Local seismic networks WEBNET and REYKJANET – the tools to understanding of the W-Bohemian and SW-Icelandic earthquake swarms

in cooperation of

Institute of Geophysics and Institute of Rock Structure and Mechanics, Academy of Sciences of the Czech Rep.

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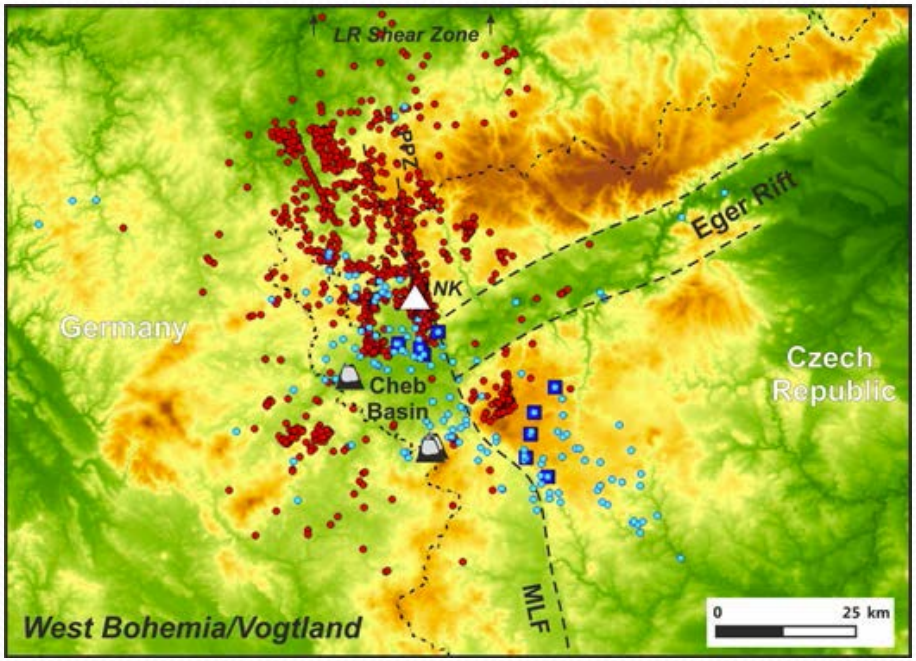
Why WEBNET?
(West Bohemia Network)

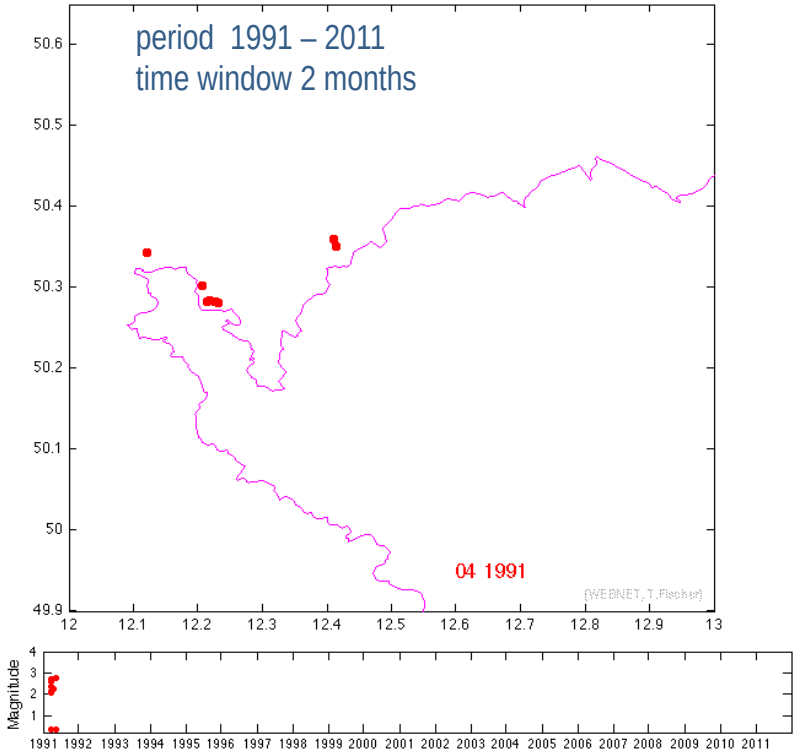
- W-Bohemia/Vogtland (Lat: ≈ 49.8°N to 50.7°N, Long: ≈12°E to 13°E) - an intraplate geodynamically active area

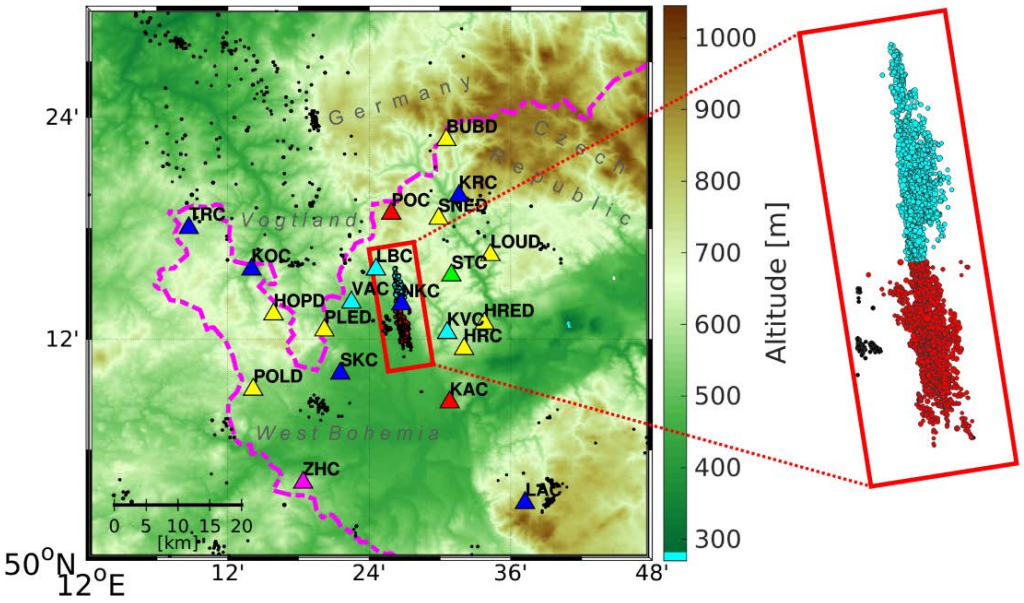
- earthquake swarms – specific type of seismicity
  sequences of seismic events closely clustered in space and time, without a single outstanding earthquake

The origin of earthquake swarms still unclear.

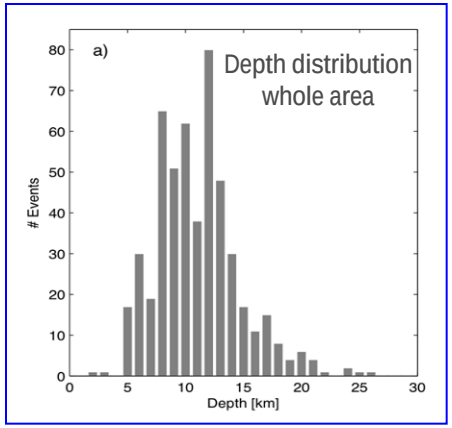


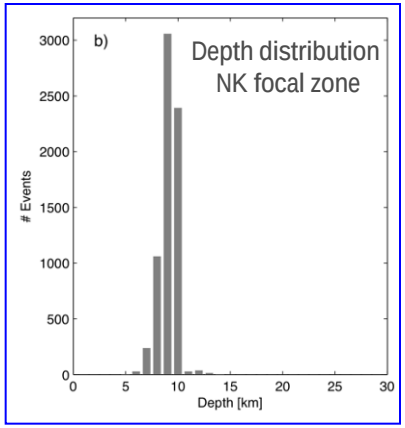
Space-time distribution of the W-Bohemia/Vogtland earthquake swarms





Swarm-like seismicity scattered in the area ≈ 40 x 60 km but ≈ 95% of seismic moment released in the Nový Kostel (NK) focal zone.





Focal depth:

5 - 22 km in the whole area,

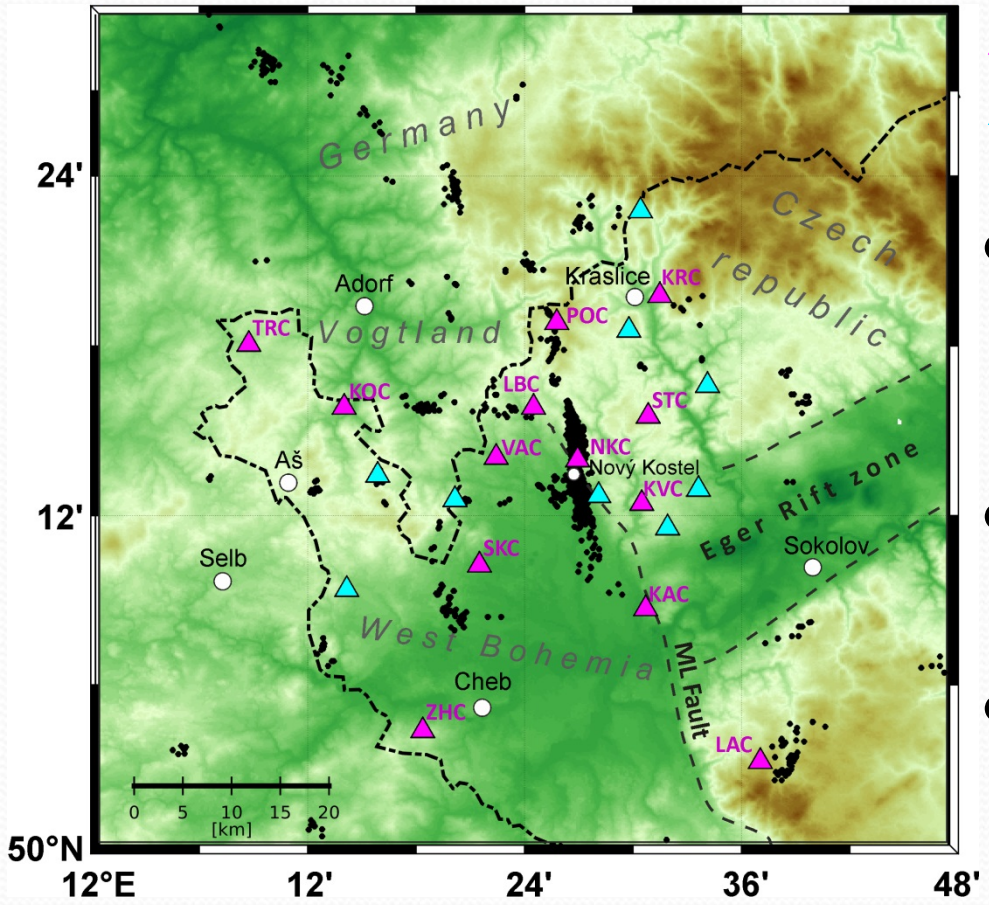
7 - 13 km in the NK zone.

However, focal depths between 7 and 10 km prevail in the whole area.

Basic characteristics of significant WB/V seismicity

	Duration [days]	*Total number of ev.*	*Number of located ev. (NLLoc)*	*Characteristics*	*ML_{max}*
1985/86	70	8000 M_L>0.5	-	swarm	**4.6**
1997	20	1 800	1 150	swarm	3.0
2000	125	25 000	3 170	swarm	3.2
2008	70	25 000	3 880	swarm	3.8
2011	120	> 25 000	4 160	swarm	3.7
2013	20	1 500	200	mini-swarm	2.5
2014	14	4 000	800	3 mainshock-aftershocks sequences	3.6 **4.4** 3.5
background: 1997-2014	-	8000	6 200		2.0

Distribution an parameters of the WEBNET stations



▲ BB networked stations

▲ SP autonomous stations

- WEBNET:
  12 BB networked and
  10 SP autonomous 3C stations
- records proportional to the ground velocity
- frequency band:
  0.03-80 Hz for the BB stations
  1.0-80 Hz for the SP stations
- sampling rate: 250 Hz.

Area covered by stations
≈ 900 km^2

WEBNET - instrumentation and data

BB stations:

Sensors: Güralp CMG3-ESP, T_0 = 30s, f_{LP} =100 Hz
Data acquisition systems: Centaur by Nanometrics
Connected to Internet by WaveLan and/or satellite telemetry

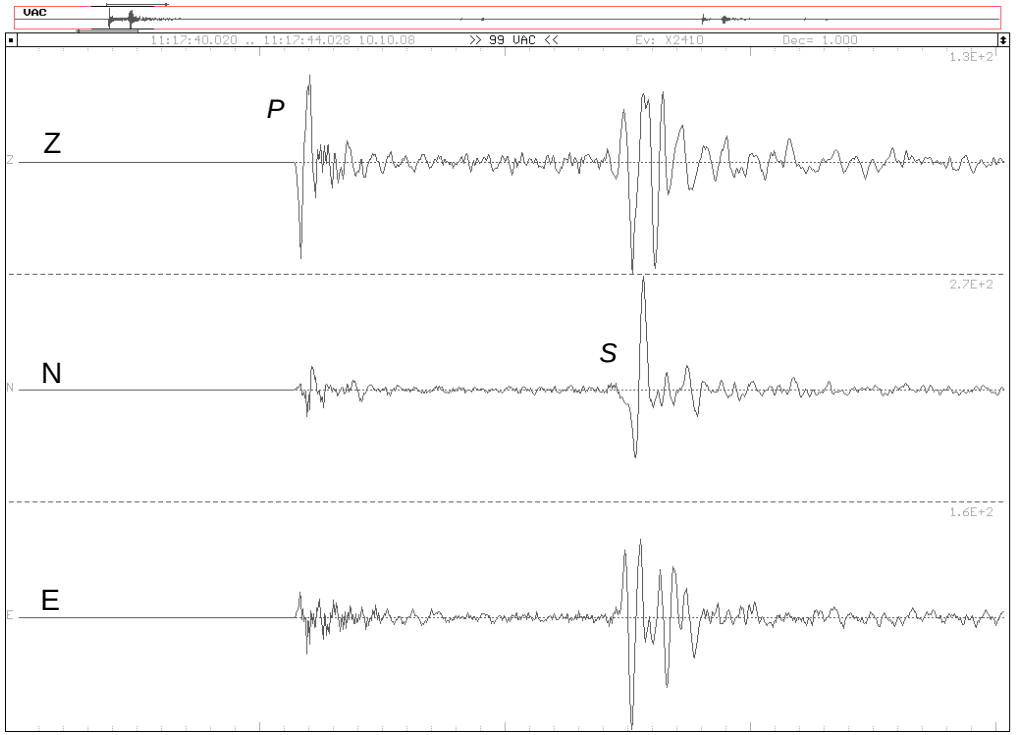
SP stations:

Sensors: Lennartz LE3-D, T_0 = 1s, f_{LP} = 80 Hz,
Data acquisition systems: Gaia II, by Vistec (domestic provenience)
Recording media: SD cards
data downloaded once in 2 months or if needed

All the stations operated in continuous mode

Data format: miniSEED
Data stored on data server SILO,
Date access: catalogs available on Internet
seismograms on reques.

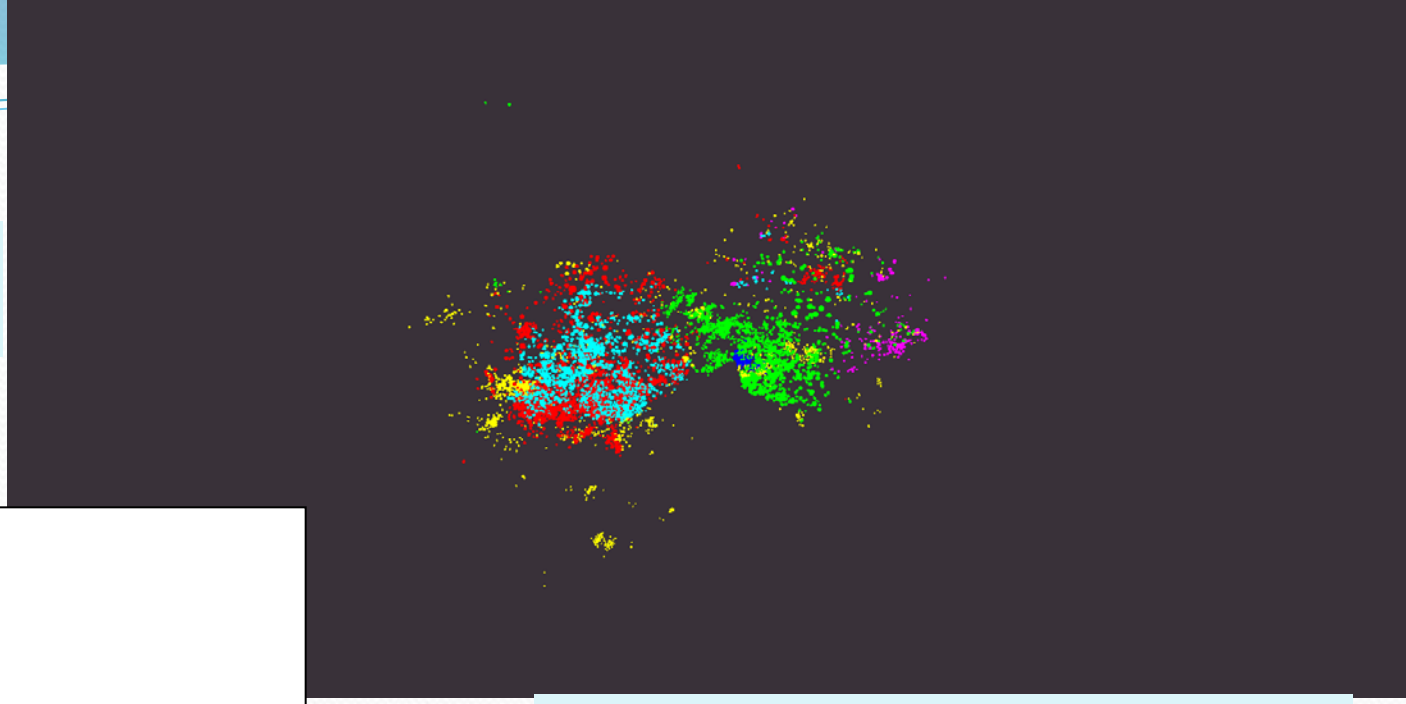
WEBNET stations and typical seismogram

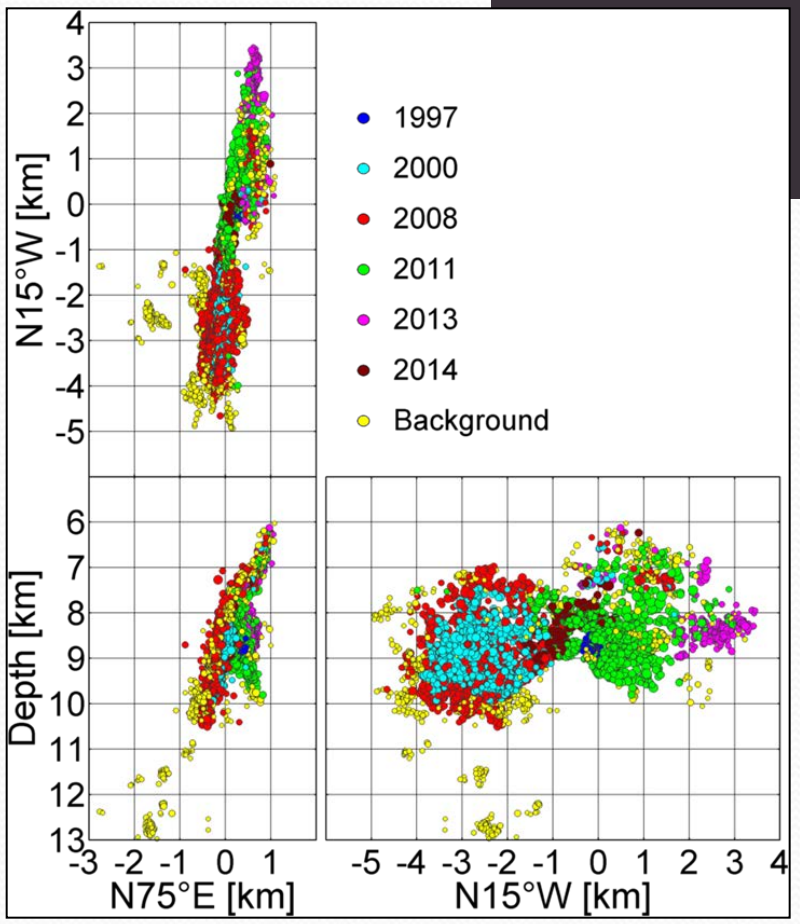


The use of the WEBNET data:

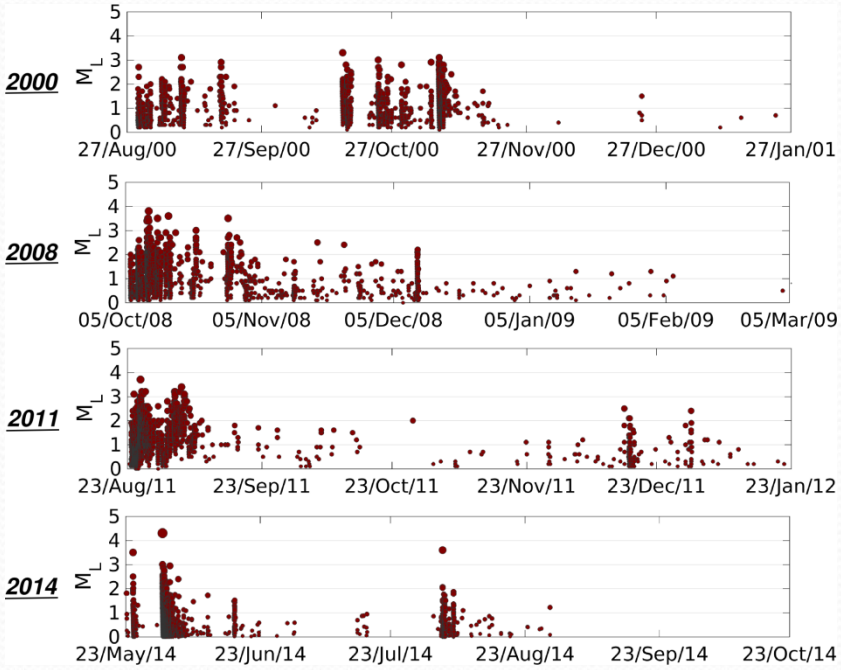
- in about 70 scientific papers published in impacted geophysical journals
- 2 PhD theses – defended
- 3 PhD theses – in progress
- 5 diploma theses

Spatial distribution of the swarms





Temporal development of the swarms

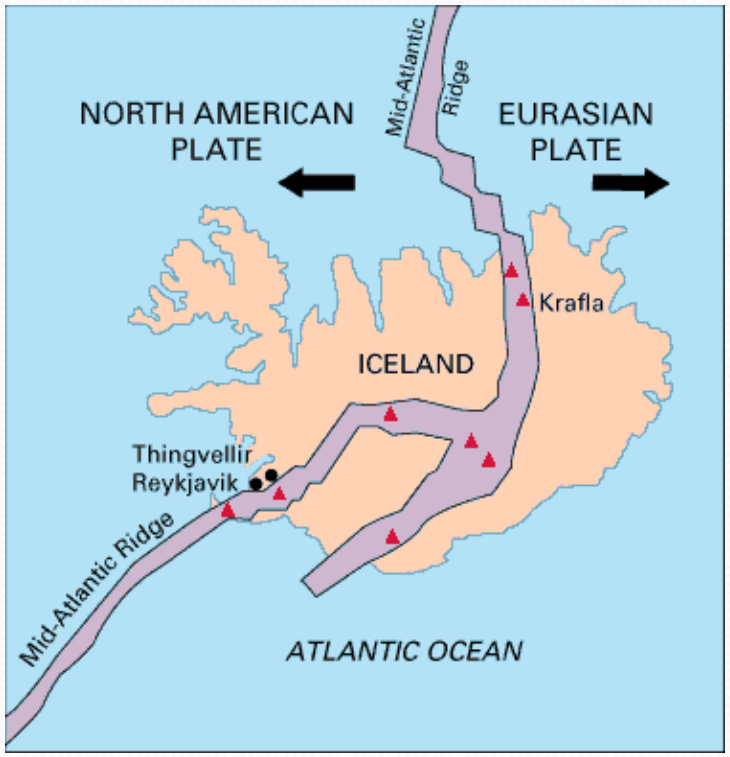


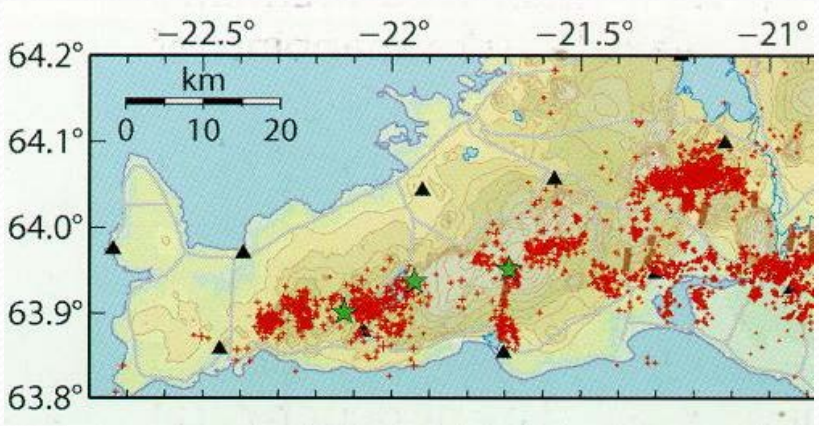
Why REYKJANET?
(Reykjanes Peninsula Network, SW Iceland)

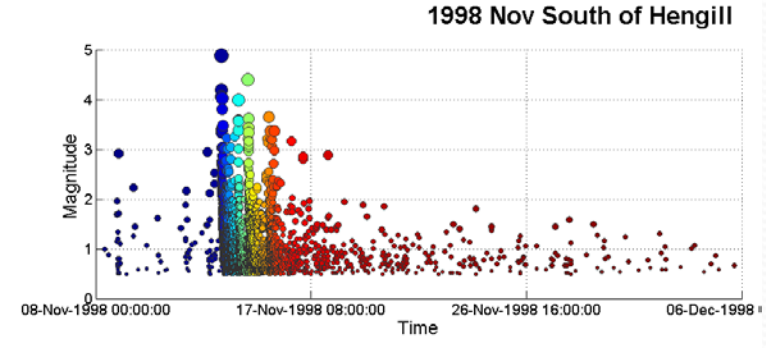
Reykjanes Peninsula: (Lat: ≈ 63.8°N to 64.1°N, Long: ≈21.5°W to 22.3°W)

- onshore continuation of the Reykjanes Ridge which is a part of the mid-Atlantic Ridge

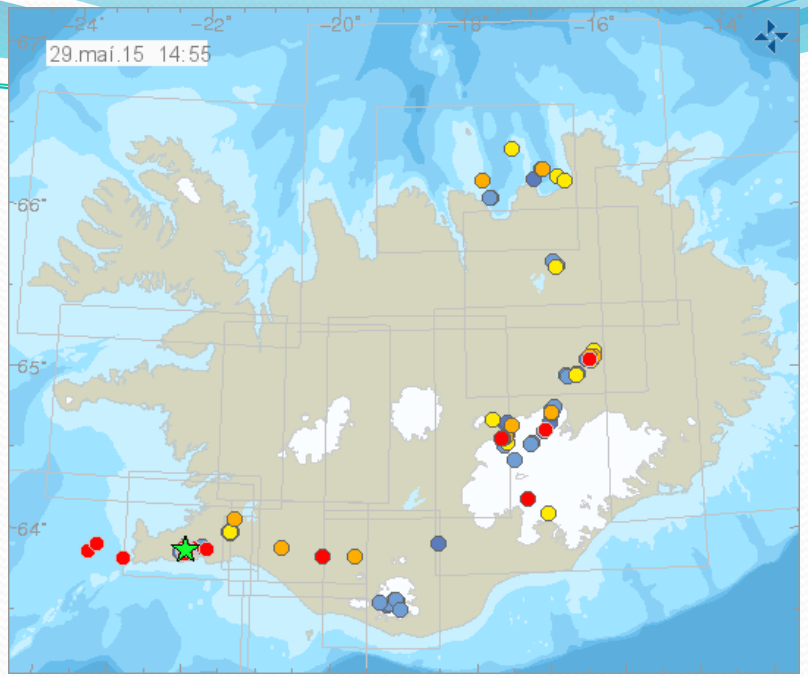
- swarm-like seismicity at a contact of lithospheric plates
  earthquake swarms – up to magnitude M_L = 5+ Iceland

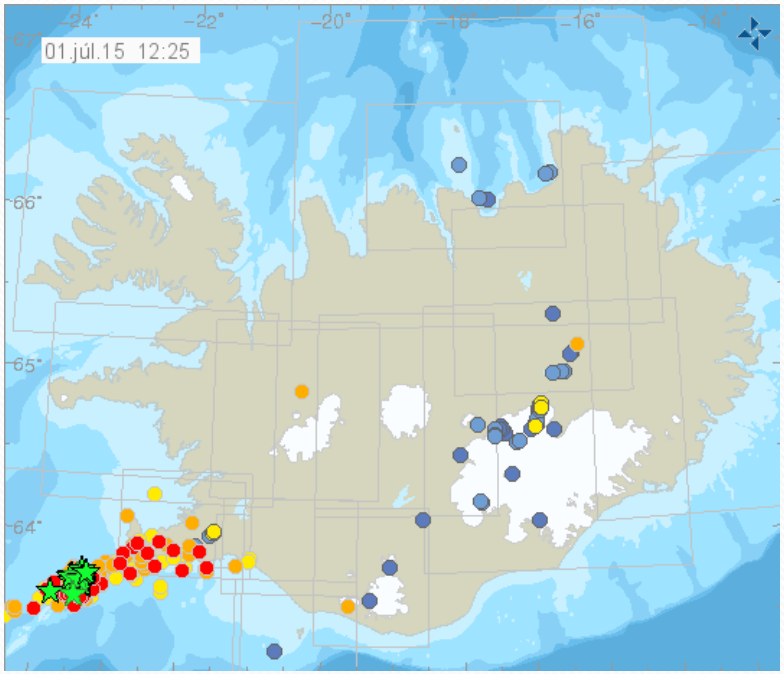


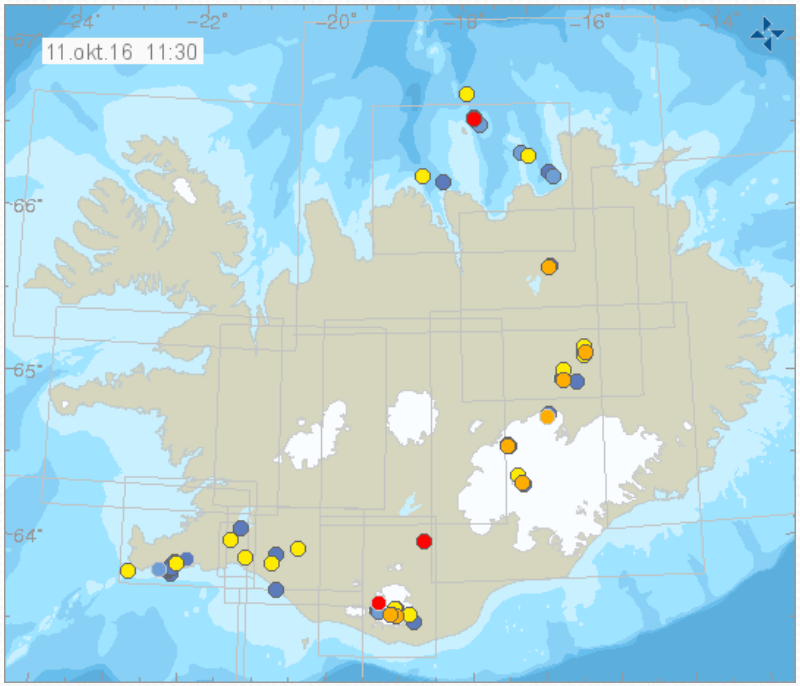




Iceland - the mid-Atlantic ridge exposed above sea level.
It is one of only a few places on the Earth where an oceanic spreading centre rises above sea level.
Seismic activity concentrated along the ridge





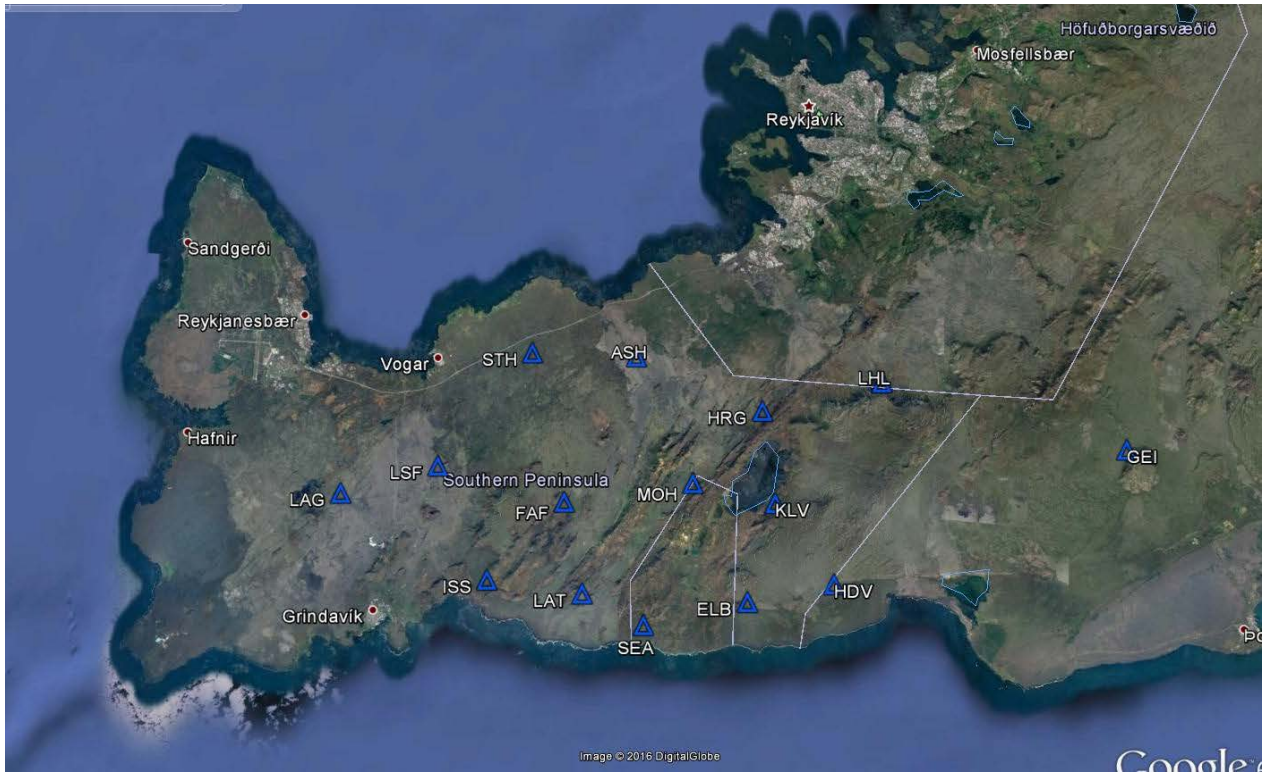


Basic characteristics of the Reykjanes Peninsula, SW Iceland

- Plate motion rate ≈ 20 mm/year in E-W and ≈ 5 mm/year in N-S.
- Interaction between volcanic and tectonic activity.
- Most of the Reykjanes Peninsula surface covered by lava.
- The largest recent swarms: *Mw* = 5.9 in 2000, *Mw = 5.3* in 2003, *Mw* = 5.0 in 2013.
- At the present time the seismicity is of diffused character along the plate boundary.
- High fluid activity - many fumaroles and geothermal systems
- Brittle/ductile transition at about 7 km depth, temperature of at least 650°C.
- Magmatic activity occurred at intervals ≈ 1000 years; the latest eruptive period ended in 1240 AD.

Typical relief of the Reykjanes Peninsula

Distribution an parameters of the REYKJANET stations



Built up:
September 2013

Area covered by
the REYKJANET stations:
≈ 60 km x 20 km

- 14 BB and 1 SP autonomous 3C stations
- records proportional to the ground velocity
- frequency band: 0.03- 80/50 Hz for the BB stations
  1.0-80 Hz for the SP station
- sampling rate: 250 Hz.

REYKJANET - instrumentation and data

14 BB stations:

Sensors: Güralp CMG 40-T, T_0 = 30s, f_{LP} = 100/50 Hz

1 SP station:

Sensor: Lennartz LE3-D, T_0 = 1s, f_{LP} = 80 Hz

Infra-sonic sensors at 7 stations: micro-barographs ≈ 0 – 25 Hz

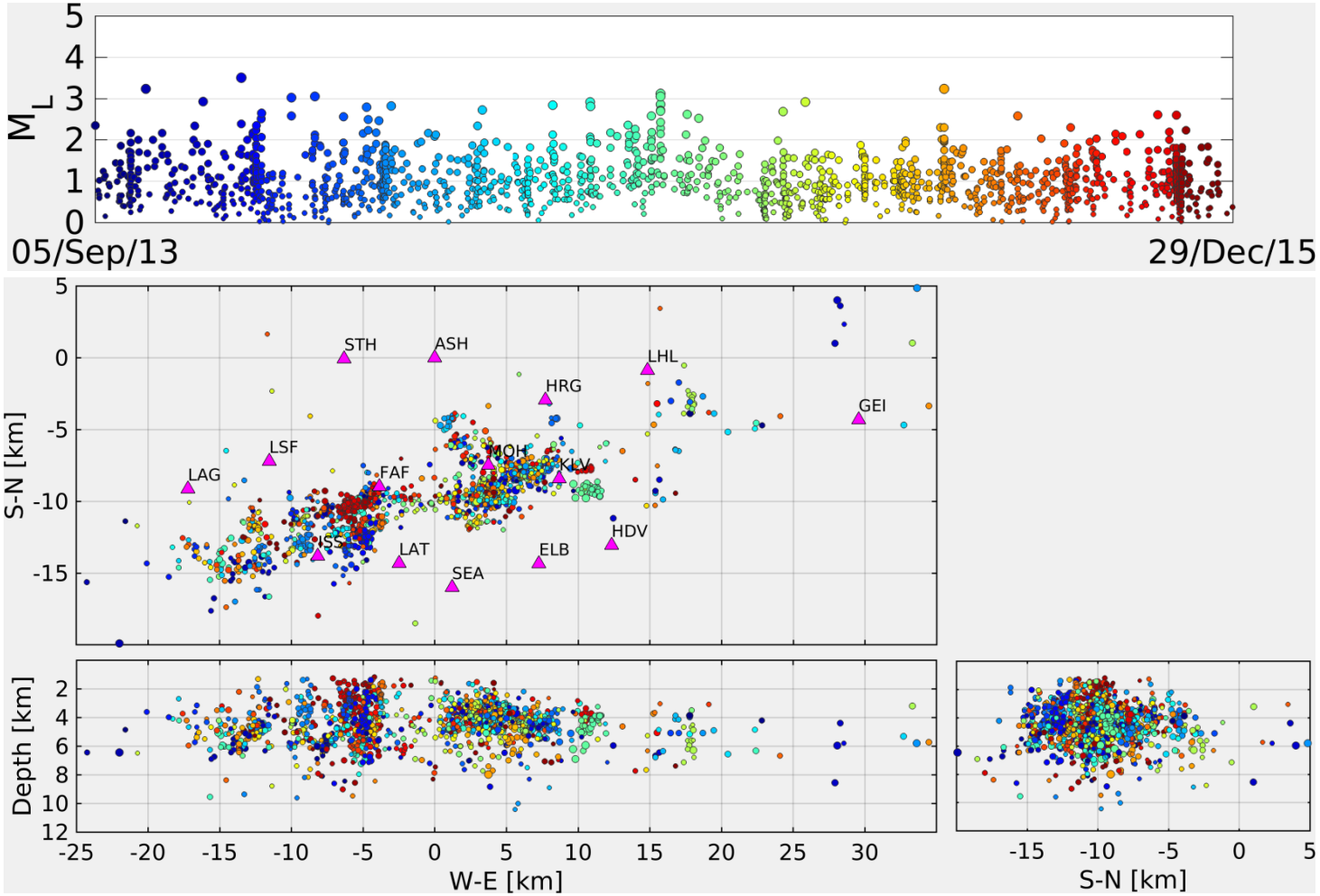
Data acquisition systems: Gaia I, III, by Vistec (domestic provenience)
Recording media: SD cards, data downloaded once in 3 months
All the stations operated in continuous mode

Power supply: solar panels – air turbine

Data format: miniSEED
Data stored on data server SILO
Date access: seismograms on request

Expert and technical support: Iceland GeoSurvey - ÍSOR
Icelandic Meteorological Office - IMO

Space-time distribution of seismicity on the Reykjanes Peninsula, period September 2013 – December 2015



Diffused „swarm-like“ seismicity along the rift, M_{Lmax} = 3.6

REYKJANET station KLV