

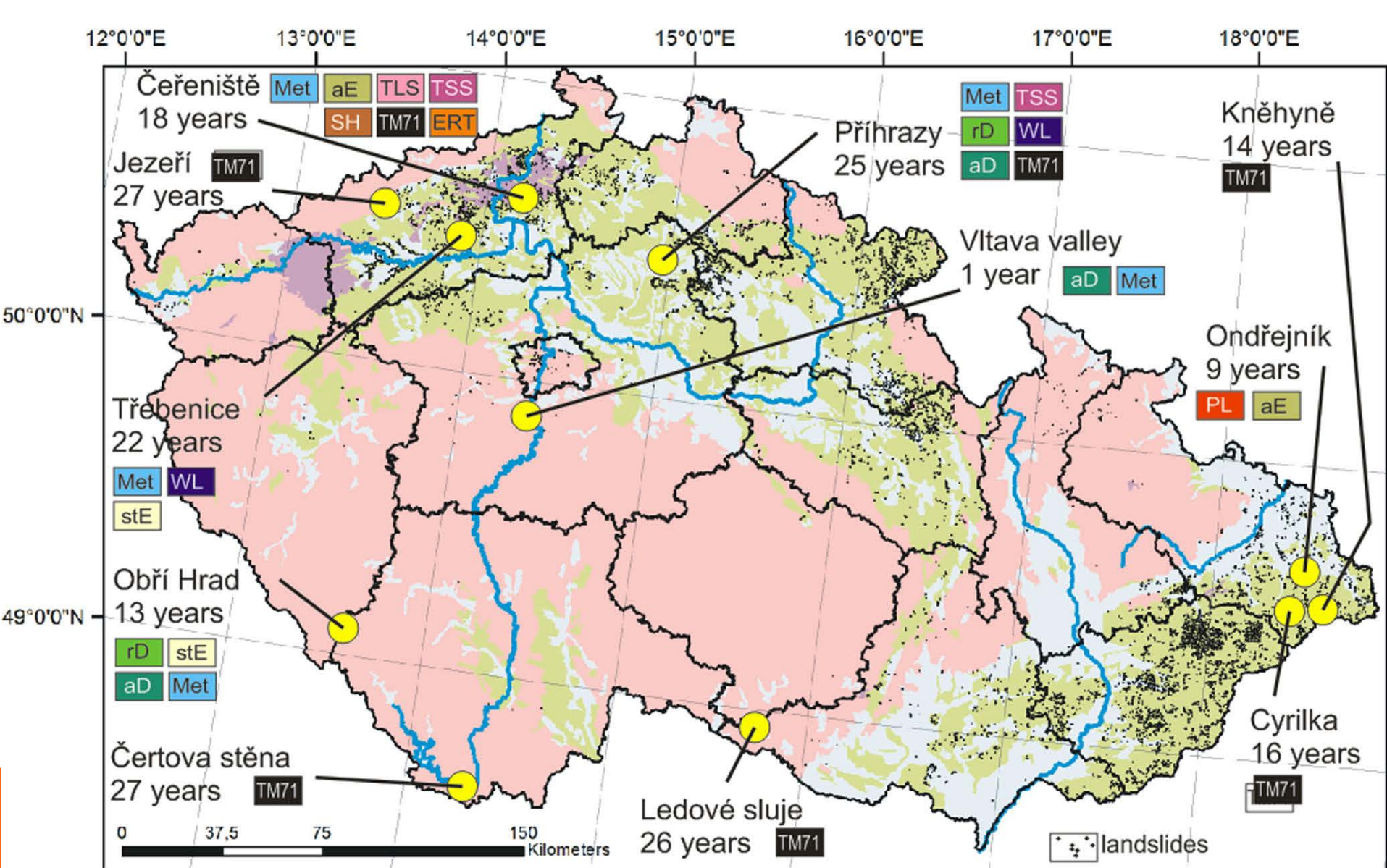
RESULTS OF MONITORING OF A GIANT LANDSLIDE ON EL HIERRO ISLAND (SLOPENET)



JAN BLAHŮT,
MATT ROWBERRY, IVO BAROŇ, JAN KLIMEŠ, JAN BALEK,
STAVROS MELETLIDIS, XAVI MARTÍ

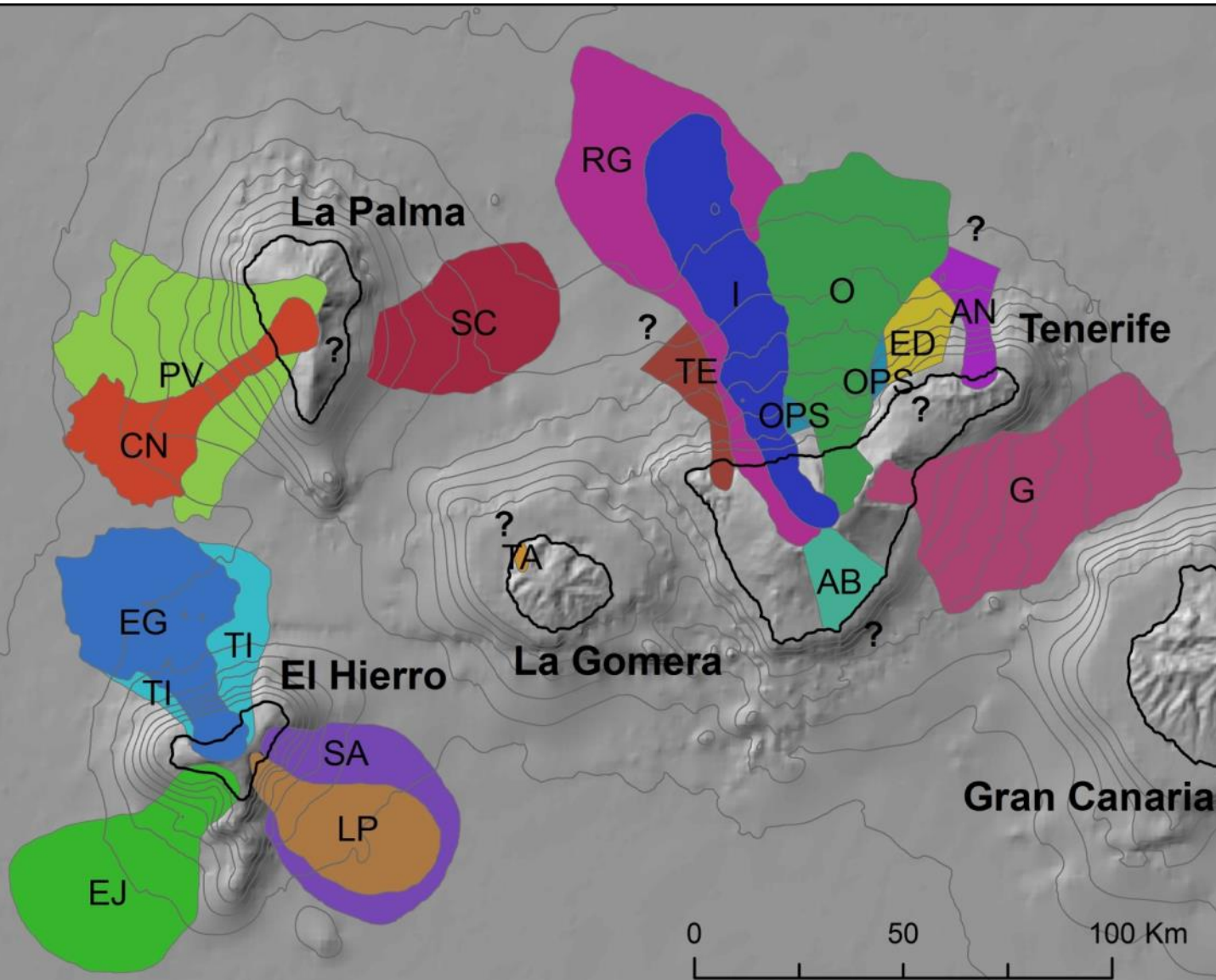
INSTITUTE OF ROCK STRUCTURE AND MECHANICS
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Met	climatic parameters	aE	automatic extensometer	SH	soil humidity		crystalline rocks
rD	rod dilatometer	TLS	laser scanner survey	PL	precise levelling		Tertiary volcanics
aD	automatic dilatometer	TSS	total station survey	ERT	resistivity survey		Cretaceous sediments
stE	steel tape extensometer	WL	water level monitoring	TM71	TM-71 device		Quaternary sediments

GIANT LANDSLIDES IN WESTERN CANARIES



- Debris avalanches
- Slumps
- Debris flows

Urgeles et al. (1990);
Ablay and Hürliemann (2000); Gee (2001);
Carracedo et al. (2001);
Masson et al. (2002);
Acosta et al. (2003);
Hürliemann et al. (2004);
Walter et al. (2005);
Casillas et al. (2010);
Davila et al. (2011);
Longprè et al. (2011)

EL HIERRO, CANARY ISLANDS

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0 Scale 5 km

Contour interval 25 m
(Topography GRAFCAN)

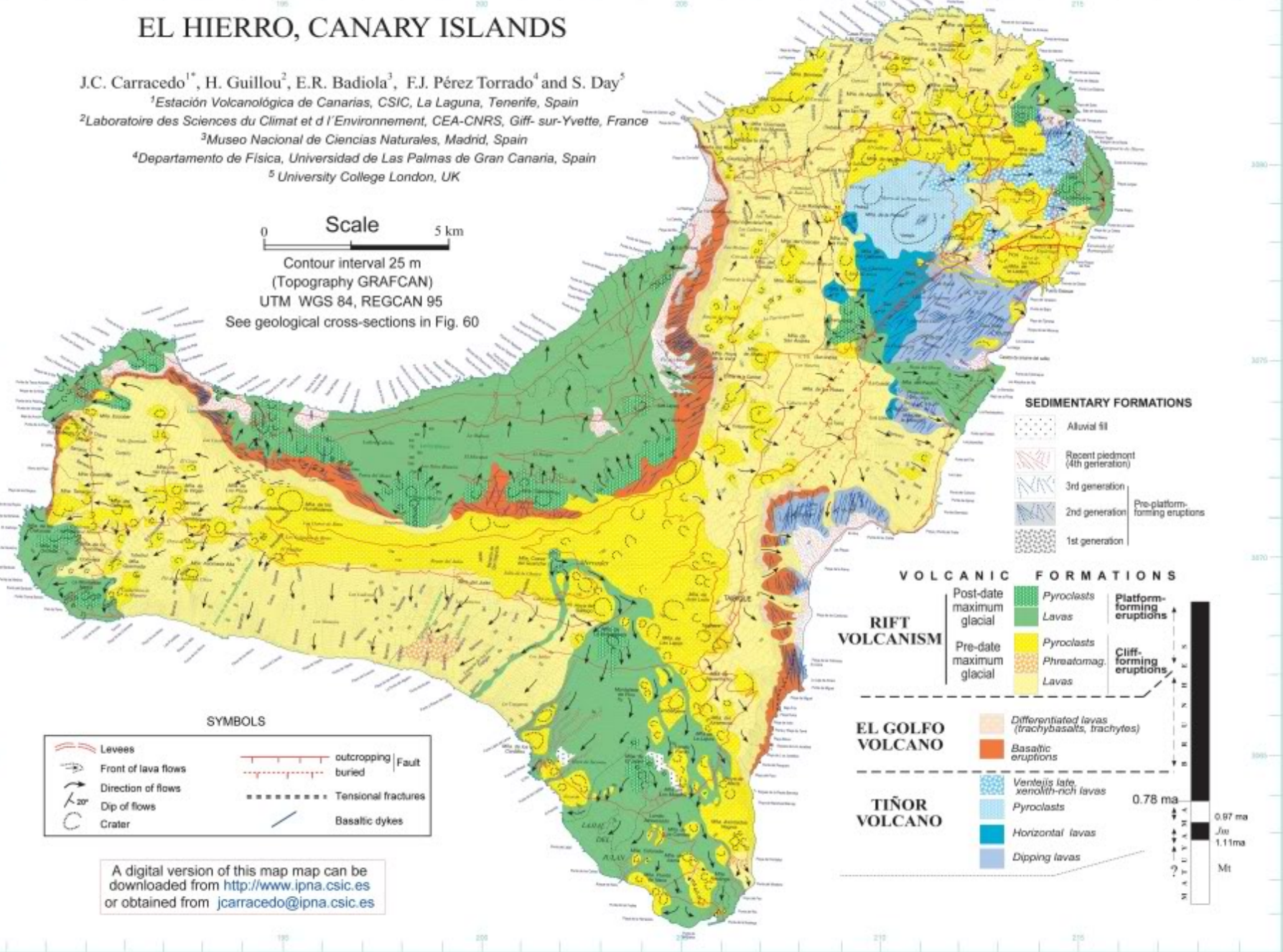
UTM WGS 84, REGCAN 95

See geological cross-sections in Fig. 60

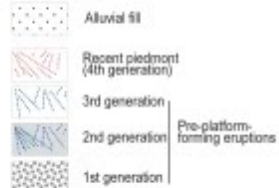
SYMBOLS



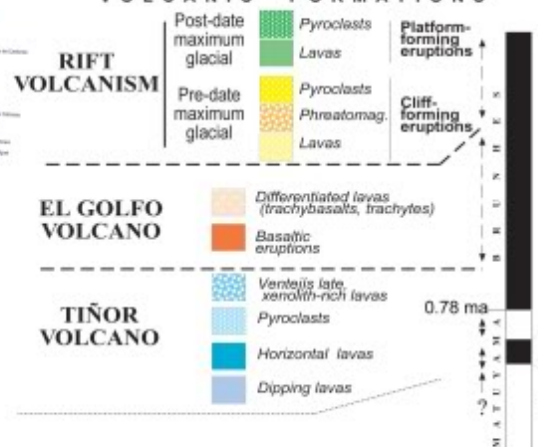
A digital version of this map can be downloaded from <http://www.ipna.csic.es> or obtained from jcarracedo@ipna.csic.es



SEDIMENTARY FORMATIONS



VOLCANIC FORMATIONS



SAN ANDRÉS GIANT LANDSLIDE I

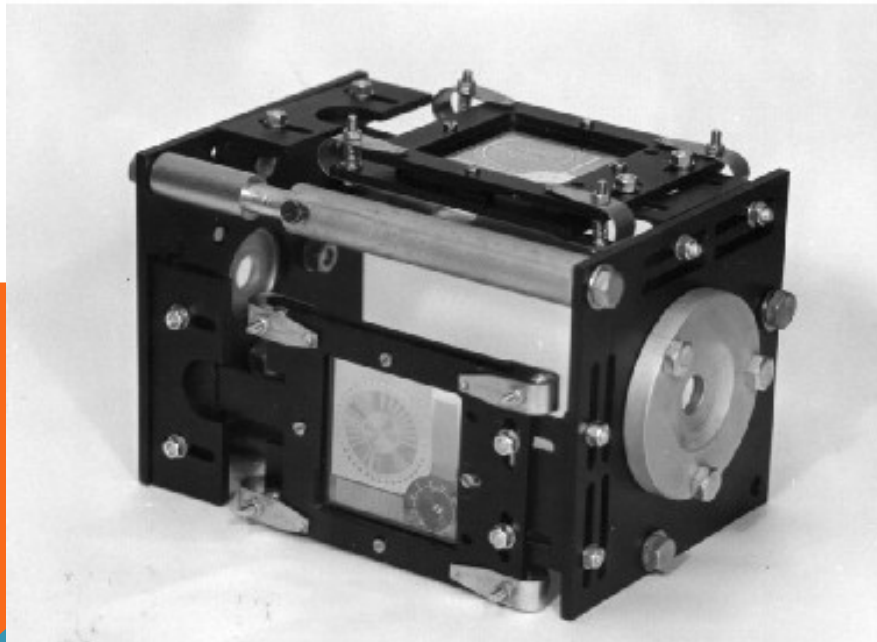
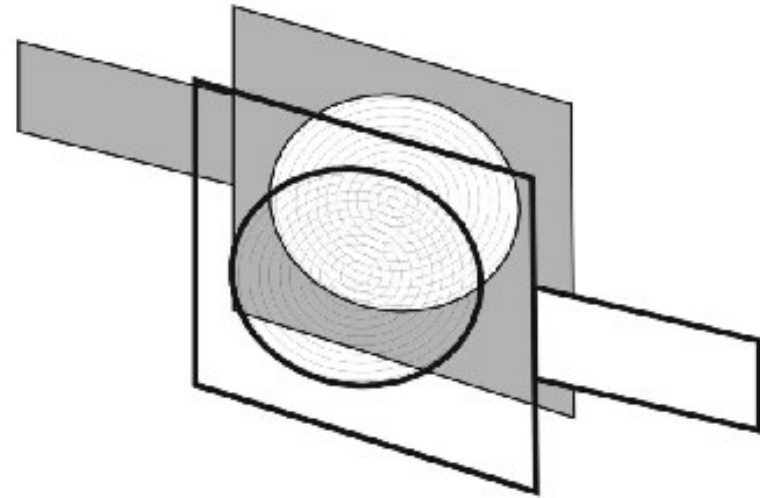
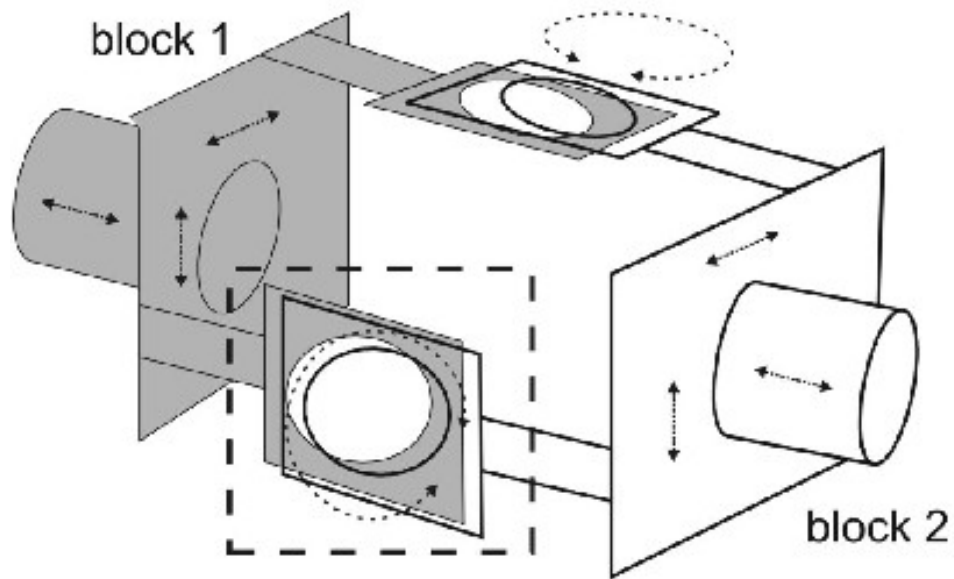


- Assumed aborted landslide of 150-250 ka
- Well developed fault system/detachment planes
- Morphologically seem still active

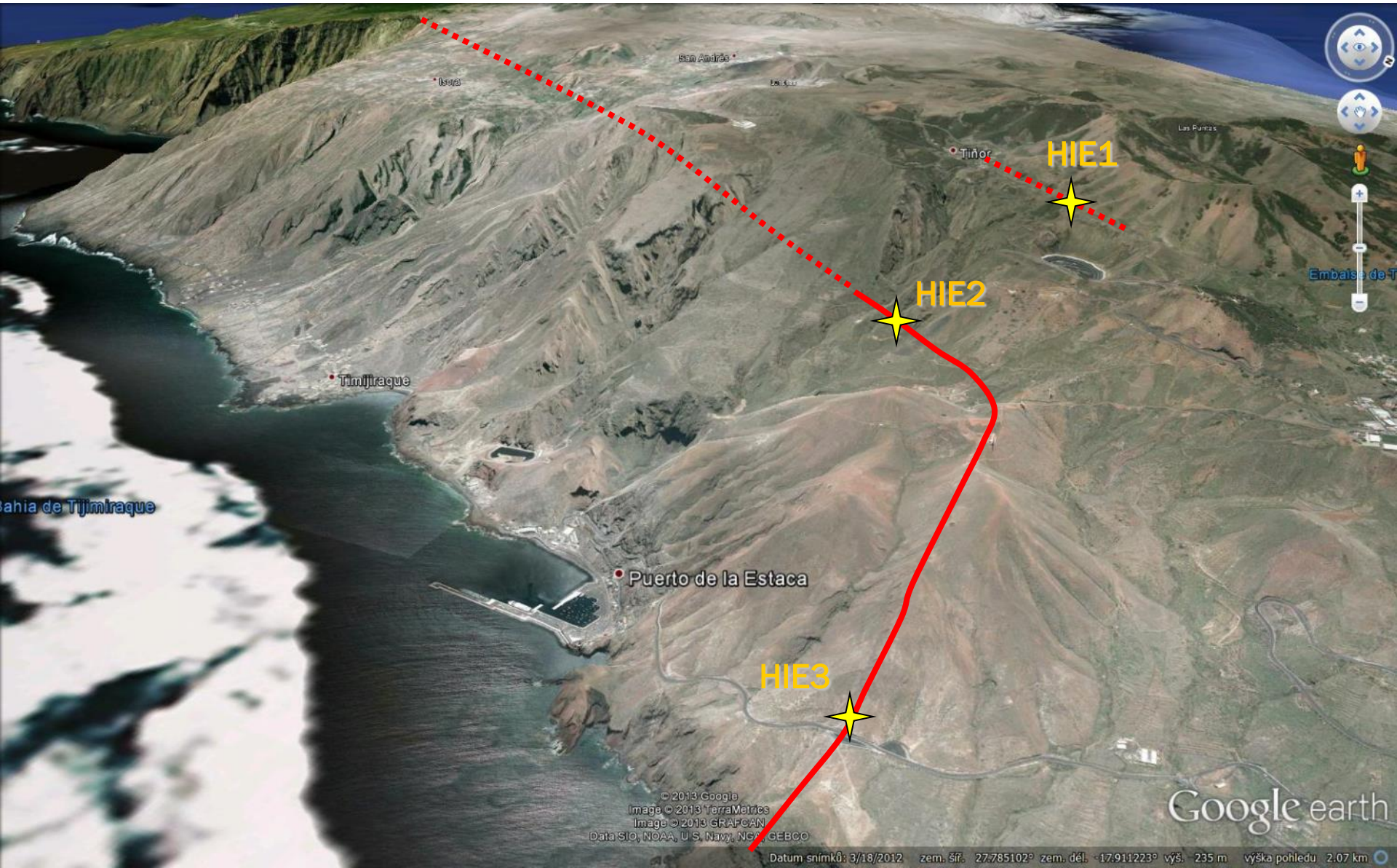
SAN ANDRÉS GIANT LANDSLIDE II



TM71 CRACK GAUGE



TM-71 CRACK GAUGE MONITORING ON EL HIERRO



HIE3



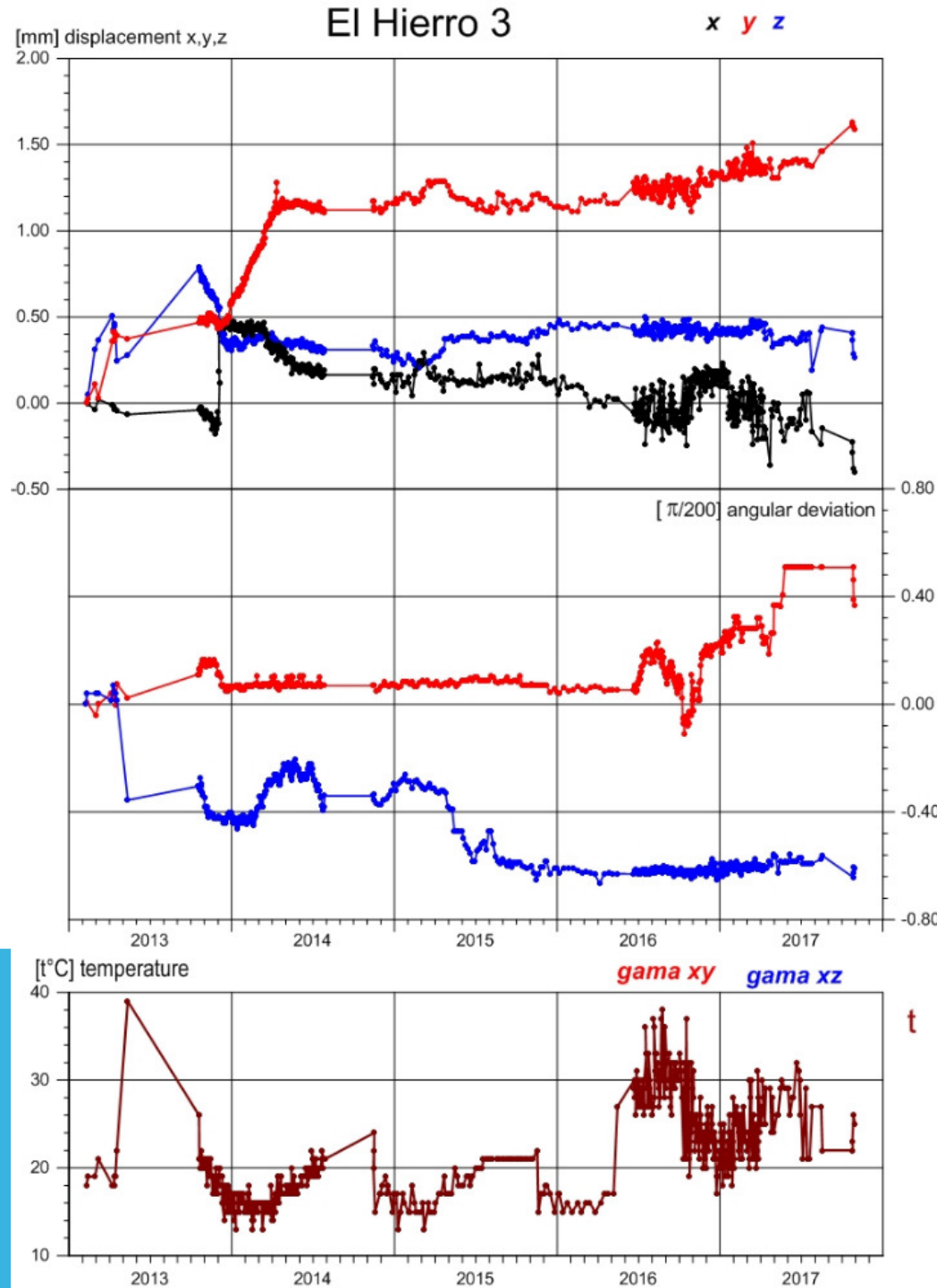
© 2013 Google

Image © 2013 GRAFCAN
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google Earth

HIE3 MEASUREMENT

- Normal fault $189^{\circ}/81^{\circ}$
- Northern block descended till end of 2013, after that it returned
- By the end of 2013 strong compression followed by seismic activity
- In early 2014 sinistral movement of 0,8 mm with extension
- Nowadays calm – minimum seismicity, reactions on temperature

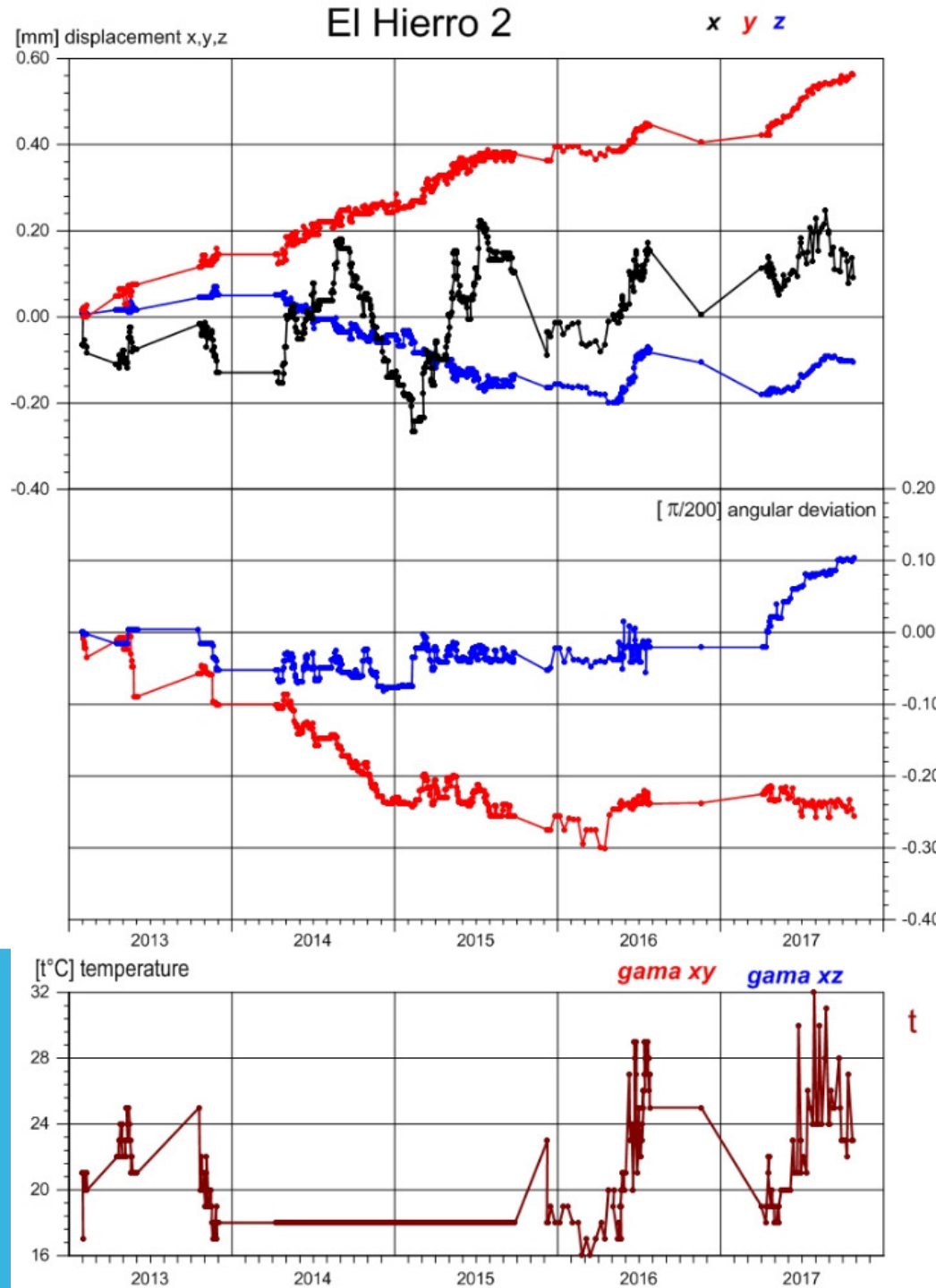


HIE2

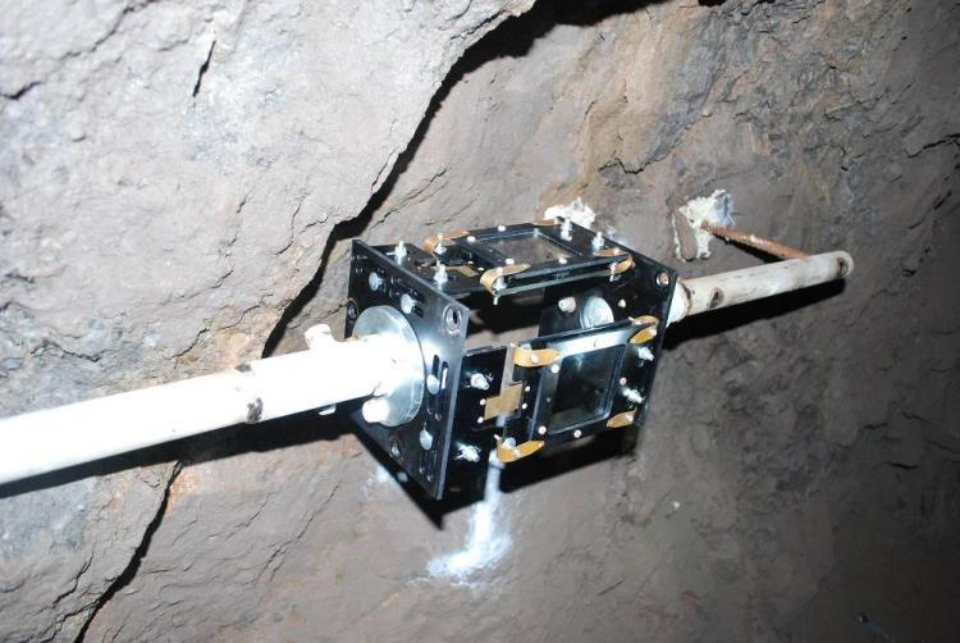


HIE2 MEASUREMENTS

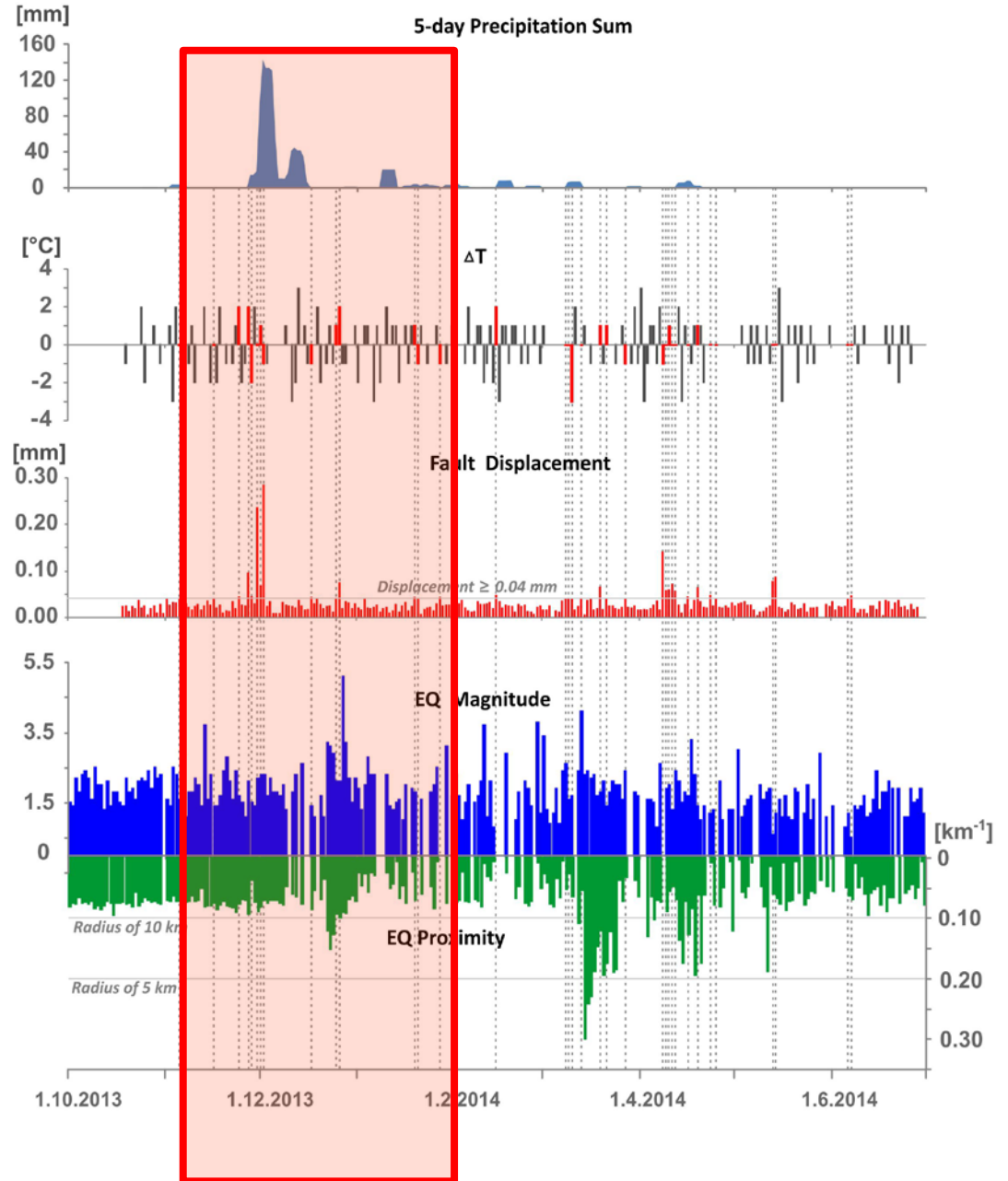
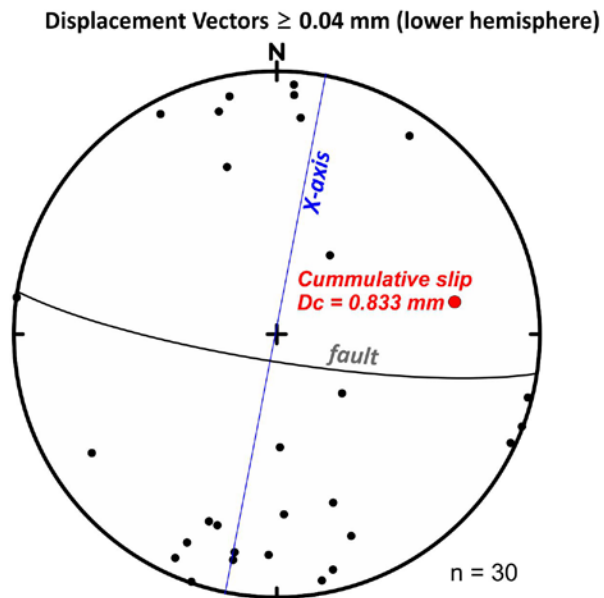
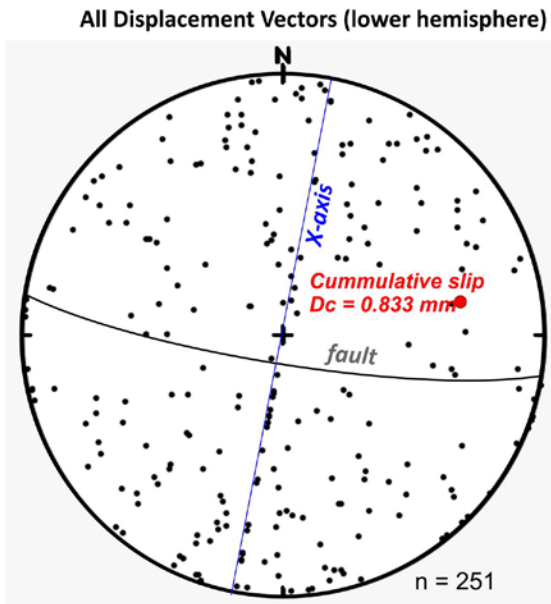
- Normal fault $140^\circ/75^\circ$
- Cyclic compression and extension (temperature)
- Continuous sinistral movement (0,45 mm/4 y)
- Vertical movement since mid 2014 (lower block descending, in 2016 ascended)
- Since 2013 rotation (xy) – opening in NW direction



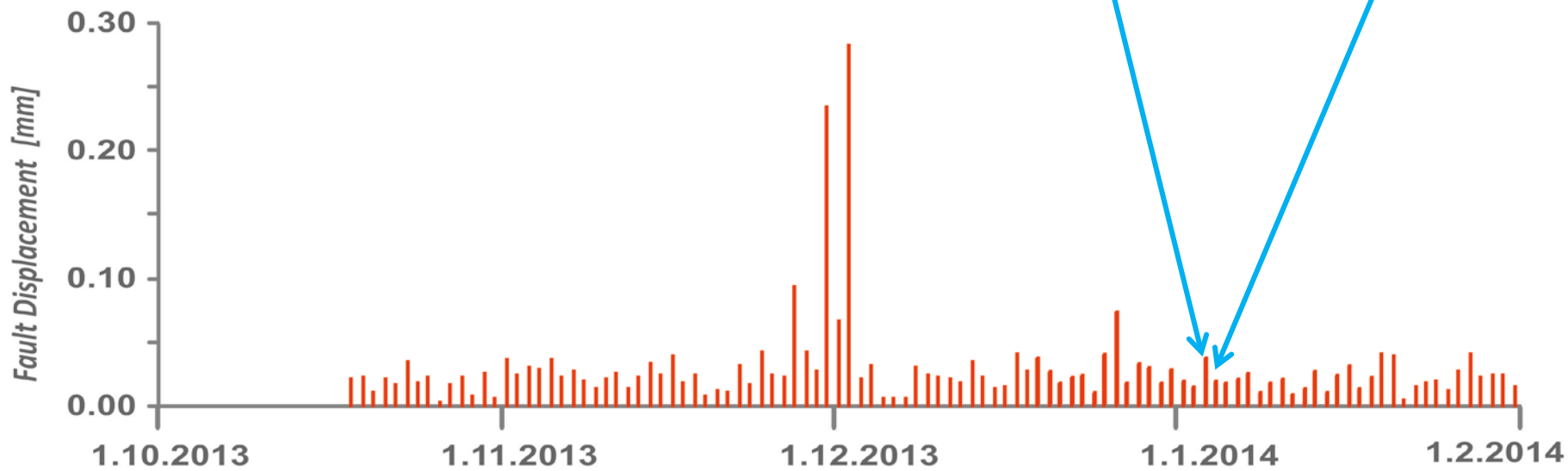
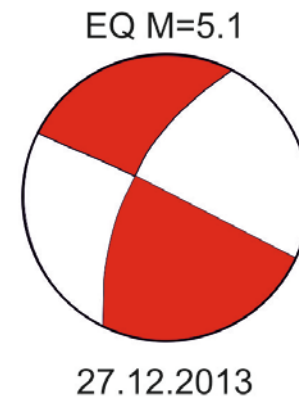
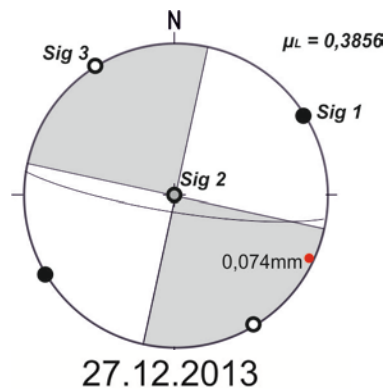
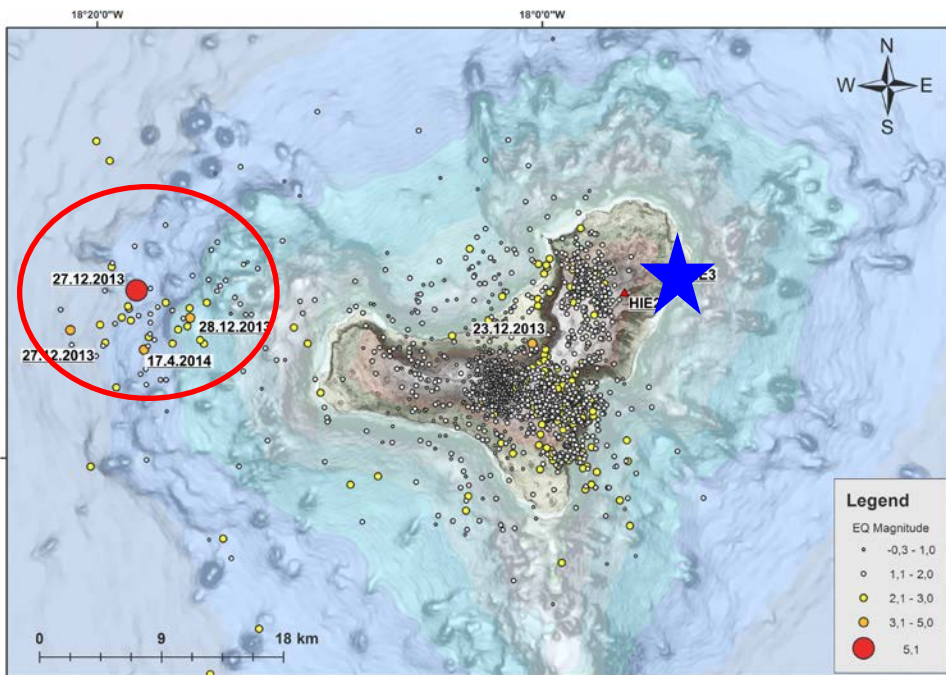
HIE1



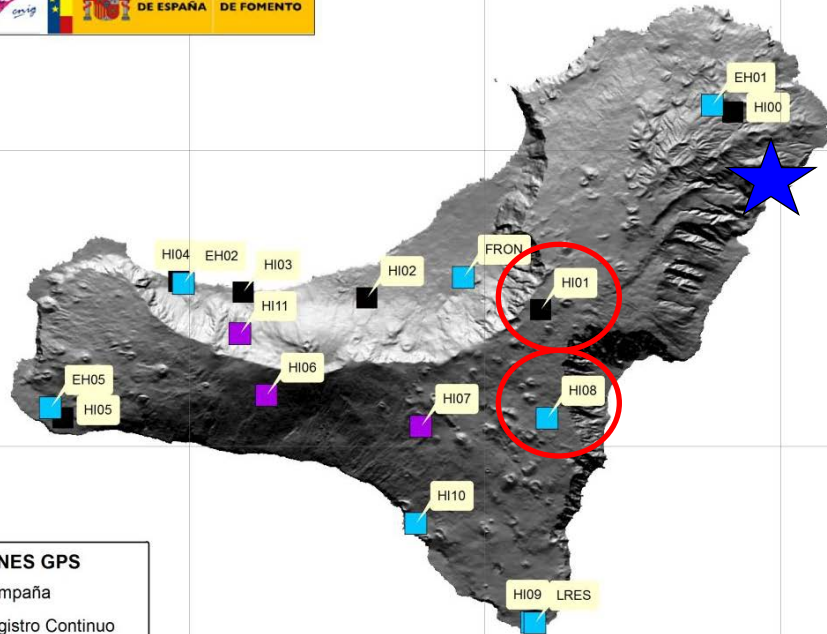
DETERMINATION OF STRESS TENSORS FROM TM71 DATA



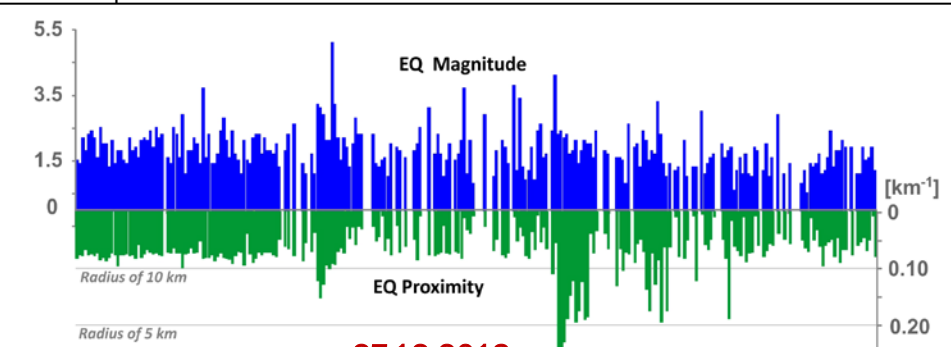
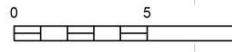
M5.1 EQ



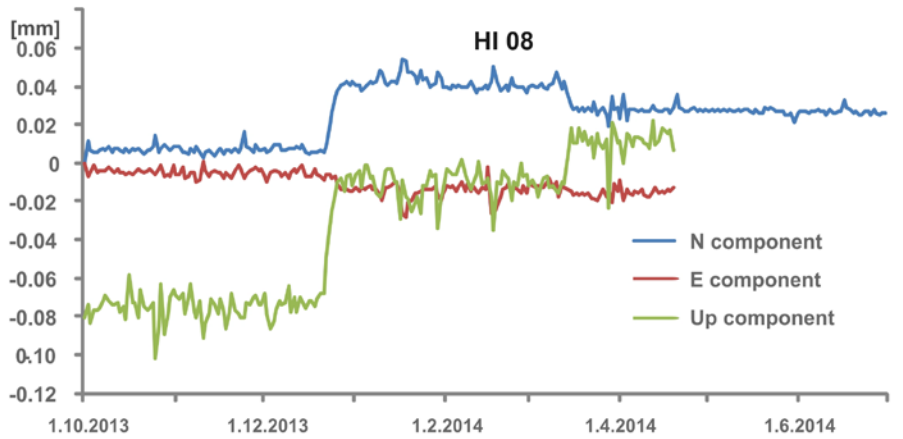
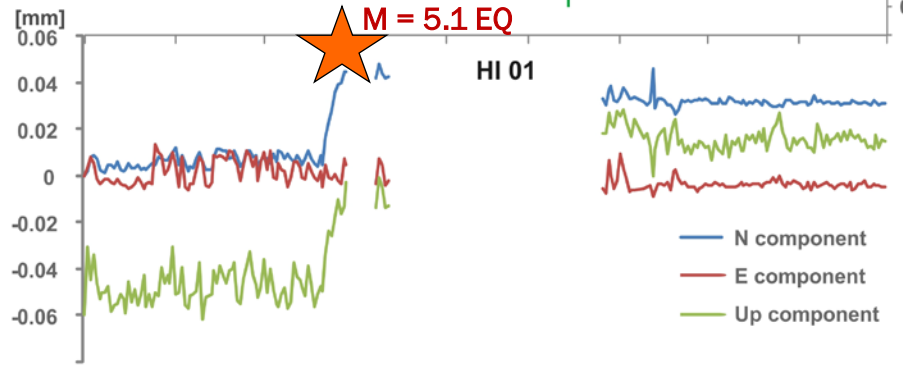
GNSS MEASUREMENT ON LEL HIERRO (IGN NETWORK)



- ESTACIONES GPS**
- Campaña
 - Registro Continuo
 - Retirada

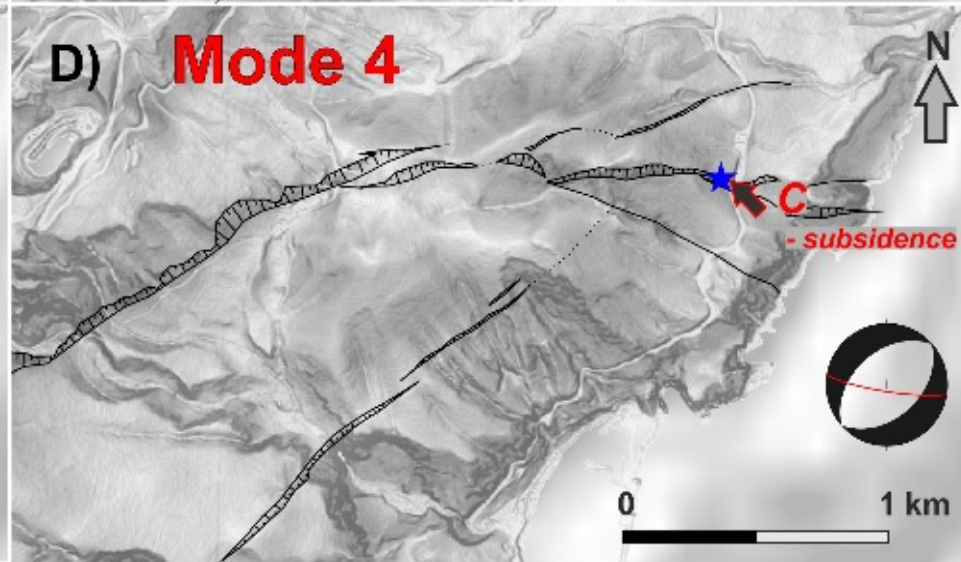
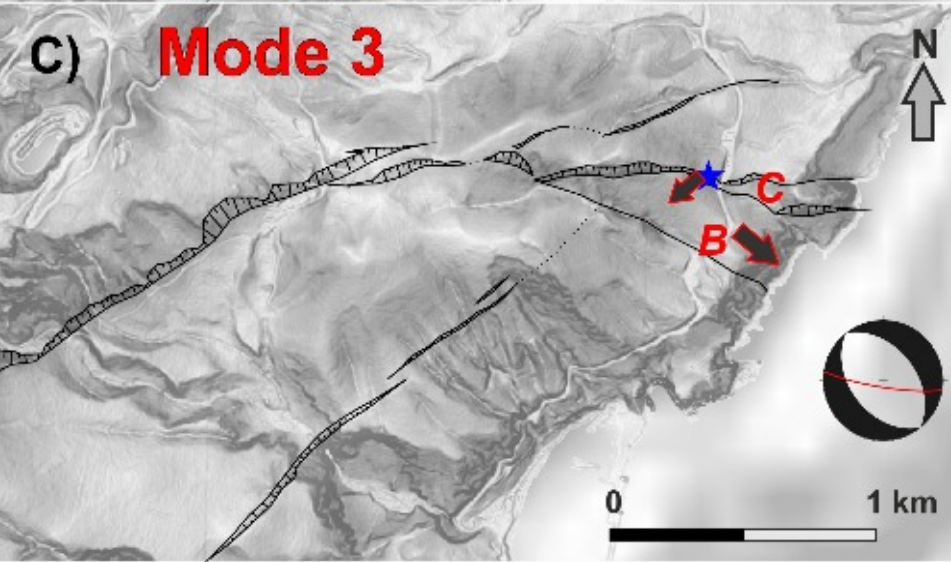
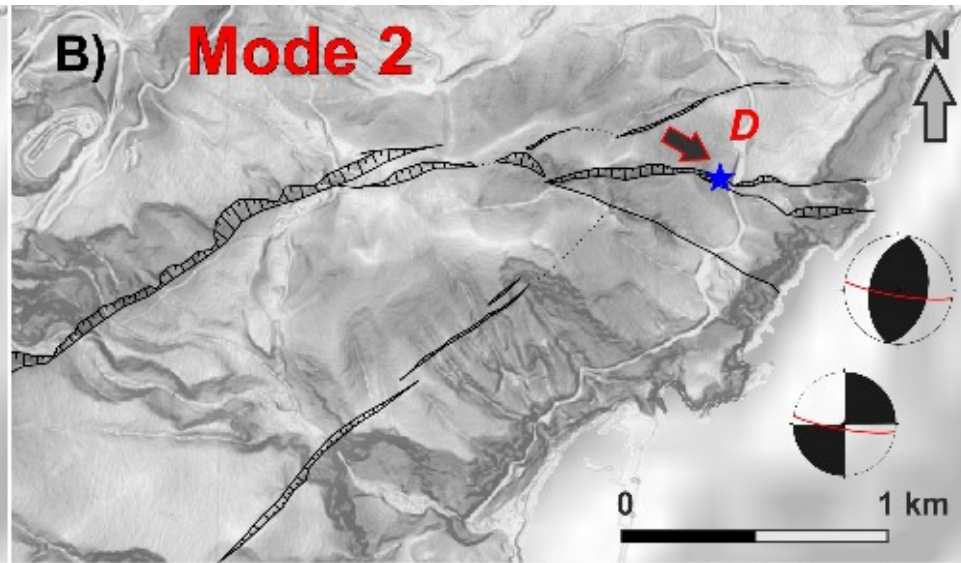
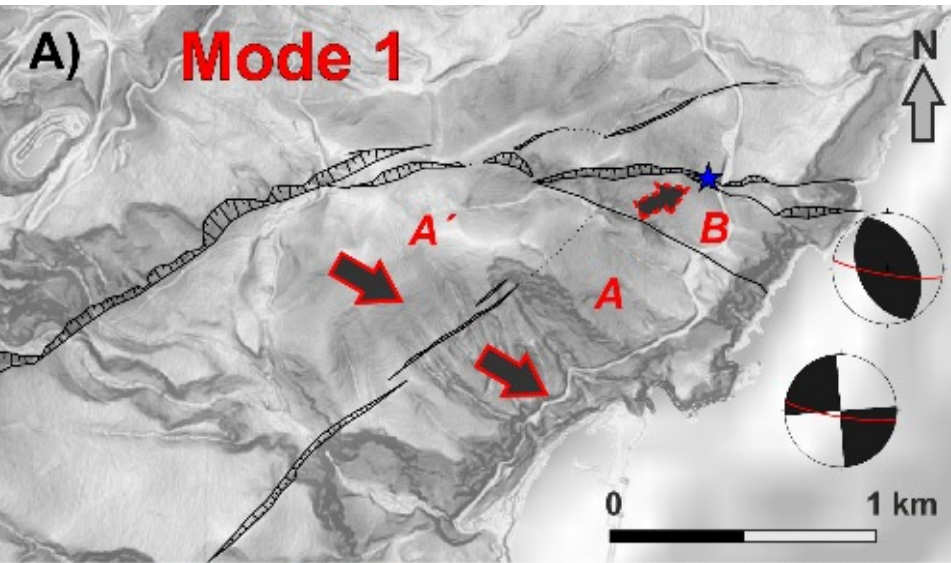


27.12.2013
M = 5.1 EQ

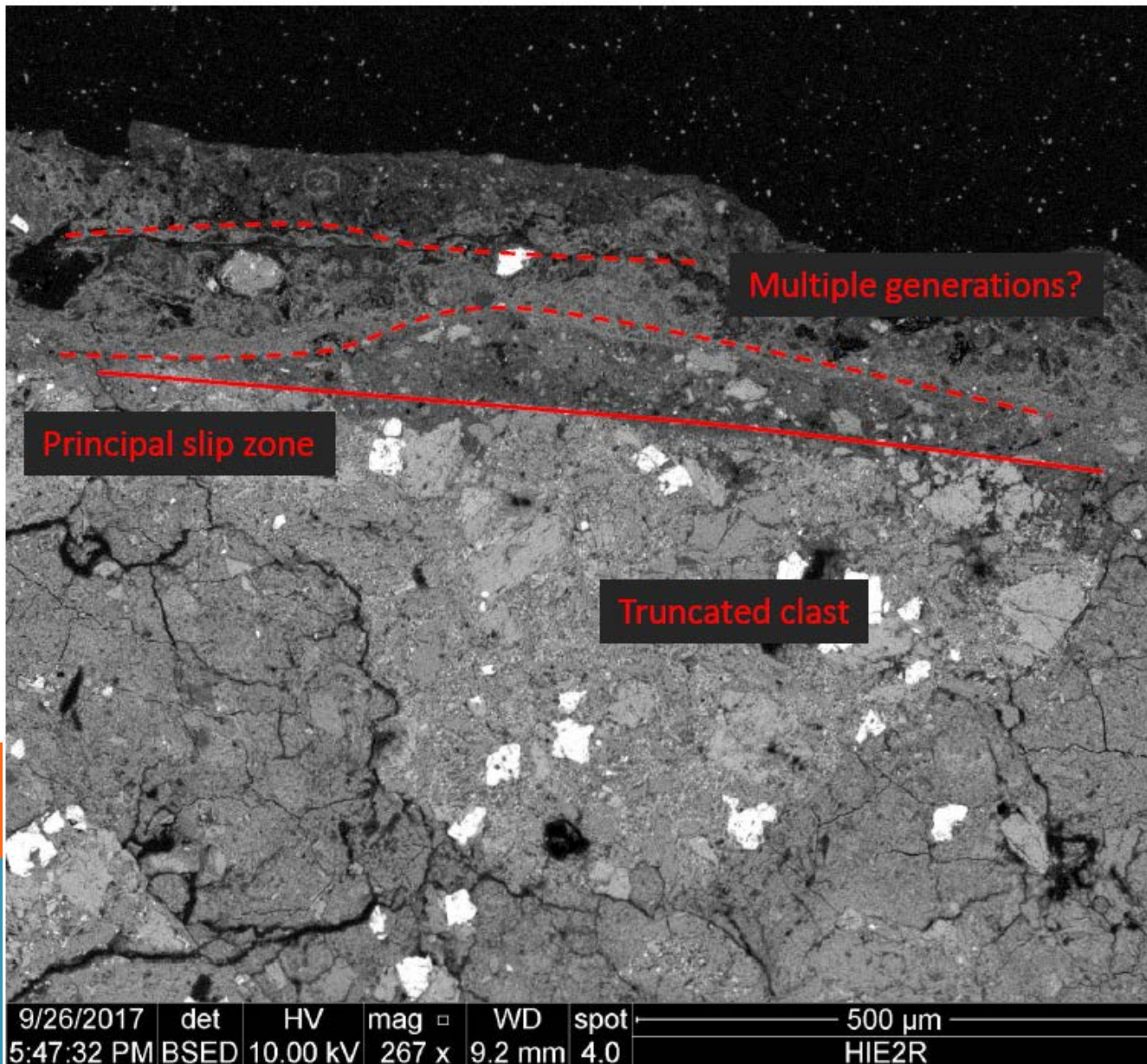


STATE O

FOUR MODES OF MOVEMENT ON HIE3 GAUGE



MICROSTRUCTURAL ANALYSIS OF HIE2 FAULT PLANE



CONCLUSIONS

- Recorded movements support the fault activity (detachment plane activity);
 - It is a sinistral strike slip (with morphological evidence) and right-hand rotation;
 - A new numerical technique for determining contemporary stress states from 3-D fault-movement data has been applied;
 - Stress is a key factor controlling DSGSD; knowing the internal stresses could be helpful for better understanding their evolution and activity;
 - Additionally, the role of contemporary regional tectonic stresses on DSGSD activation has been studied scarcely in the scientific community;
 - Microstructural analysis suggests multiple events rather than single slip.
-
- Were the other giant landslides mostly catastrophic or mostly creeping?
(confr. Hunt et al. 2013)

THANK YOU FOR YOUR ATTENTION!

