

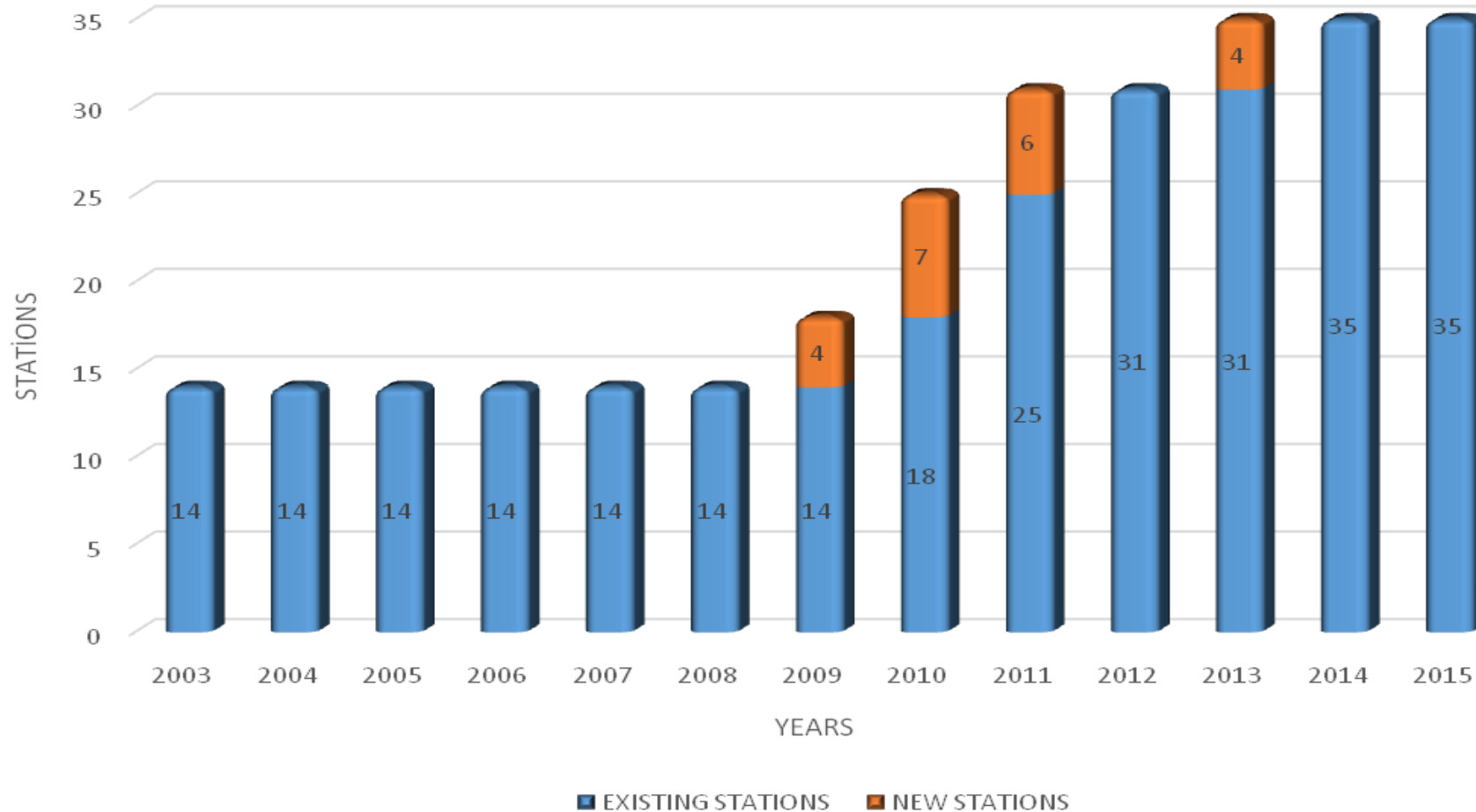
# AZERBAIJAN SEISMIC NETWORK

From past to future

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

# THE DISTRIBUTION OF BROAD BAND STATIONS BY YEARS

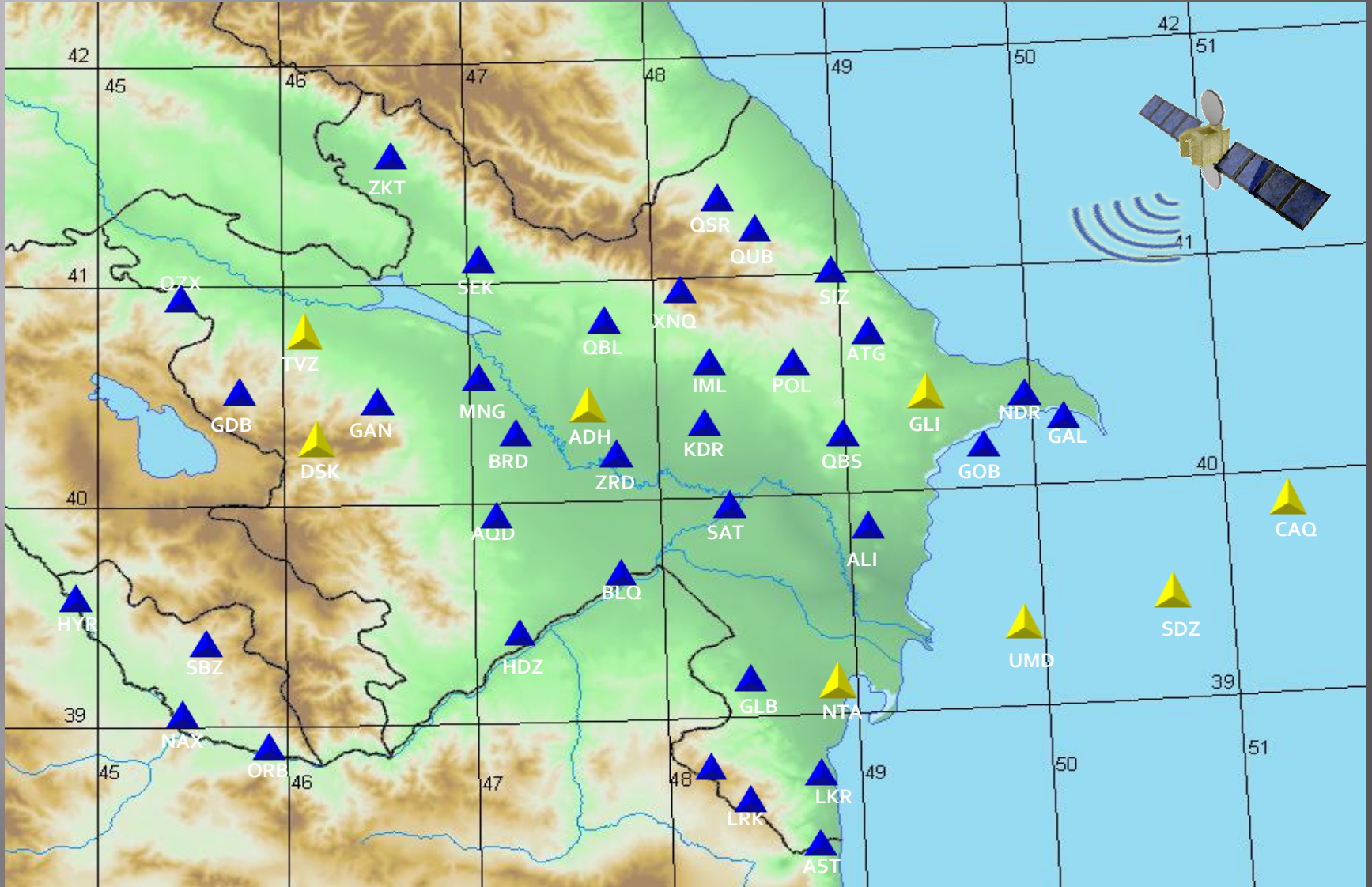
## ANNUAL INSTALLATION OF BB STATIONS



# 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 expanded 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*

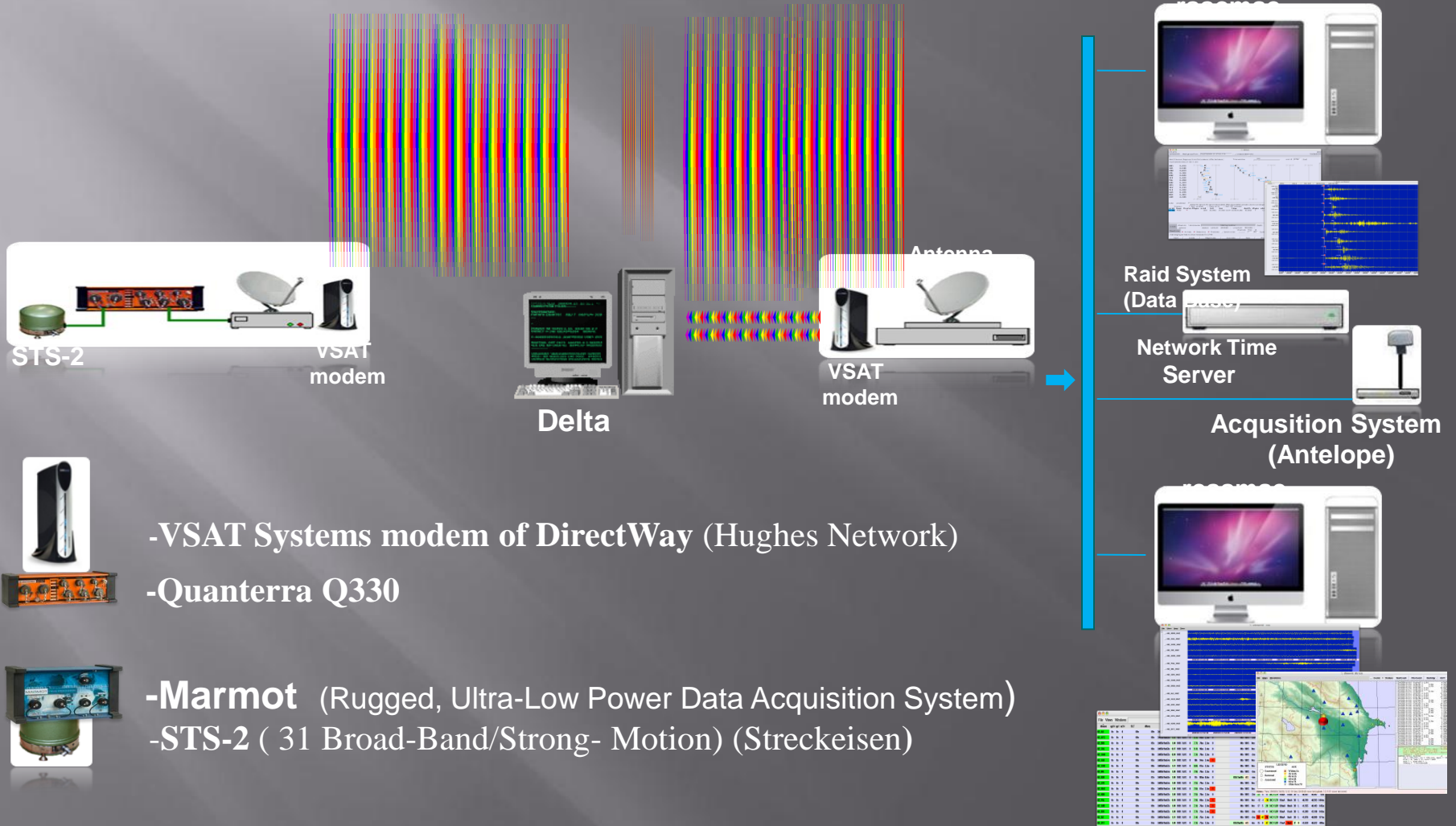
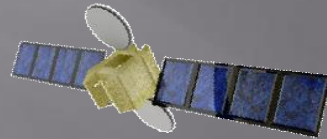


*G-856 Magnetometer*

## *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



-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**



**Telemetric seismic stations**



**Inside view of seismic station**



**Main power control and management unit**

# Telemetric seismic stations



**Shaki**



**Shahbuz**



**Altiagac**



**Gusar**



**Pirqulu**



**Berde**

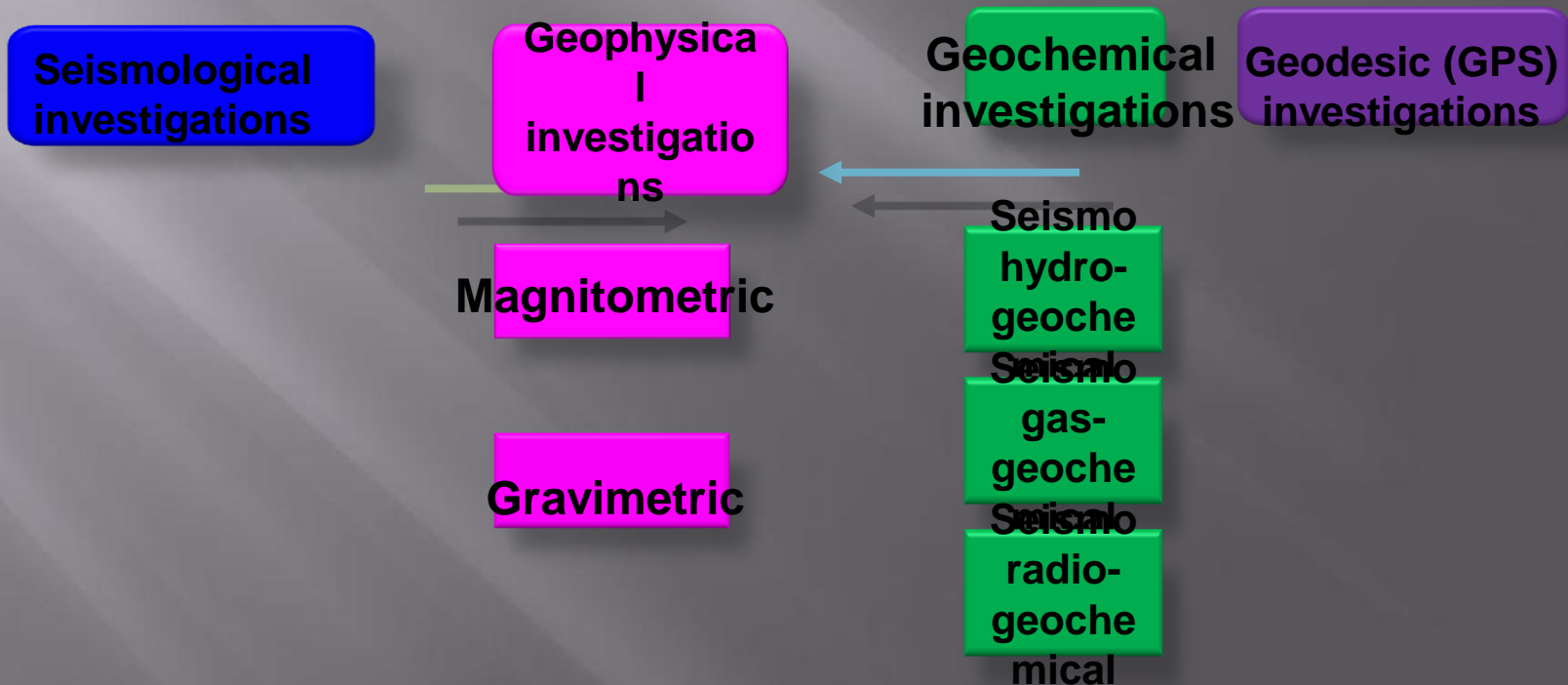


# Shaki Geophysical Observatory



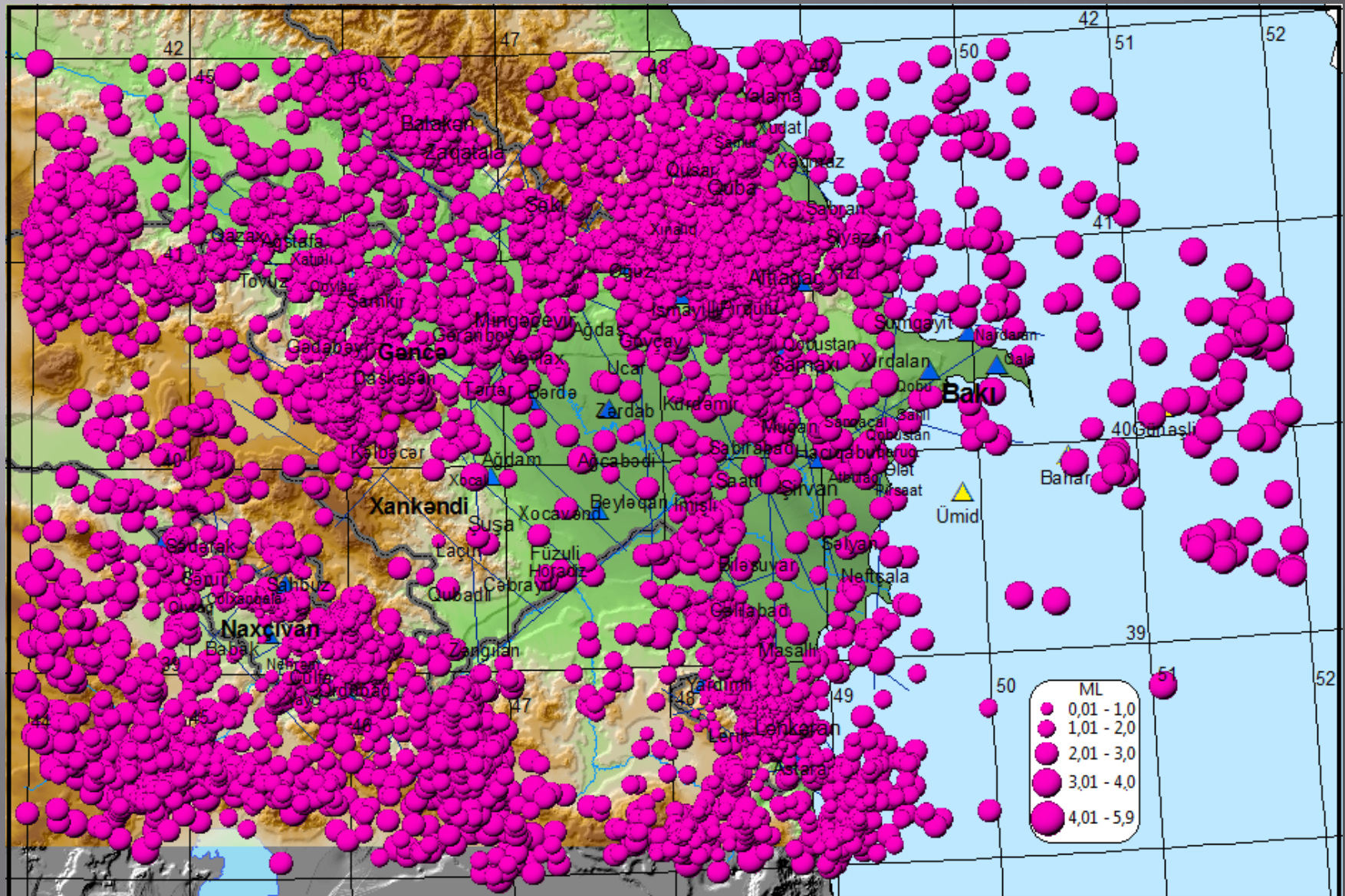
# RSSC ANAS

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



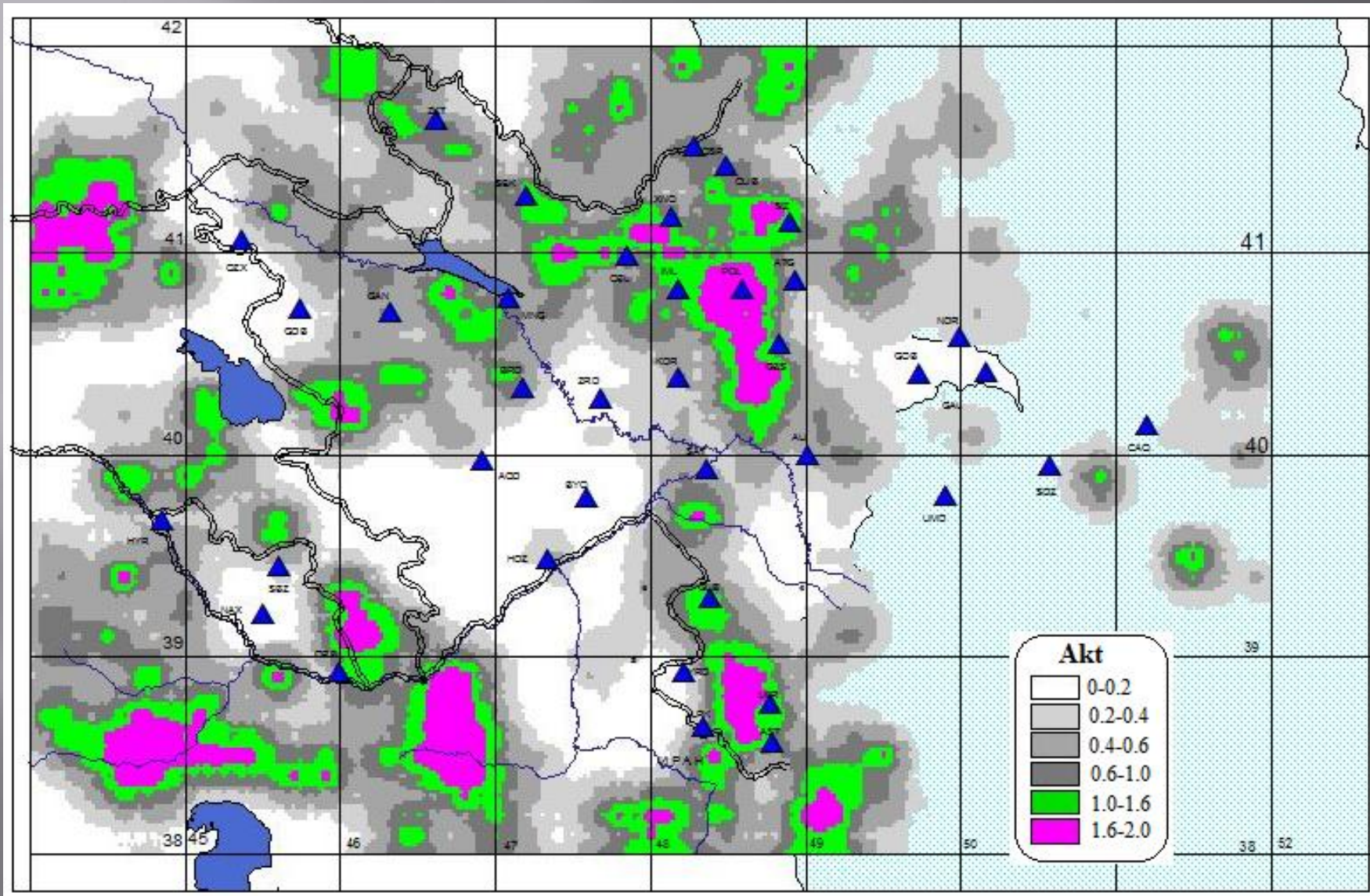


# Map of the epicenters of earthquakes in Azerbaijan and adjacent areas 2015. (N=7666)

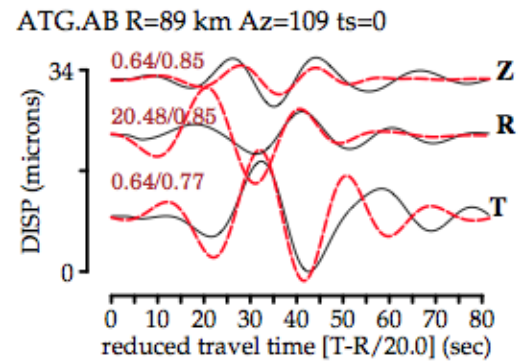
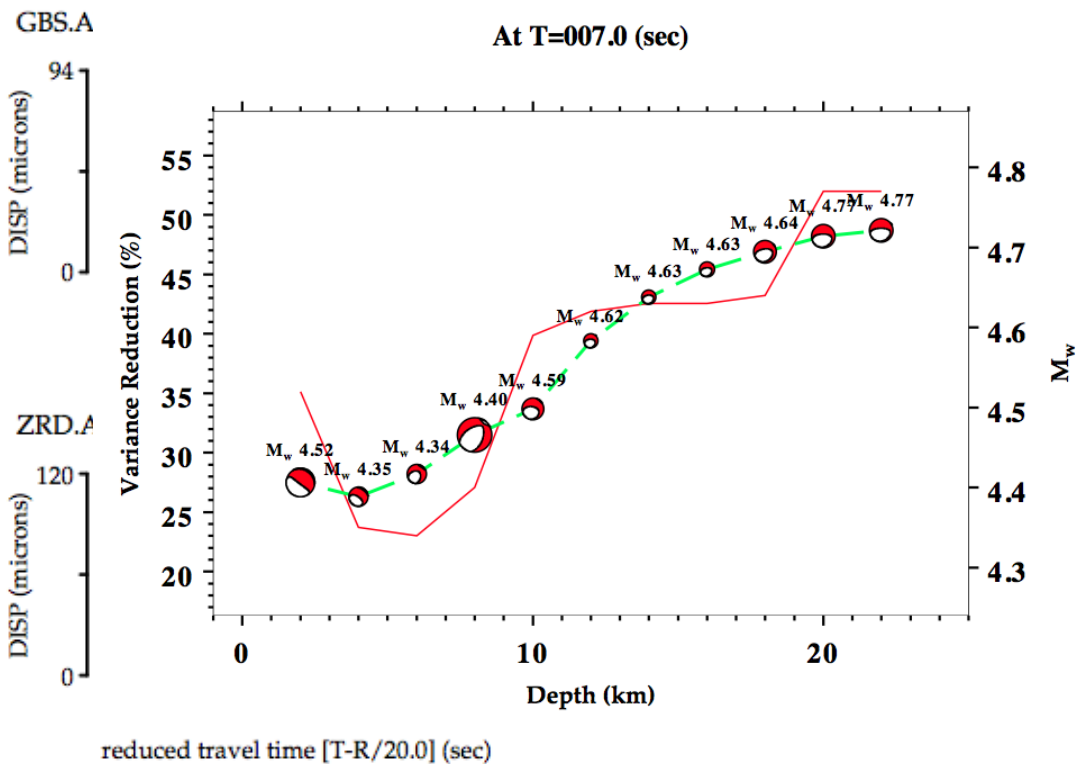
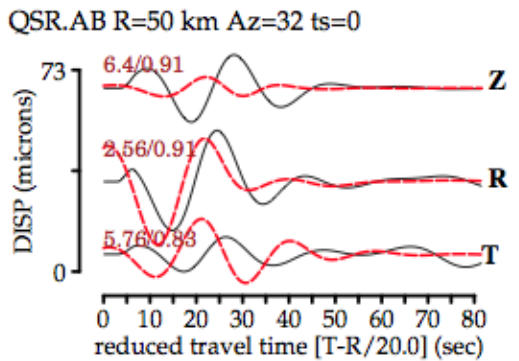
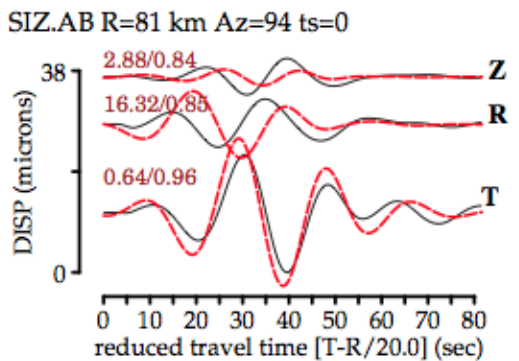
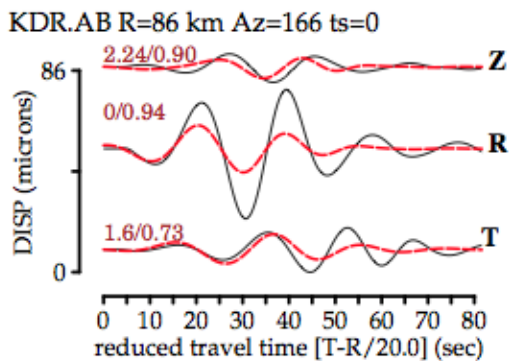




# The map of seismic activity of Azerbaijan and adjacent areas in 2015.



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



**Qabala**

Major      Minor

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  $M_w$ =4.52

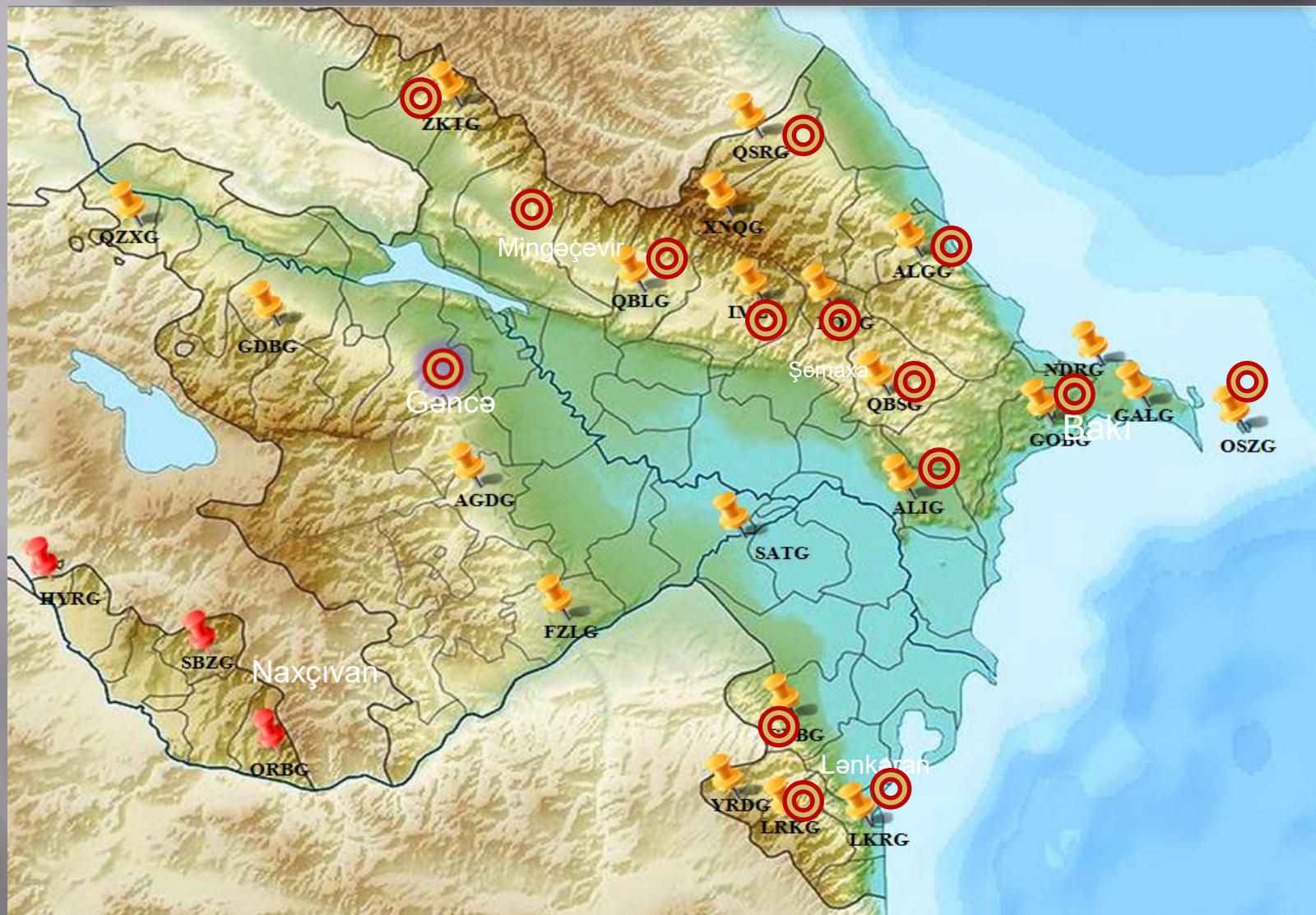
Mo=7.58E+22 xx=-3.39 xy=-1.94 xz=6.42 yy=0.90 yz=-1.80 zz=2.49  
 T ev= 7.60 az=325 pl=51 Epsilon=0.00  
 B ev= -0.03 az= 82 pl=20  
 P ev= -7.57 az=186 pl=32







# GPS Network stations



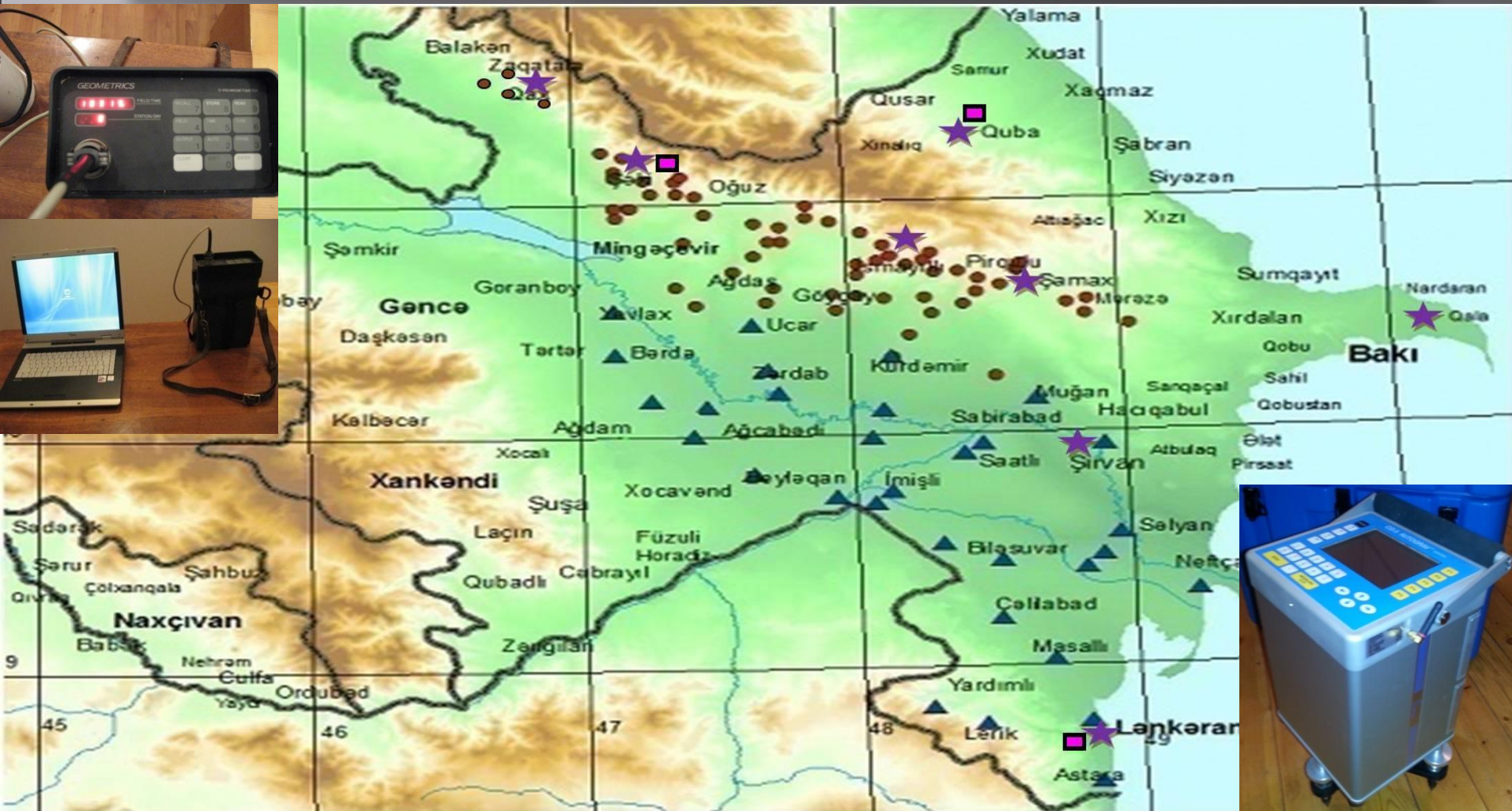
 working stations





 will be installed in 2016

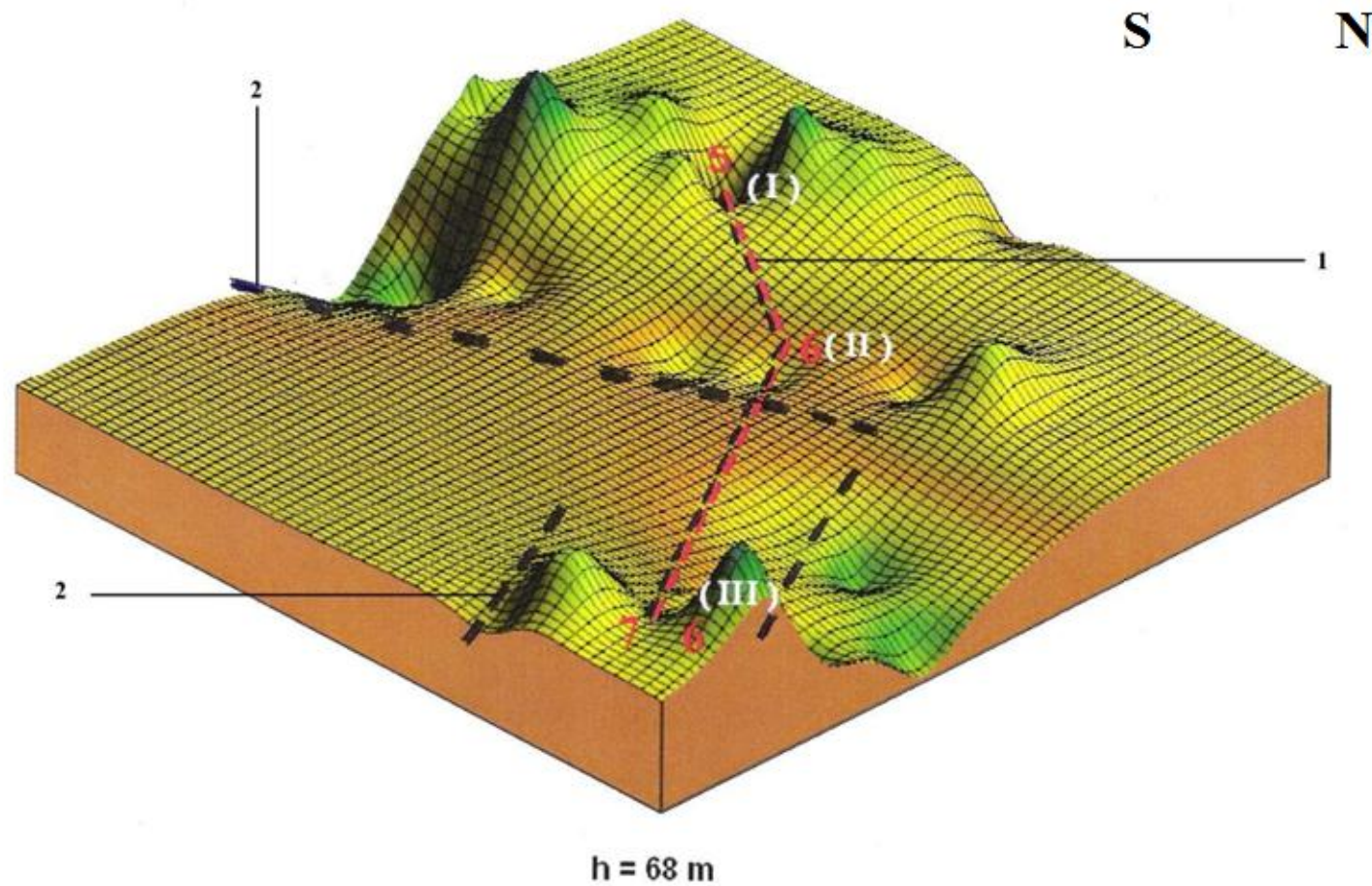
 tiltimetr



# Schematic map of the existing points of geomagnetic regime observations.



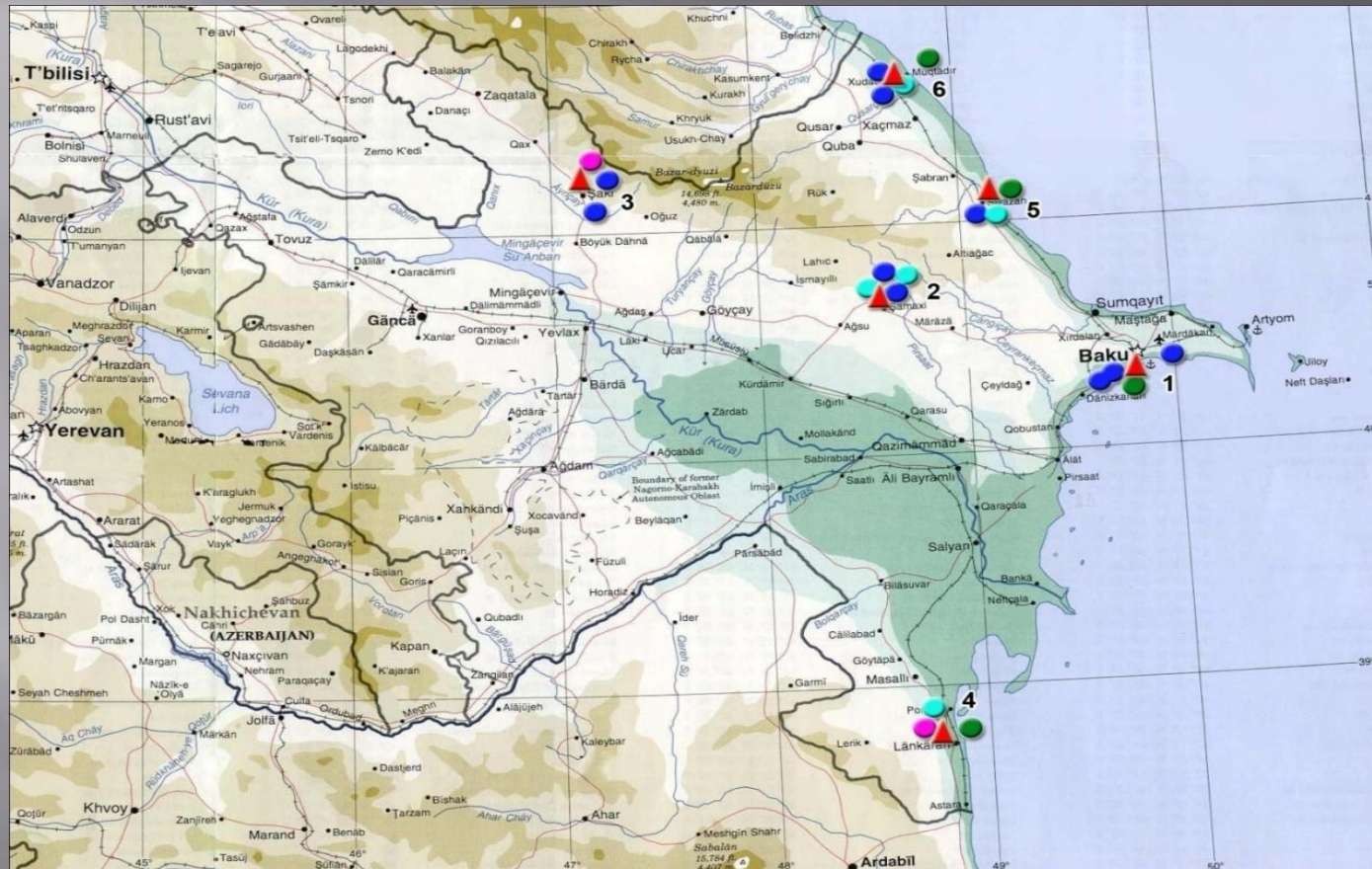
-  - magnetic stands-stations
-  - stands gravimetric stations
-  - Shekhi-Shamakhi magnetometric and gravimetric polling stations ions
-  - Kura-Talish magnetometric and gravimetric polling stations ions



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).







Conditional symbols.

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

In Azerbaijan regions (gc/st.):

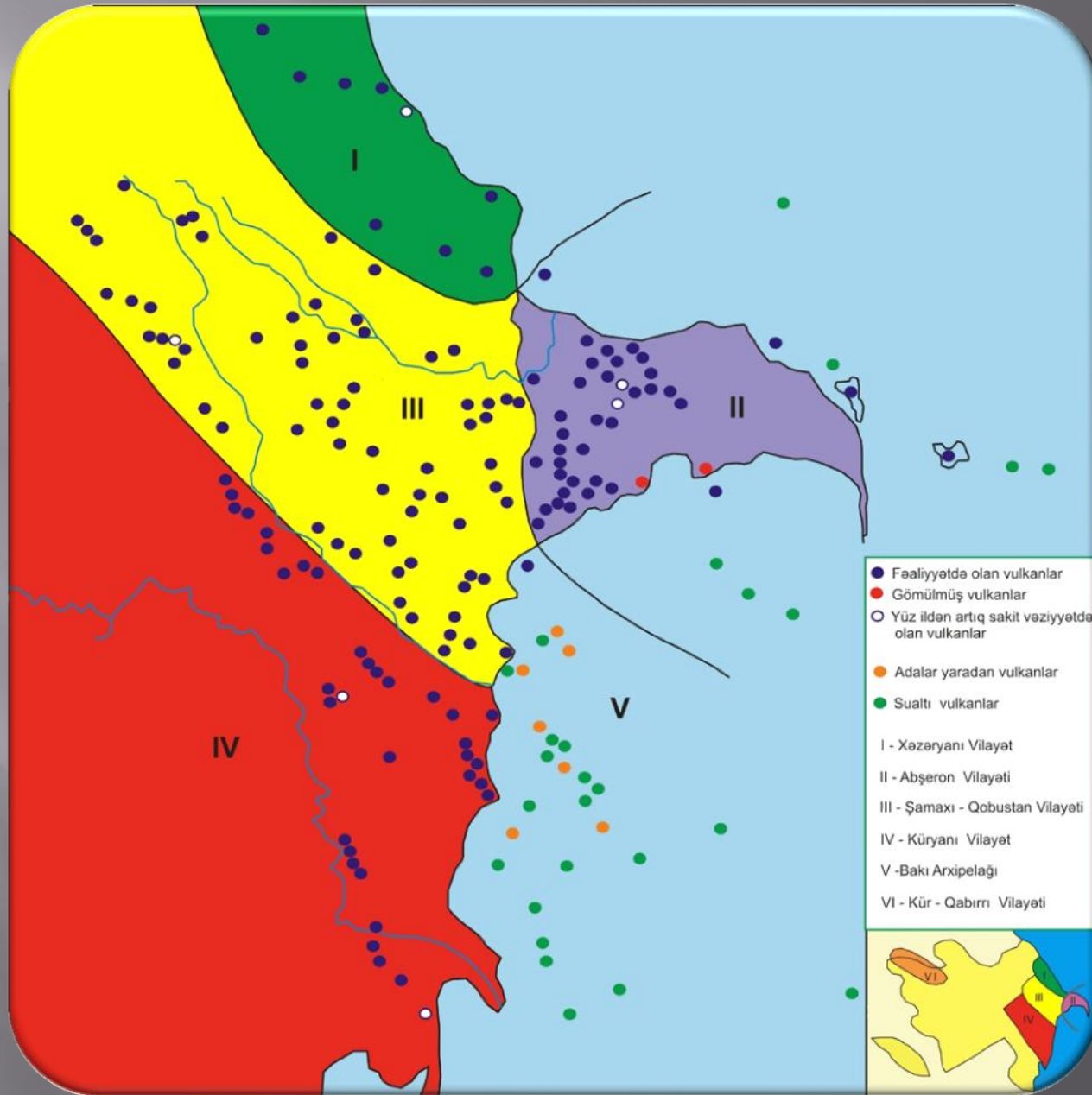
1. Baku city ("Bibi-Heybet" - 1979-2014)
2. Region Shamakhi ("Shamakhi"- 1983-2014)
3. Region Sheki ("Kish" 1981-2014)
4. Region Lankaran ("Osakuche"2001-2014)
5. Region Siyezen ("Boyuk Hemye" 2001-2014)
6. Region Khachmaz ("Muqtadir" 2013-2014)



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



# The map of mud volcanoes of Azerbaijan

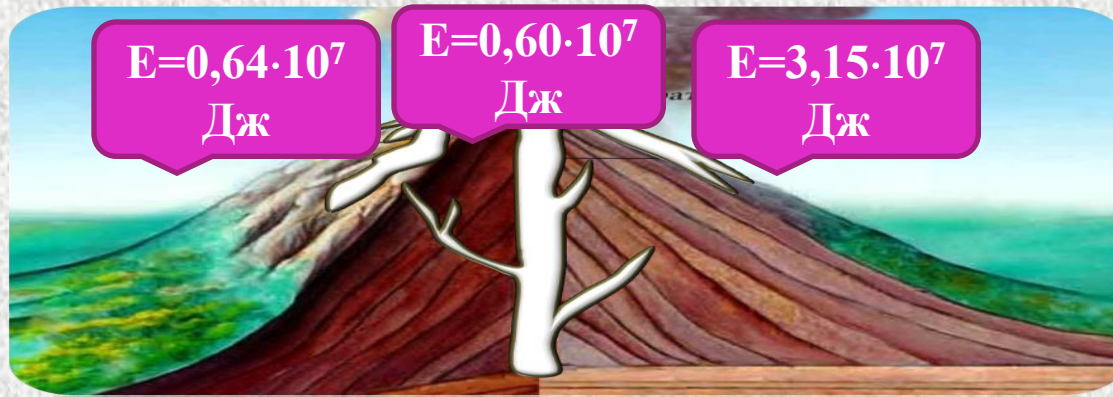


## Examples of eruption of mud volcanoes





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



*phase of the eruption*

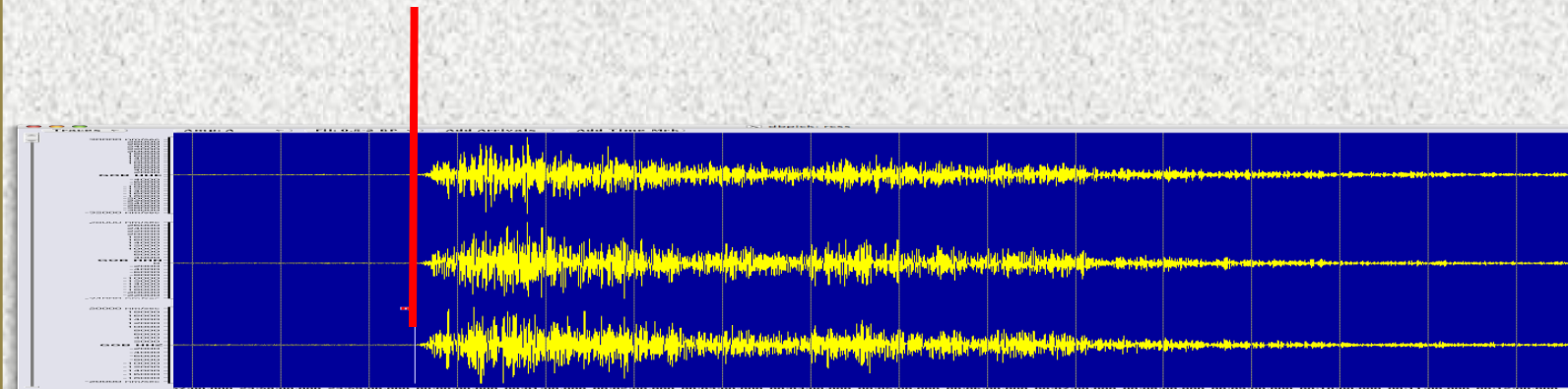
I                  II                  III



*7 min*

*4 min*

*12 min*

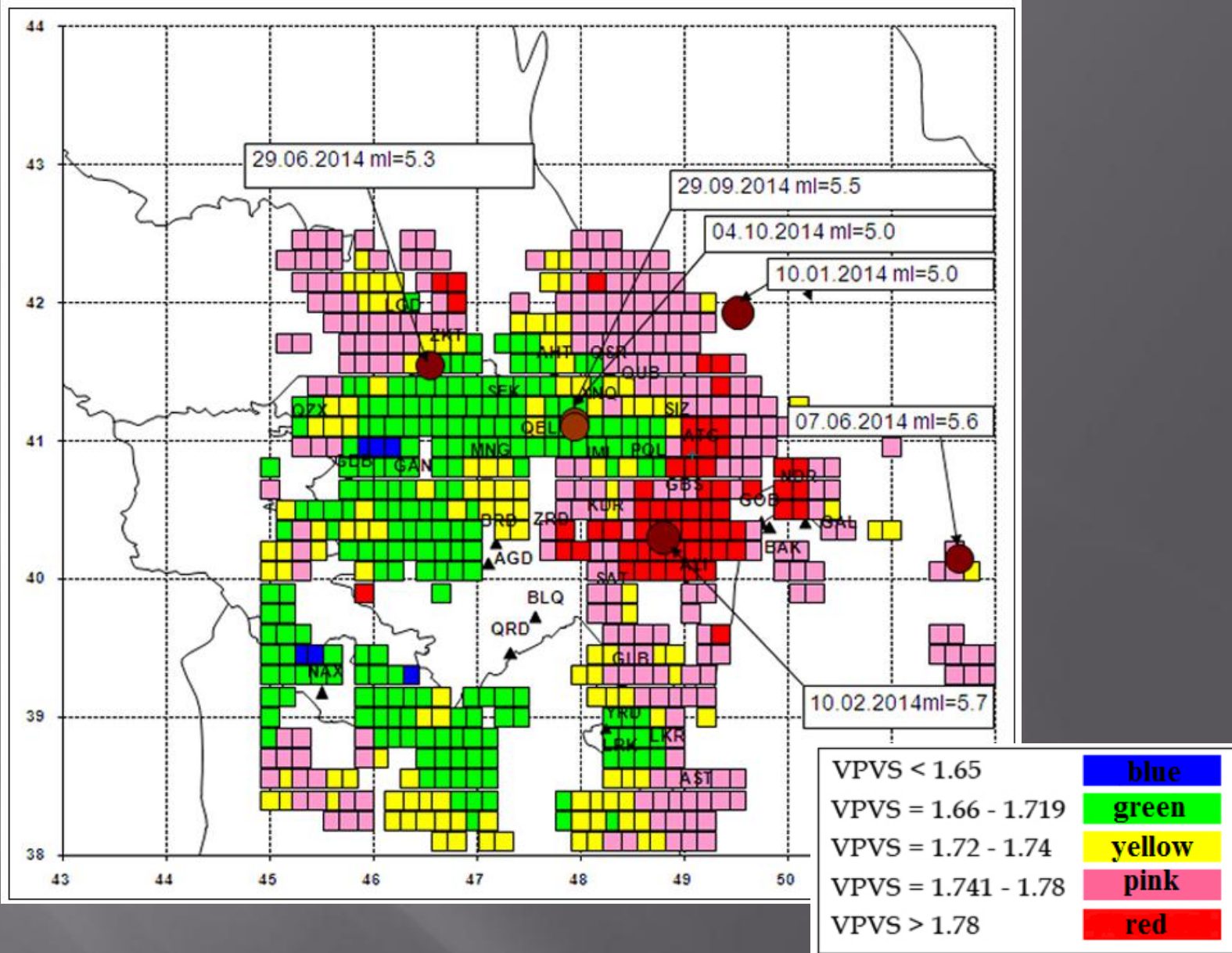


## The parameters of Shikhzaherli mud volcano

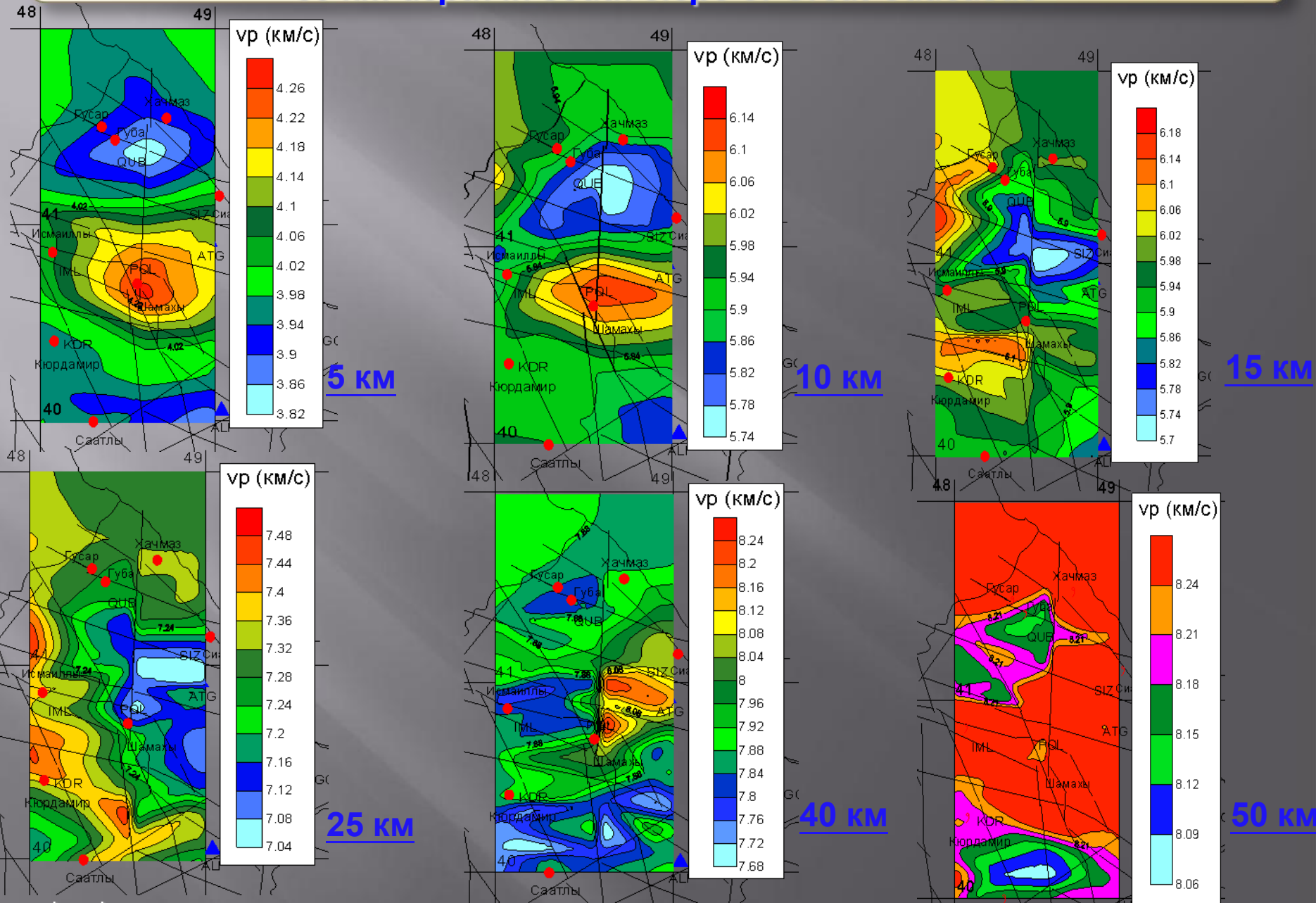
Date	Time	Ml	H	Distribution of seismic energy	Continuation period of eruption
12/20/2013	12:46:02	1.4	3	$E=6.4 \cdot 10^6$	3 minutes
12/20/2013	13:10:28	0.9	3	$E=1.5 \cdot 10^6$	2 minutes
12/20/2013	13:12:37	1.4	4	$E=6.4 \cdot 10^6$	2.5 minutes
12/20/2013	13:19:44	1.2	4	$E=3.8 \cdot 10^6$	5 minutes
12/20/2013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



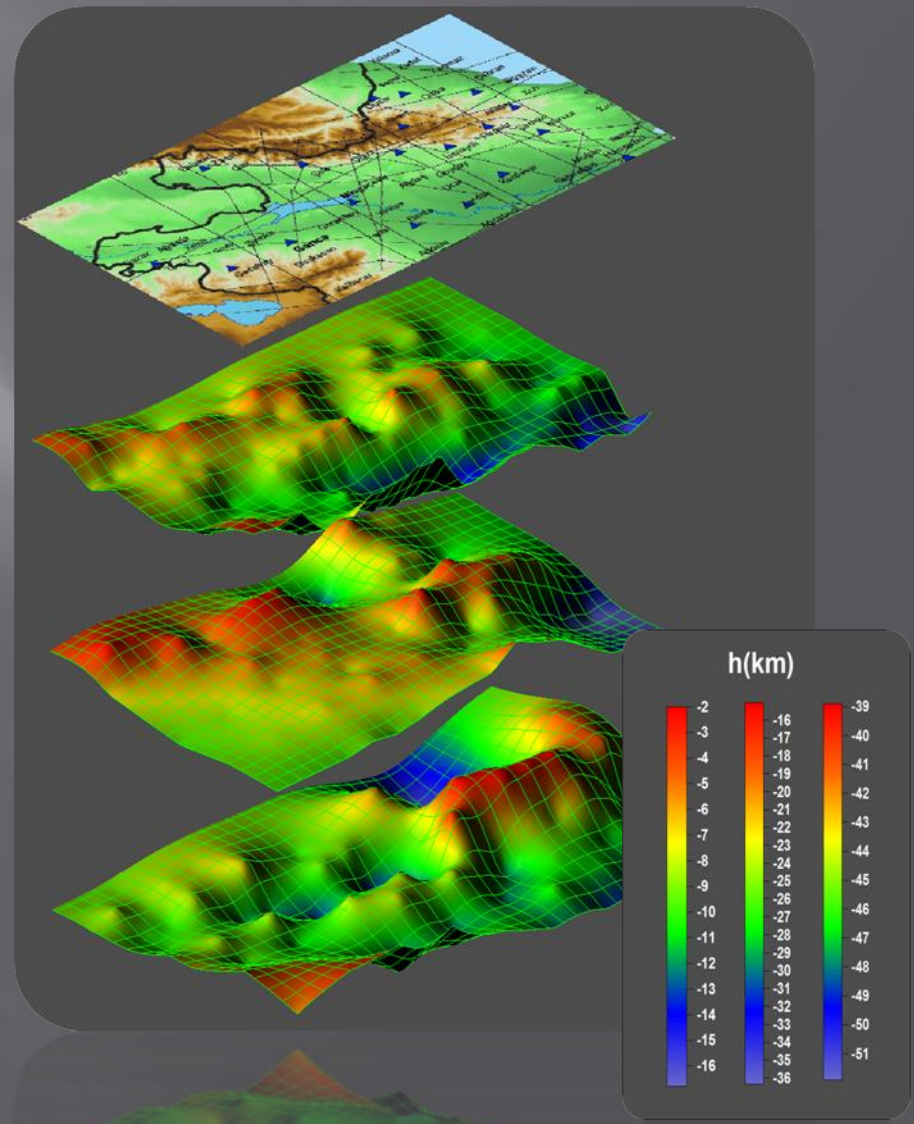
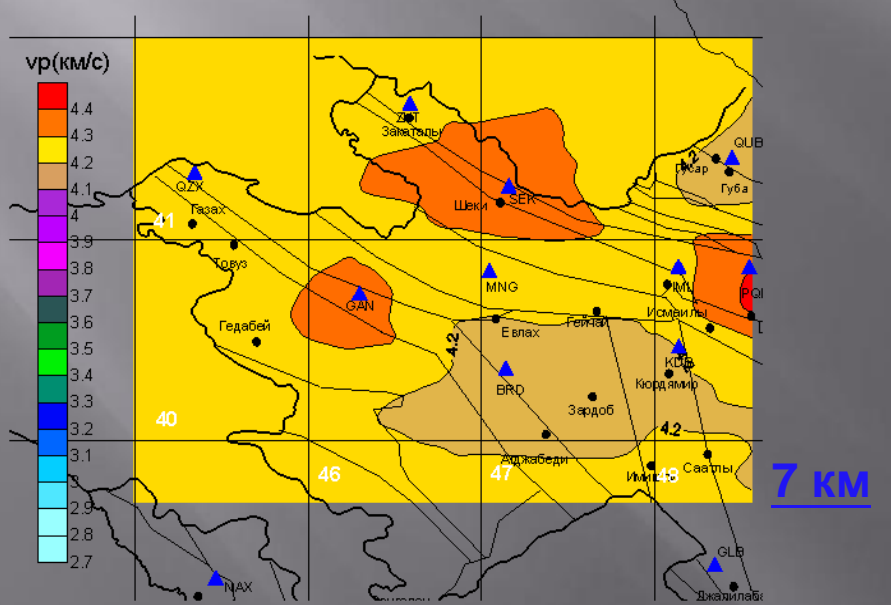
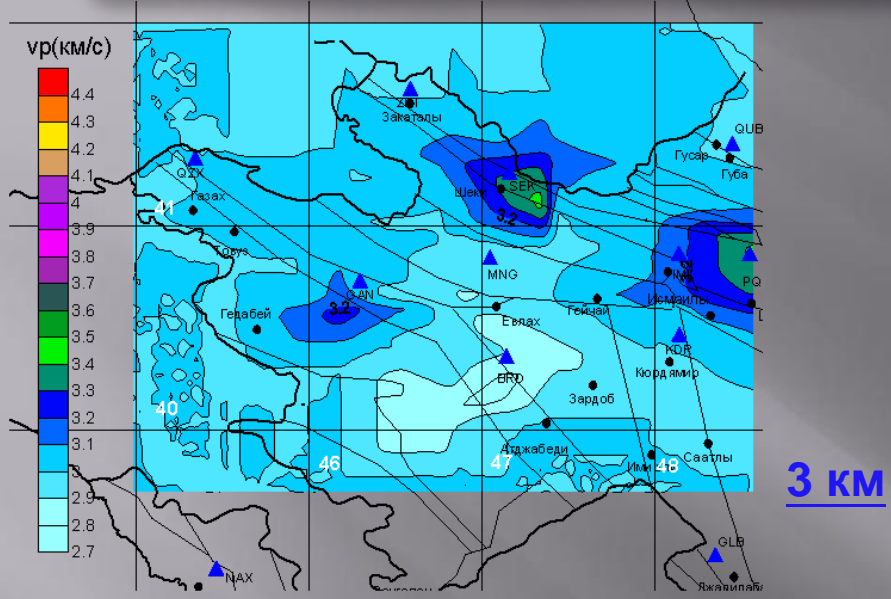
# Prognostic curve of the $\Delta\tau$ parameter Vp/Vs for all stations .



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

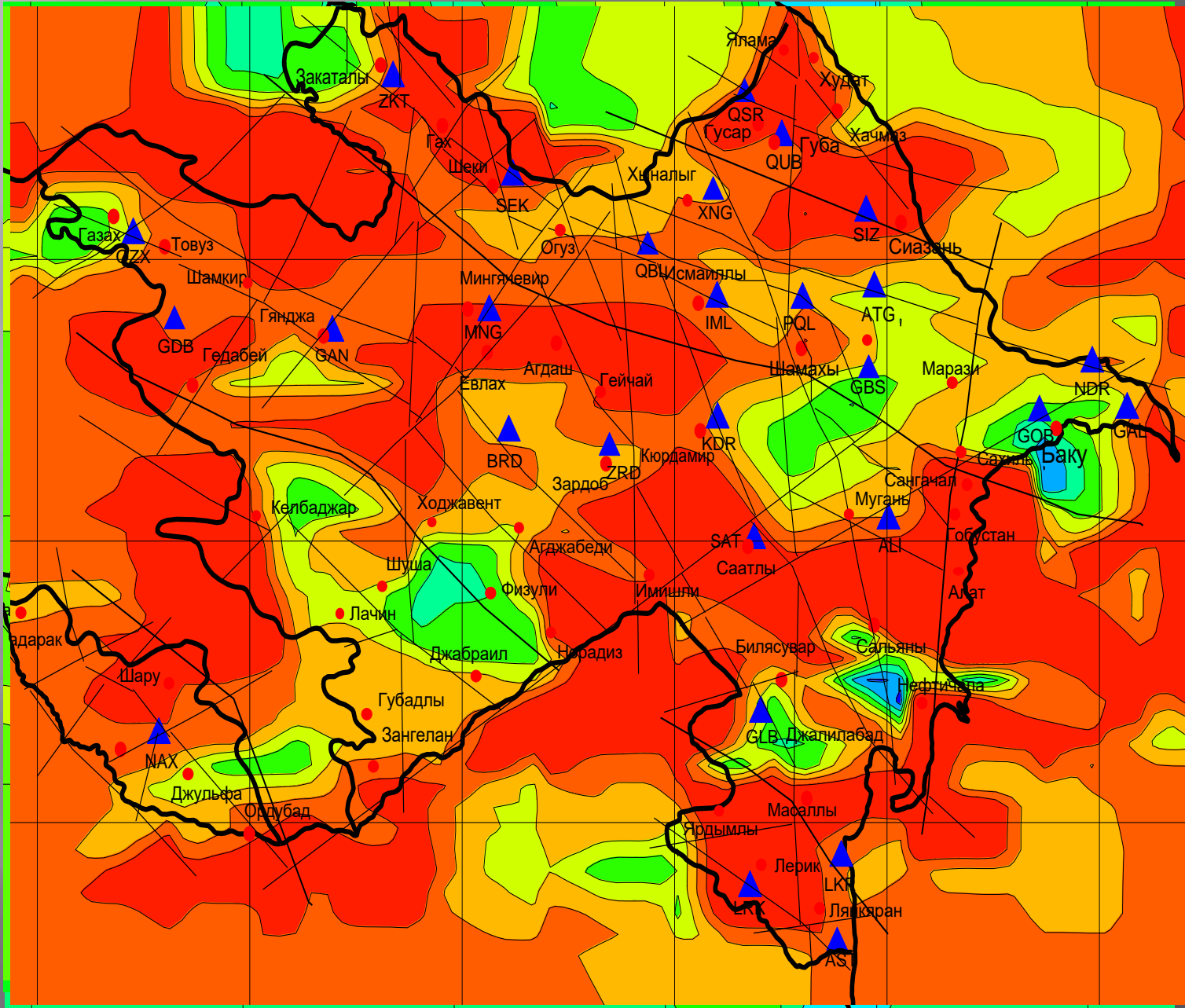


# Distribution of velocities of P-waves according to space in 3, 5, 7, 15 km depth in Azerbaijan



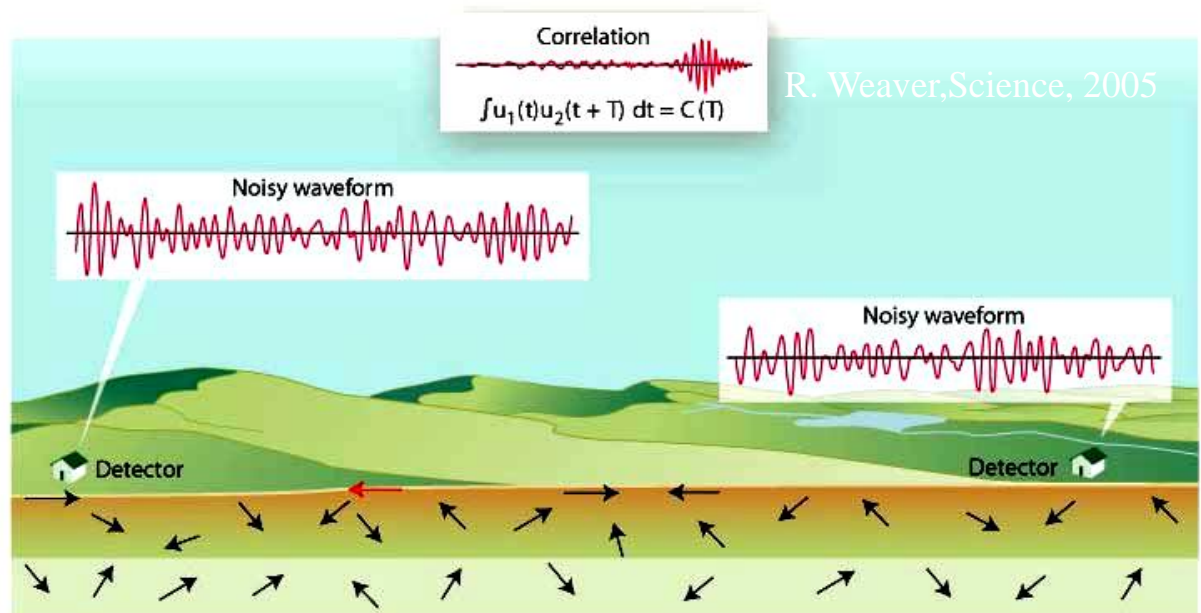


Horizontal section of three-dimensional velocity model at different depths



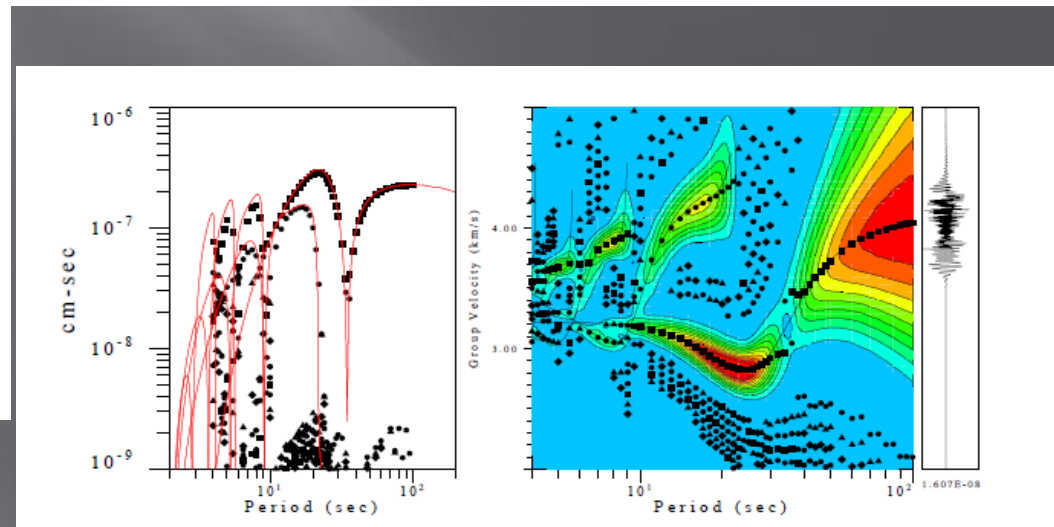
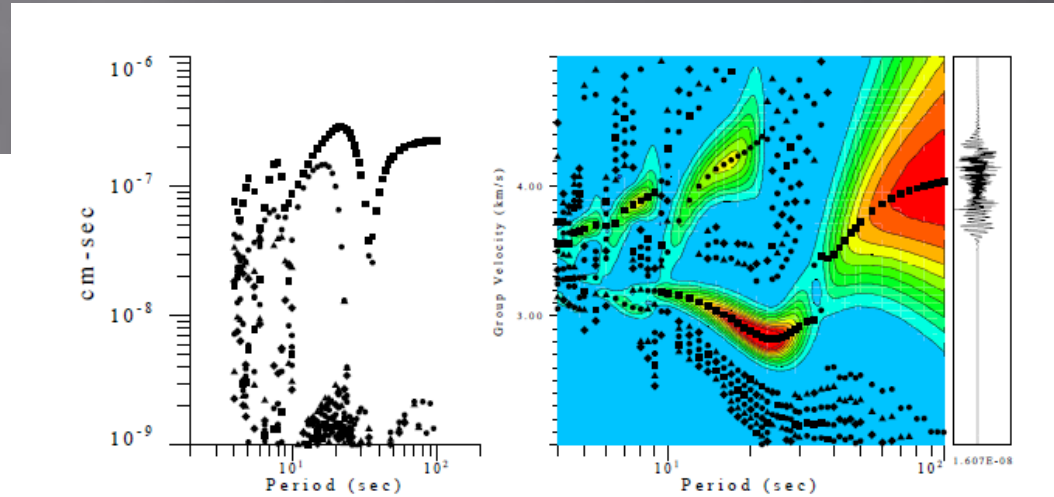
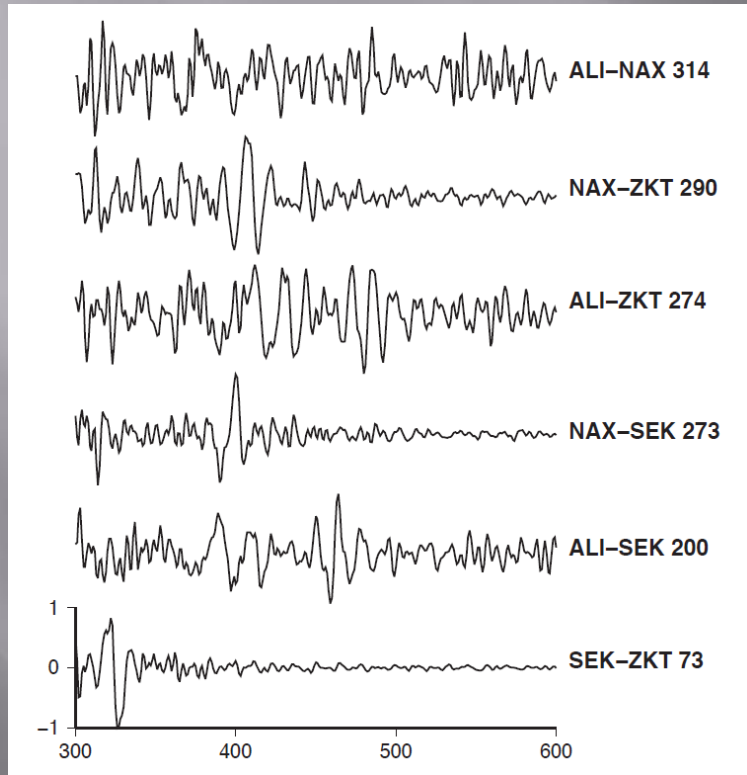


## Seismic Tomography without Earthquakes: Progress in Ambient Noise Tomography



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 Sciences



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*Thank you for your attention*

[www.seismology.az](http://www.seismology.az)