Introducing our passive seismic monitoring system through a detected earthquake in the vicinity of Szederkény, in Mecsek

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Contents

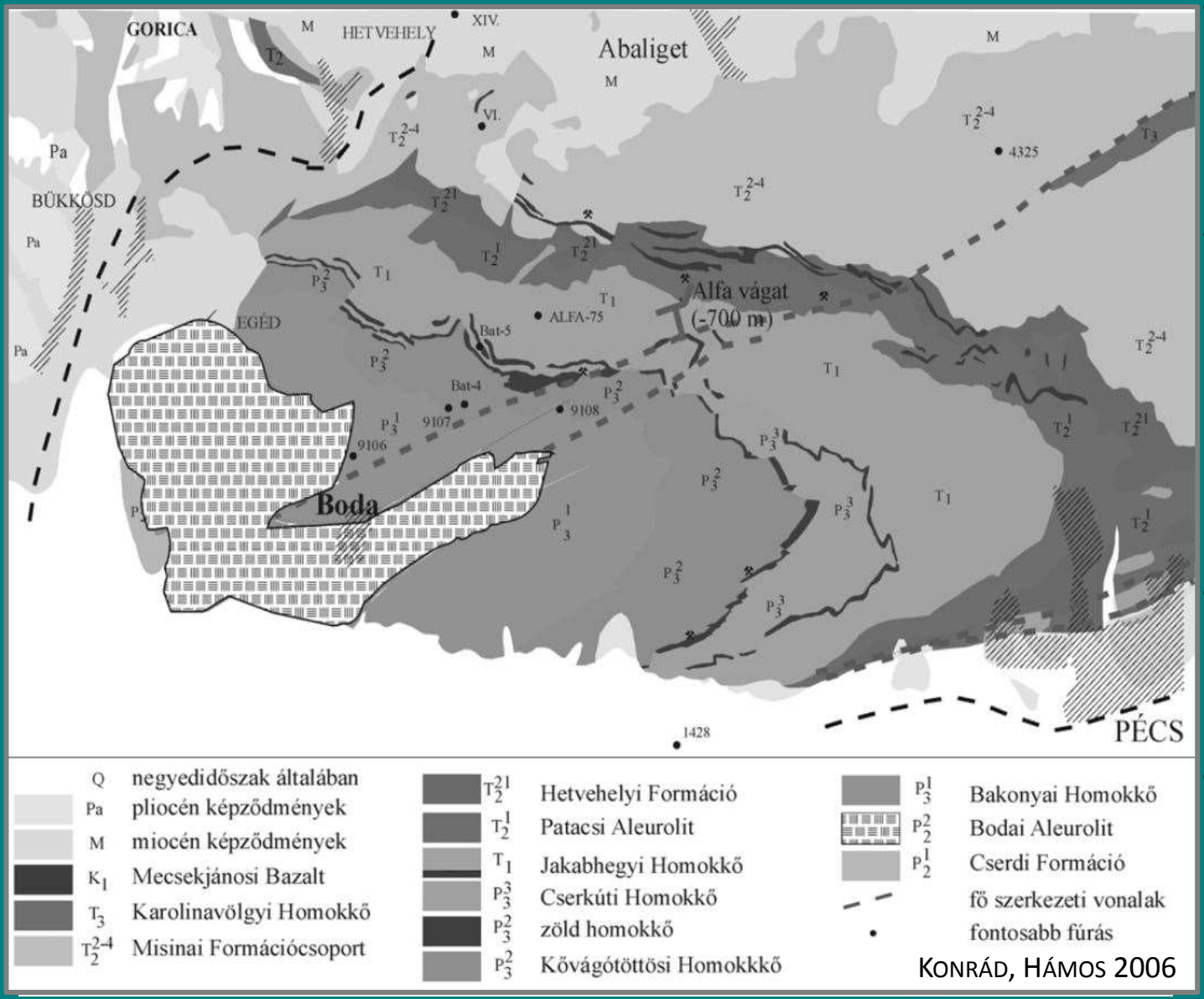
I. Introduction

- In 2004, the MECSEKÉRC ZRt. contracted with **Eötvös Loránd Geophysical Institute** (present Geological and Geophysical Institute of Hungary) to make geophysical investigations:

  - the project focused on the designation of suitable place/places in a geological reservoir for the long-lived **radioactive wastes**, which have high activity as well as **dead fuel elements**.

Locating and operating a SEISMOLOGICAL MONITORING SYSTEM to observe the seismic events which emit from the recent motion of tectonic zones.

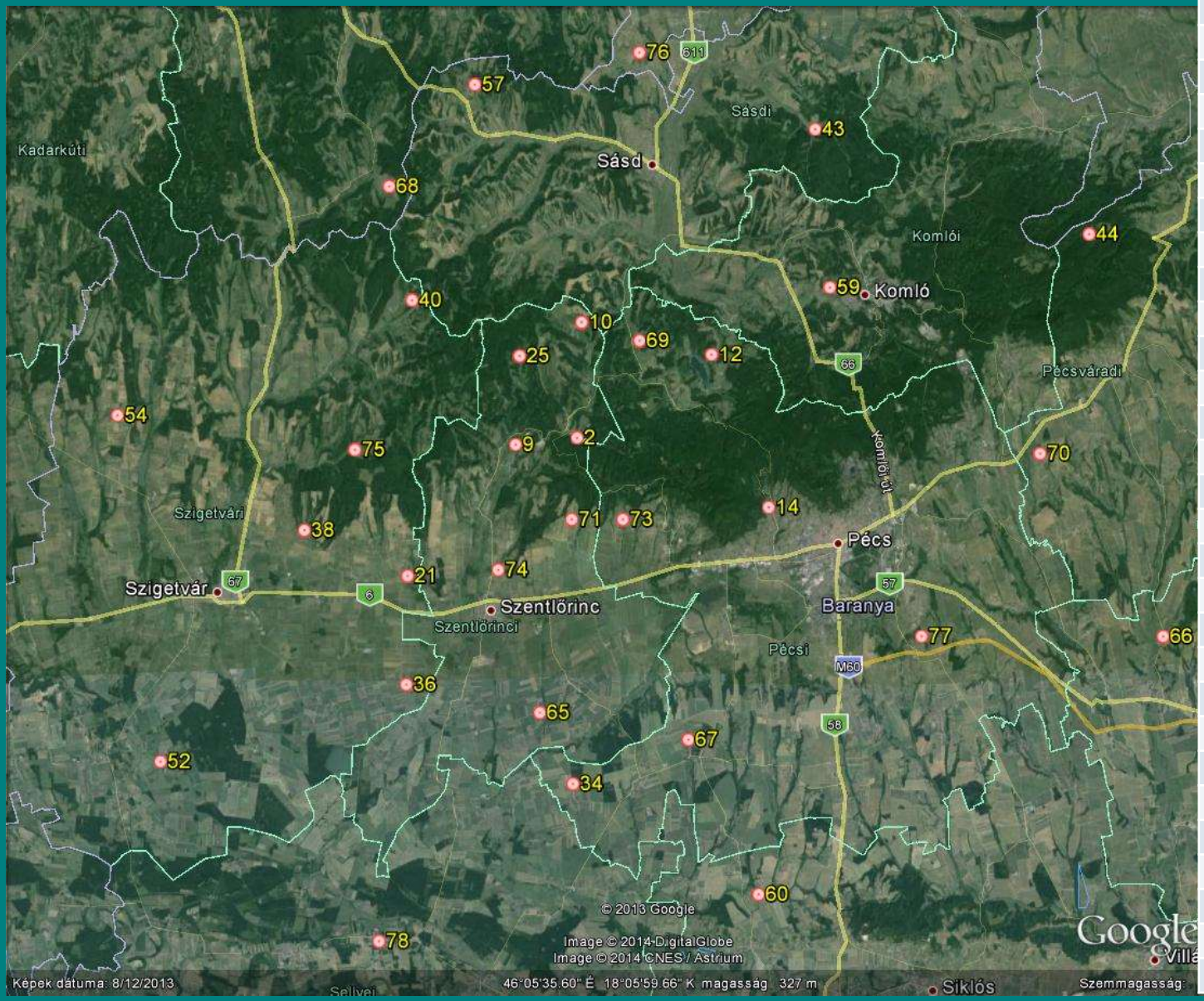
II. Geological setting



KONRÁD, HÁMOS 2006

- Our monitoring system firstly focused on the vicinity of Boda Aleurolit Formation
- Age: Upper-Permian, Extent: 150 km^2, Thickness: nearly 1000 m, builds up homogenous, good waterproofing and isolation capability formations
- Tectonical movements are younger than 9 million years
- Southern border is Mecsekalja line, northernmost occurence came from some wells

III. Location of the measured area



	Number and Location of the stations
2	Hetvehely
9	Bükkösd
10	Szentkatalin - Karácodfa
12	Orfű - Mecsekszakál
14	Pécs
21	Nagyváty
25	Hetvehely - Kán
34	Téseny
36	Szentdénes
38	Szigetvár - Zsibót
40	Csebény
43	Kisvaszar
44	Óbánya
52	Bürüs
54	Diószpuszta
57	Gödre
59	Komló
60	Szava
65	Gerde
66	Máriakéménd
67	Görcsöny
68	Gálosfa-Kistótváros
69	Husztót
70	Martonfa
71	Boda
73	Bakonya
74	Szentlőrinc-Szőlőhegy
75	Almáskeresztúr
76	Jágónak
77	Kozármisleny
78	Csányoszró

IV. Field measurements

- **Autonom seismic data loggers**

ELGI development

- Modern electronic technology
- Wide variety of applications
- Increasing memory capacity
- Continuous GPS time base synchronization
- Small size, light weight, easy utility
- Acceptable costs which enables the massive applications

-The facility of the stations: geophone, data logger, GPS,

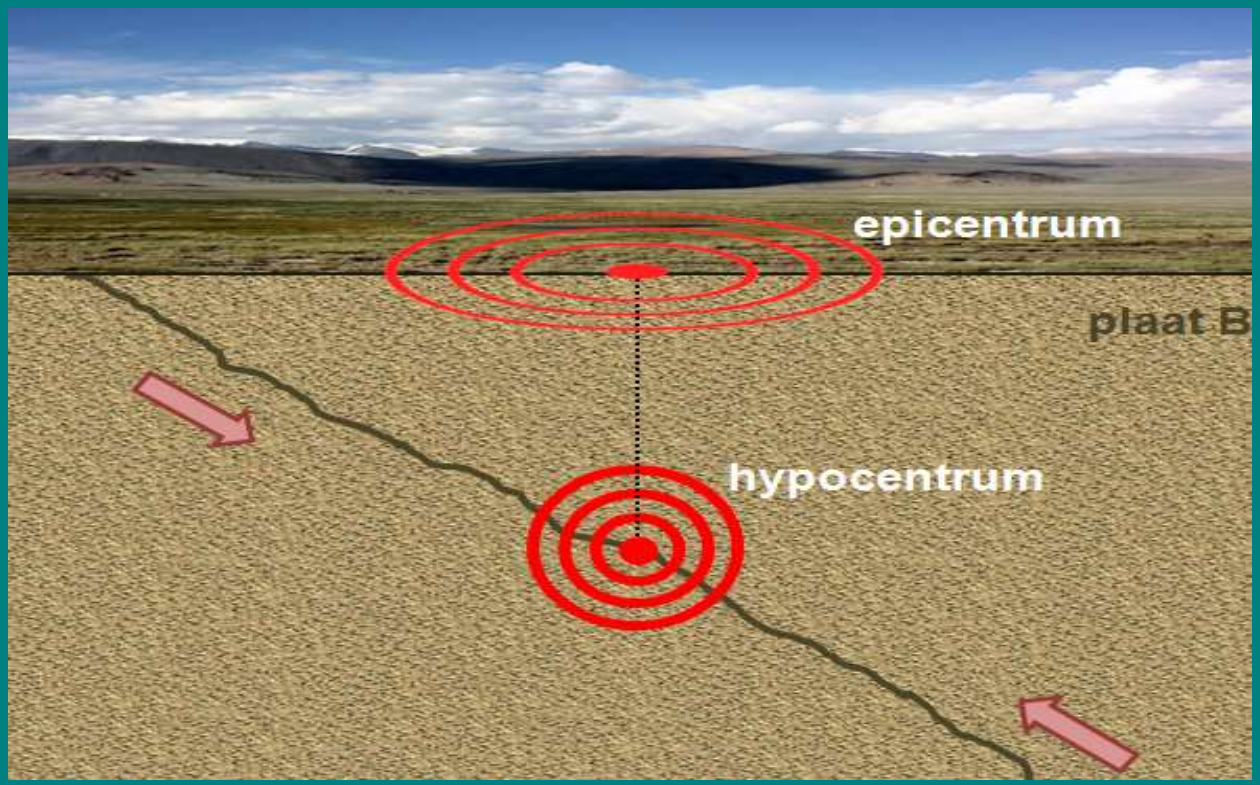
- Sample interval: 10 ms

-Collect data in every month (4 GB data)

V. Basic concepts

The **magnitude** is an arbitrary number proportional to the size of the event (energy released, maximal recorded amplitude) in logaritmic scale, if the register is the standard Wood-Anderson seismograph at an epicentral distance of 100 km.

$$M = \log\left(\frac{A}{T}\right)_{max} + f(\Delta, h) + c_f + c_s$$



A – amplitude of ground displacement (max)

T – wave period (related to the max amplitude)

f(Δ,h) – distance correction function (seismic absorption and scattering)

Δ – epicentral distance

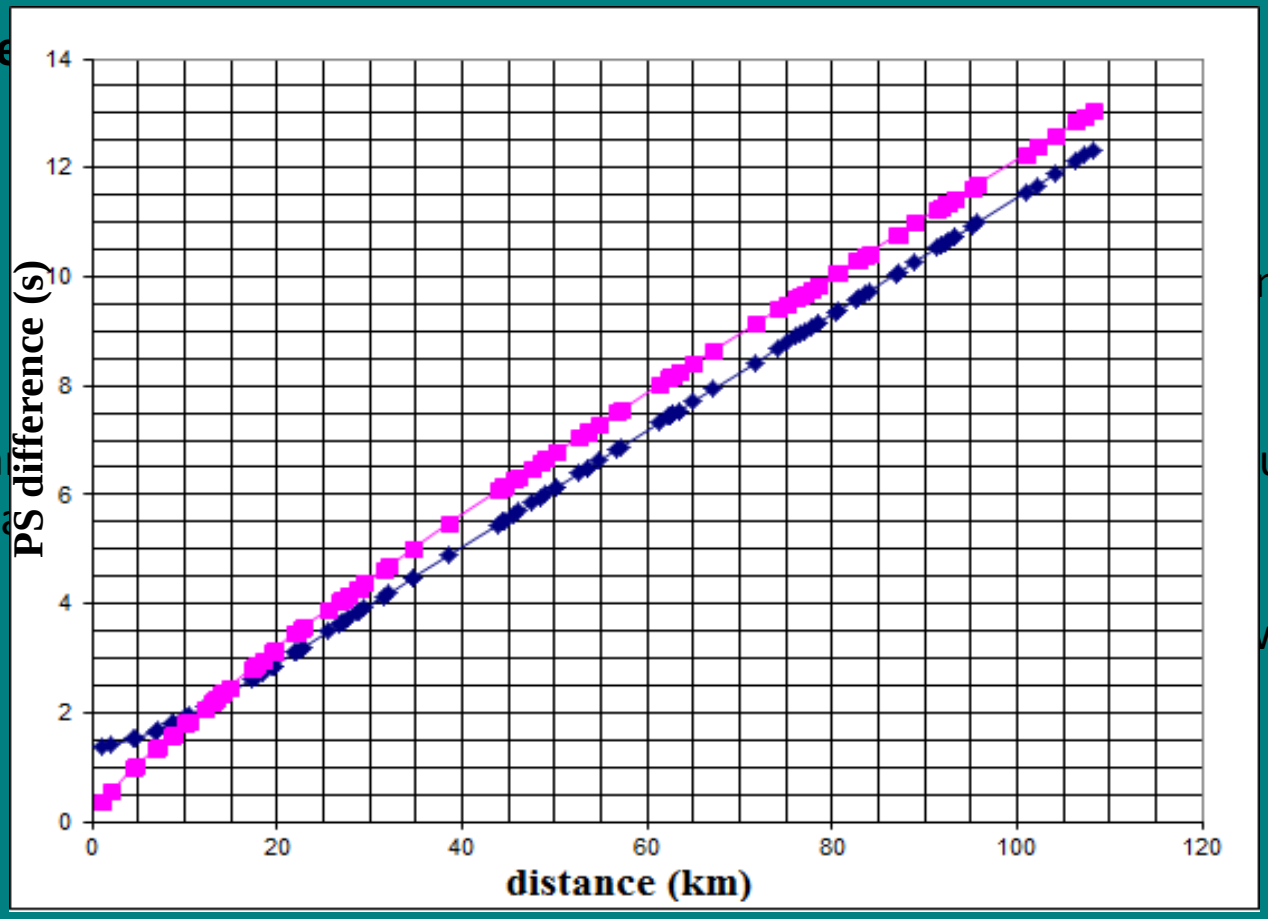
h – hypocentral depth

c_f - correction refers to the vicinity of the station

c_s - correction refers to the vicinity of the hypocentrum

VI. Data processing

- **Conve**



noise's level

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- We ca

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noise a

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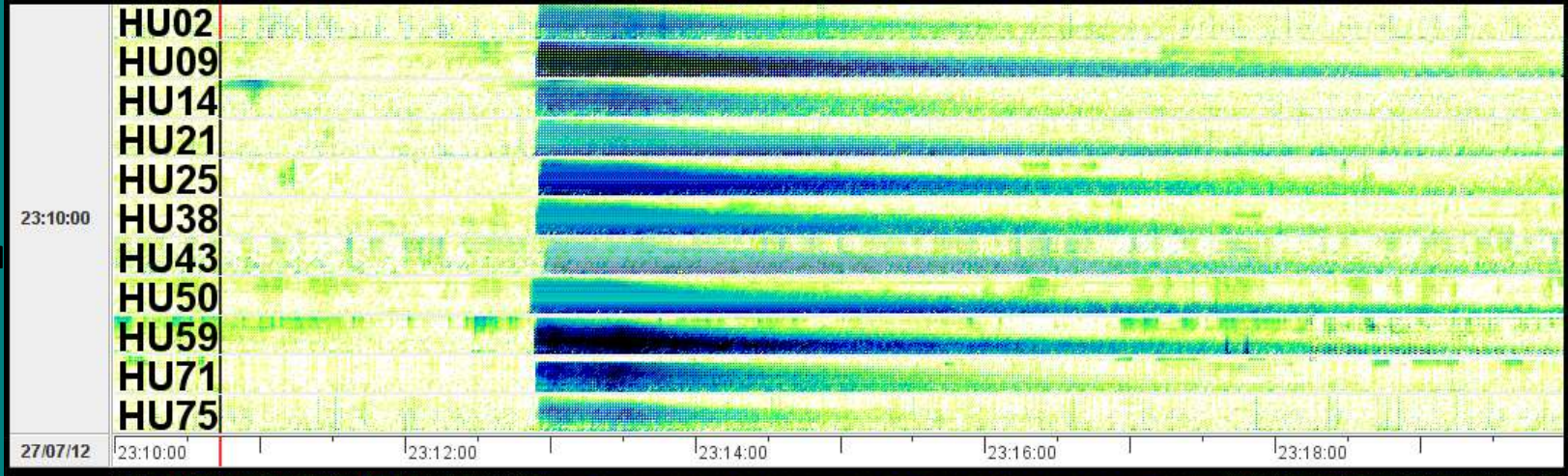
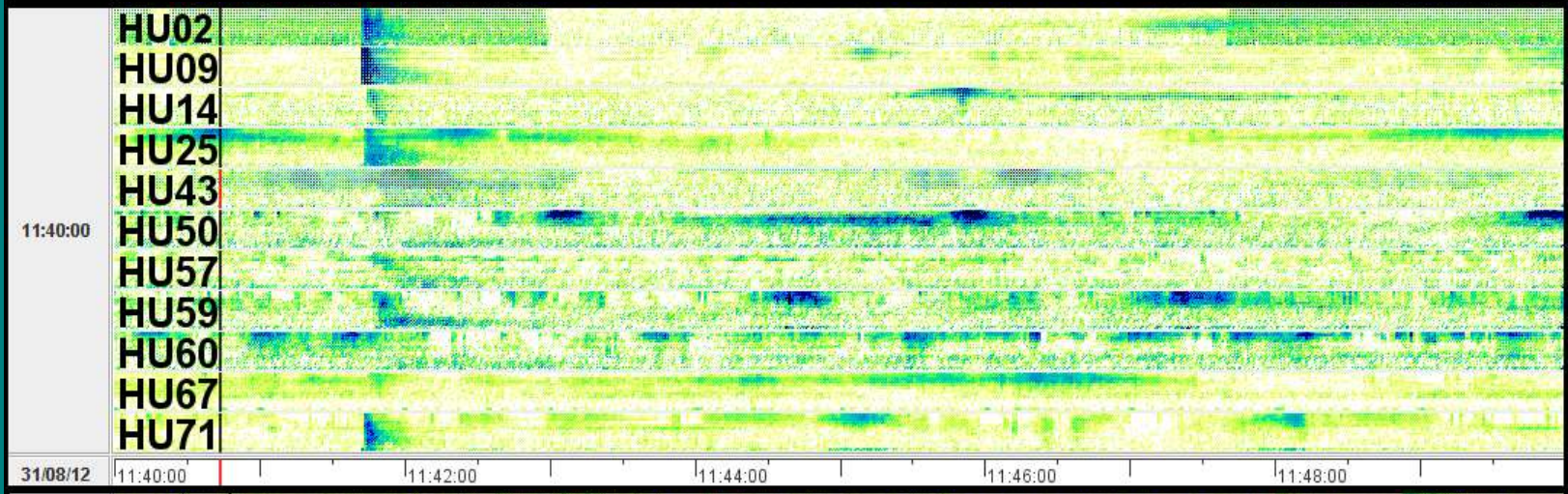
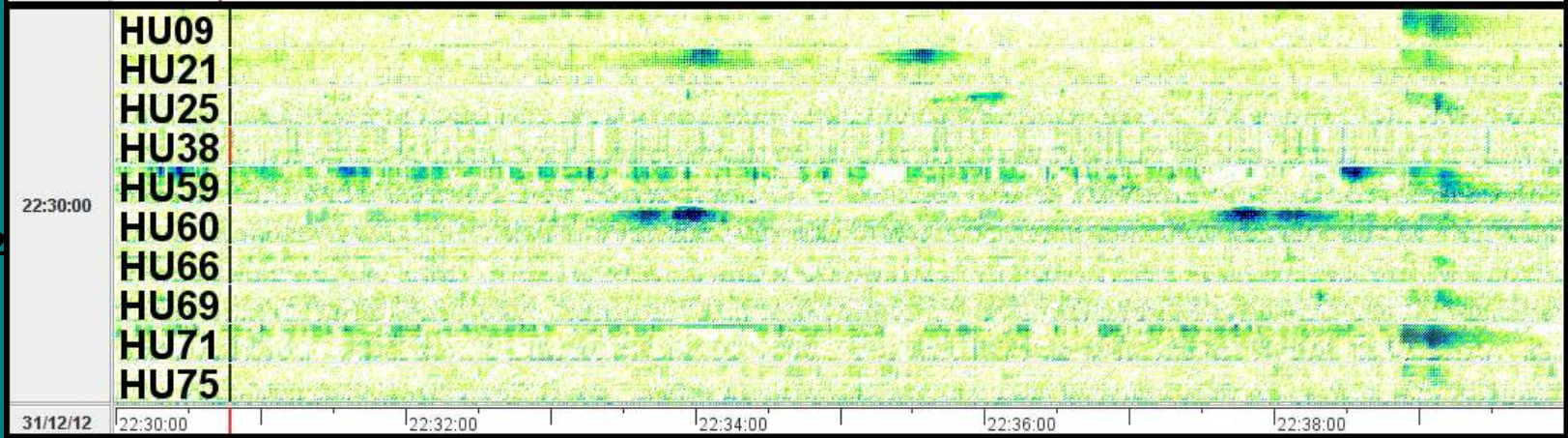
Bosnia-Herzegovina 4,8 M
27 July 2012



Bükkösd explosion
31 August 2012



Close earthquake
31 December 2012



VI. Data processing

- **PQL** program: the exact wave incidence in time of the selected seismic event can be read

- **Hypoline** program:

    - Calculate **Hypocentrum and time of the event**: we use more stations (min 6 phase or 4 stations)

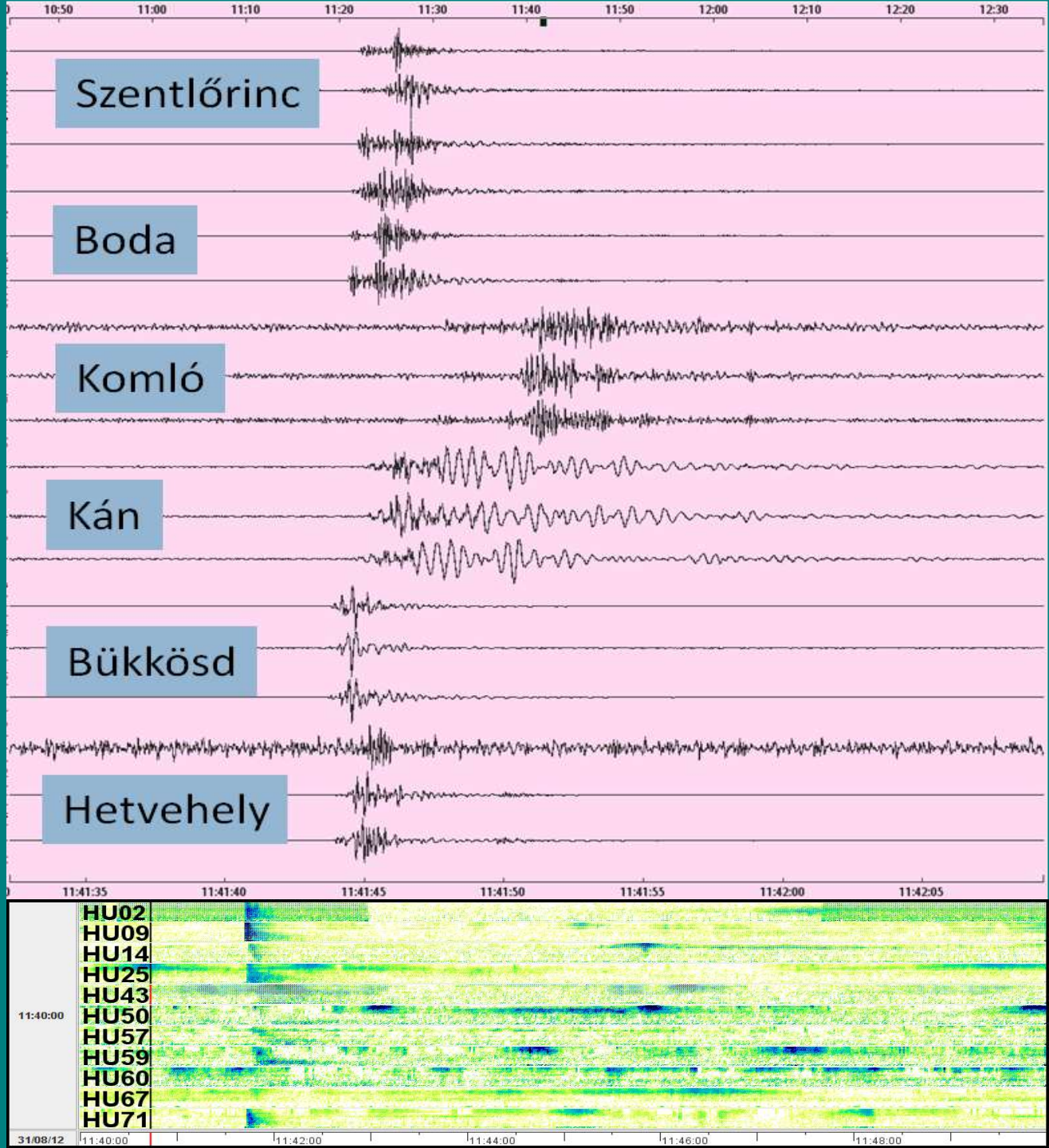
    - The territory is written by horizontal layered model (7 layer)

    - The applied velocity functions in the model were derived from the seismic lines which cross the examined area

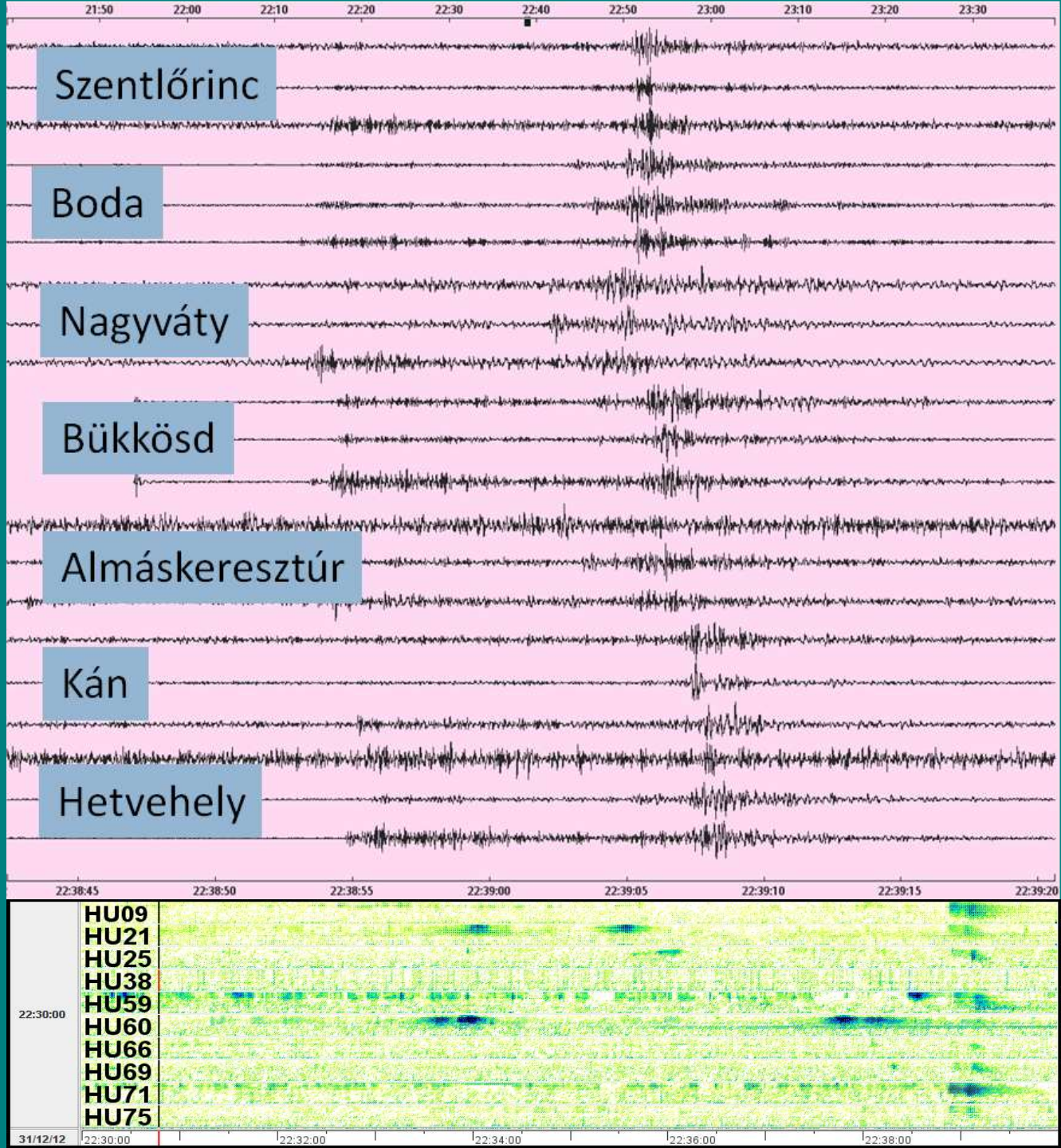
    - Detect **magnitude**

    - The sensitivity of the system is magnitude -1
    - The lateral accuracy is in half km

Bükkösd explosion
31 August 2012



Close earthquake
(PS distance 10s)
31 December 2012



VII. Validation

- Verifying: detect known explosions

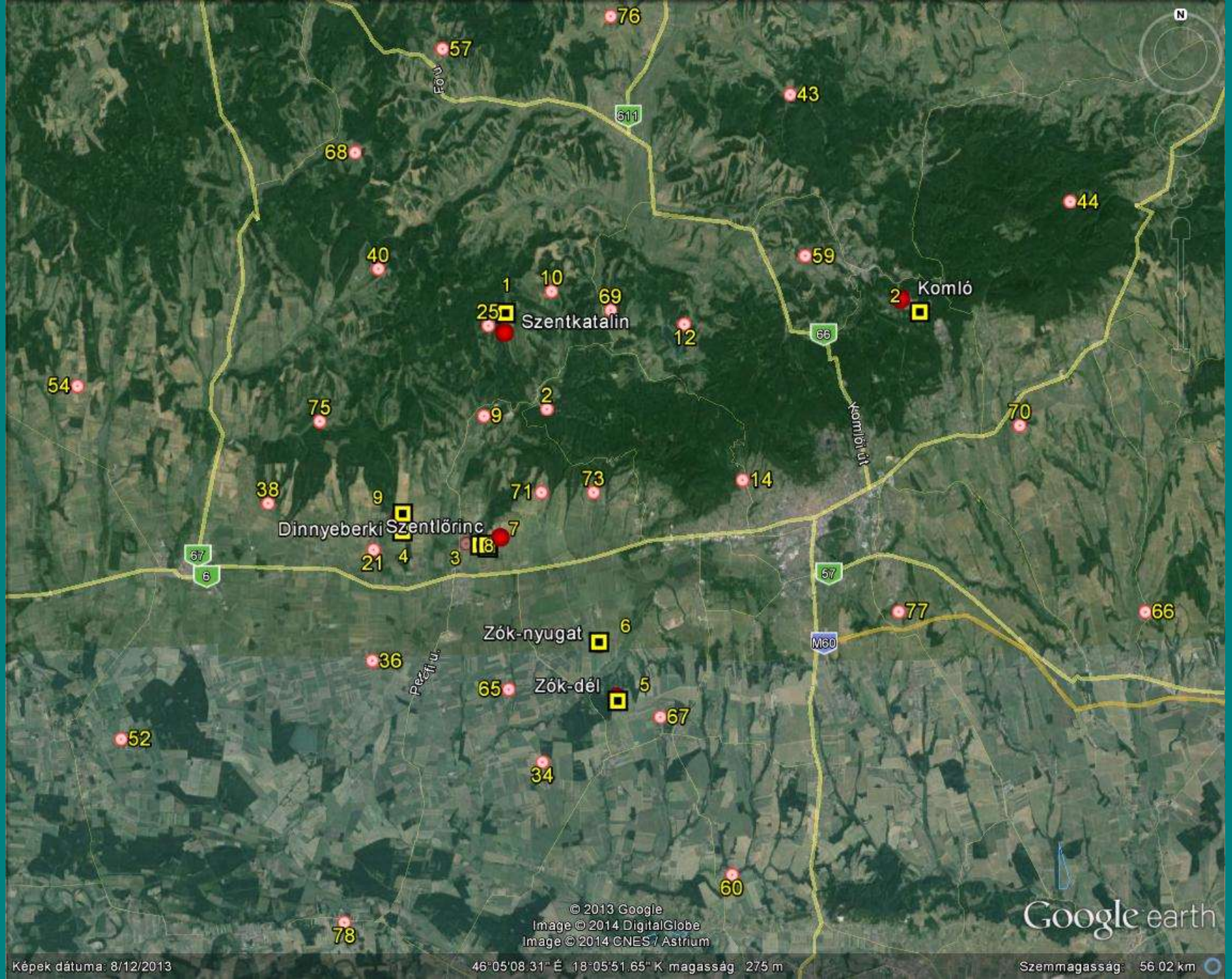
- **Testexploisions** (5-8 December 2011)

  - 6 location:
    - Komló mine, Szentlőrinc, Szentkatalin, Dinnyeberki, Zók-South, Zók-West

  - 14 explosoins, 15-25 m borehole depth and 20-40 kg charge

- Localization: same way, Sonoview, PQL, Hypoline

- **Results**: the maximum accuracy of the localization of the explosions is 400 m.


76
57
Fő u.
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1
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Komló
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Szentkatalin
12
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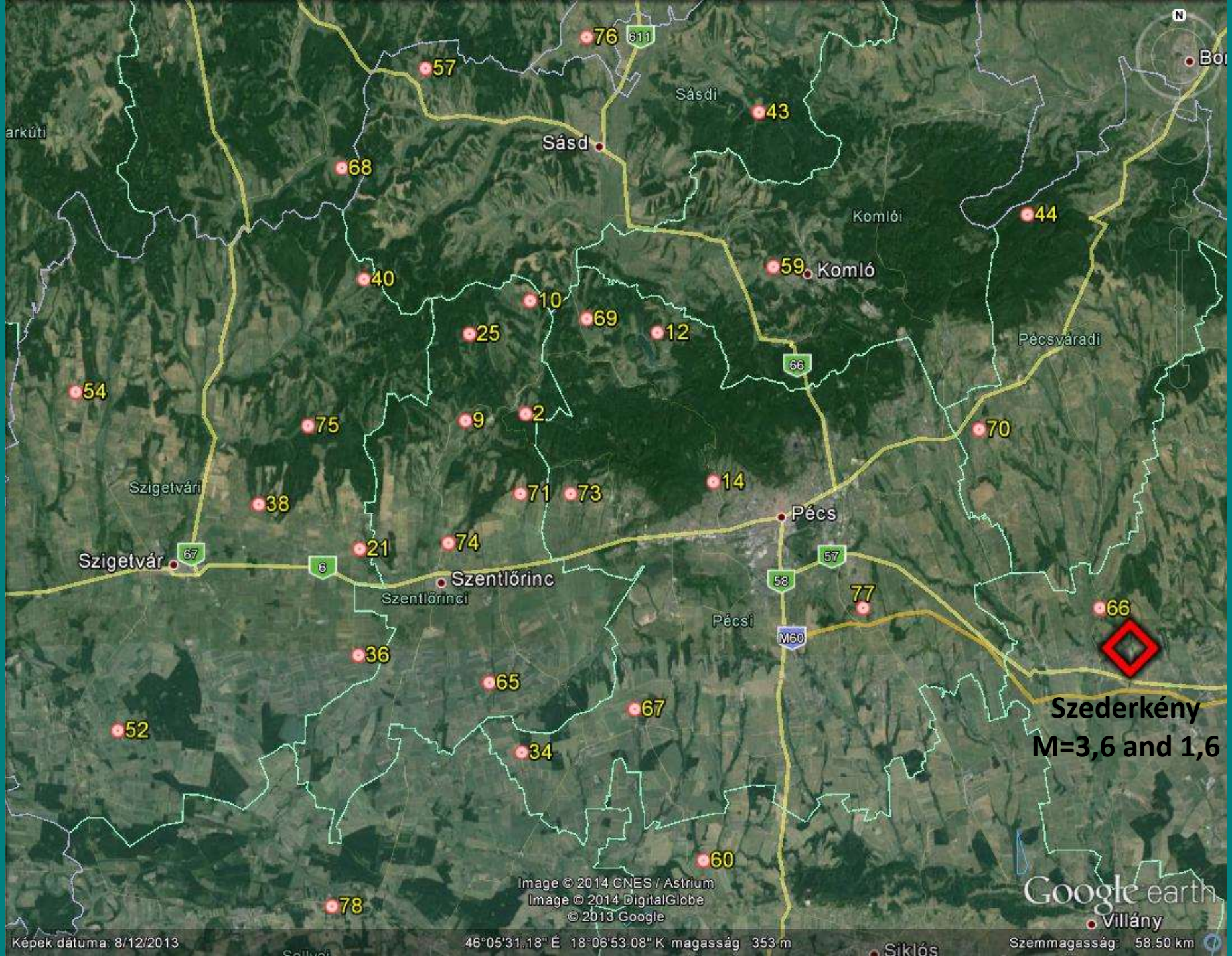
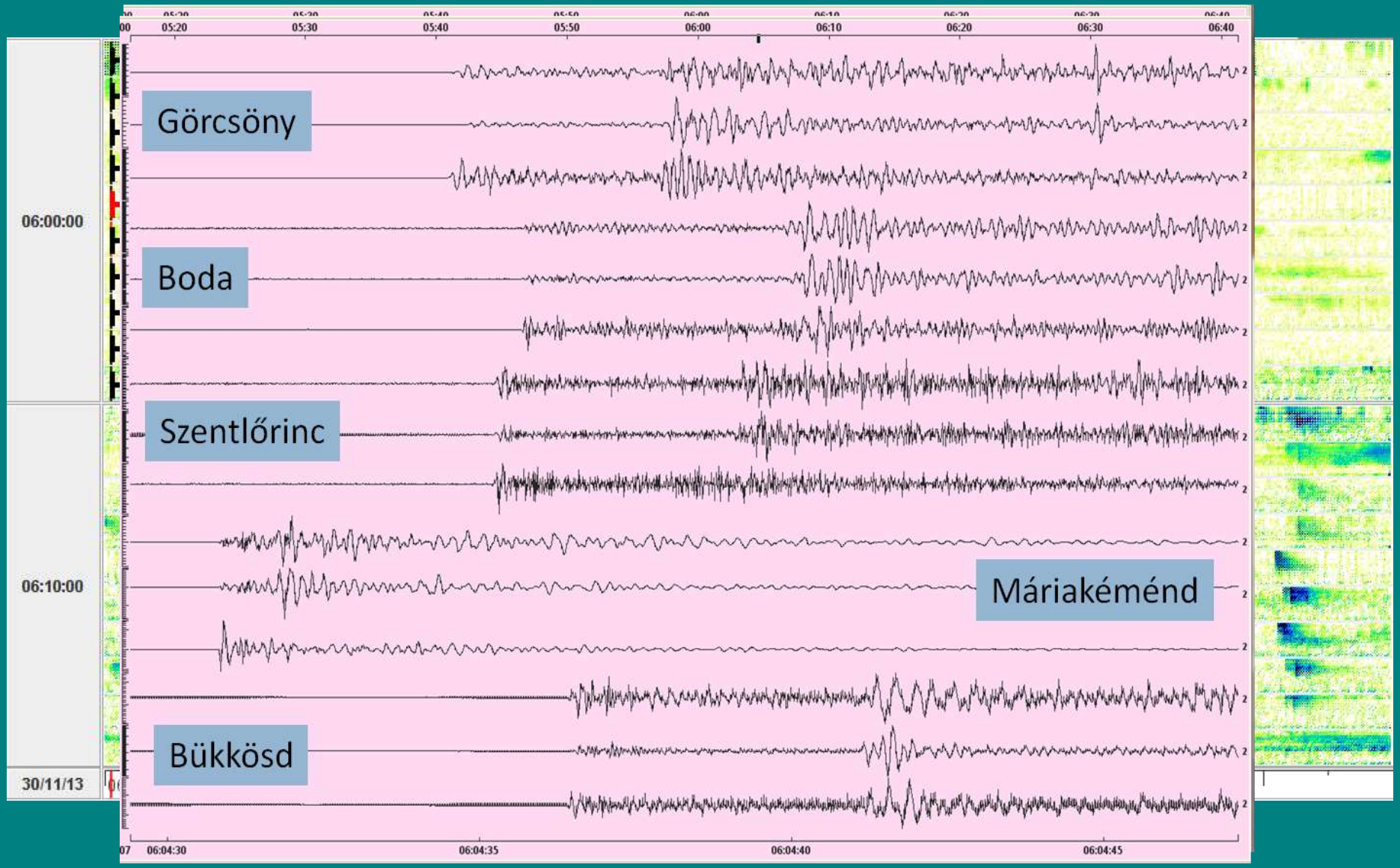
75
9
70
Komlói út
38
9
71
73
14
Dinnyeberki
Szentlőrinc
7
8
21
4
3
57
6
57
77
66
Zók-nyugat
6
M60
36
Petőfi u.
65
Zók-dél
5
67
52
34
60
78
© 2013 Google
Image © 2014 DigitalGlobe
Image © 2014 CNES / Astrium
Google earth
Képek dátuma: 8/12/2013
46°05'08.31" É 18°05'51.65" K magasság 275 m
Szemmagasság: 56.02 km

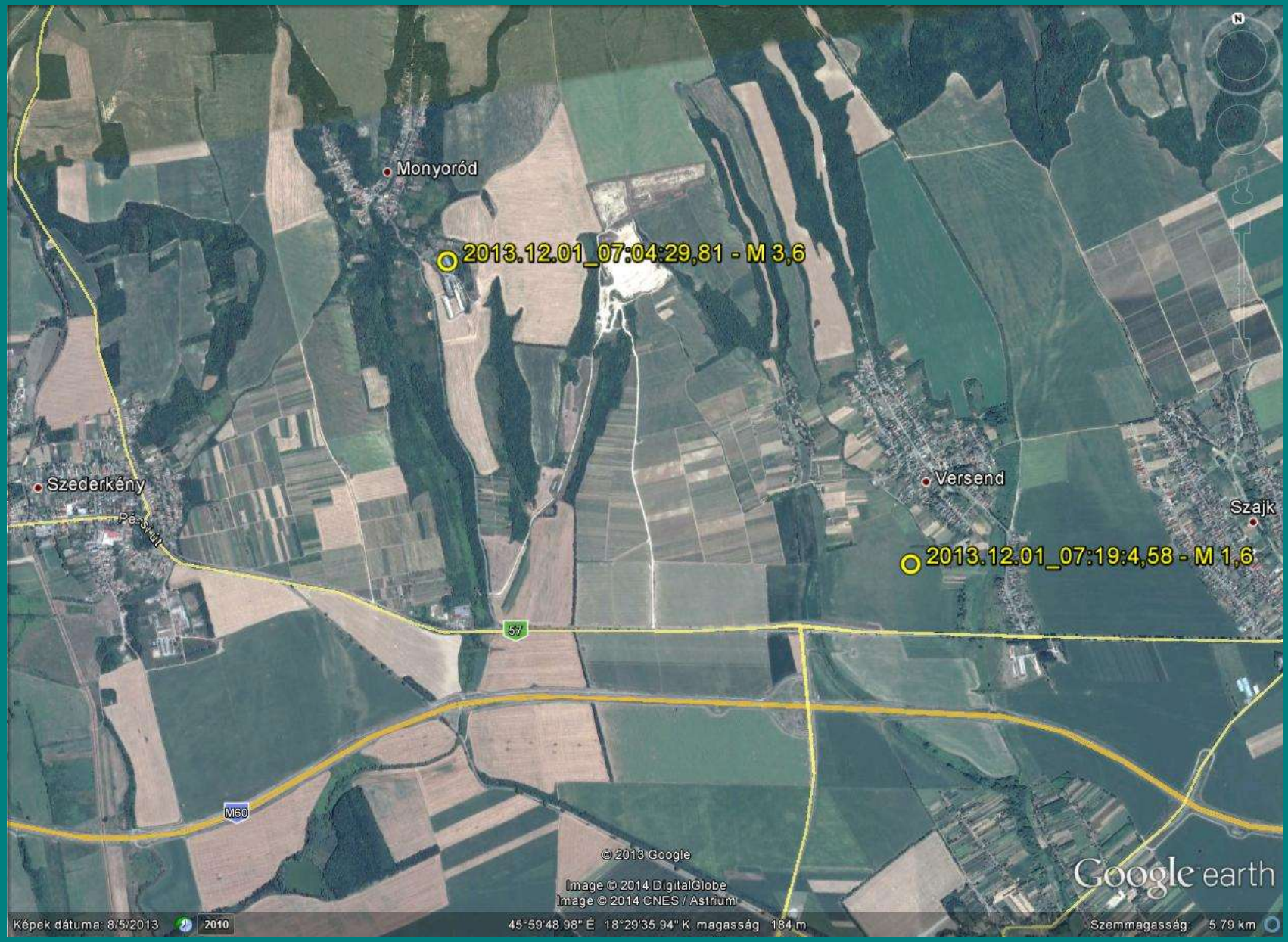
VII. 1st December 2013 earthquake near Szederkény

- In the vicinity of Szederkény **two earthquakes** occured on December 1st 2013.
- Based on the stations of the monitoring system the first quake took place at 7:04:29,81 the aftershock occured at 7:19:4,58
- The **hypocentral depth** of the two earthquakes was near the same, **4 km**.
- The **magnitude** of the main event was **3,6 M**, the aftershock was **1,6 M** accordance with the data of the Georisk.


76
611
57
Sásdi
43
Sásd
68
Komlói
44
59
Komló
40
10
69
12
25
Pécsváradi
66
54
75
9
2
70
14
Szigetvári
71
73
38
Pécs
21
74
Szigetvár
67
6
Szentlőrinc
Szentlőrinci
58
57
77
66
Pécsi
M60
36
65
67
52
34
60
78
Szederkény
M=3,6 and 1,6
Image © 2014 CNES / Astrium
Image © 2014 DigitalGlobe
© 2013 Google
Google earth
Villány
Képek dátuma: 8/12/2013
46°05'31.18" É 18°06'53.08" K magasság 353 m
Szemmagasság 58.50 km


05:20
05:30
05:40
05:50
06:00
06:10
06:20
06:30
06:40
Görcsöny
Boda
Szentlőrinc
Máriakéménd
Bükkösd
06:00:00
06:10:00
30/11/13
06:04:30
06:04:35
06:04:40
06:04:45

The result of the localization of the earthquake on 1st december 2013



VIII. Conclusion

- In the measured area we recorded circa 10-15 microseismic events per year between M 2 and M -1.

- After several years of evaluation we can determine 2 region which are typical of geological and tectonical aspects.

- **<u>Dráva area</u>**
  - Earthquakes with high amplitude, 20 km from our monitoring system
- **<u>The vicinity of Kozármisleny-Máriakéménd</u>**
  - It can be connected to tectonical zones, 25 km from our research area
- **Earthquake near Szederkény**

IX. References

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BODOKY T., KOVÁCS A. Cs., (2006): Előzetes kutatási jelentés a szeizmotektonikai vizsgálatokhoz szükséges állomáshálózat üzemeltetéséről, MECSEKÉRC Zrt, Pécs

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