

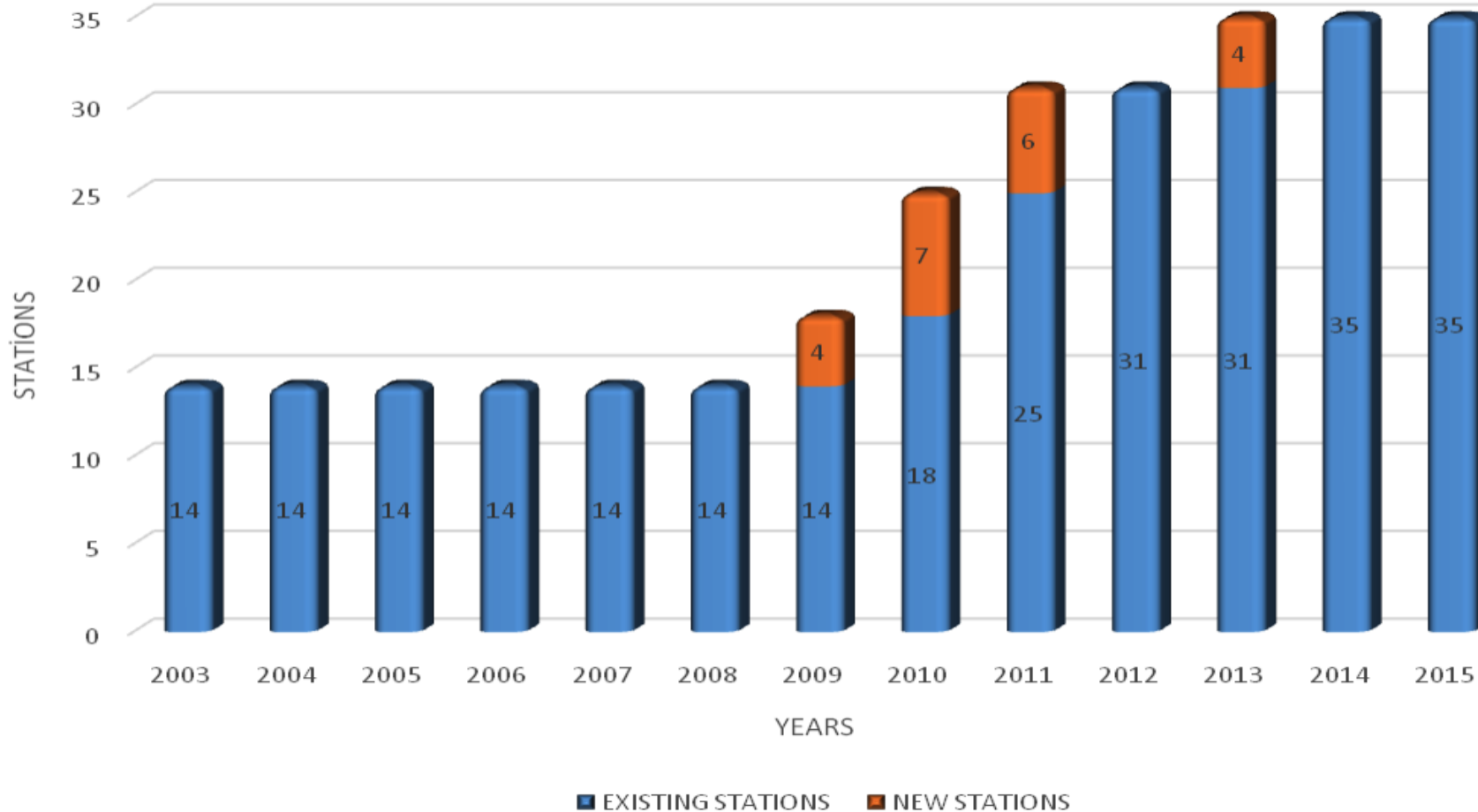
AZERBAIJAN SEISMIC NETWORK

From past to future

Karimova Rugija
Antelope User Group meeting
May 2016, Rome, Italy

THE DISTRIBUTION OF BROAD BAND STATIONS BY YEARS

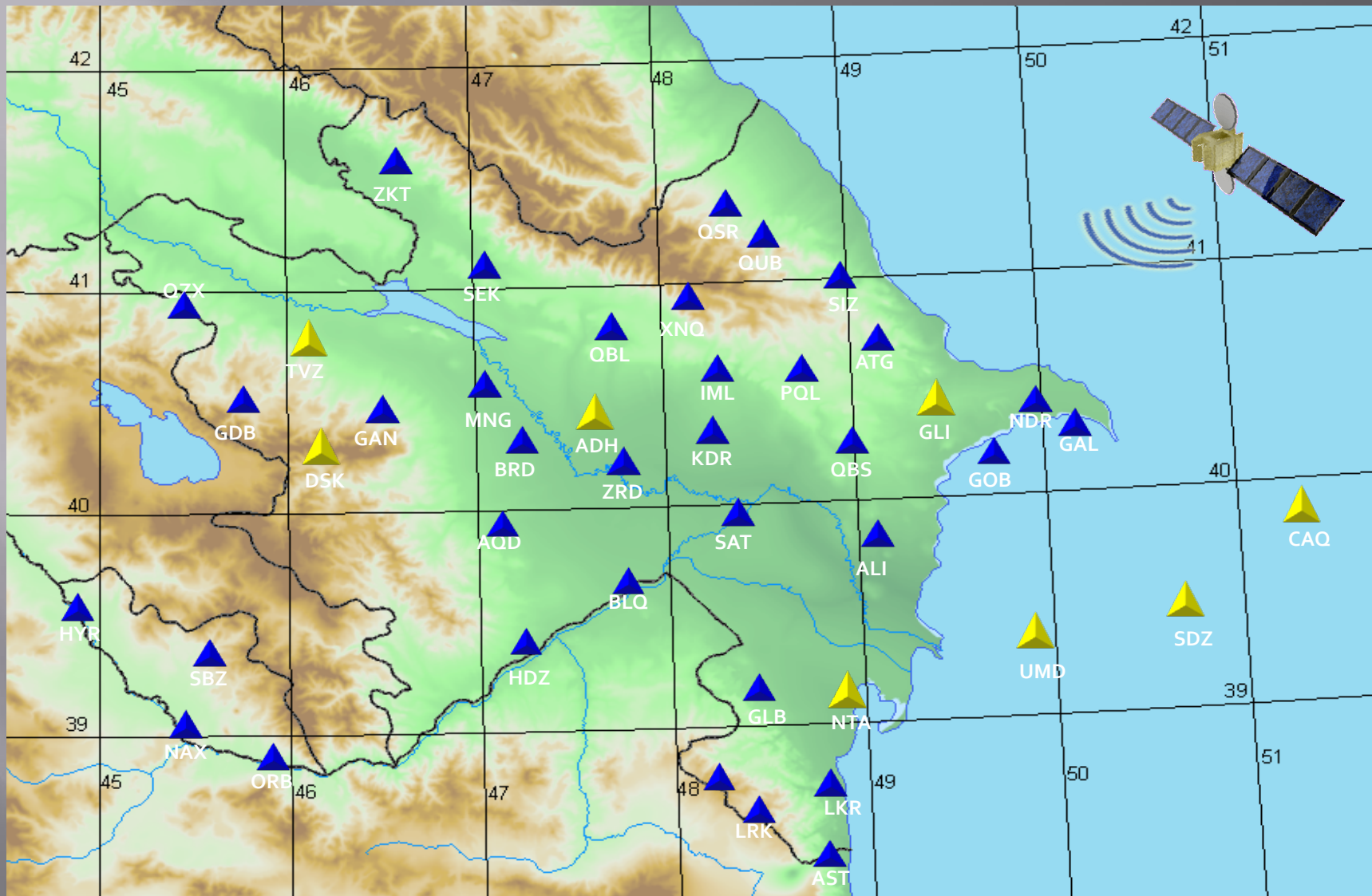
ANNUAL INSTALLATION OF BB STATIONS



Azerbaijan seismic network

- ▣ Starting from 2003 the Republican Seismic Survey Center of Azerbaijan has developed its real time digital seismic network.
- ▣ This network consists of 35 field stations. The present network is going to be expended in the near future. Thus, till 2016 RSSC will install 5 field stations in Azerbaijan territory and 3 Ocean Bottom Seismograph (OBS) in Caspian Sea.
- ▣ The communication from digital seismic stations to the Processing Center in Baku is achieved by provider Delta telecom, which assures the back-up communication lines.
- ▣ The Processing center runs Antelope Real Time System 5.2 . Data acquisition and processing software runs on 7 workstations for real time processing

The Seismic network of RSSC ANAS



▲ *currently working s/st.*

▲ *will be installed s/st*

Stations for fixing strong ground motion in Absheron peninsula and Chilov island

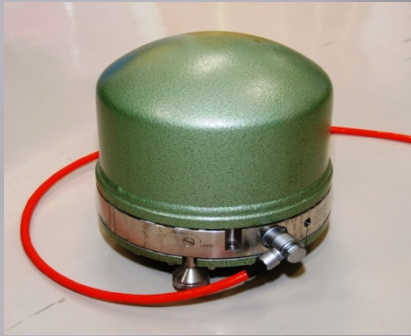


*stations for fixing
strong ground motion (Basalt)*



seismic stations

Equipments of seismic stations



*Three- component
broadband
seismometer, STS-2*



Quanterra Q330



Marmot



*Three- component
EpiSensor
accelerometer*



*GPS
Trimble Netr9*



*Gravimeter
CG-5 AutoGrav TM*



Model D701 Tiltmeter

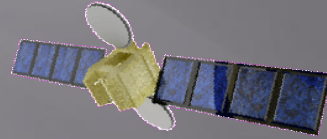


G-856 Magnetometer

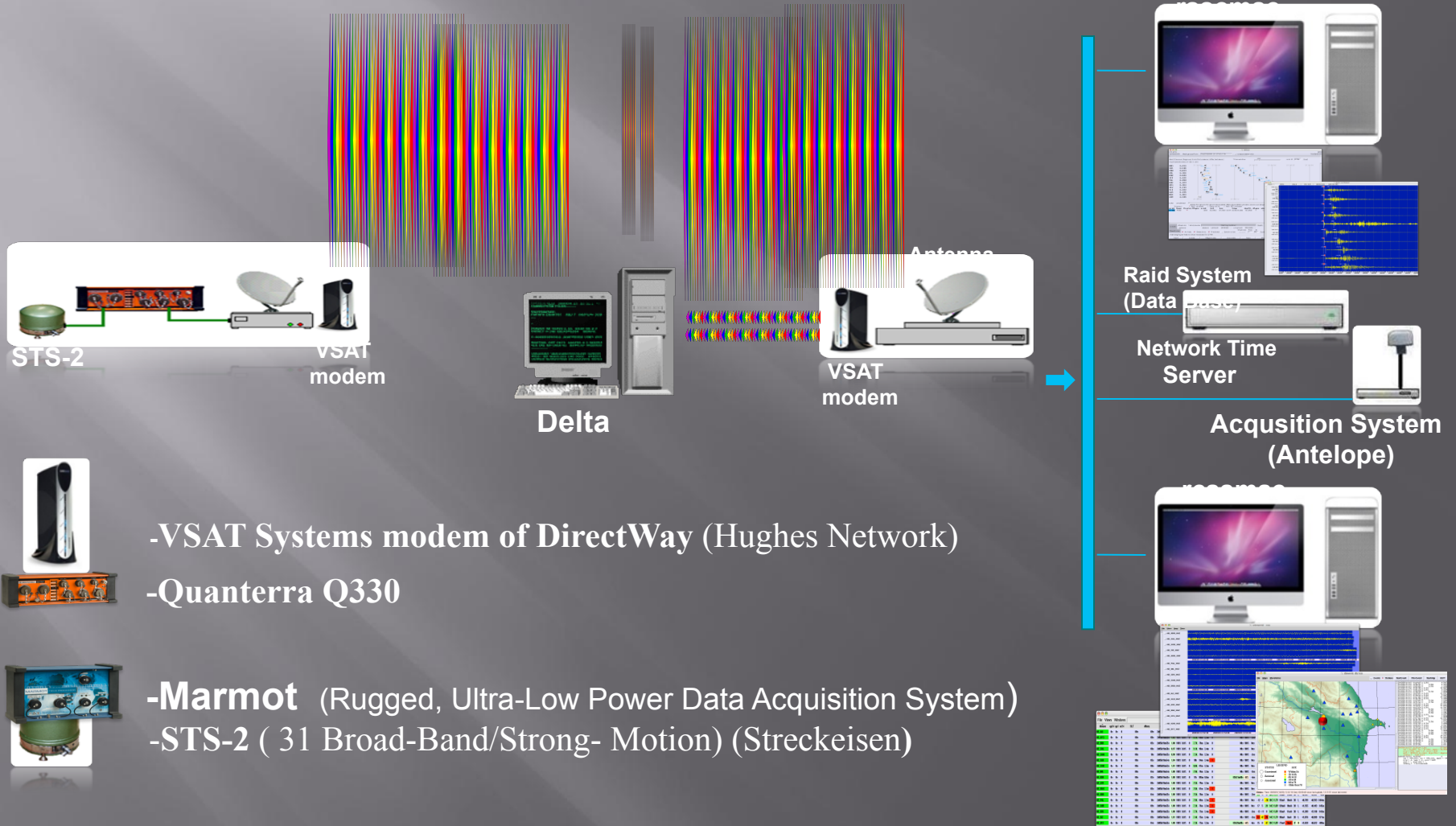
Seismic network of Azerbaijan

Sta	Date	lat	lon	elev	Name	Recording Equipment
AGD	2013-10-23	40.1083	47.1083	0.1520	Agdam	Q330+Marmot, Episensor+STS-2.5
ALI	2003-03-29	39.9581	49.0060	0.1000	Ali-Bairamli	Q330+Marmot, Episensor+STS-2
AST	2010-11-29	38.5600	48.7910	0.1500	Astara	Q330+Marmot, Episensor+STS-2
ATG	2009-08-22	40.8610	48.9380	1.1350	Alti-Agach	Q330+Marmot, Episensor+STS-2
BLQ	2013-10-23	39.7210	47.5590	0.1250	Beylaqan	Q330+Marmot, Episensor+STS-2.5
BRD	2003-03-29	40.2632	47.1790	0.1000	Barda	Q330+Marmot, Episensor+STS-2
GAL	2003-03-29	40.4106	50.1553	0.0300	Qala	Q330+Marmot, Episensor+STS-2
GAN	2003-03-29	40.6519	46.3297	0.5600	Ganja	Q330+Marmot, Episensor+STS-2
GBS	2011-04-02	40.5350	48.9420	0.8290	Gobustan	Q330+Marmot, Episensor+STS-2
GDB	2010-12-22	40.7210	45.7800	1.6430	Gedebey	Q330+Marmot, Episensor+STS-2
GLB	2003-03-29	39.2425	48.3927	0.1400	Jalilabad	Q330+Marmot, Episensor+STS-2
GOB	2003-03-29	40.4007	49.7332	0.1600	Gobu	Q330+Marmot, Episensor+STS-2
HYR	2011-11-30	39.7190	44.8520	0.8490	Hejdarabad	Q330+Marmot, Episensor+STS-2
IML	2003-03-29	40.7925	48.1820	0.7100	Ismailli	Q330+Marmot, Episensor+STS-2
KDR	2009-10-23	40.3800	48.1800	0.0540	Kurdemir	Q330+Marmot, Episensor+STS-2
LKR	2003-03-29	38.7100	48.7788	0.0700	Lenkaran	Q330+Marmot, Episensor+STS-2
LRK	2009-11-25	38.6400	48.3400	1.5920	Lerik	Q330, Episensor+STS-2
MNG	2010-01-01	40.7730	47.0850	0.0980	Mingecevir	Q330+Marmot, Episensor+STS-2
NAX	2003-03-29	39.1740	45.4948	0.9200	Nakhichevan	Q330, Episensor+STS-2
NDR	2003-03-29	40.5811	49.9868	0.0280	Nardaran	Q330+Marmot, Episensor+STS-2
ORB	2011-11-30	38.9280	45.9940	0.9480	Ordubad	Q330+Marmot, Episensor+STS-2
PQL	2003-03-29	40.7889	48.5929	1.4700	Pirgulu	Q330+Marmot, Episensor+ STS-2
QBL	2011-04-21	40.9460	47.8370	0.6700	Qebele	Q330+Marmot, Episensor+STS-2
QRD	2013-10-23	39.4615	47.3203	0.2010	Qoradiz	Q330+Marmot, Episensor+STS-2.5
QSR	2011-04-12	41.5100	48.2630	0.6300	Qusar	Q330+Marmot, Episensor+STS-2
QUB	2003-03-29	41.3552	48.4927	0.6500	Quba	Q330+Marmot, Episensor+STS-2
QZX	2010-01-18	41.0480	45.3720	0.5740	Qazah	Q330+Marmot, Episensor+STS-2
SAT	2010-04-07	39.9300	48.3600	0.0400	Saatli	Q330+Marmot, Episensor+STS-2
SBZ	2011-11-30	39.3970	45.5530	1.2020	Shahbuz	Q330+Marmot, Episensor+STS-2
SEK	2003-03-29	41.2093	47.2977	0.8200	Sheki	Q330+Marmot, Episensor+STS-2
SIZ	2003-03-29	41.0759	48.8992	0.9500	Siazan	Q330+Marmot, Episensor+STS-2
XNQ	2010-11-30	41.1800	48.1400	1.9850	Xinaliq	Q330+Marmot, Episensor+STS-2
YRD	2013-10-24	38.9162	48.2409	0.9220	Yardimli	Q330+Marmot, Episensor+STS-2.5
ZKT	2009-10-23	41.6400	46.6300	0.5080	Zakatala	Q330, Episensor+STS-2
ZRD	2010-12-01	40.2790	47.6840	0.2500	Zerdab	Q330, Episensor+STS-2

Principle of network structure



Seismic Network Center



-VSAT Systems modem of DirectWay (Hughes Network)

-Quanterra Q330

-Marmot (Rugged, Ultra-Low Power Data Acquisition System)

-STS-2 (31 Broad-Band/Strong- Motion) (Streckeisen)



Solar Panel



Teletometric seismic stations



Inside view of seismic station



Main power control and management unit

Telemetric seismic stations



Shaki



Shahbuz



Altiagac



Gusar



Pirqulu



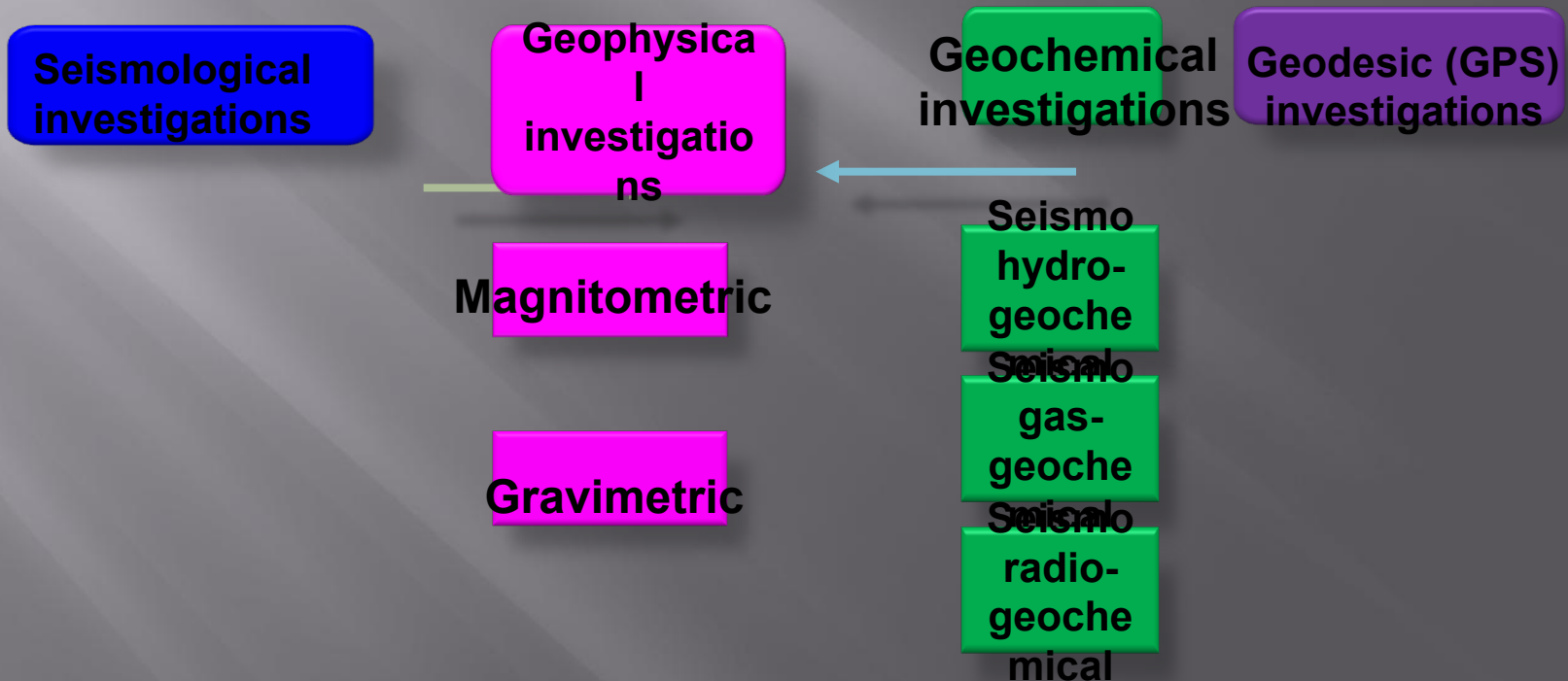
Berde

Shaki Geophysical Observatory

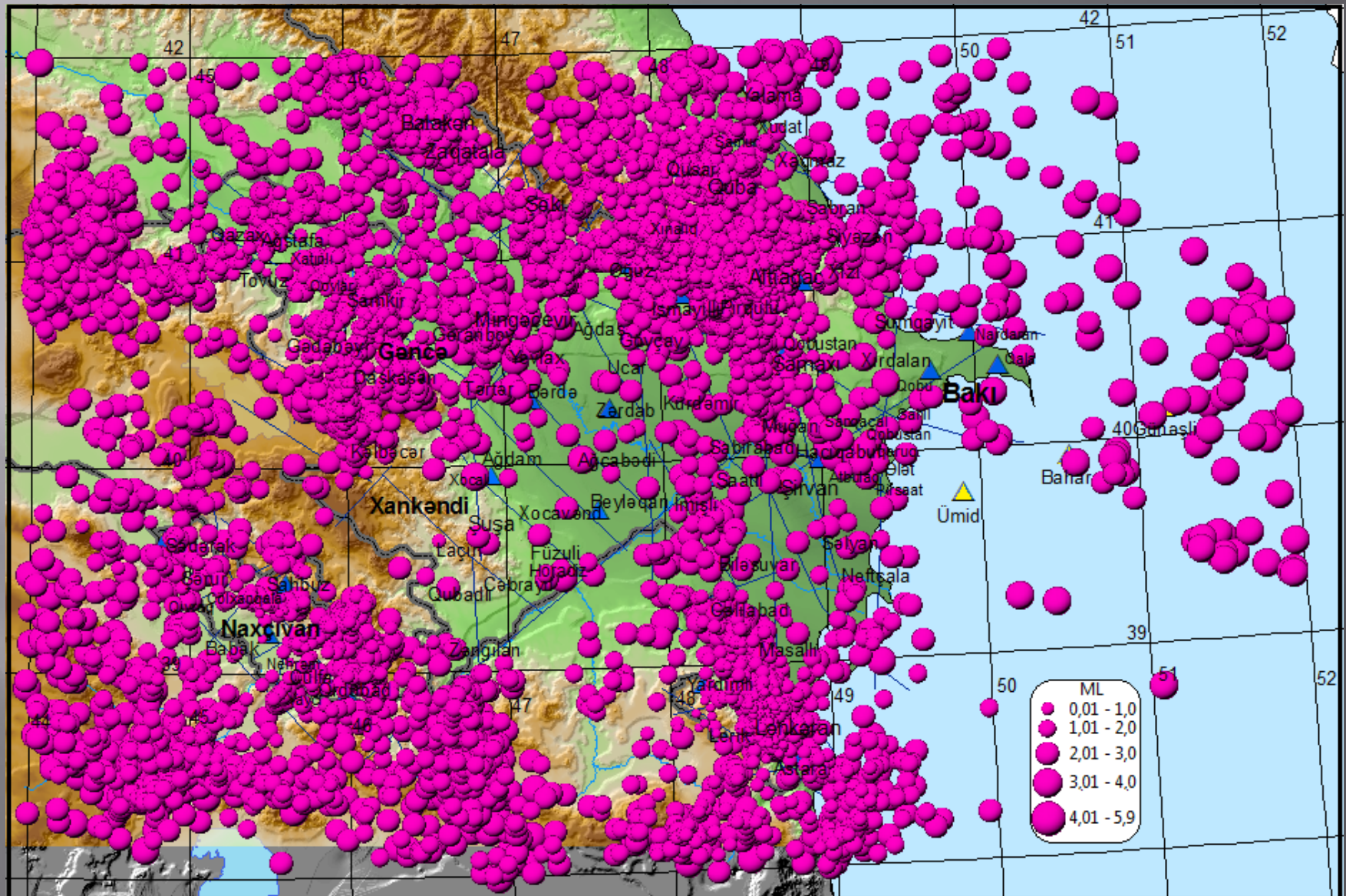


RSSC ANAS

Research in our center mainly are conducted in 4-th directions:

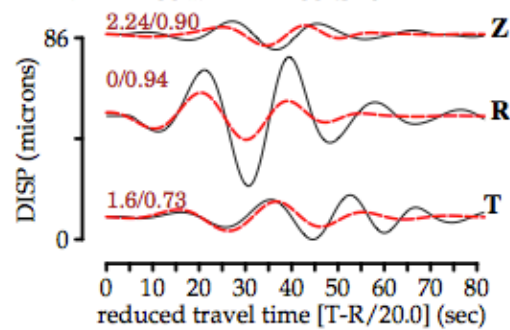


Map of the epicenters of earthquakes in Azerbaijan and adjacent areas 2015.
(N=7666)

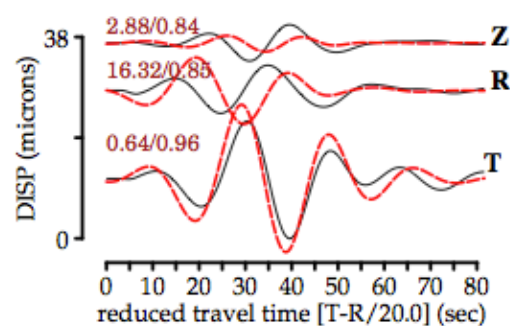


Definition of the mechanism of earthquake on the Moment Tensor program for Gabala earthquake (29.09.2014)

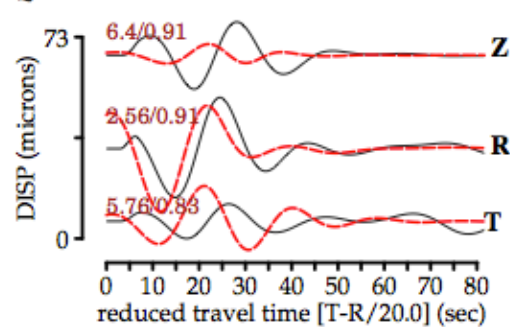
KDR.AB R=86 km Az=166 ts=0



SIZ.AB R=81 km Az=94 ts=0



QSR.AB R=50 km Az=32 ts=0

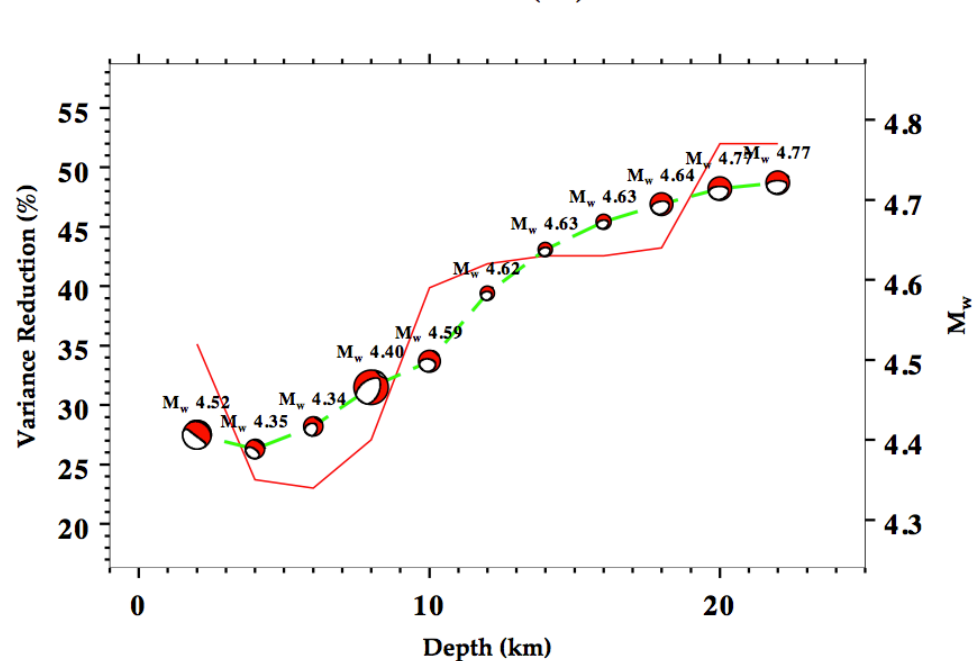


GBS.A

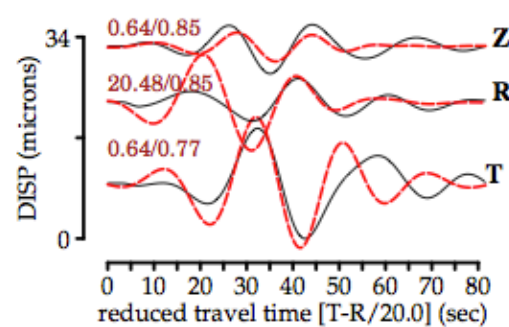


reduced travel time [T-R/20.0] (sec)

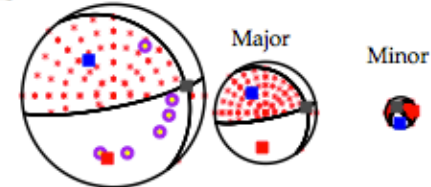
At T=007.0 (sec)



ATG.AB R=89 km Az=109 ts=0



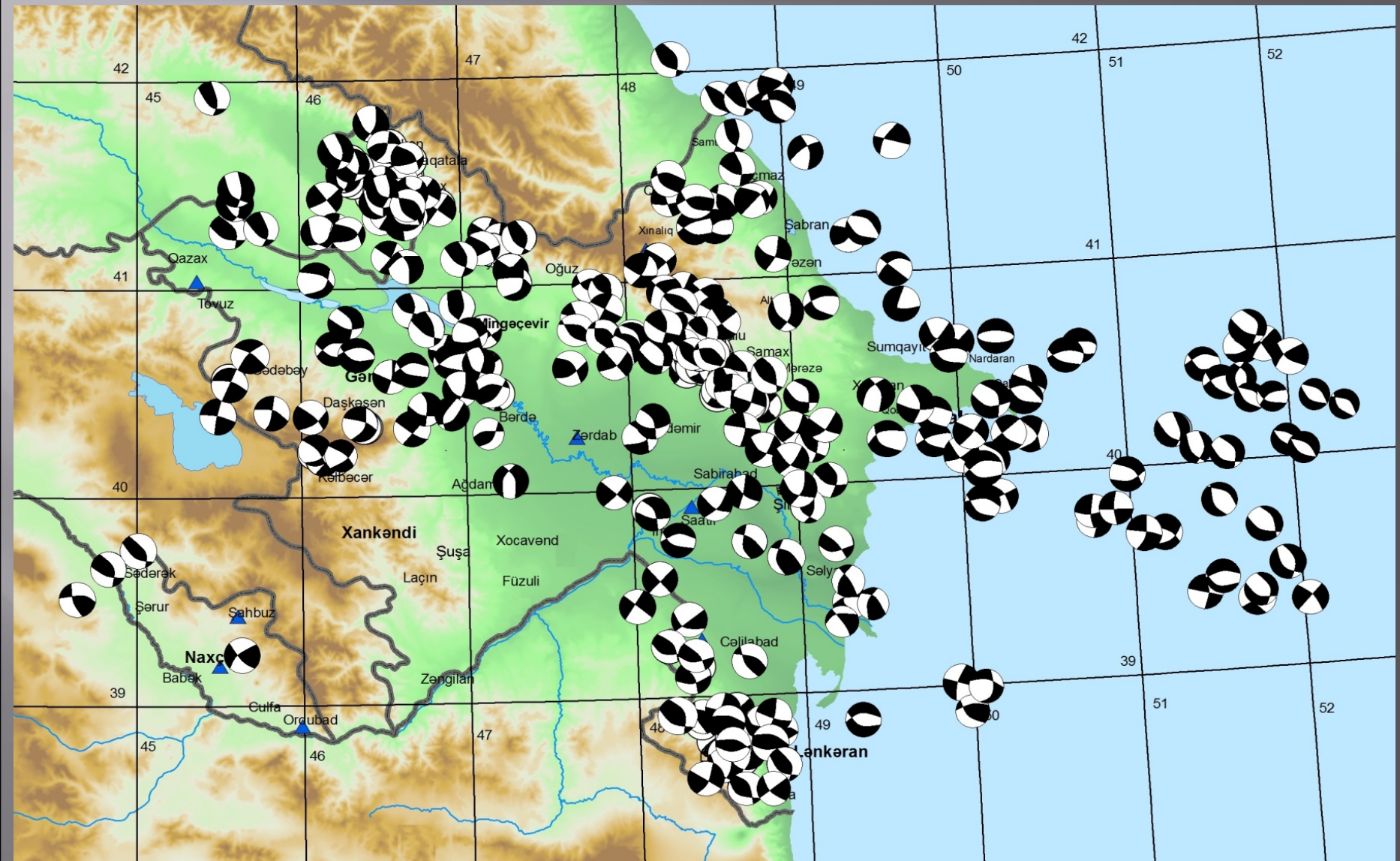
Qabala



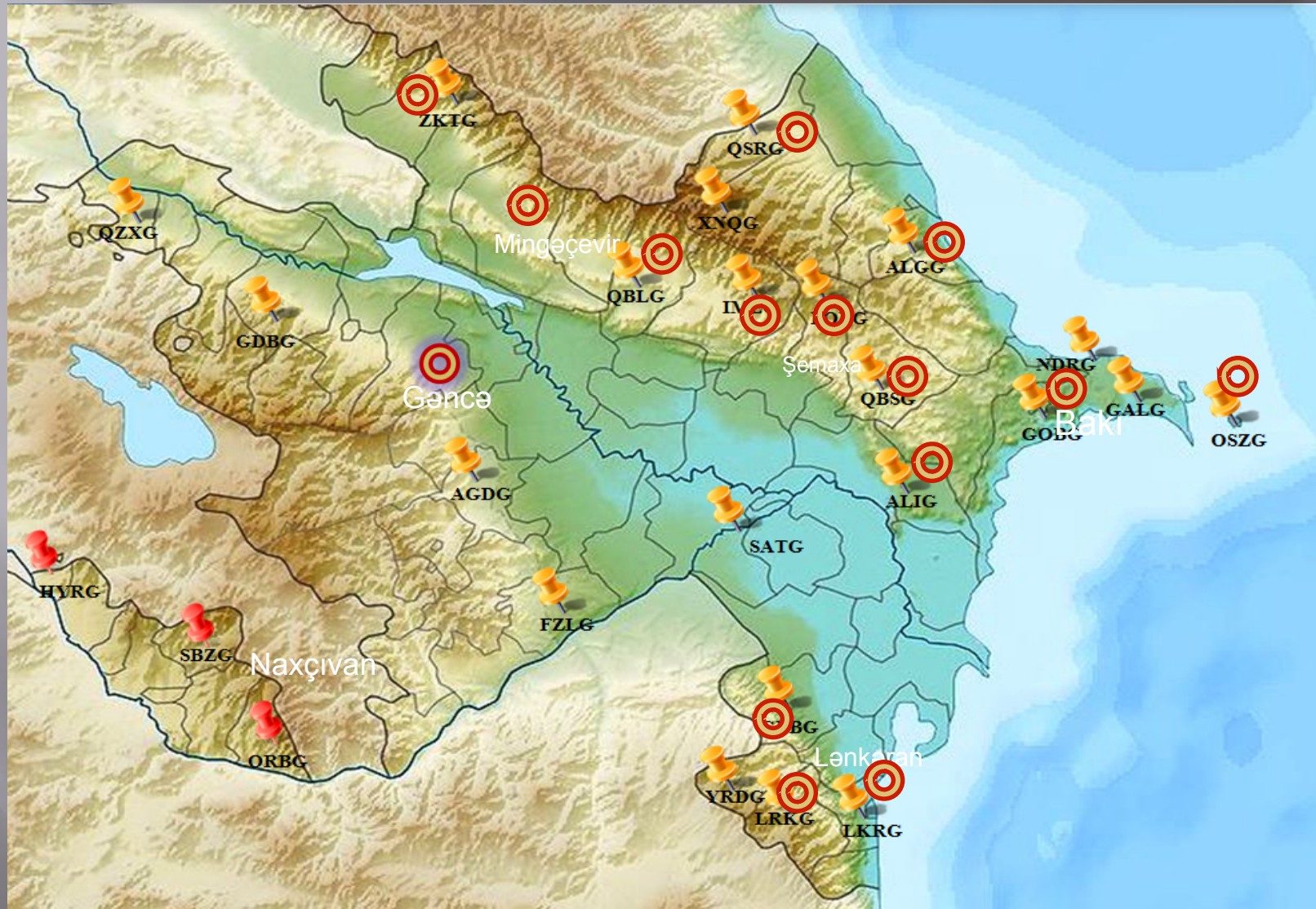
2014/09/29/01:38:04.0 41.130N 47.940E 16.0 km
 NP1: strike=323 Dip=23 Rake=153
 NP2: strike=79 Dip=80 Rake=69
 DEVIATORIC MT DC=99.2% CLVD=0.8%
 VarRed=30.6% TOTFIT=17.2 Mw=4.52

M₀=7.58E+22 xx=-3.39 xy=-1.94 xz=6.42 yy=0.90 yz=-1.80 zz=2.49
 T ev= 7.60 az=325 pl=51 Epsilon=0.00
 B ev=-0.03 az= 82 pl=20
 P ev=-7.57 az=186 pl=32

Map of mechanisms of earthquakes in 2003-2016 yy. ($M>3.0$)



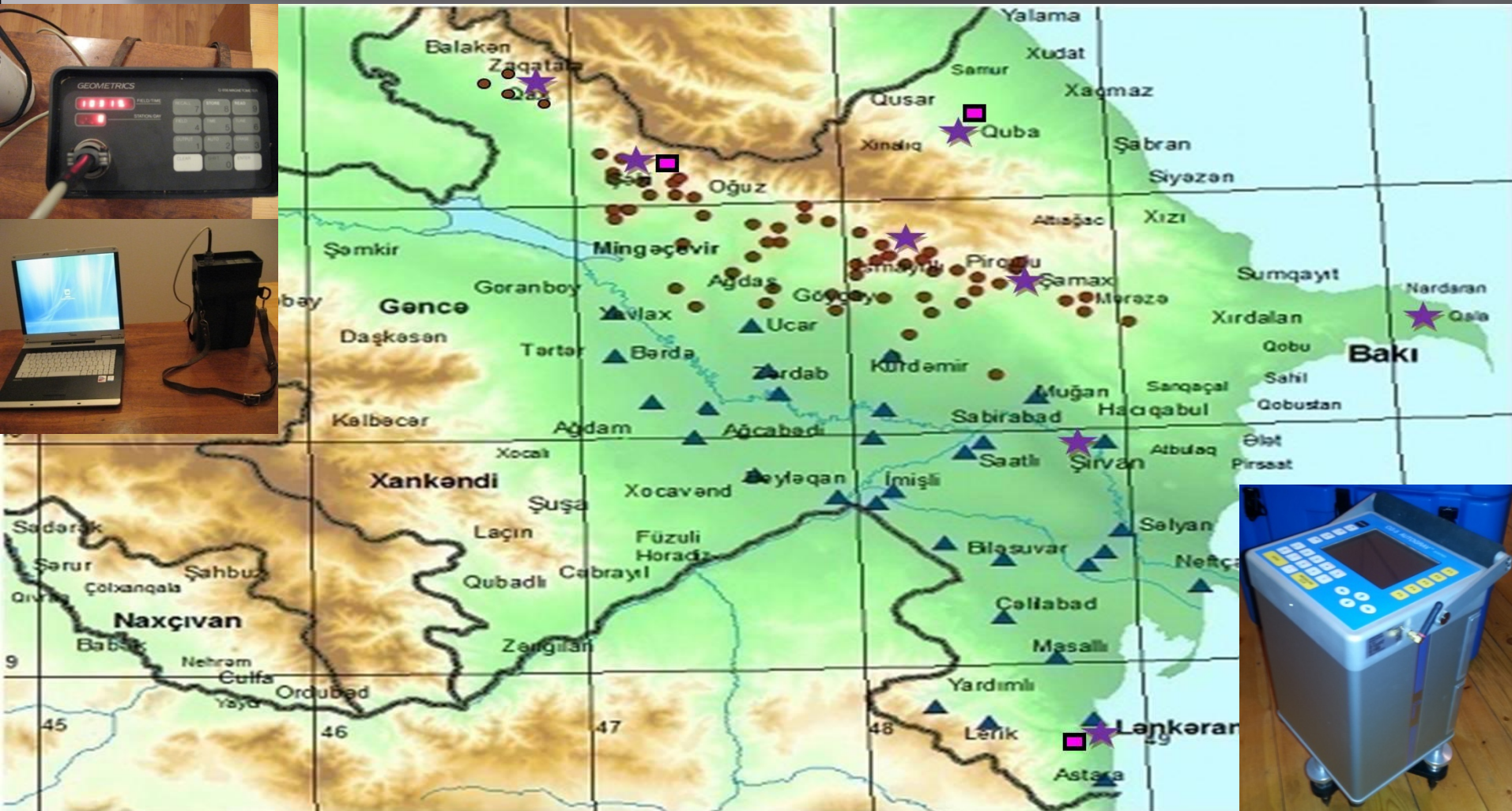
GPS Network stations







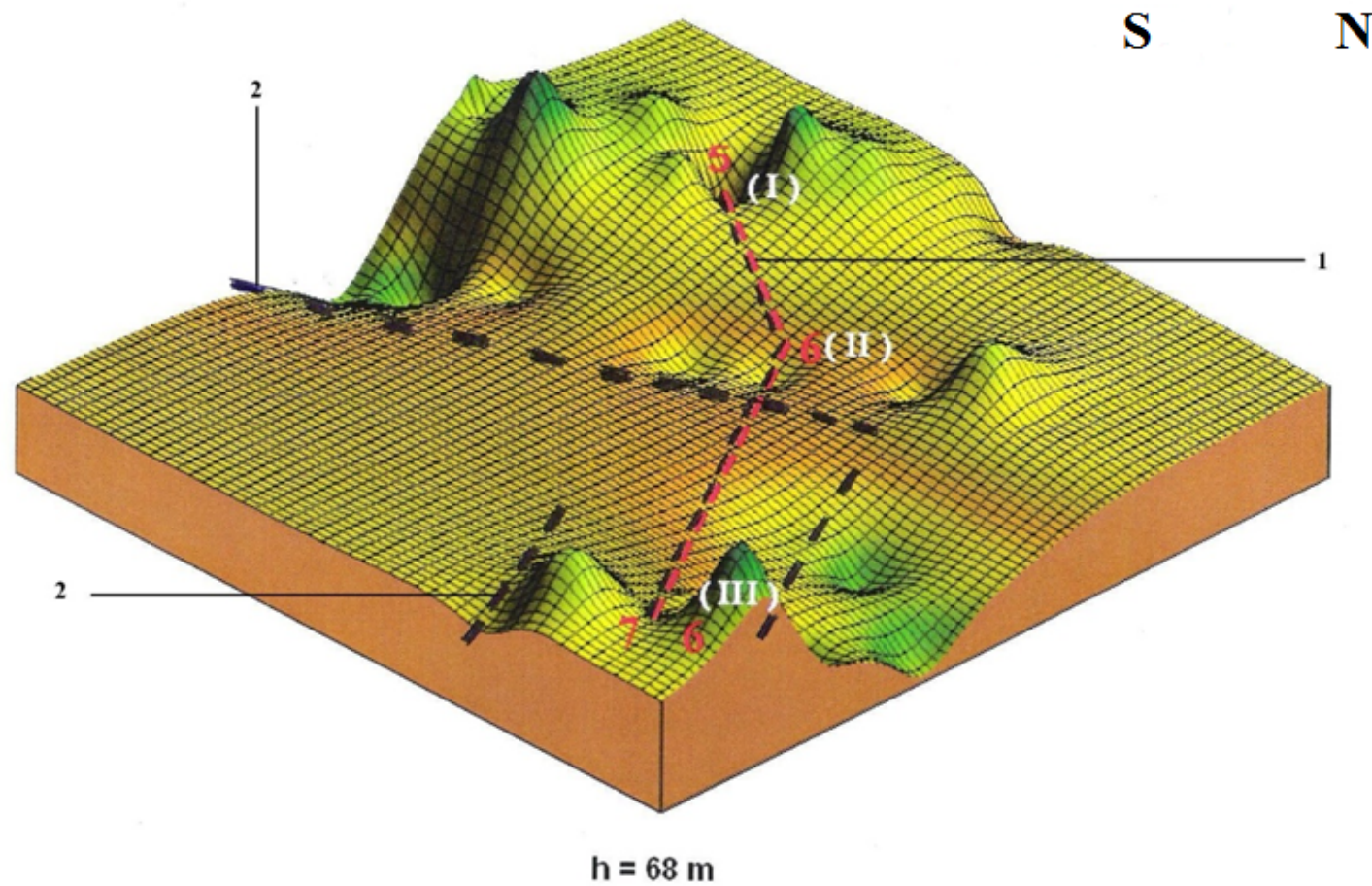
 working stations

 will be installed in 2016  tiltimetr

Schematic map of the existing points of geomagnetic regime observations.

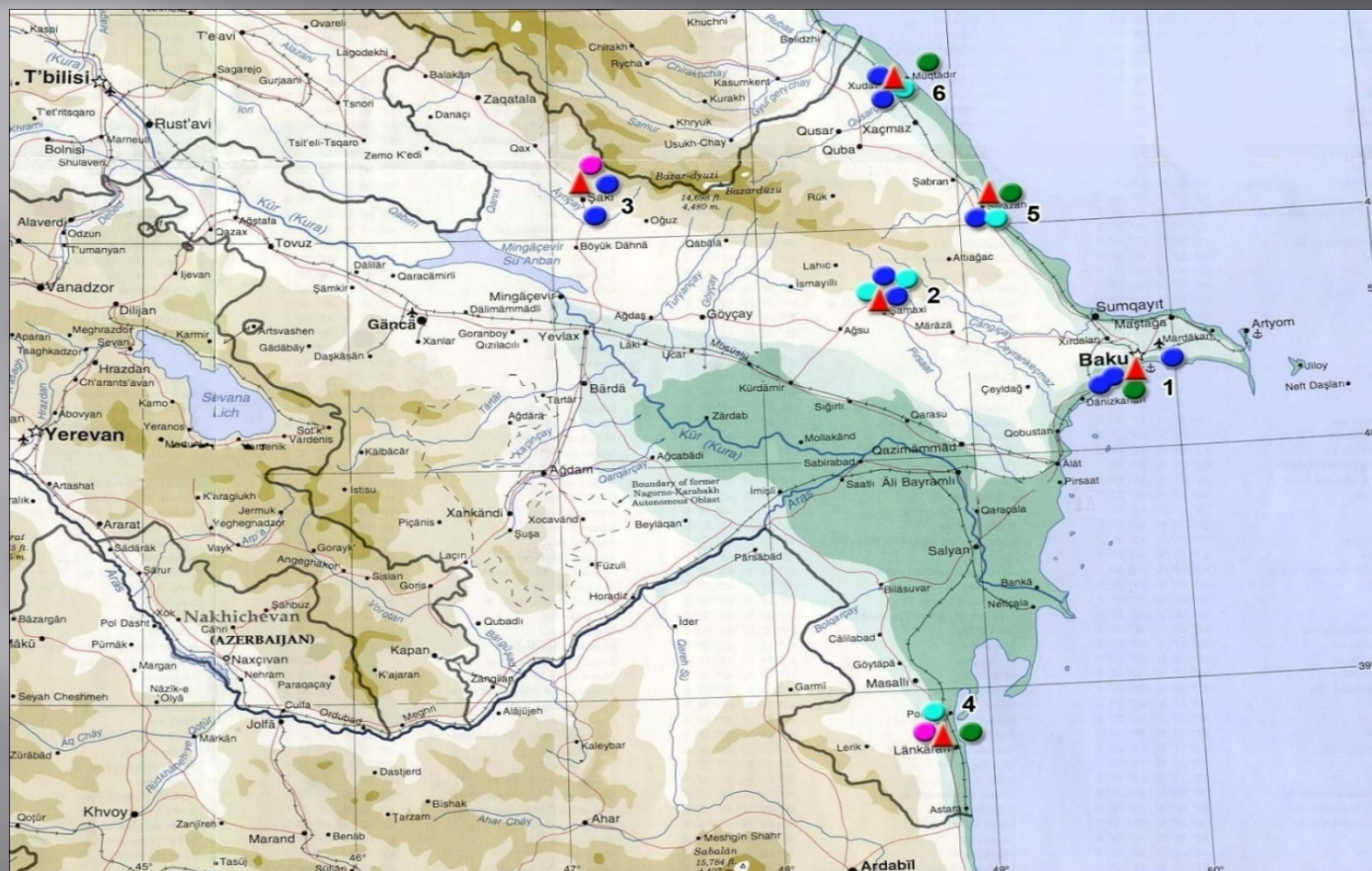


-  - magnetic stands-stations
-  - stands gravimetric stations
-  - Shekhi-Shamakhi magnetometric and gravimetric polling stations ions
-  - Kura-Talish magnetometric and gravimetric polling stations ions



3D model of the distribution of gravity, and shows the areas (black lines) possible formation of cracks

THE SEISMICFLUIDGEOODYNAMICAL (SFGD) STATIONS NETWORK IN AZERBAIJAN (2016).



Conventional symbols:

▲ - stationary seismicgeochemical stations (gc/st) – 1979-2013

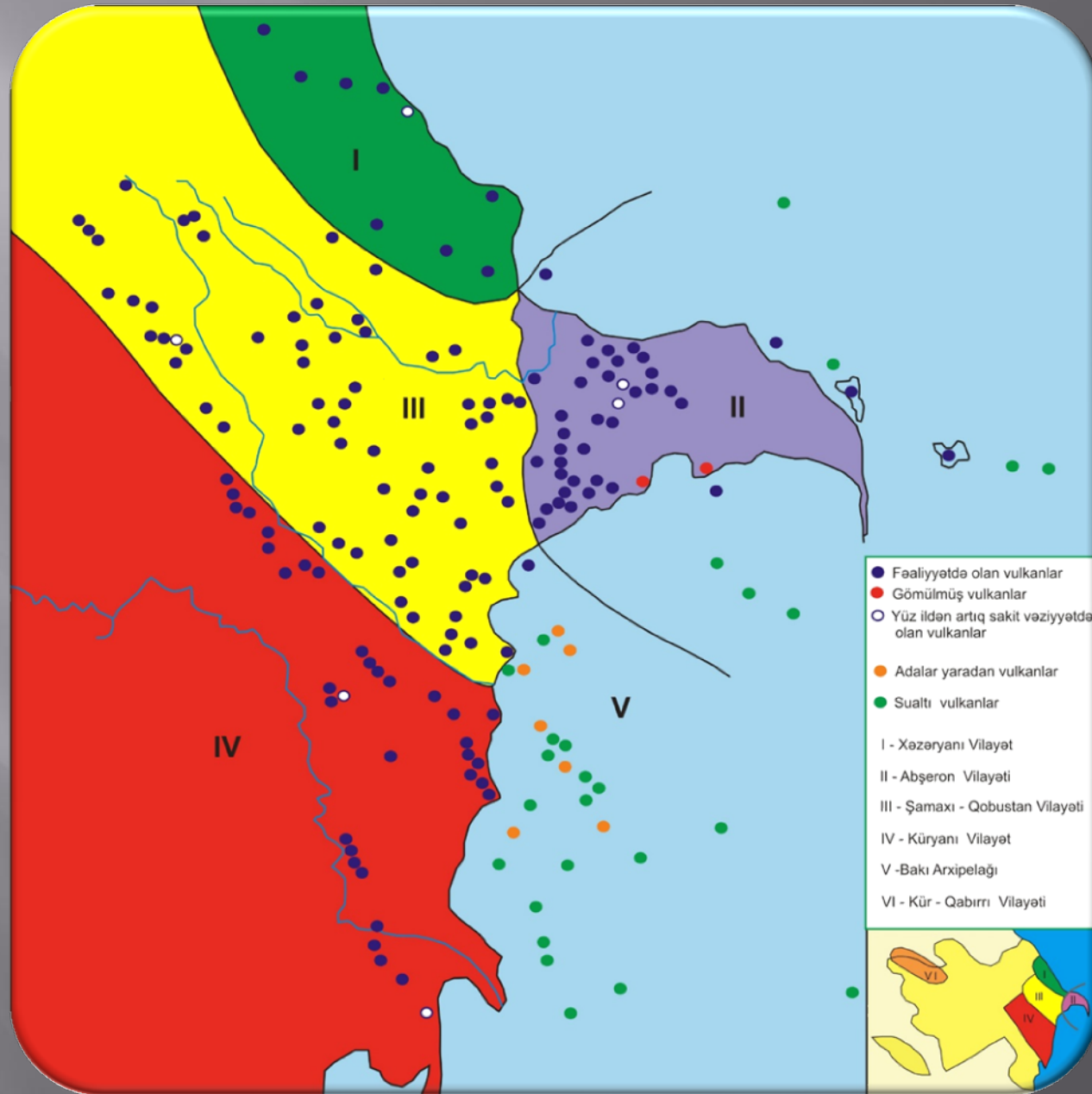
In Azerbaijan regions (gc/st.):

1. Baku city ("Bibi-Heybet" - 1979-2014)
2. Region Shamakhi ("Shamakhi" - 1983-2014)
3. Region Sheki ("Kish" 1981-2014)
4. Region Lankaran ("Osakuche" 2001-2014)
5. Region Siyezen ("Boyuk Hemye" 2001-2014)
6. Region Khachmaz ("Muqtadir" 2013-2014)



- wells (geological-exploration, artesian and subartesian)
- well water source
- Caspian sea water
- mineral water-sea water

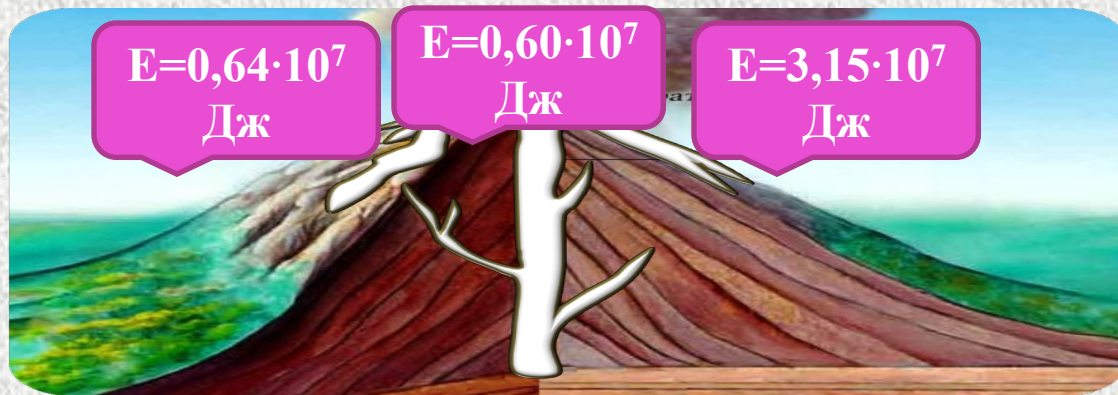
The map of mud volcanoes of Azerbaijan



Examples of eruption of mud volcanoes



We also determine how many phases, the depth, the duration and releasing energy by the eruption of mud volcanoes.



phase of the eruption

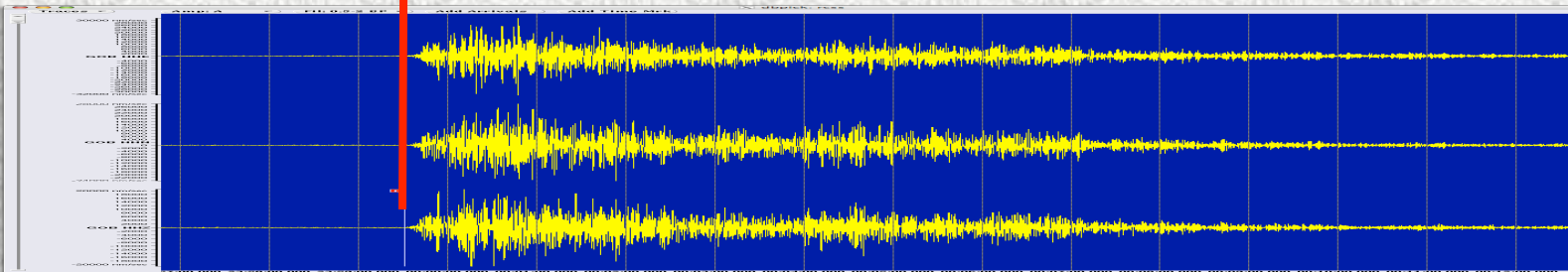
I II III



7 min

4 min

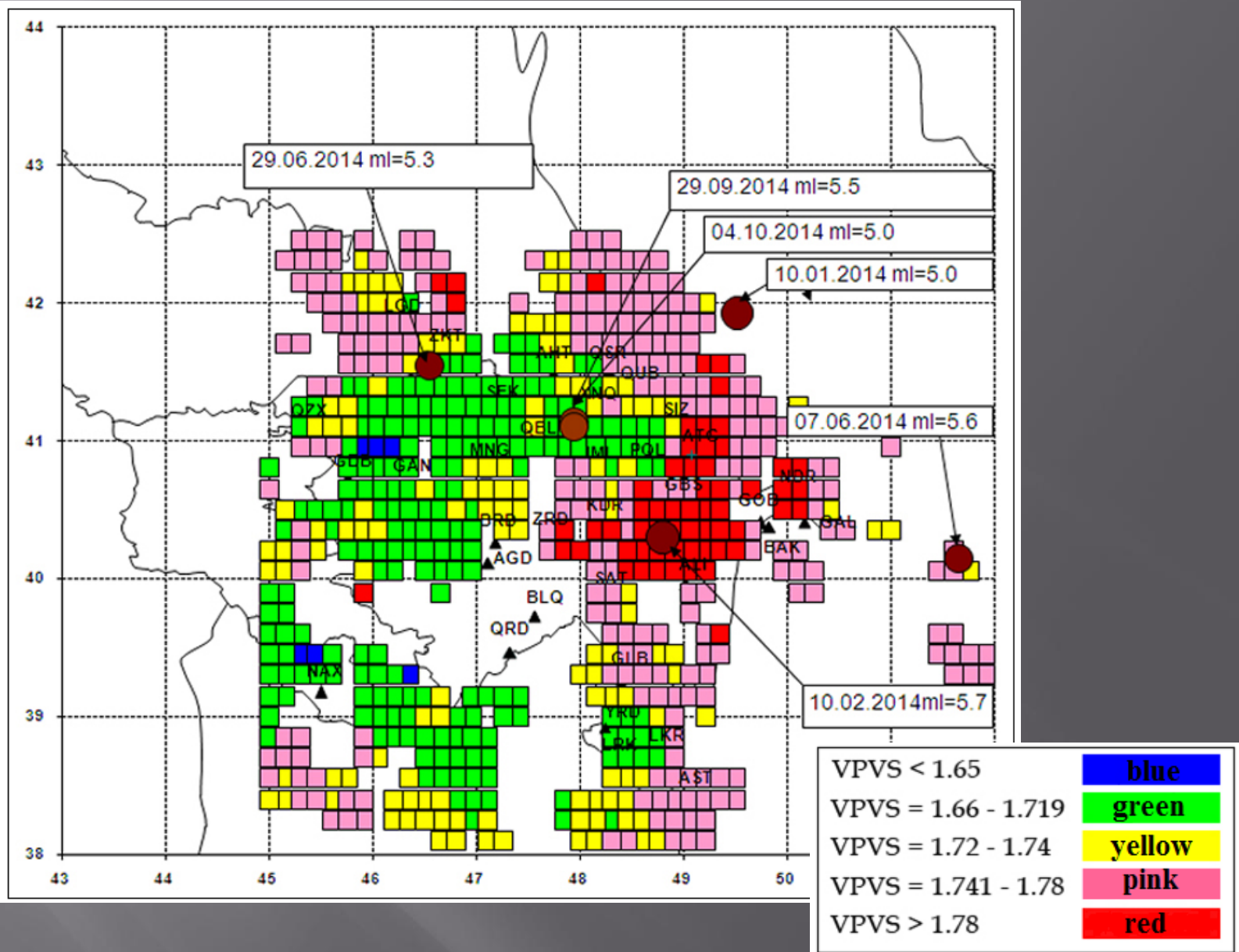
12 min



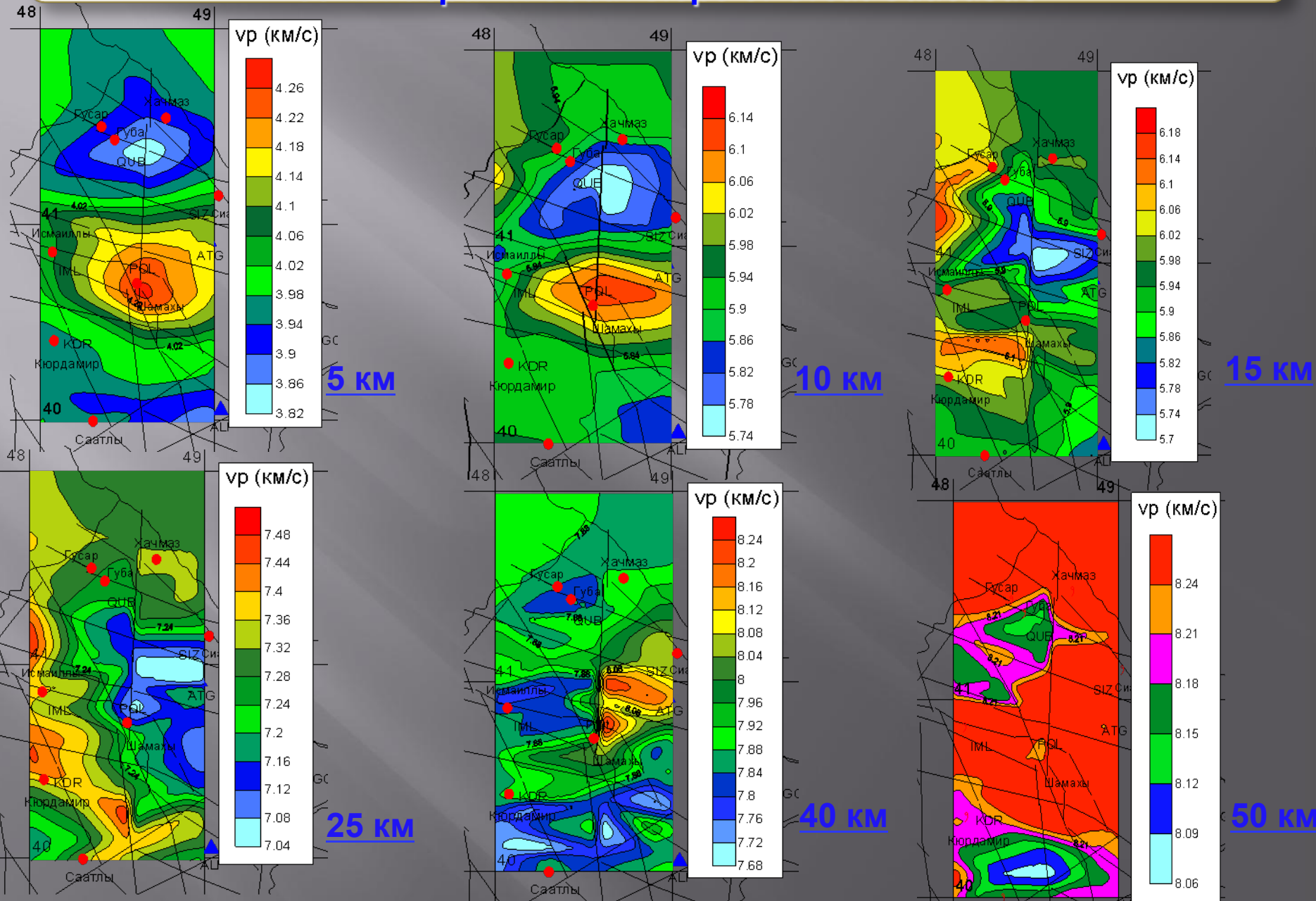
The parameters of Shikhzaherli mud volcano

Date	Time	MI	H	Distribution of seismic energy	Continuation period of eruption
12/20/2013	12:46:02	1.4	3	$E=6.4 \cdot 10^6$	3 minutes
12/20/2013	13:10:28	0.9	3	$E=1.5 \cdot 10^6$	2 minutes
12/20/2013	13:12:37	1.4	4	$E=6.4 \cdot 10^6$	2.5 minutes
12/20/2013	13:19:44	1.2	4	$E=3.8 \cdot 10^6$	5 minutes
12/20/2013	13:33:06	1.4	4	$E=7.3 \cdot 10^6$	4 minutes
12/20/2013	14:05:33	1.2	3	$E=3.7 \cdot 10^6$	4 minutes

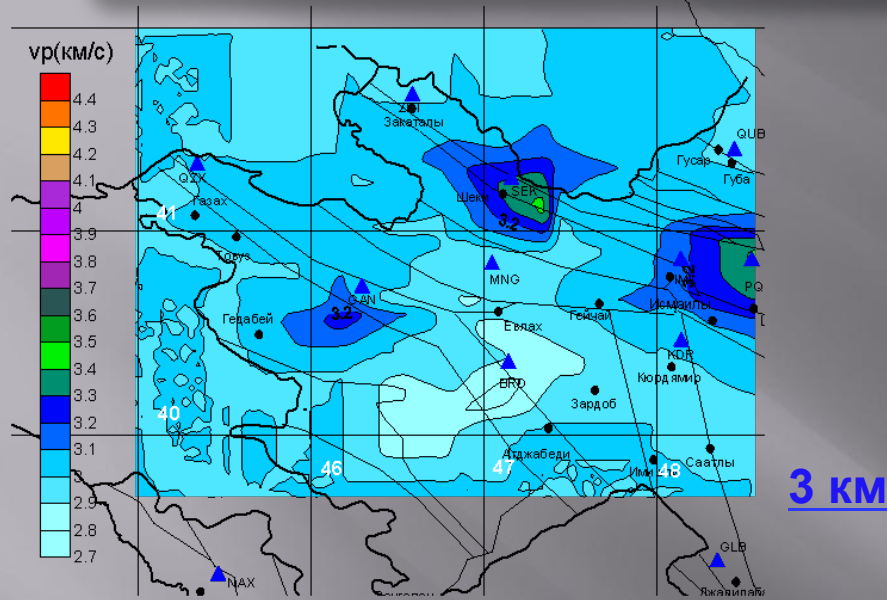
Prognostic curve of the $\Delta\tau$ parameter Vp/Vs for all stations .



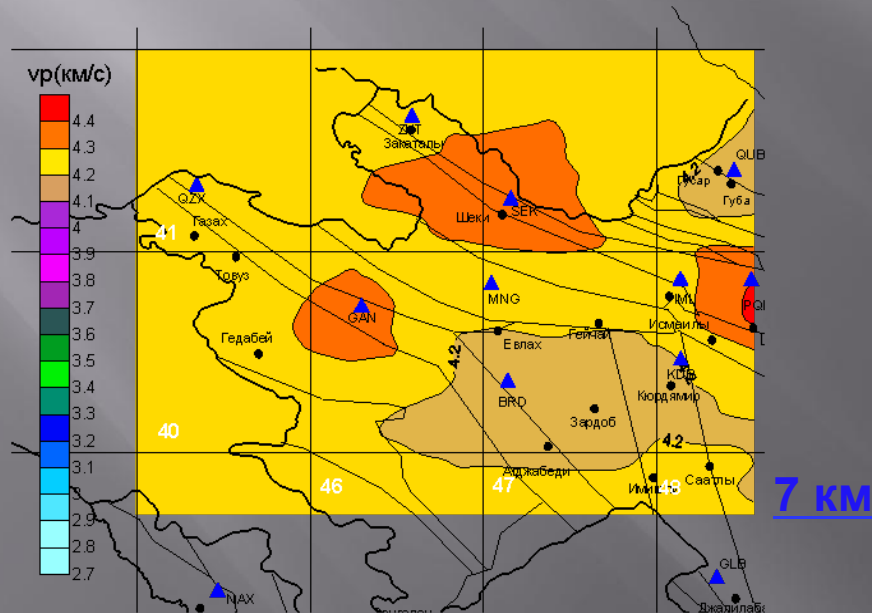
Distribution of velocities of P-waves according to space in 5, 10, 15, 25, 40, 50 km depth in south slope of Great Caucasus



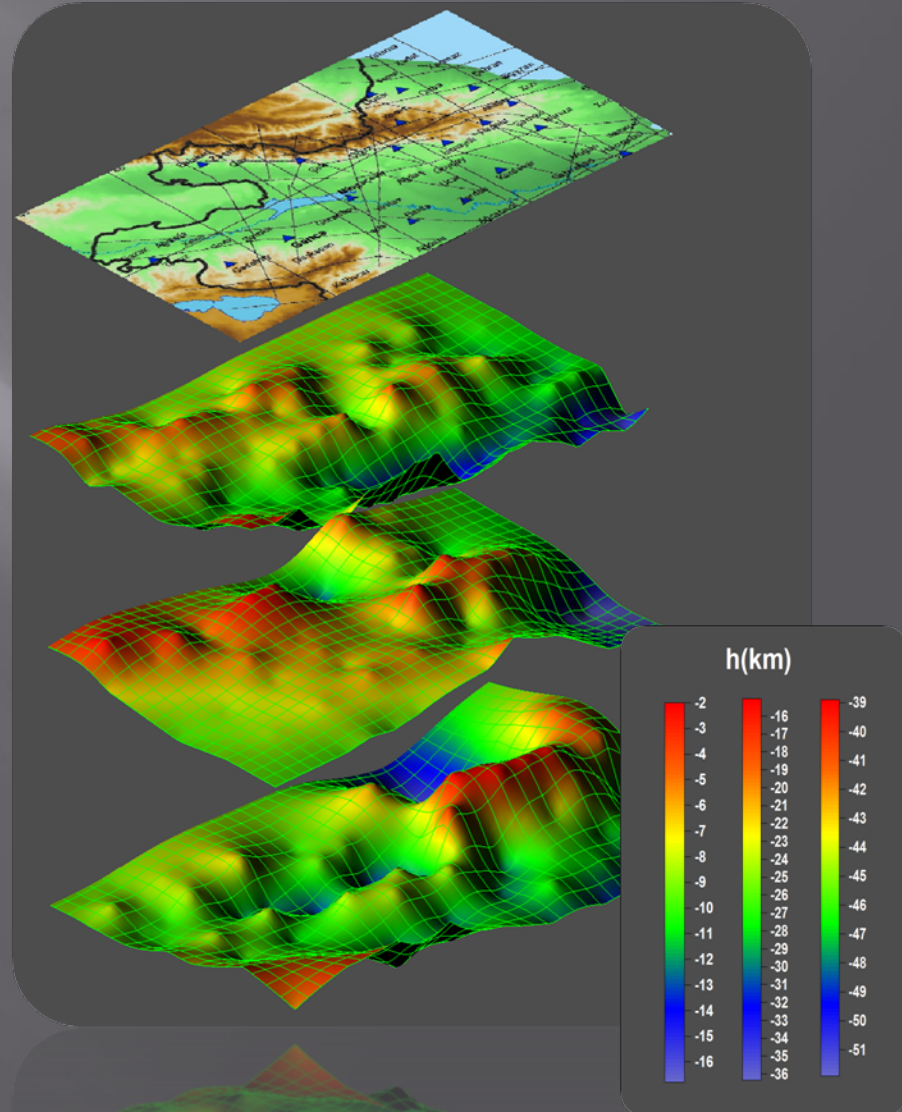
Distribution of velocities of P-waves according to space in 3, 5, 7, 15 km depth in Azerbaijan



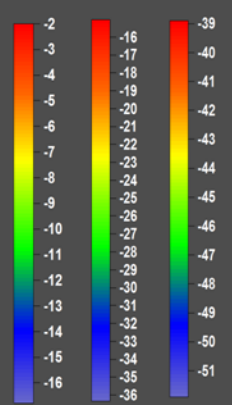
3 KM



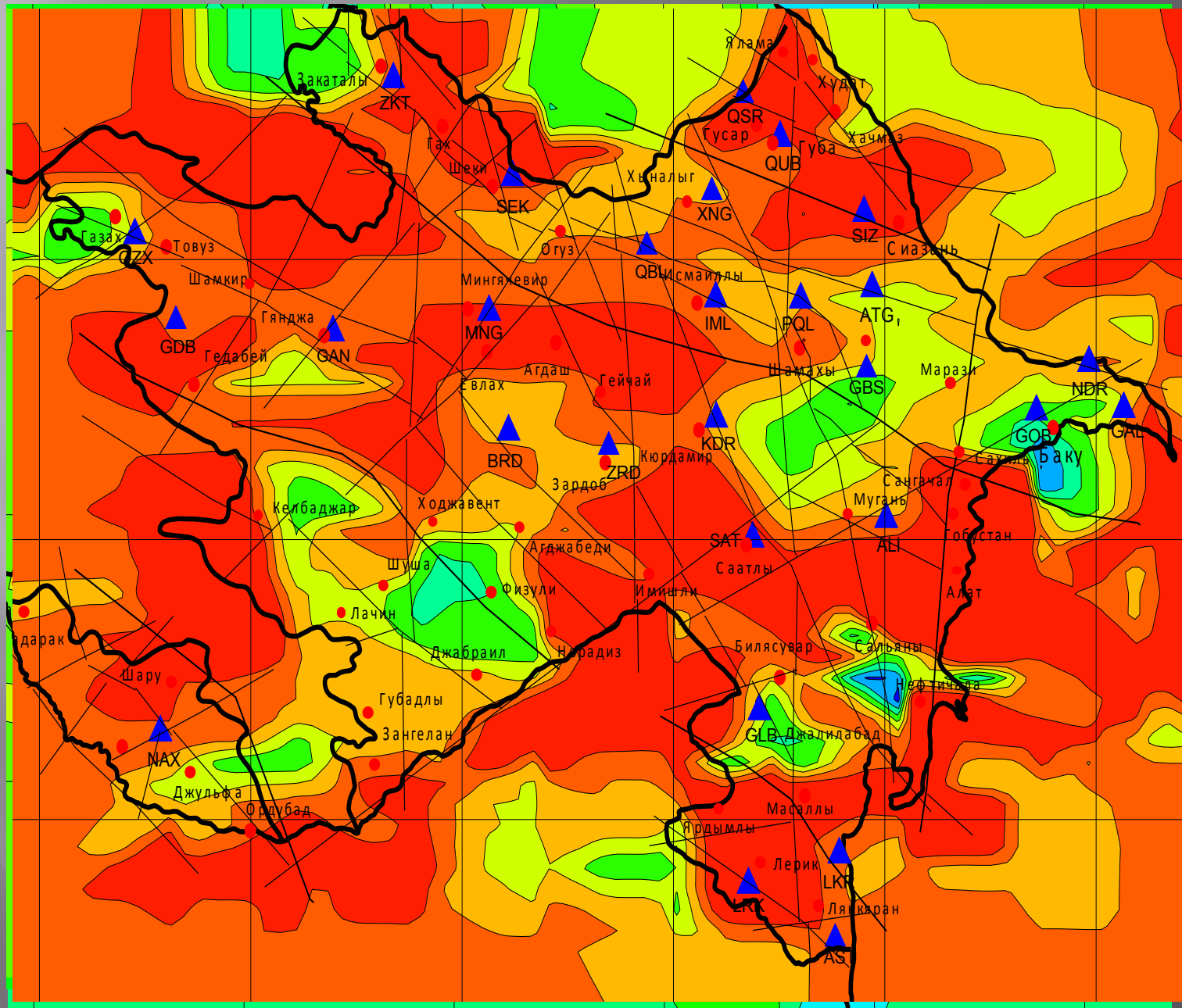
7 KM



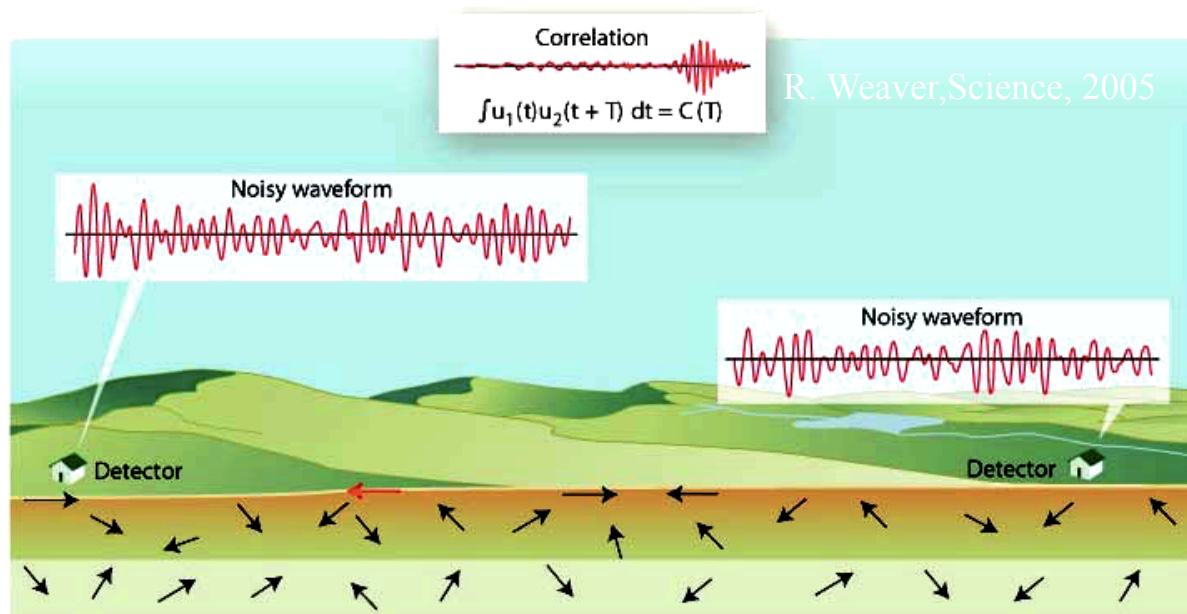
h (km)



Horizontal section of three-dimensional velocity model at different depths

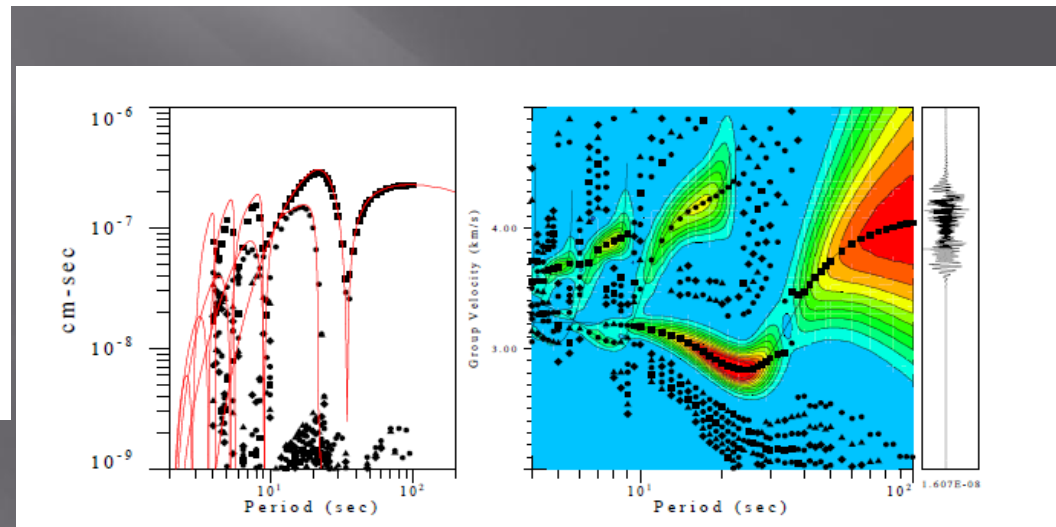
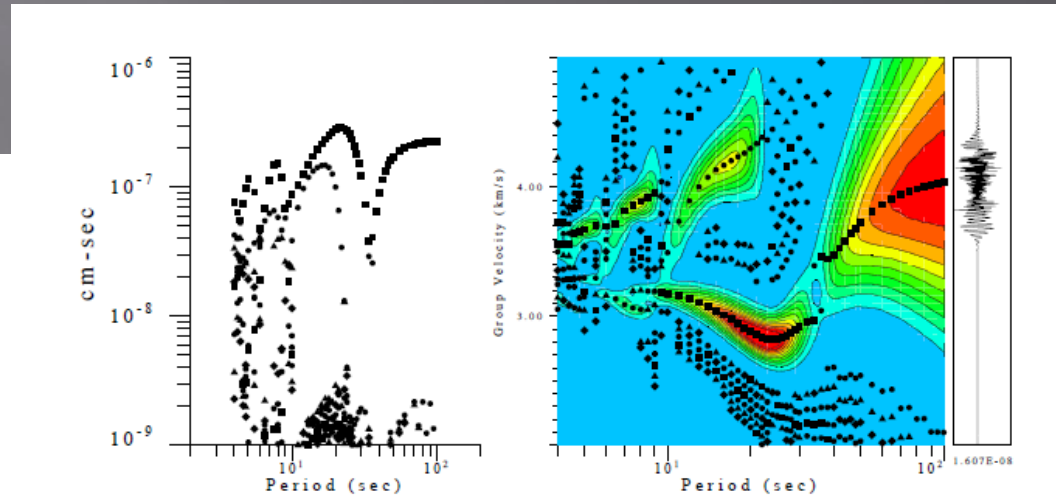
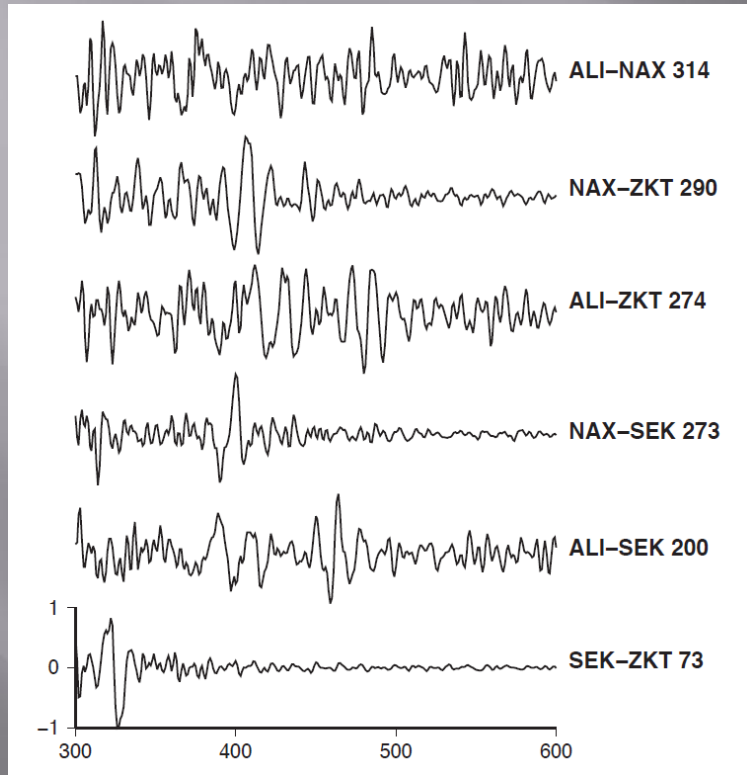


Seismic Tomography without Earthquakes: Progress in Ambient Noise Tomography



Using noise in seismology. When a diffuse wave field is generated by distant sources and/or by multiple scattering, detectors report random signals. Occasionally a ray (for example, the one shown in red) passes through both detectors. As a result, the signals are weakly correlated.

Seismic Tomography without Earthquakes: Progress in Ambient Noise Tomography (LLNL)



OUR GOALS

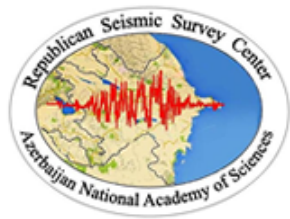
- ❖ Convert all analog recordings to digital, to create a single archive database.
- ❖ Upgrade Antelope version to 5.6
- ❖ Create in the autonomous region of Nakhichevan separate seismic center, which will be carried out processing seismic data together with seismological data Nakhchivan neighboring countries such as Iran, Turkey.
- ❖ On the basis of telemetry data was refined and adjusted 3D velocity model the territory of Azerbaijan.
- ❖ Expand the network of telemetry stations, implement and develop new techniques and developments for the study and analysis of earthquakes.

- ❖ Improving models of crust and upper mantle structure .
- ❖ Monitoring of seismic events and shed light on broad structural features such as the volcanism .
- ❖ Exploring and analyzing the weak seismicity of the region have created a map of zones of potential earthquake.
- ❖ Defined seismogenic zone geodynamic processes in order to better study the structure of the earth and the Caspian Sea on the basis of geodetic stations GPS.
- ❖ To monitor regional seismicity and seismic hazard reduction to provide high quality data for scientific research.



Welcome to Baku





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of Azerbaijan National Academy
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