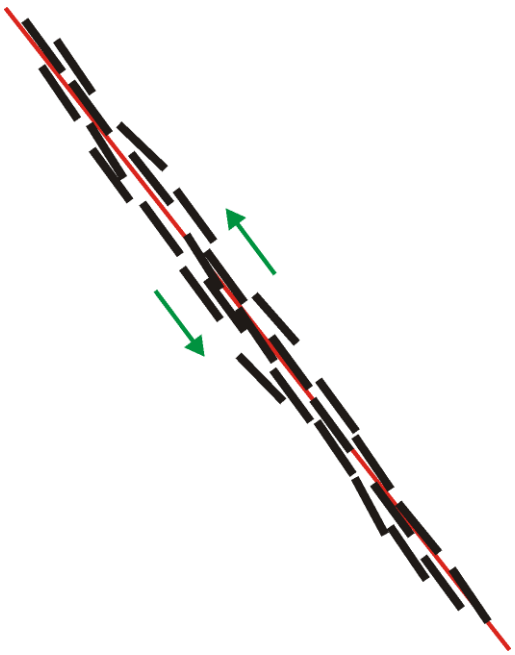
Reverse

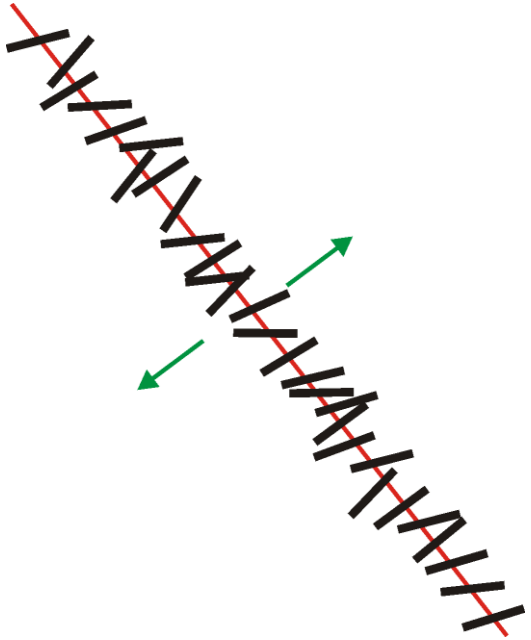


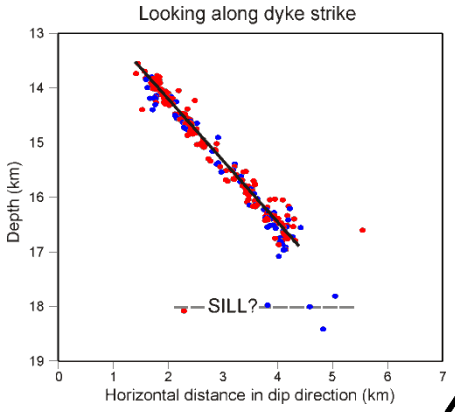
Nodal planes: thrust faults





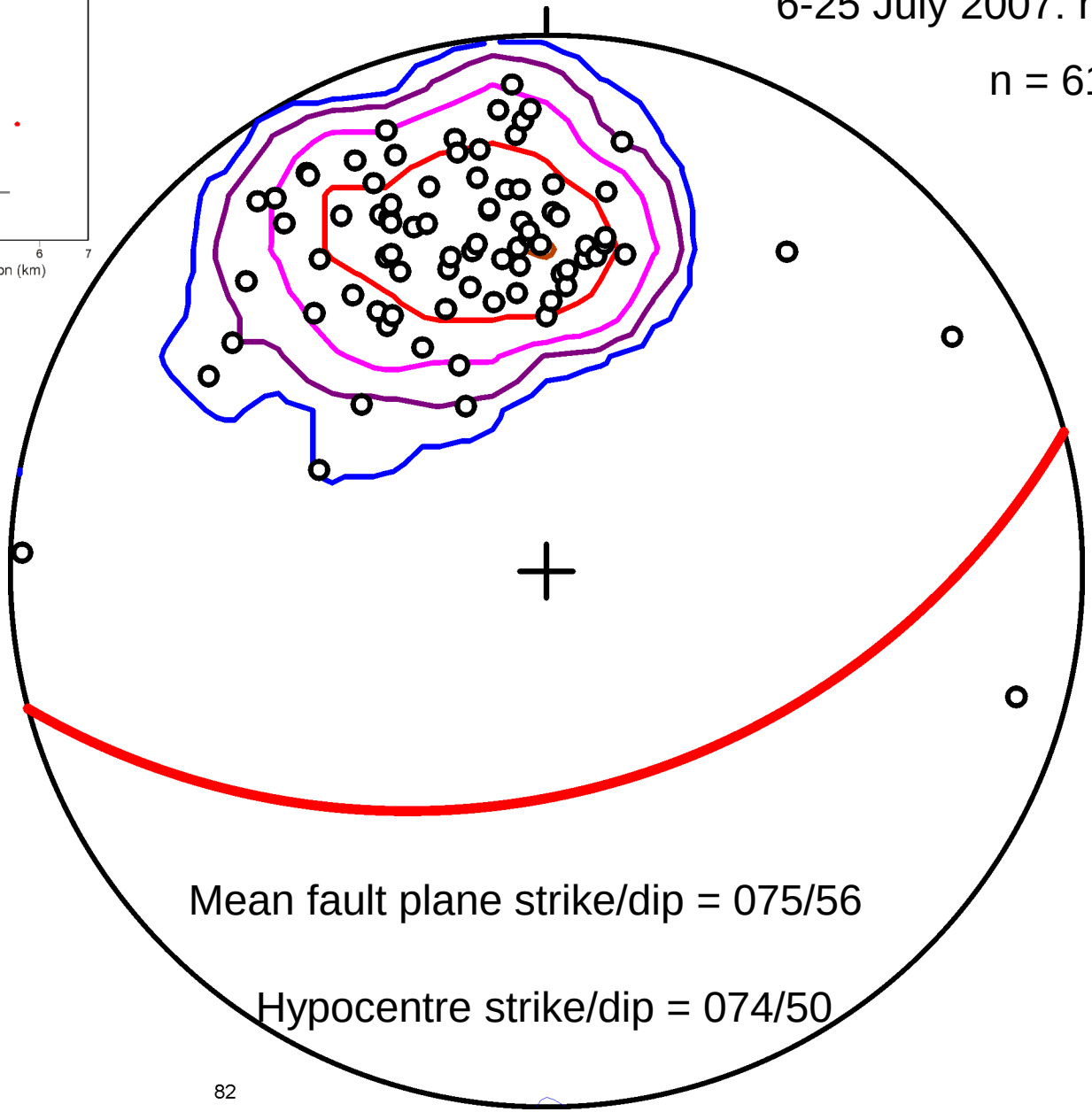






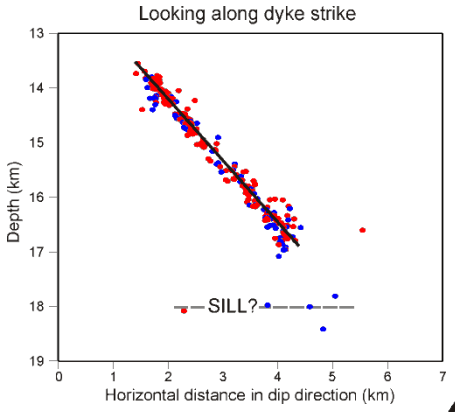
6-25 July 2007: normal faults

n = 61



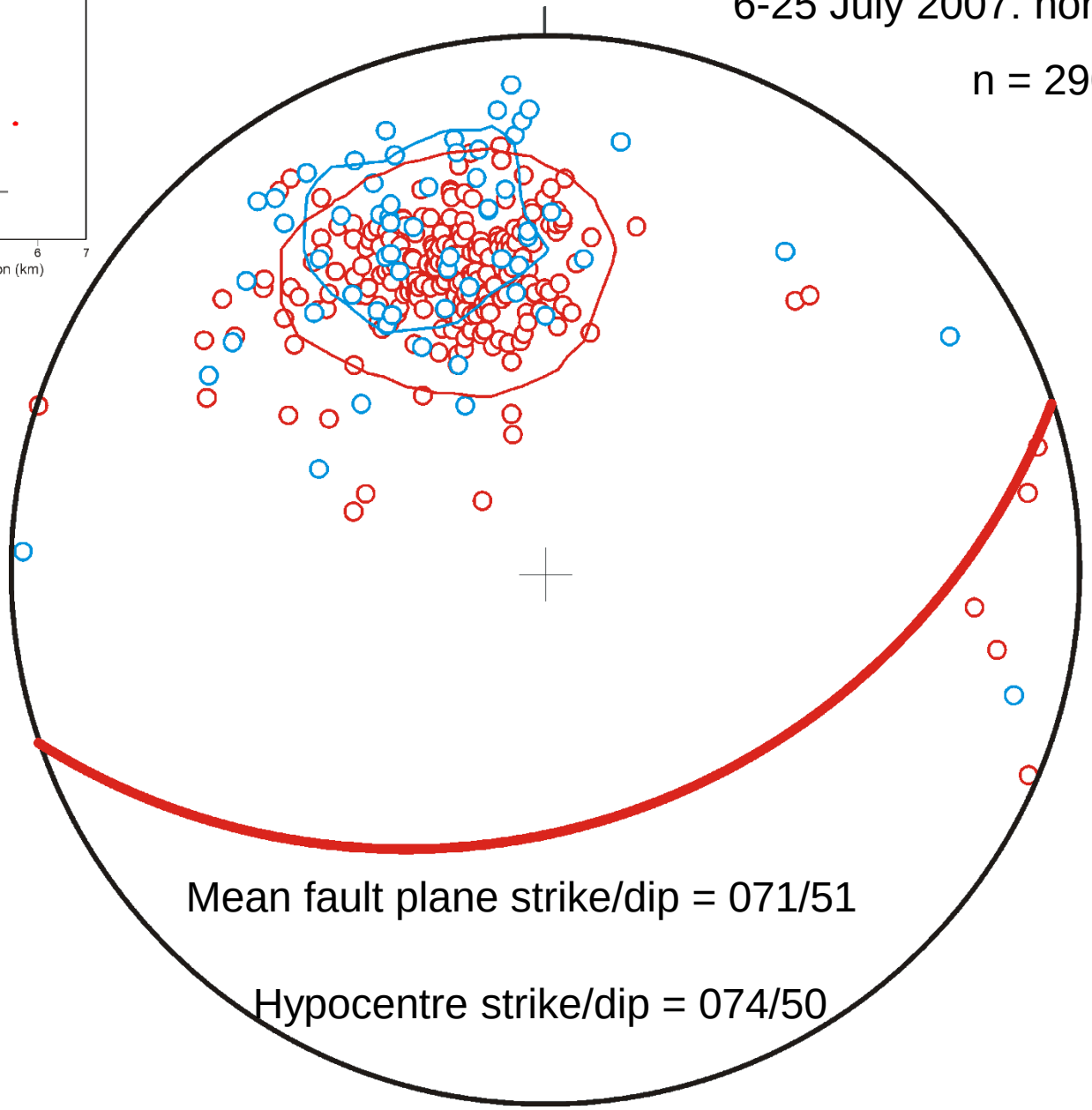
Mean fault plane strike/dip = 075/56

Hypocentre strike/dip = 074/50



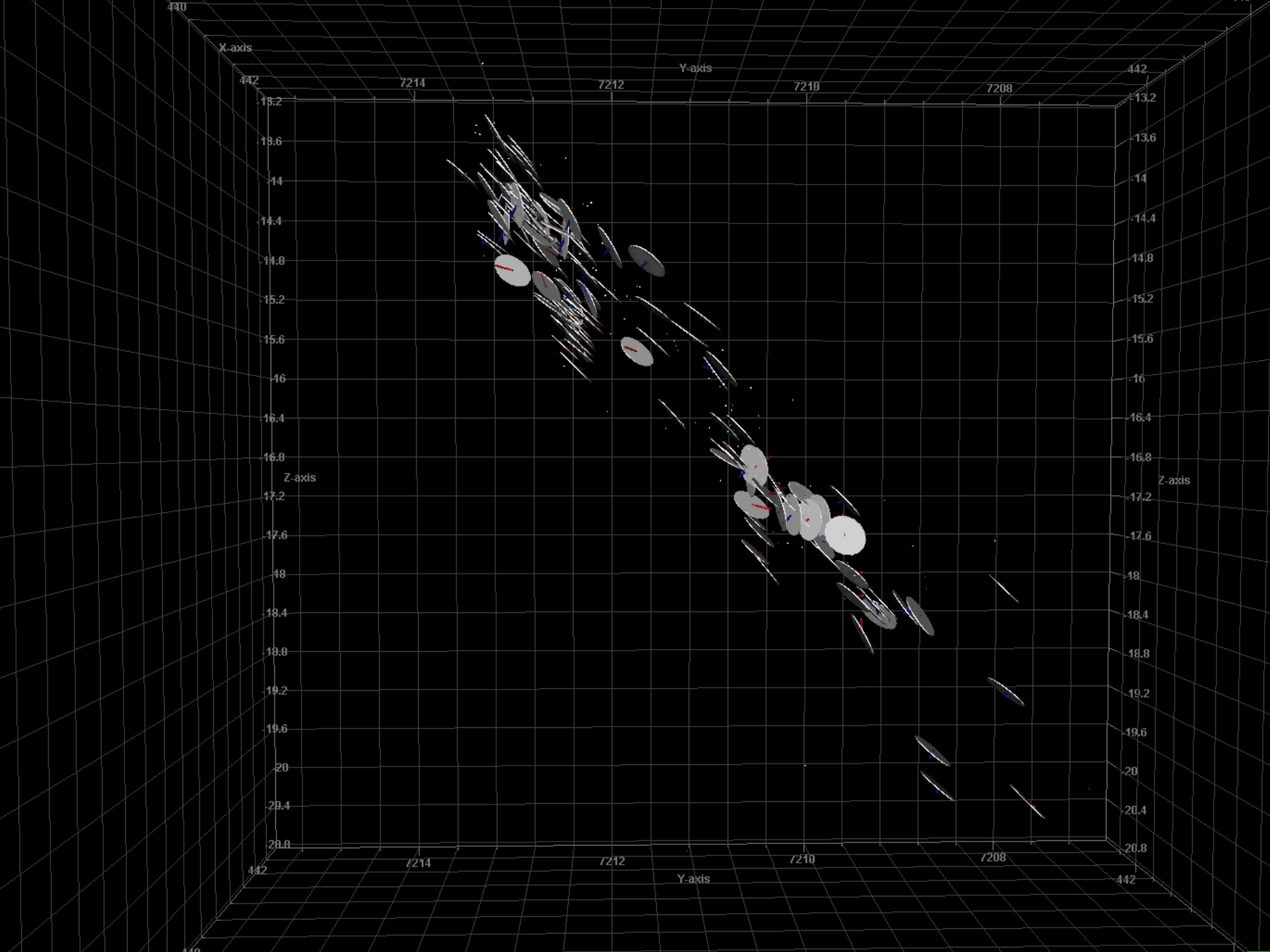
6-25 July 2007: normal + reverse

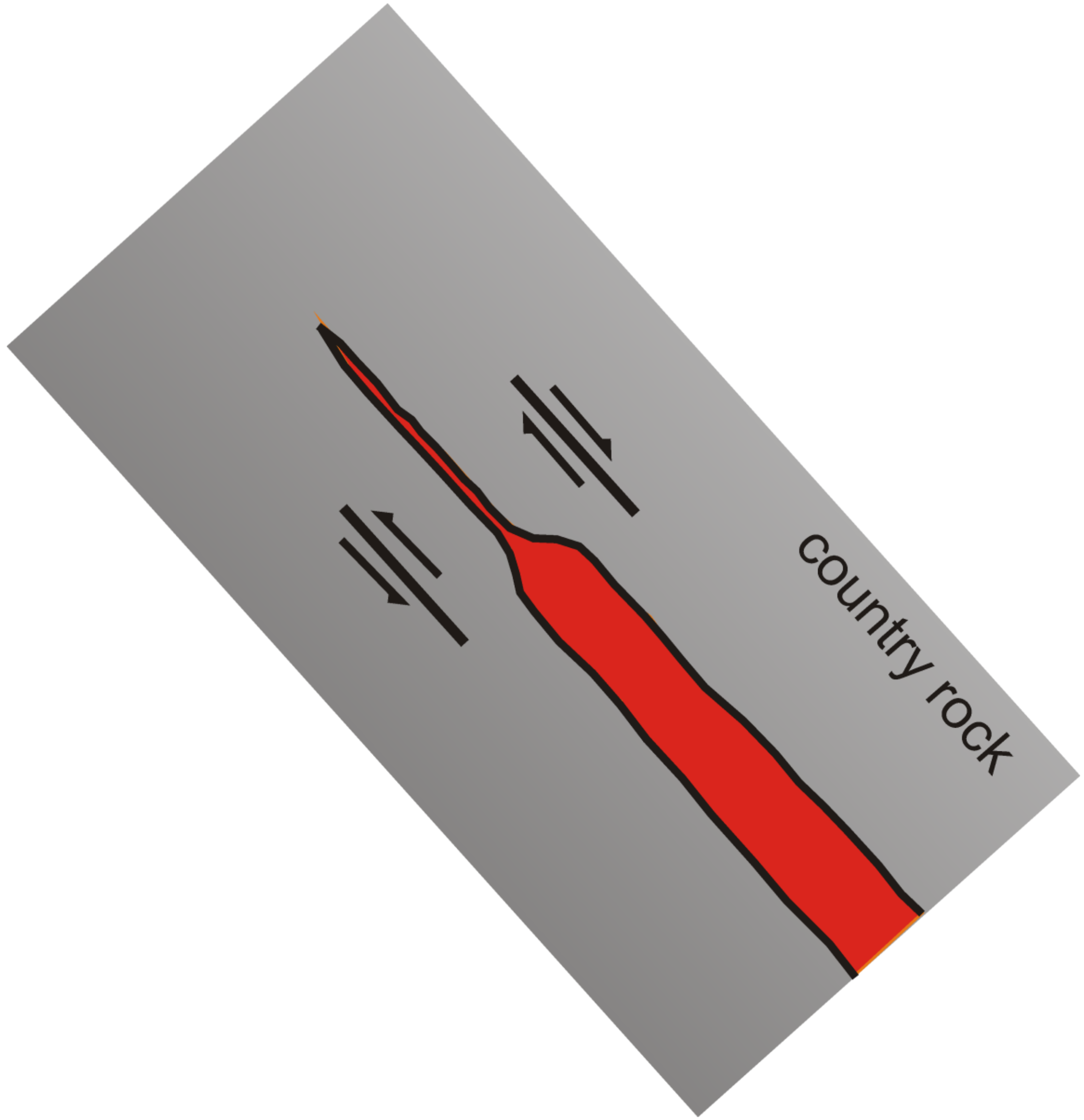
n = 290



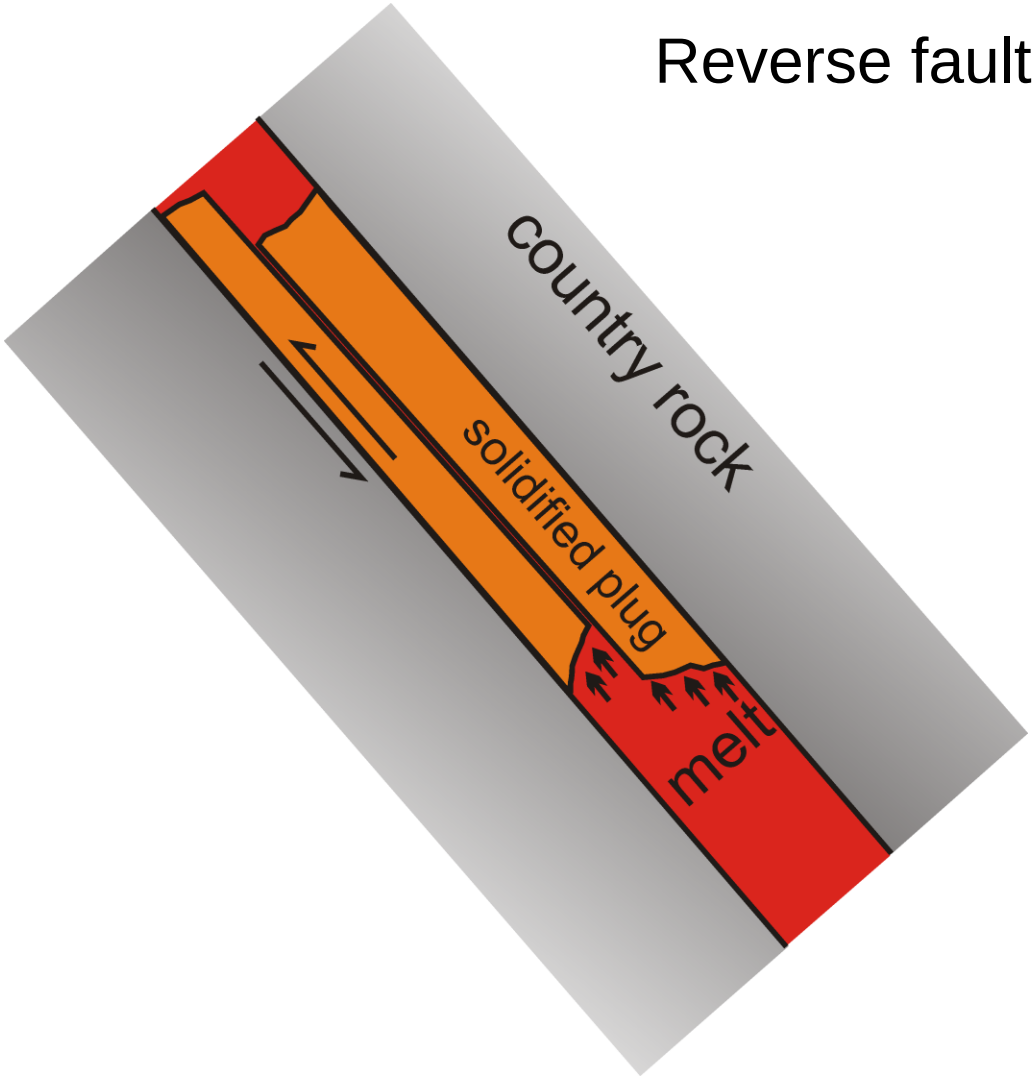
Mean fault plane strike/dip = 071/51

Hypocentre strike/dip = 074/50

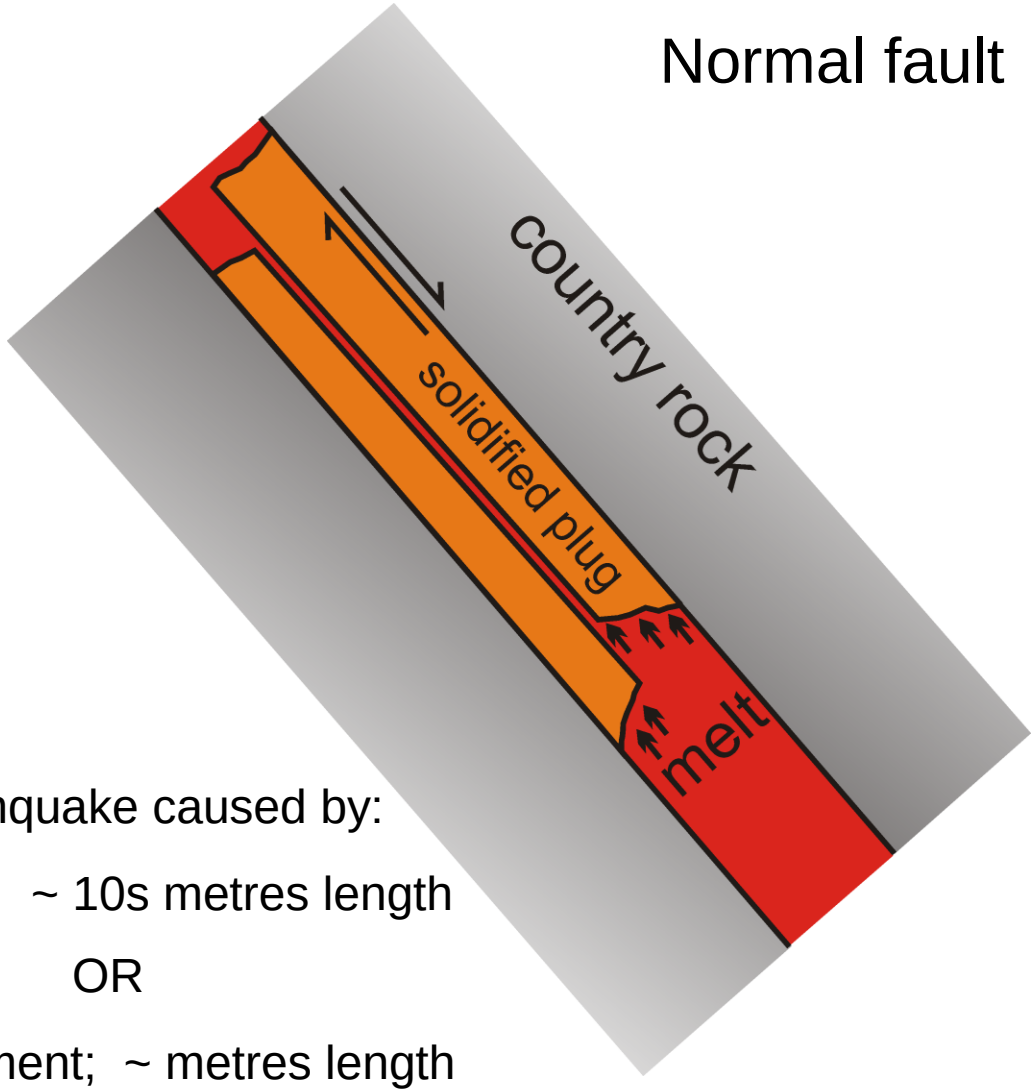

X-axis
Y-axis
Z-axis
442
7214
7212
7210
7208
13.2
13.6
14
14.4
14.8
15.2
15.6
16
16.4
16.8
17.2
17.6
18
18.4
18.8
19.2
19.6
20
20.4
20.8


country rock

Reverse fault



Normal fault

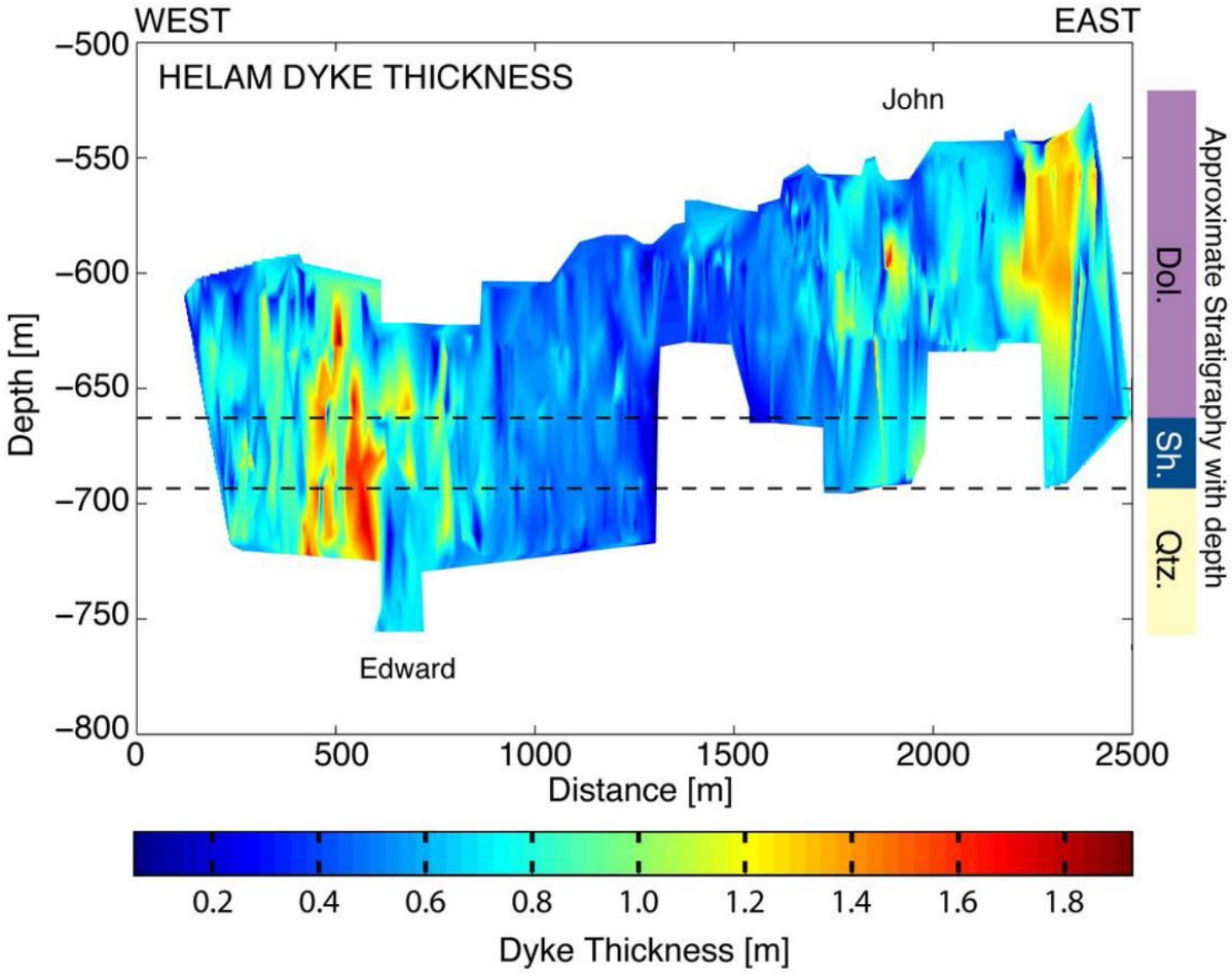


Magnitude 1 earthquake caused by:

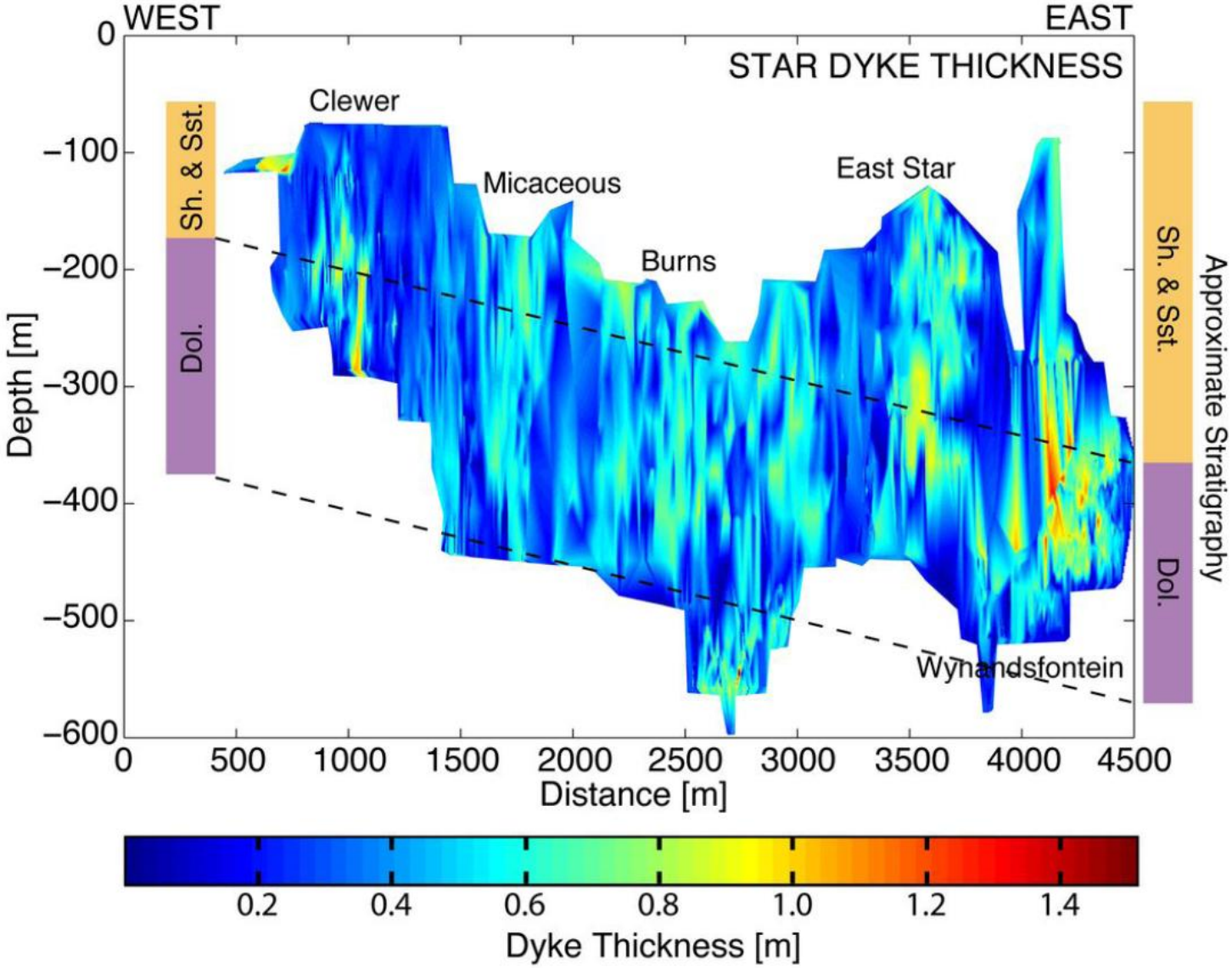
~ mms movement; ~ 10s metres length

OR

~ 10s mms movement; ~ metres length



from Kavanagh & Sparks: Insights of dyke emplacement mechanics from detailed 3-D dyke thickness datasets, *J Geol. Soc.*



from Kavanagh & Sparks: Insights of dyke emplacement mechanics from detailed 3-D dyke thickness datasets, *J Geol. Soc.*


Thank you for listening
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