



# ARMUTLU NETWORK (ARNET) MARMARA REGION-TURKEY

**B. TUNÇ<sup>1</sup>, D. ÇAKA<sup>1</sup>, Ş. BARIŞ<sup>1</sup>, M. F. ÖZER<sup>1</sup>, H. WOITH<sup>2</sup>, B. LÜHR<sup>2</sup>**

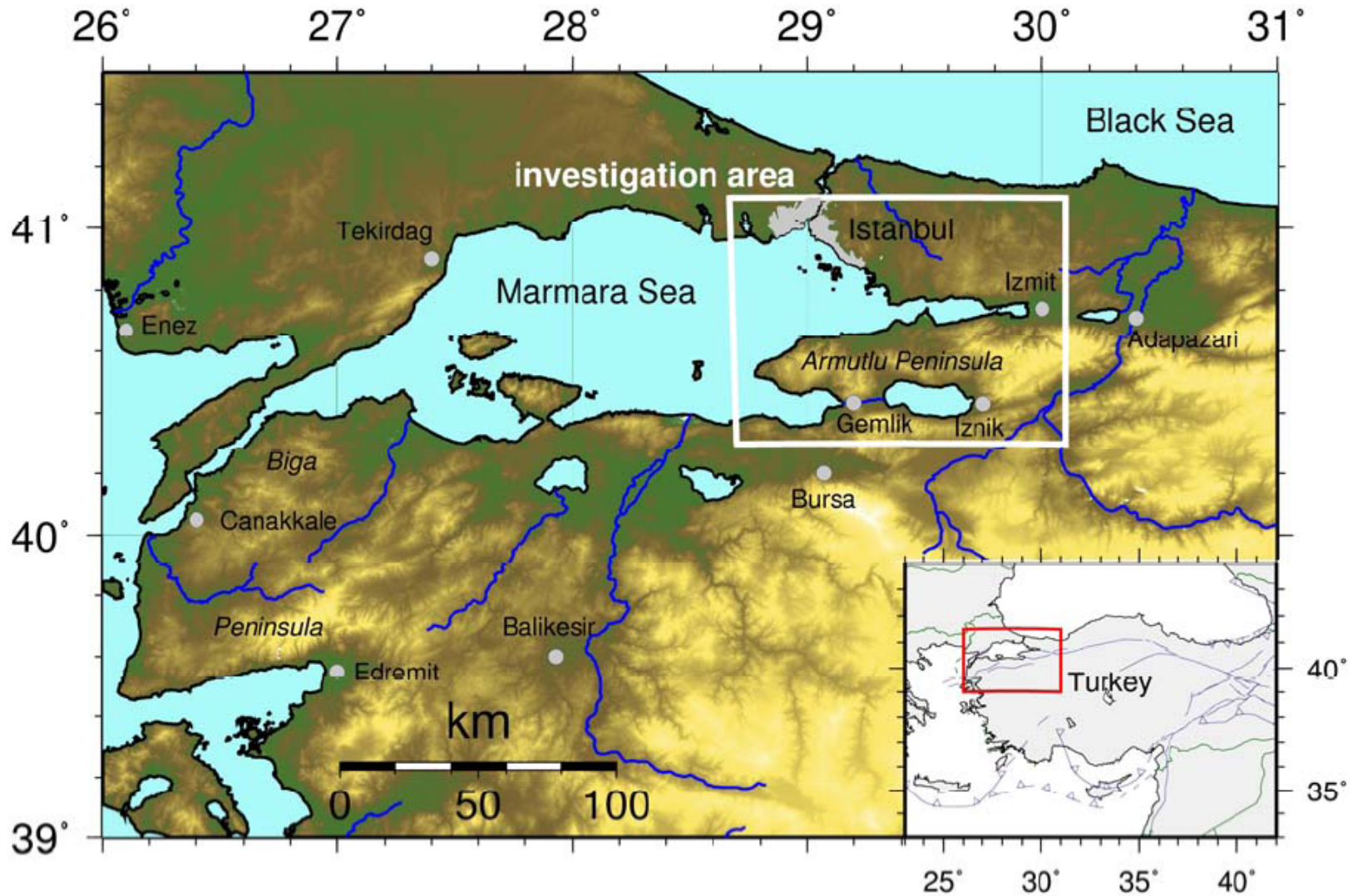
[berna@kocaeli.edu.tr](mailto:berna@kocaeli.edu.tr), [sbaris@kocaeli.edu.tr](mailto:sbaris@kocaeli.edu.tr)

<sup>1</sup> *Kocaeli University Earth and Space Science Research Center, Kocaeli, TURKEY*

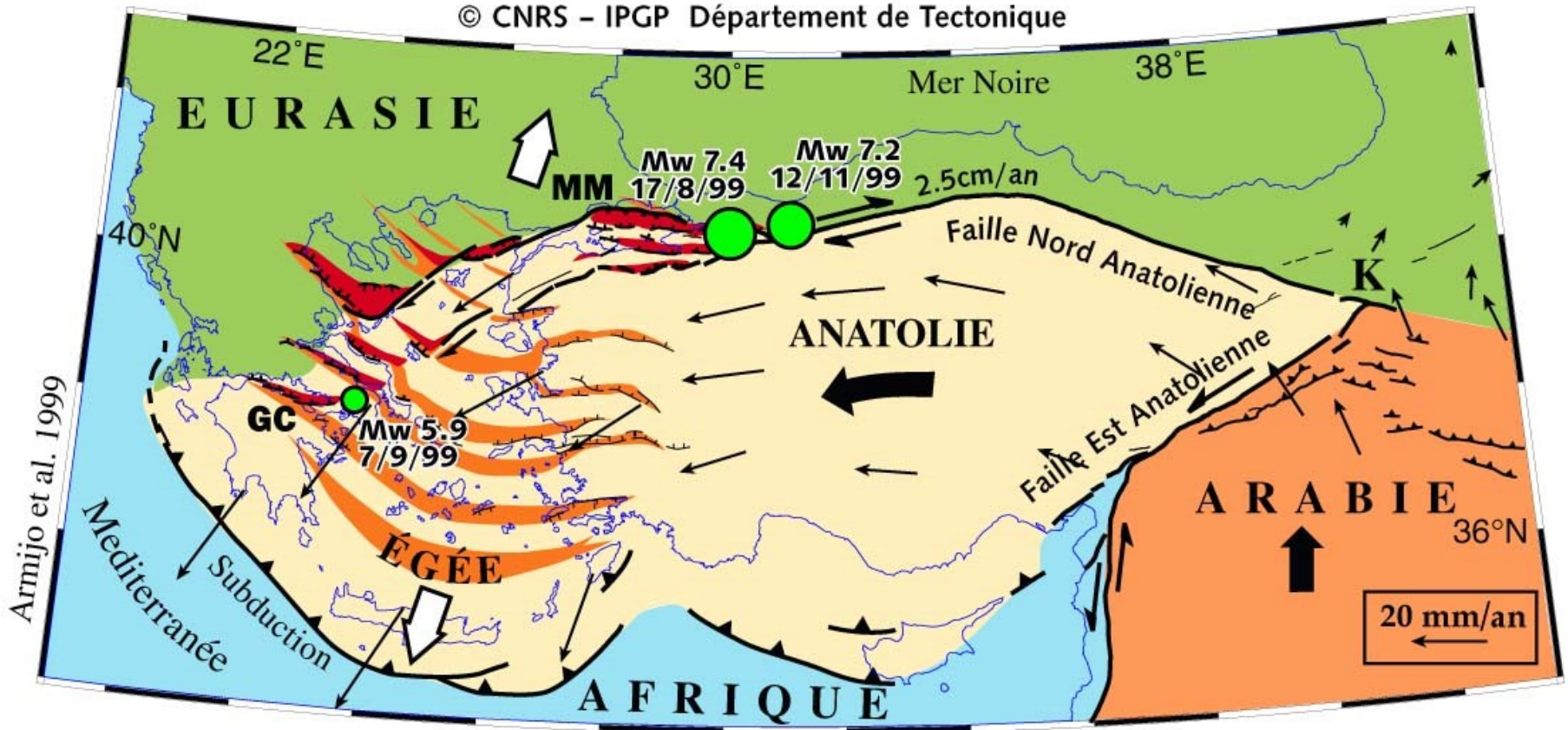
<sup>2</sup> *Deutsches GeoForschungsZentrum, Potsdam, GERMANY*

# OUTLINE

- Tectonic Features
  - Seismicity
  - Motivation
    - ARNET
    - Results



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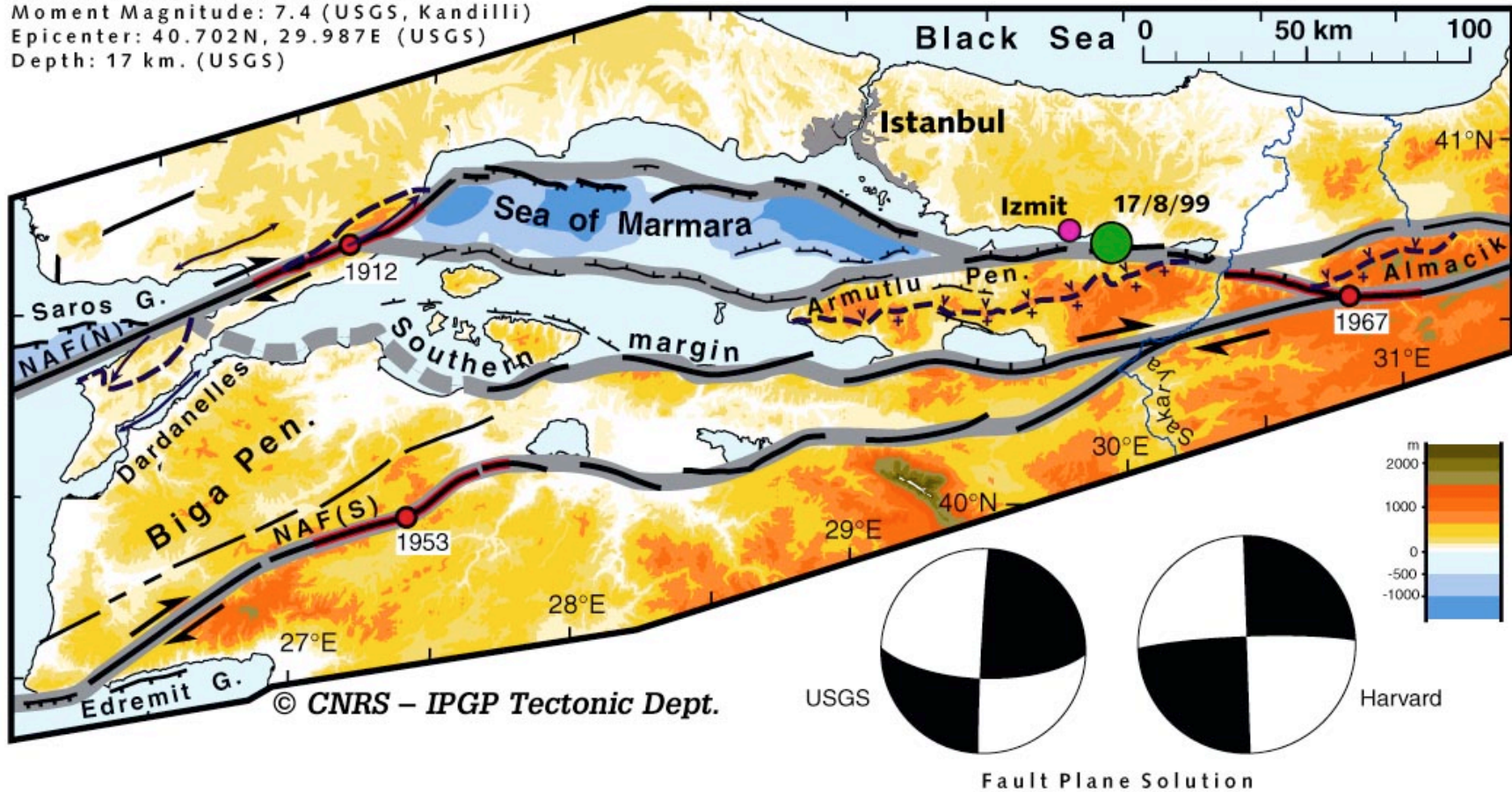


**MM** = Mer de Marmara  
**GC** = Golfe de Corinthe



Date: 1999-08-17 at 00:01:39.80(UTC), 03:01:37 a.m local time  
Surface Wave Magnitude: 7.8 (USGS)  
Body Wave Magnitude: 6.3 (USGS)  
Duration Magnitude: 6.7 (Kandilli)  
Moment Magnitude: 7.4 (USGS, Kandilli)  
Epicenter: 40.702N, 29.987E (USGS)  
Depth: 17 km. (USGS)

Seismotectonic sketch of  
Istanbul region  
(Armijo et al. 1999)



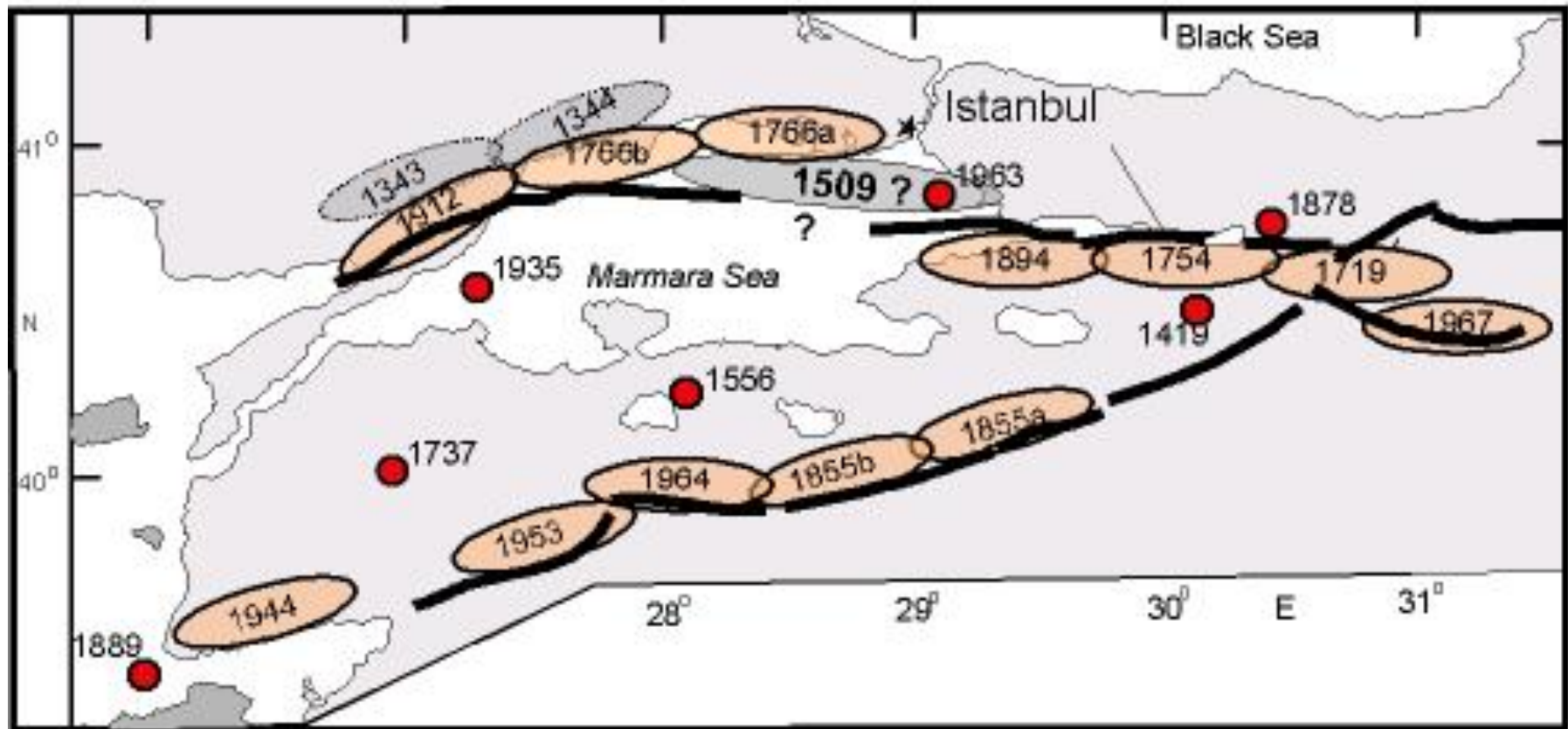
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USGS

Harvard

Fault Plane Solution

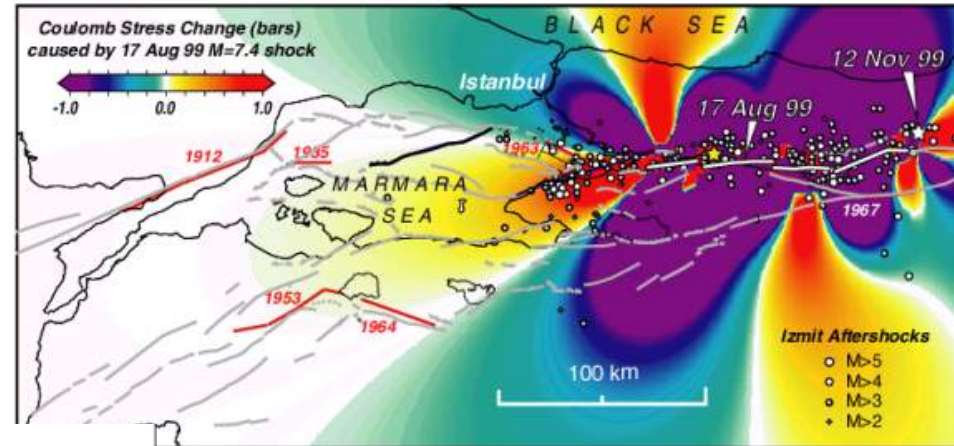
**Historical earthquakes in the Marmara Sea provide clues about the long-term behaviour of the NAF**



Atakan et al., 2002

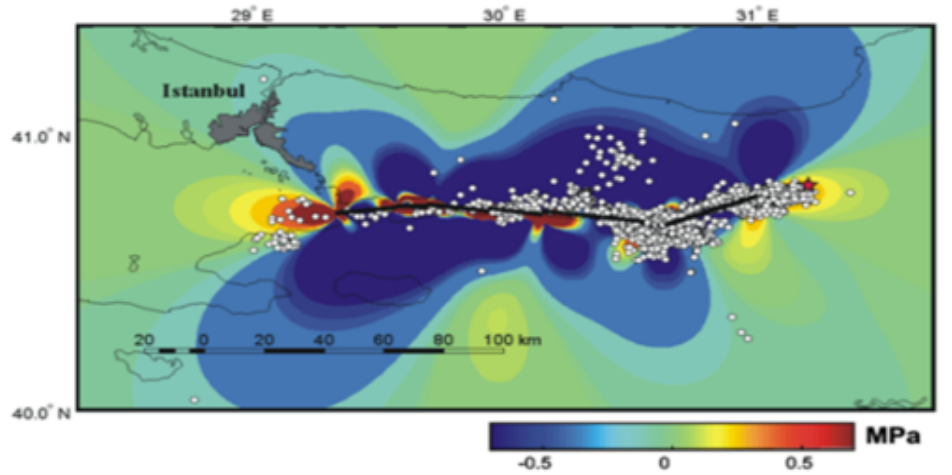
12 November 1999 M=7.2 Düzce earthquake struck off east end of the 17 August 1999 M=7.4 Izmit rupture

## Coulomb Stress Changes



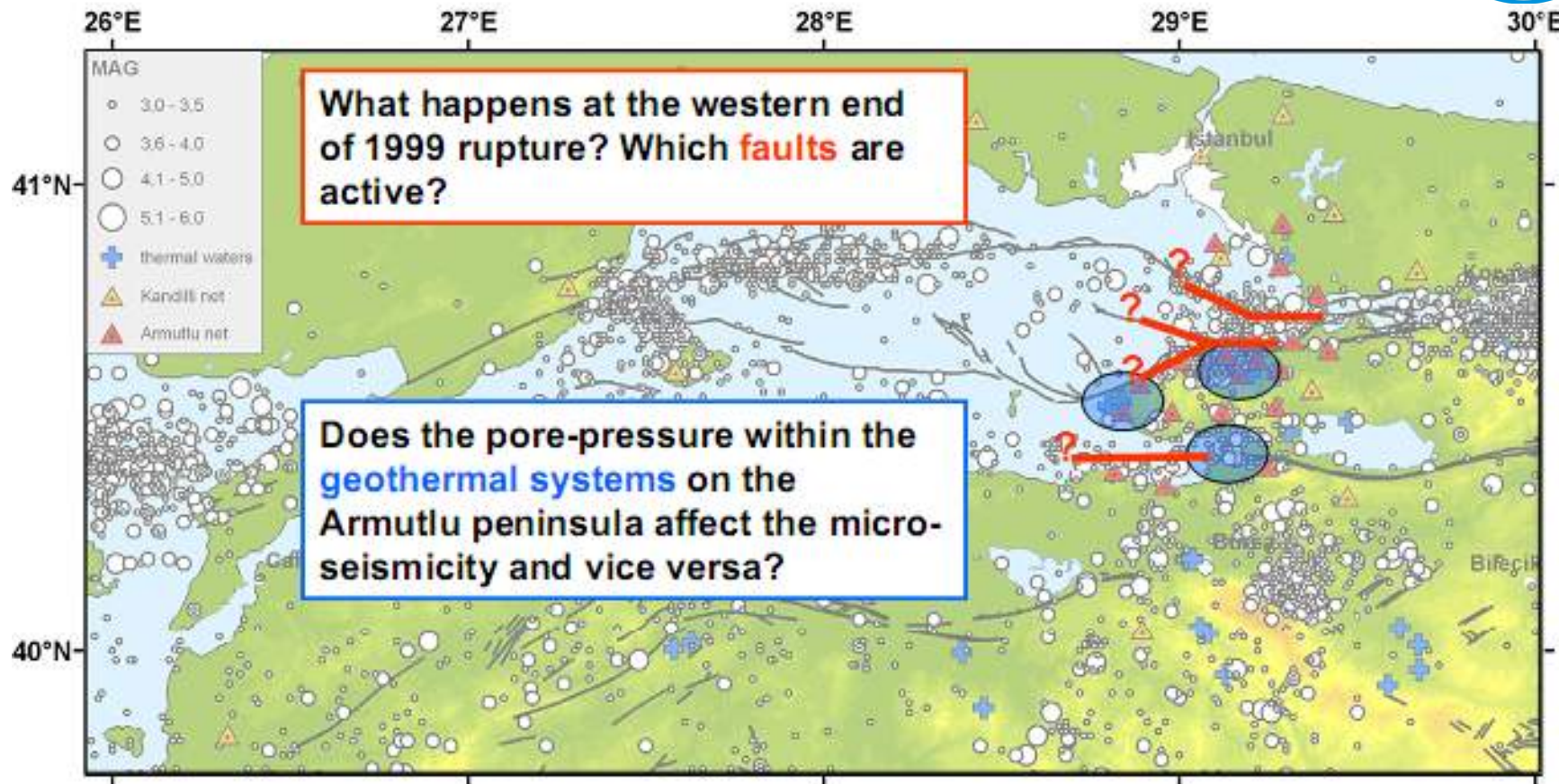
Calculations by Shinji Toda (ERI), Tom Parsons & Ross Stein (USGS)

17 August 1999 M=7.4 Izmit Earthquake



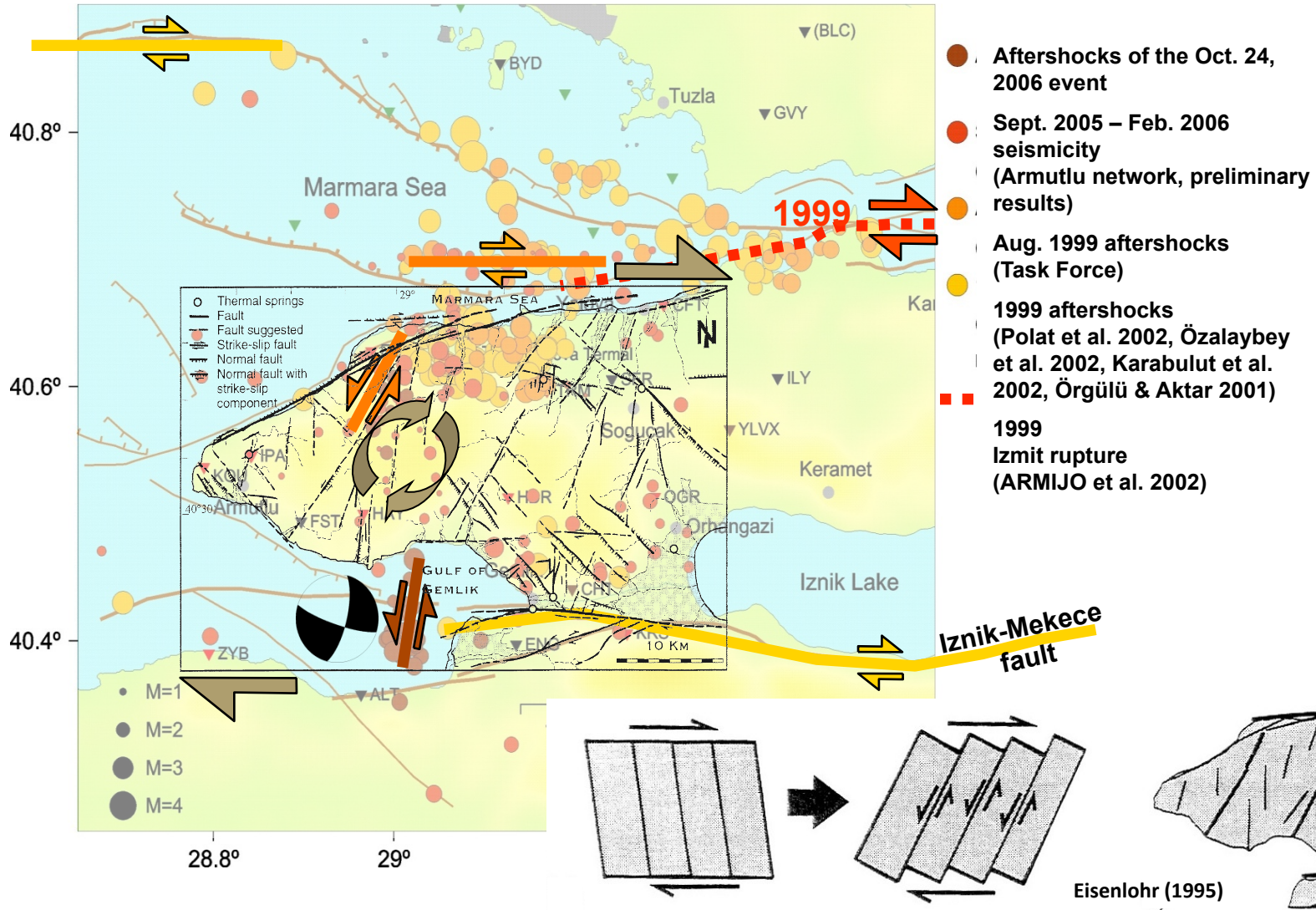
Wang et al., 2006





The Armutlu Experiment, Nov. 2009

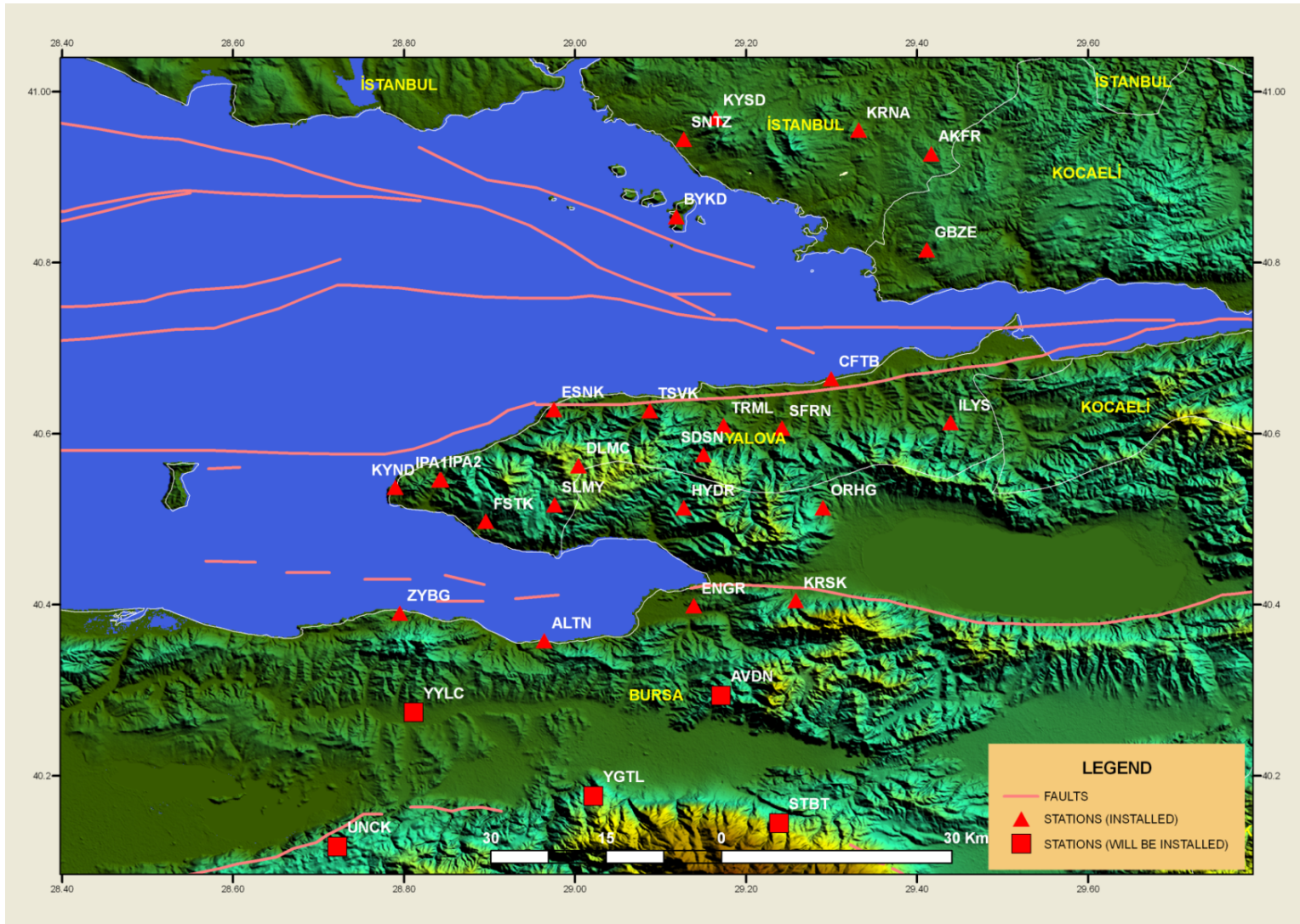




## **ARNET (Armutlu Network)**

- ❖ ***Established in September, 2005 to better understand relationship between the micro-earthquake activity and thermal areas and tectonics of Armutlu Peninsula cooperation with GeoForschungsZentrum, Potsdam (GFZ)***
- ❖ ***Now 28 stations (17BB , 11SP , 6Acc)***
- ❖ ***20 Online / 8 Offline***
- ❖ ***1 borehole (-98m)***
- ❖ ***1 thermal water pressure***

# Distribution of the ARNET stations





# GFZ

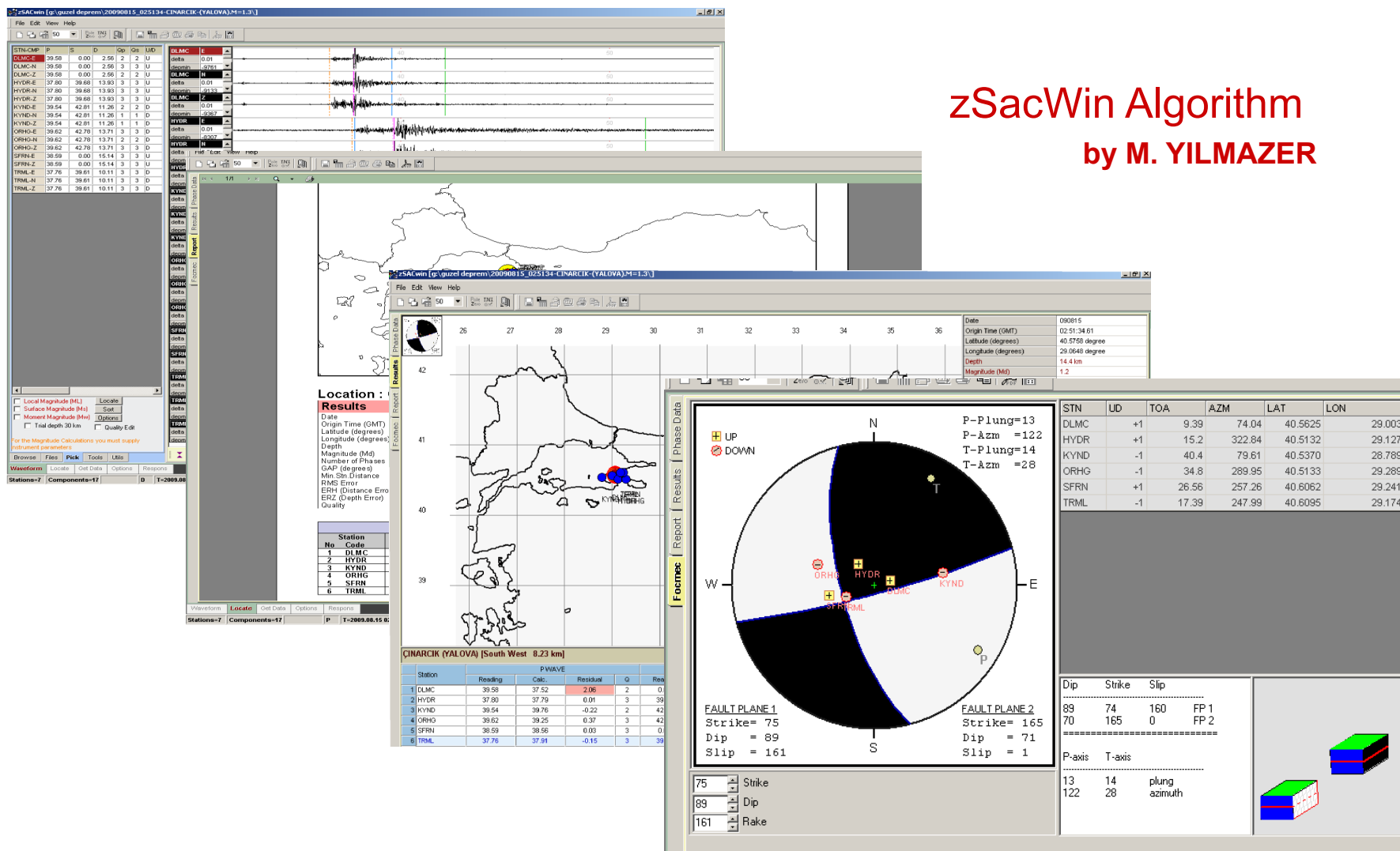
POTSDAM



Station	N Lat.	E Lon.	Elev. (m)	Sensor	Sensor Type	Sensor Period	Digitizer	Sampling	Data Format	Comm. Type
ORHG	40,51333	29,28967	170	L-4C	SP	1	DM24	100	GCF	ADSL
KRSK	40,40500	29,25817	170	CMG-3TDE	BB	120	DM24	100	GCF	ADSL
ZYBG	40,39000	28,79483	70	L-4C	SP	1	DM24	100	GCF	ADSL
ENGR	40,39850	29,13867	75	CMG-6TD	BB	1	DM24	100	GCF	ADSL
ALTN	40,35783	28,96383	30	CMG-40T	BB	1	DM24	100	GCF	ADSL
UNCK	40,11589	28,72224	508	CMG-40T	BB	30	DM24	100	GCF	ADSL
STBT	40,14451	29,23842	721	CMG-40T	BB	30	DM24	100	GCF	ADSL
YYLC	40,30364	28,81688	242	CMG-40T	BB	30	DM24	100	GCF	ADSL
YGTL	40,17620	29,02328	476	CMG-40T	BB	30	DM24	100	GCF	ADSL
AVD	40,29327	29,16459	476	CMG-40T	BB	30	DM24	100	GCF	ADSL
HYDR	40,51317	29,12700	390	L-4C	SP	1	DM24	100	GCF	OFFLINE
KRN	40,95500	29,33167	150	CMG-3ESP	BB	30	DM24	100	GCF	ADSL
AKFT	40,92733	29,41650	210	L-4C	SP	1	DM24	100	GCF	OFFLINE
BYAD	40,85383	29,11817	175	CMG-3ESP	BB	100	DM24	100	GCF	OFFLINE
KYSD	40,96965	29,16430	429	L-4C	SP	1	DM24	100	GCF	OFFLINE
GBZE	40,81500	29,41133	200	CMG-40T	BB	1	DM24	100	GCF	ADSL
ESNK	40,62800	28,97517	200	L-4C	SP	1	DM24	100	GCF	ADSL
İPA2	40,54650	28,84300	85	CMG-3TDE	BB	120	DM24	100	GCF	ADSL
TRM	40,60950	29,17350	204	L-4C	SP	1	DM24	100	GCF	ADSL
CFTB	40,66417	29,29933	-98	LENNARTZ LE-3D	SP	1	DM24	100	GCF	ADSL
SFRN	40,60617	29,24183	115	CMG-3ESP	BB	100	DM24	100	GCF	ADSL
TSVK	40,62667	29,08733	70	CMG-3TDE	BB	120	DM24	100	GCF	ADSL
ILYS	40,61283	29,43900	240	CMG-3ESP	BB	1	DM24	100	GCF	ADSL
FSTK	40,49750	28,89550	60	CMG-3ESP	BB	30	DM24	100	GCF	ADSL
KYND	40,53700	28,78967	48	L-4C	SP	1	DM24	100	GCF	OFFLINE
DLM	40,56256	29,00388	728	L-4C	SP	1	DM24	100	GCF	OFFLINE
SLMY	40,51687	28,97577	460	CMG-3ESP	BB	100	DM24	100	GCF	OFFLINE
SDSN	40,57531	29,14996	204	L-4C	SP	1	DM24	100	GCF	OFFLINE



**zSacWin Algorithm**  
by M. YILMAZER



The screenshot displays the zSacWin software interface with several key components:

- Top Panel:** A list of stations and their corresponding waveforms. The station list includes DLMC, HYDR, KYND, ORHG, SFRN, and TRML, with columns for P, S, and D components.
- Map Panel:** A map of the region around Kocaeli, Turkey, showing the location of the stations and the epicenter (marked with a red star).
- Location Results Panel:**

**Location Results**

Date: 090815  
 Origin Time (GMT): 02:51:34.61  
 Latitude (degrees): 40.5758 degree  
 Longitude (degrees): 29.0648 degree  
 Depth: 14.4 km  
 Magnitude (M): 1.2
- Phase Data Panel:** A circular diagram showing the arrival times of P, S, and T waves at various stations. The diagram is labeled with 'UP' and 'DOWN' directions.
- Station Data Table:**

STN	UD	TOA	AZM	LAT	LON
DLMC	+1	9.39	74.04	40.5625	29.0038
HYDR	+1	15.2	322.84	40.5132	29.1270
KYND	-1	40.4	79.61	40.5370	28.7897
ORHG	-1	34.8	289.95	40.5133	29.2897
SFRN	+1	26.56	257.26	40.6062	29.2418
TRML	-1	17.39	247.99	40.6095	29.1743
- Fault Plane Solution Panel:**

**FAULT PLANE 1**  
 Strike = 75  
 Dip = 89  
 Slip = 161

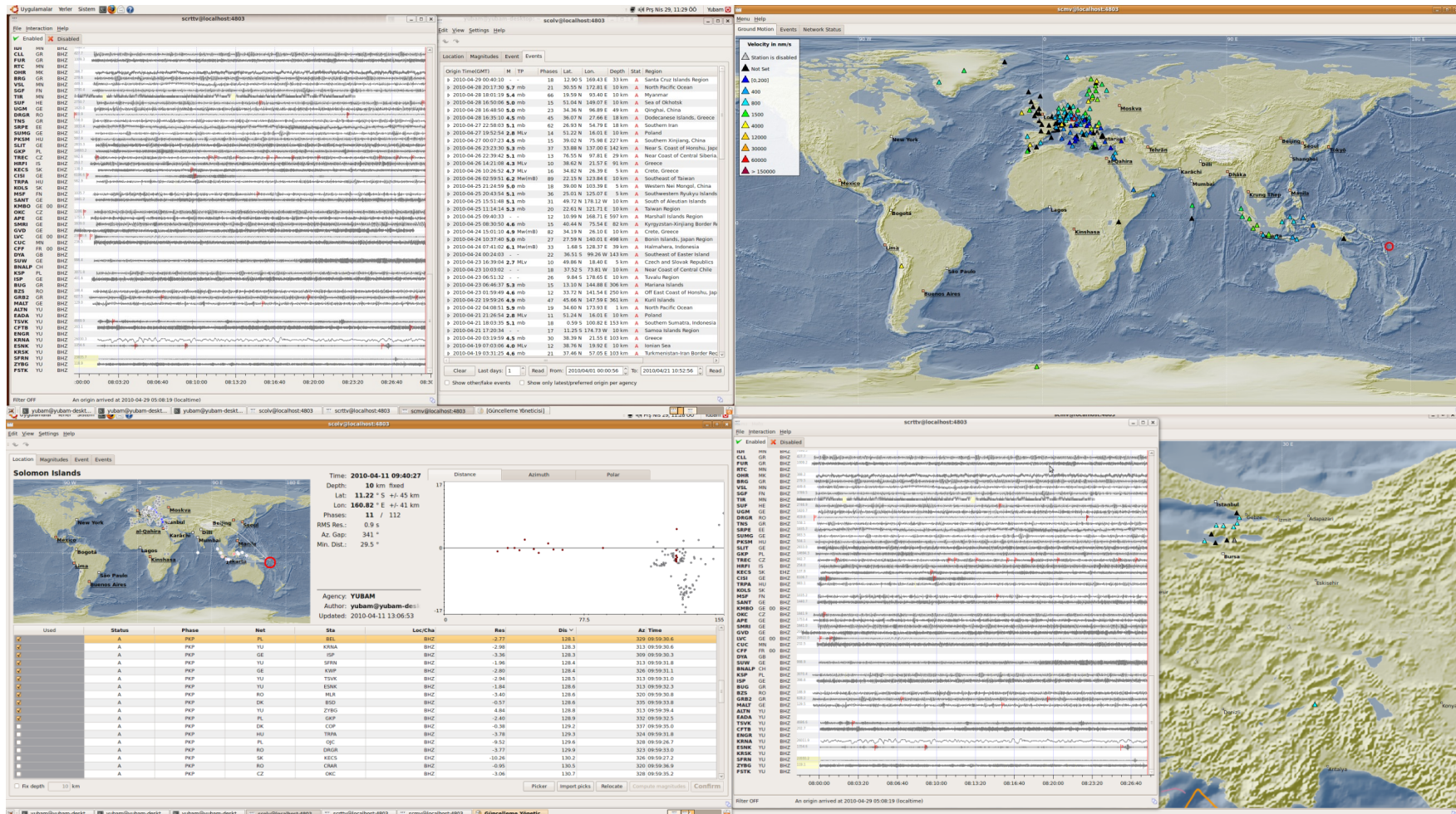
**FAULT PLANE 2**  
 Strike = 165  
 Dip = 71  
 Slip = 1
- 3D Model Panel:** A 3D block diagram showing the fault planes and the direction of slip.

# GFZ

## POTSDAM

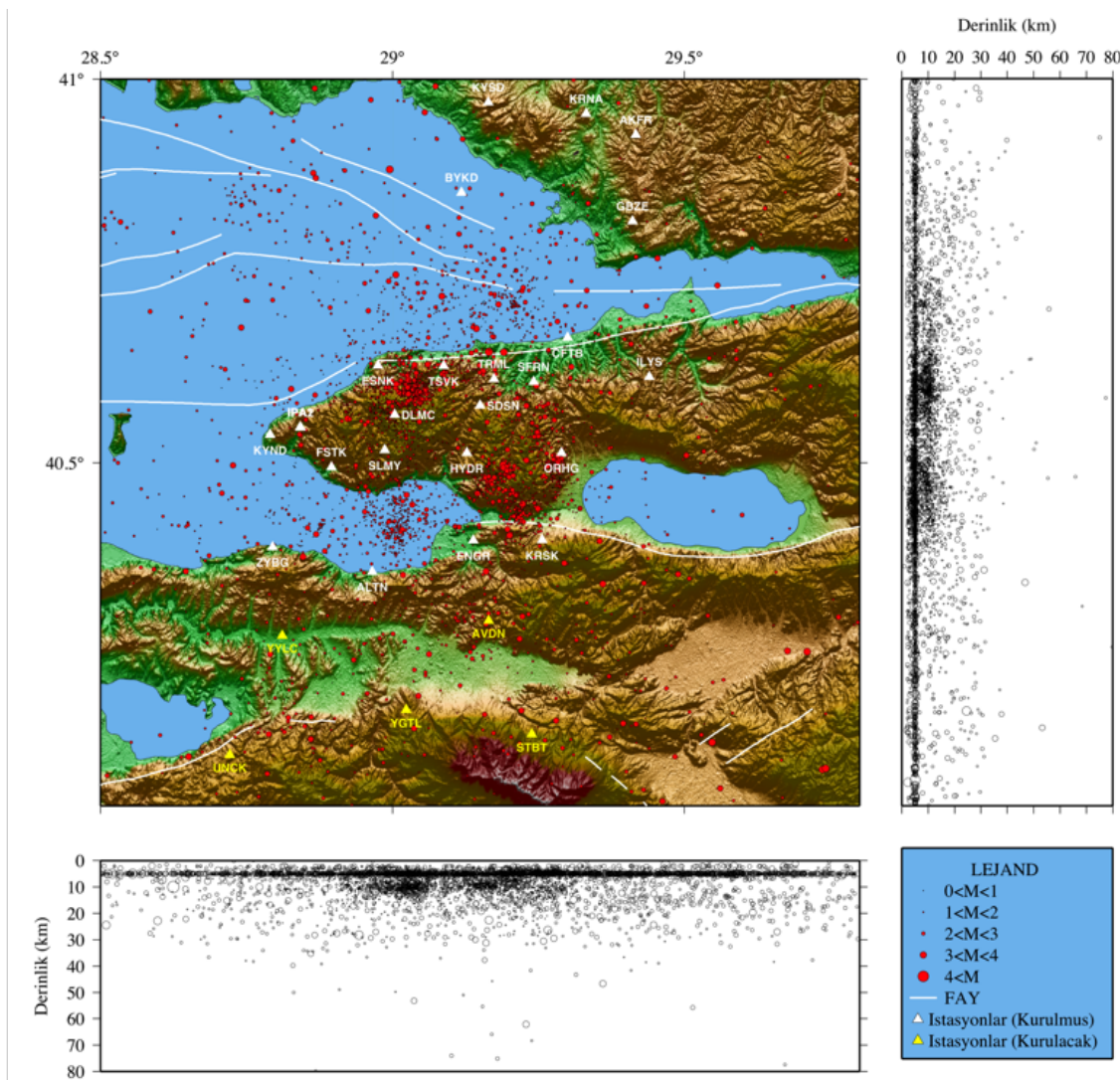


SeisComP3 is a seismological software for seismological data acquisition, processing and distribution that has been developed by the GEOFON Program at Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences and gempa GmbH.



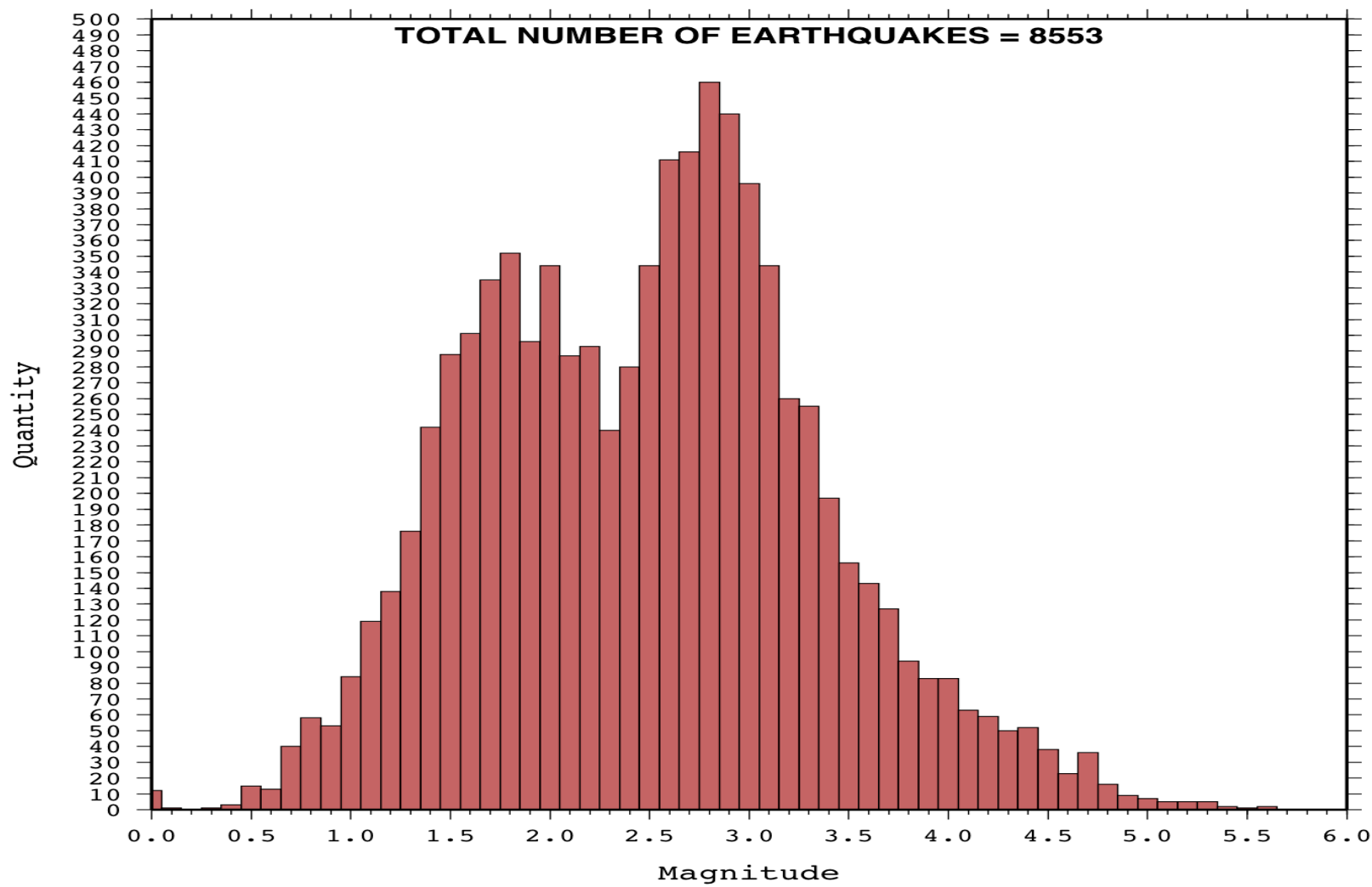
IRIS Metadata Workshop Managing Wave form Data and Related Metadata for Seismic Networks – 14-18 Jan.2013, Kuwait

**Between 01.2006 – 12.2011**



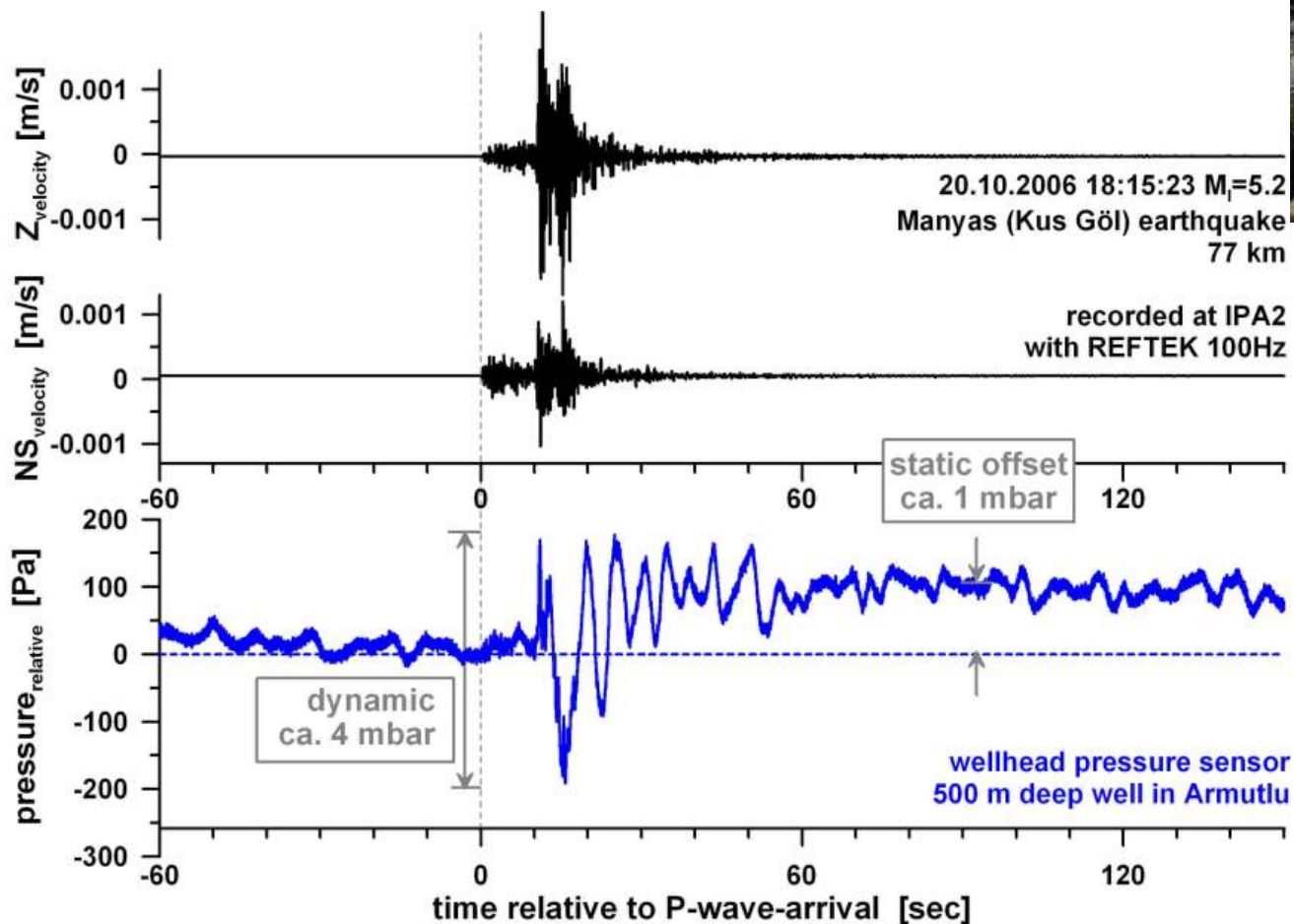


**Between 01.2006 – 12.2011**

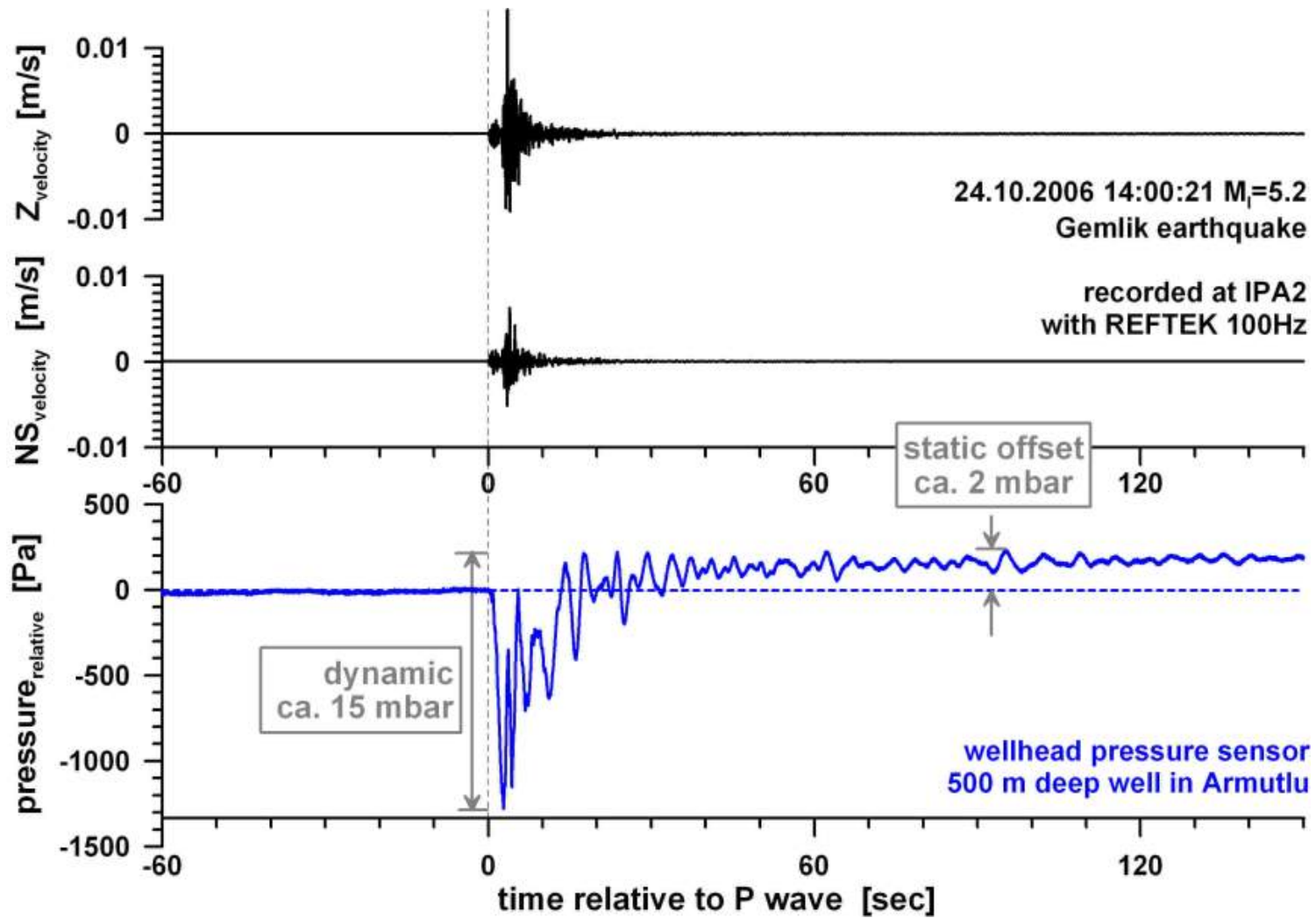




### (Hydro-) seismogram of 20.10.2006 Manyas earthquake



## (Hydro-) seismogram of 24.10.2006 Gemlik earthquake



## ESSRC DLMC station









## Results

- Very complex tectonic structure
- Rather high micro-earthquake activity (especially after 1999 earthquakes)
- Besides micro-earthquakes moderate earthquakes
- Monitoring seismicity, seismicity patterns, shear wave splitting, seismic tomography, fluid pressure-seismicity
- Location error is large (tectonic is complicated and area is highly deformed, crustal structure is unknown)
- ARNET data can be shared with the interested institutions or persons with mutual agreement
- ARNET is the first network which has dense equipment in a local area
- ARNET is a scientific network and no has aim to announce the recorded earthquakes.

**thanks for your attention**