Phan Trong Trinh

Undergraduate , Geology-geography	Hanoi Unversity	1973-1977
Master -DEA Internal geophysics	University of Paris 7	1985-1987
Doctorate. Internal Geophysics	University of Paris 7 and Institut de Physique du Globe de Paris	1987-1989
Post-doctorate, remote sensing	Institut de Physique du Globe de Paris	1992-1993
Associate Professor	Vietnam Academy of Science and Technology	2006- 2013
Director of Research (~ Research Professor)	Vietnam Academy of Science and Technology	2010 - present
Full Professor	Vietnam Academy of Science and Technology	2013 - present

Position

- Institute of Geological Sciences , VAST (1978-present)
- Permanent associate member, International Centre for Theoretical Physics (UNESCO – IAEA), Trieste, Italy, 1998-2005
- Corresponding member, Royal Academy for Oversea Sciences (Belgium, from 2006-present).
- President of Council , Faculty of Earth Science, Graduate University of Science and Technology - VAST(from 2015 – present).
- Lecture at USTH on GPS from 2016 - present.
- member, Earth-Science Council of Vietnam Academy of Science and Technology (from 2002 – present).
- Member, Earth-Science Council of Nafosted (from 2009– present).
- Editor-in-chief, Vietnam Journal of Earth Sciences, Vietnam Academy of Science and Technology (from 2016 - present).

Why do I take part in the school ?

- Learn advanced remote sensing in atmospheric sciences.
- Propose to combine earth observation school with international conferences organised every two years with the support of Nafosted.
- Searching interesting papers to be published in Vietnam Journal of Earth Sciences

National project of 03/2012
(2012-2014)

Evaluation of tectonic gradient for in the selection of Ninh thuan Nuclear Power plant

Phan Trong Trinh:
Insitute of Geological Siences, VAST.

Objective of the project:

- Make in invidence of tectonic gradient in late pleistocene and present day in selected area of the construction of Ninh Thuan Power plant.
- based on GPS data, make in evidence of fault activity in the area of radius of 8km of Nuclear power plant

- General objective : scienctific basis to review the evaluation of active fault, capable fault, Peak Ground Acceleration and tsunami risk in the area of Ninh Thuan Nuclear Power Plant

Methods of geomorphology and geology

Remote sensing, combination of satellite image and DEM

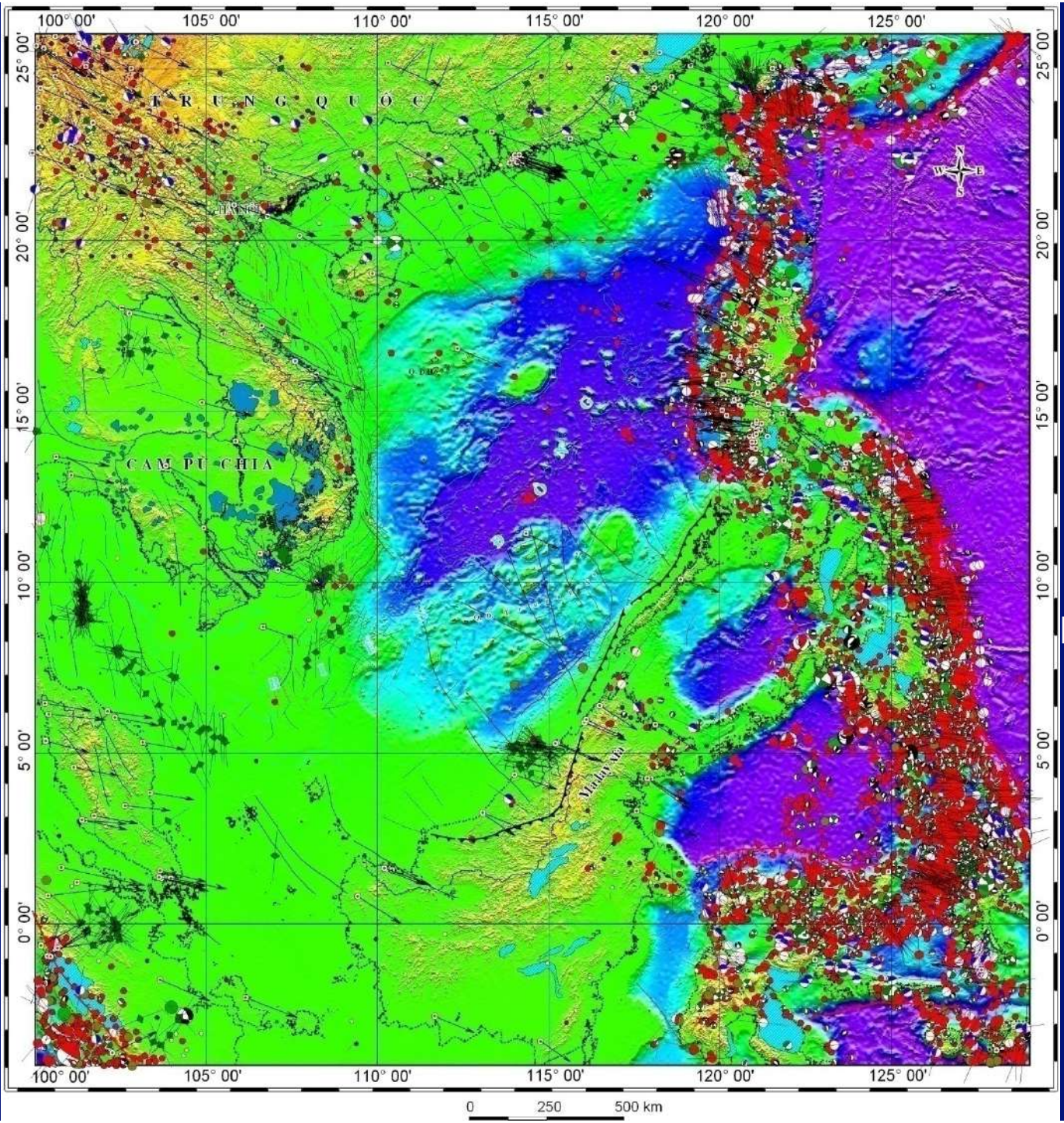
Methods of reflexion seismics

Method of GPS

Method of determination of strain rate from slip rate on the fault (in late pleistocene)

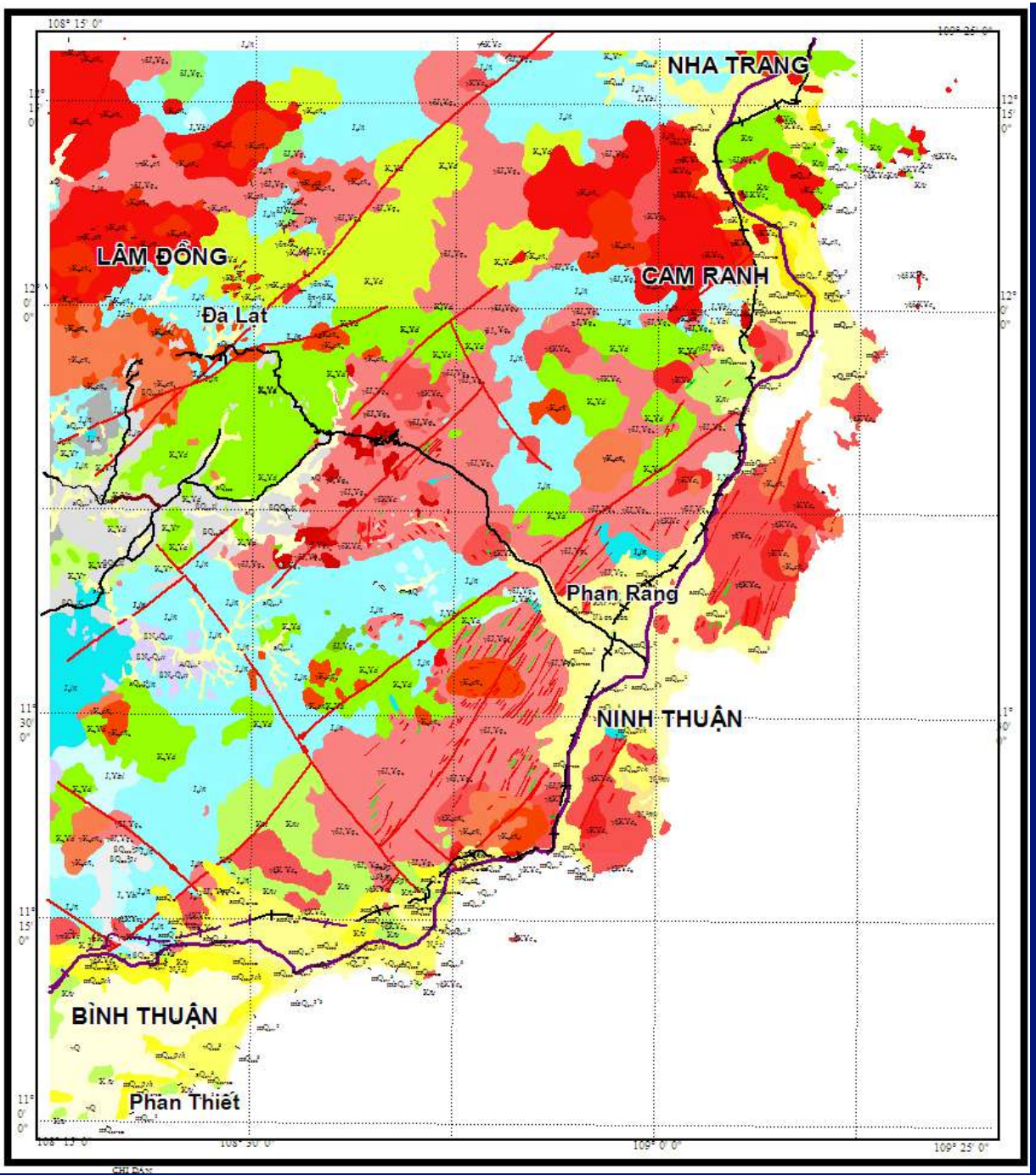
Methods of determination of tectonic gradient (strain rate)

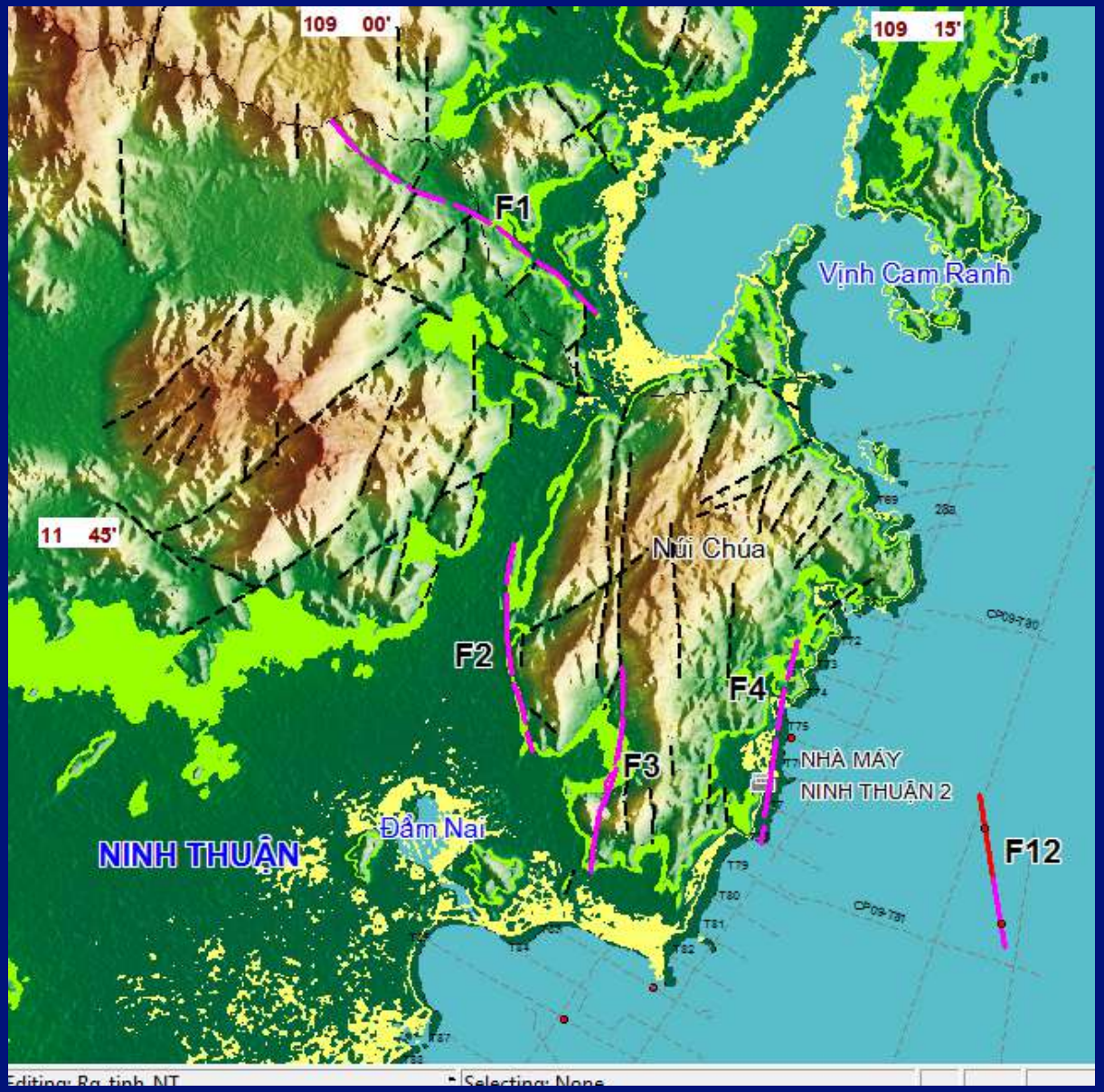
- **Determination of present day strain rates from slip rate**
- **Determination of principal strain rates (value and direction)**
- **Determination of rotation strain rate**
- **Determination of maximum shear strain rate**
- **Determination of first and second invariable of strain rate tensor**



Map of recent tectonics and present day geodynamics of Vietnam sea and surrounding region

Phan Trọng Trịnh, 2010


NHA TRANG
LÂM ĐỒNG
CAM RANH
Đà Lạt
Phan Rang
NINH THUẬN
BÌNH THUẬN
Phan Thiết



The distribution of fault in the land at Ninh Thuan

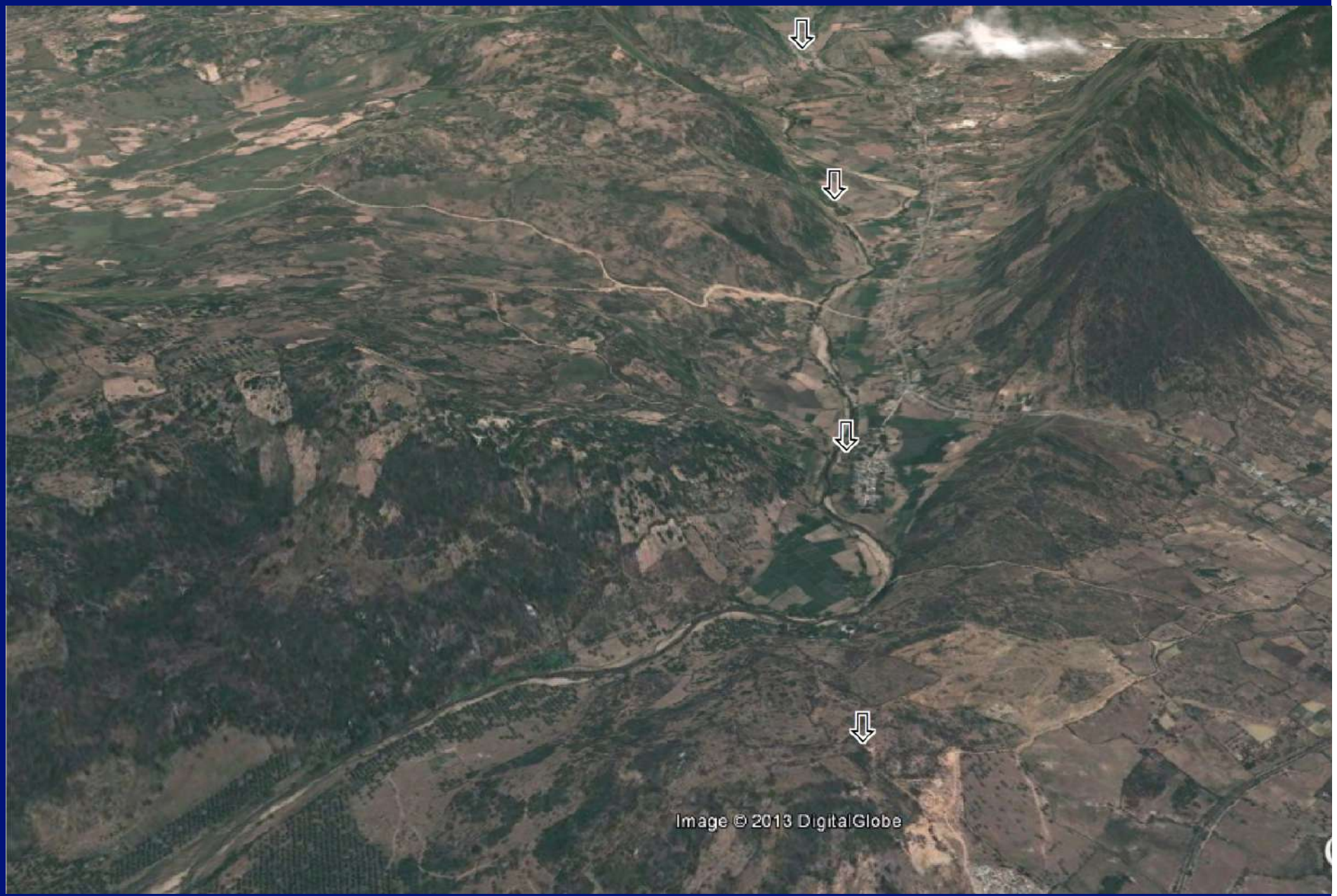
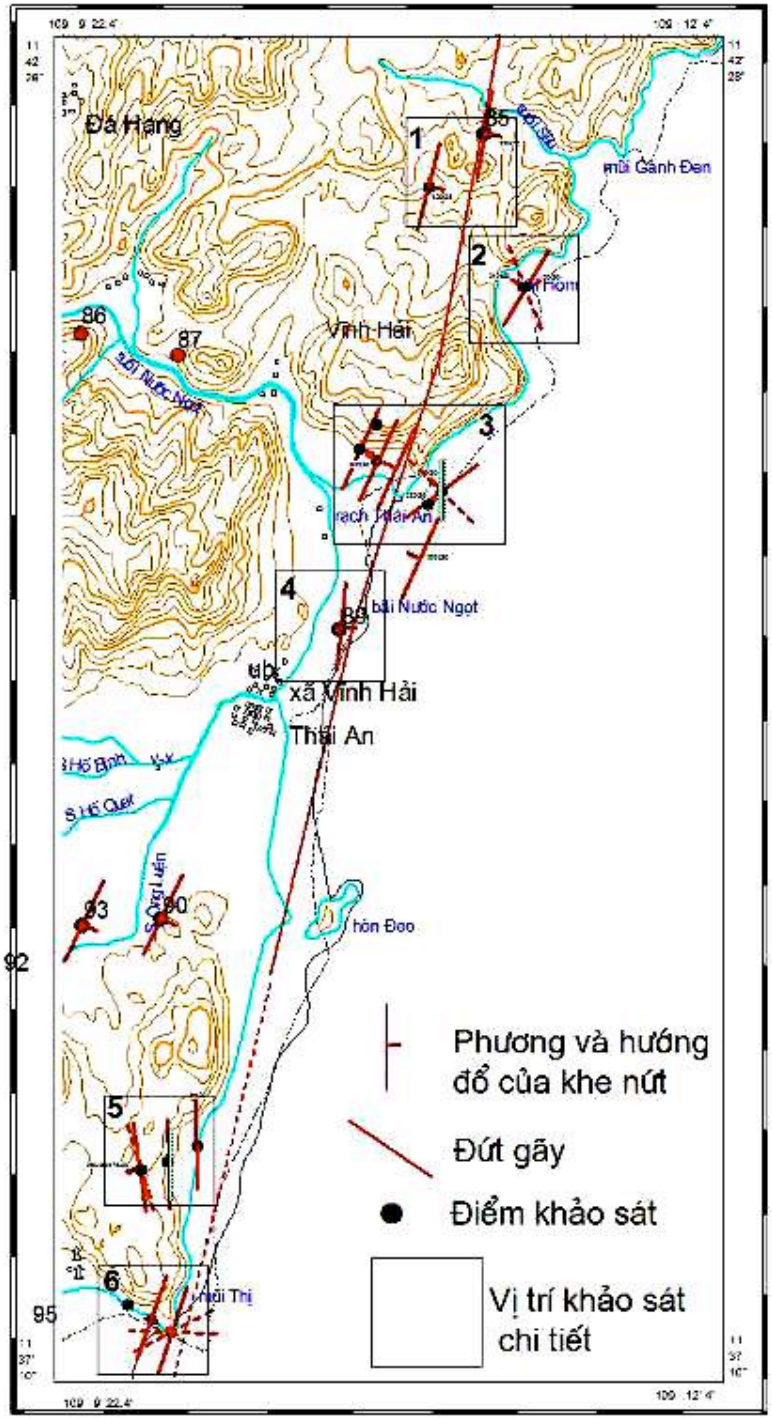


Image © 2013 DigitalGlobe

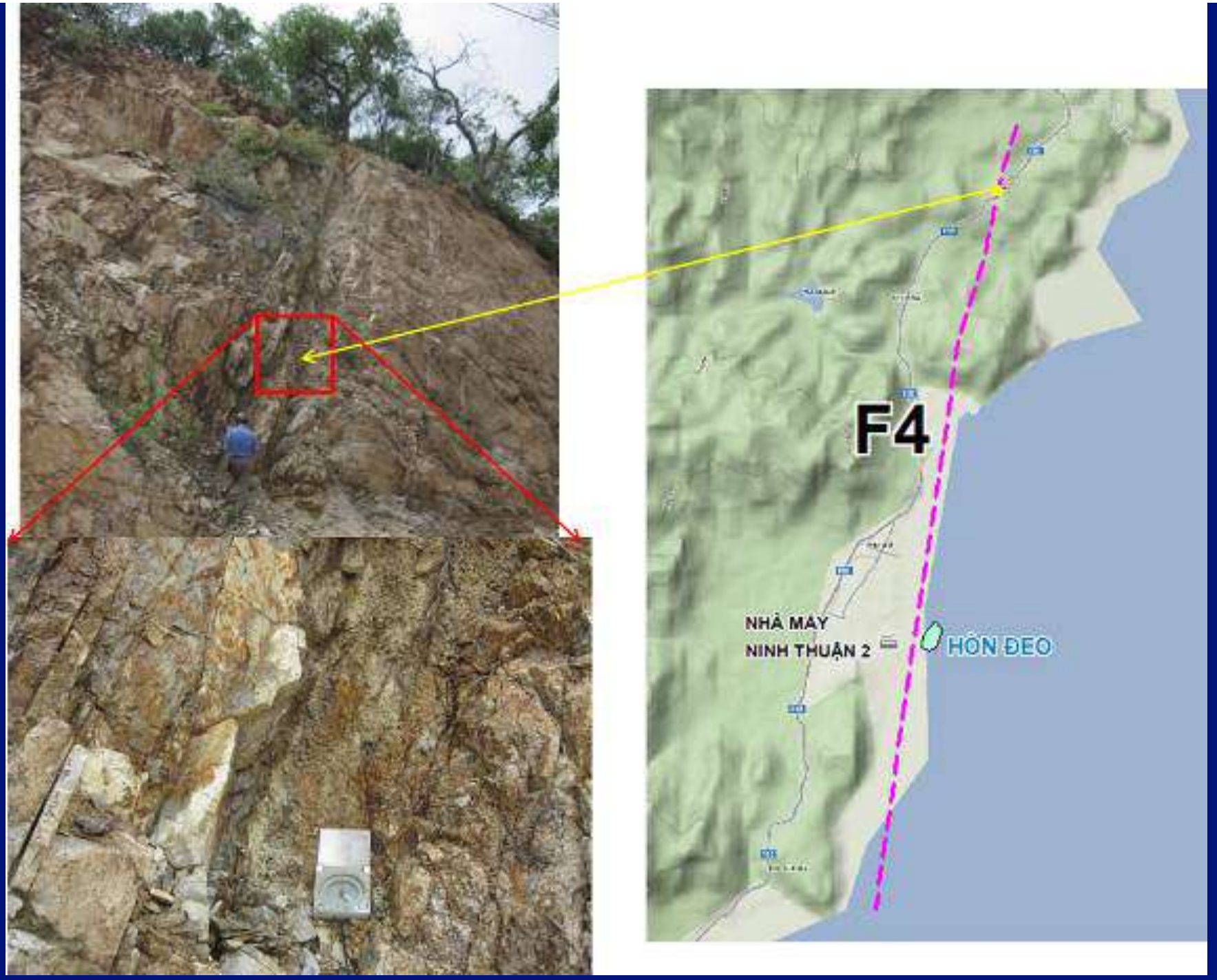

F1

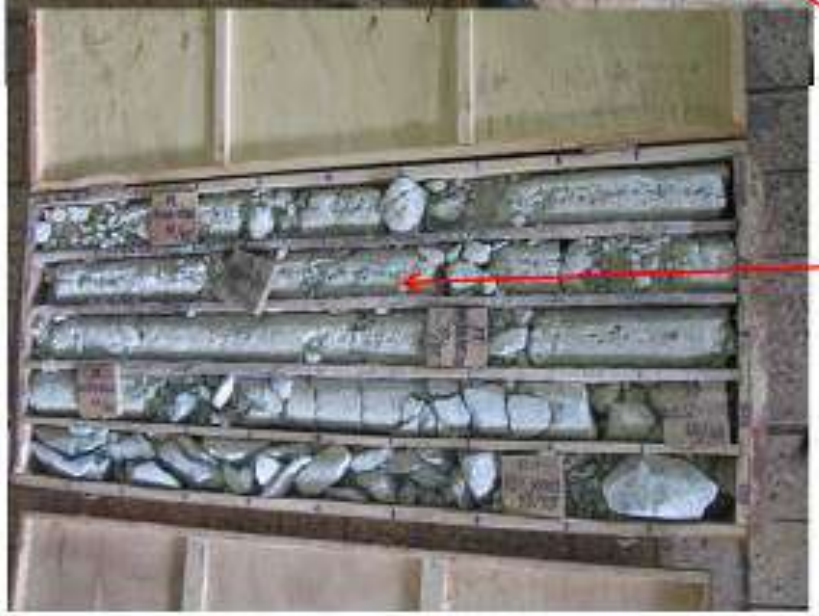

F1


F1



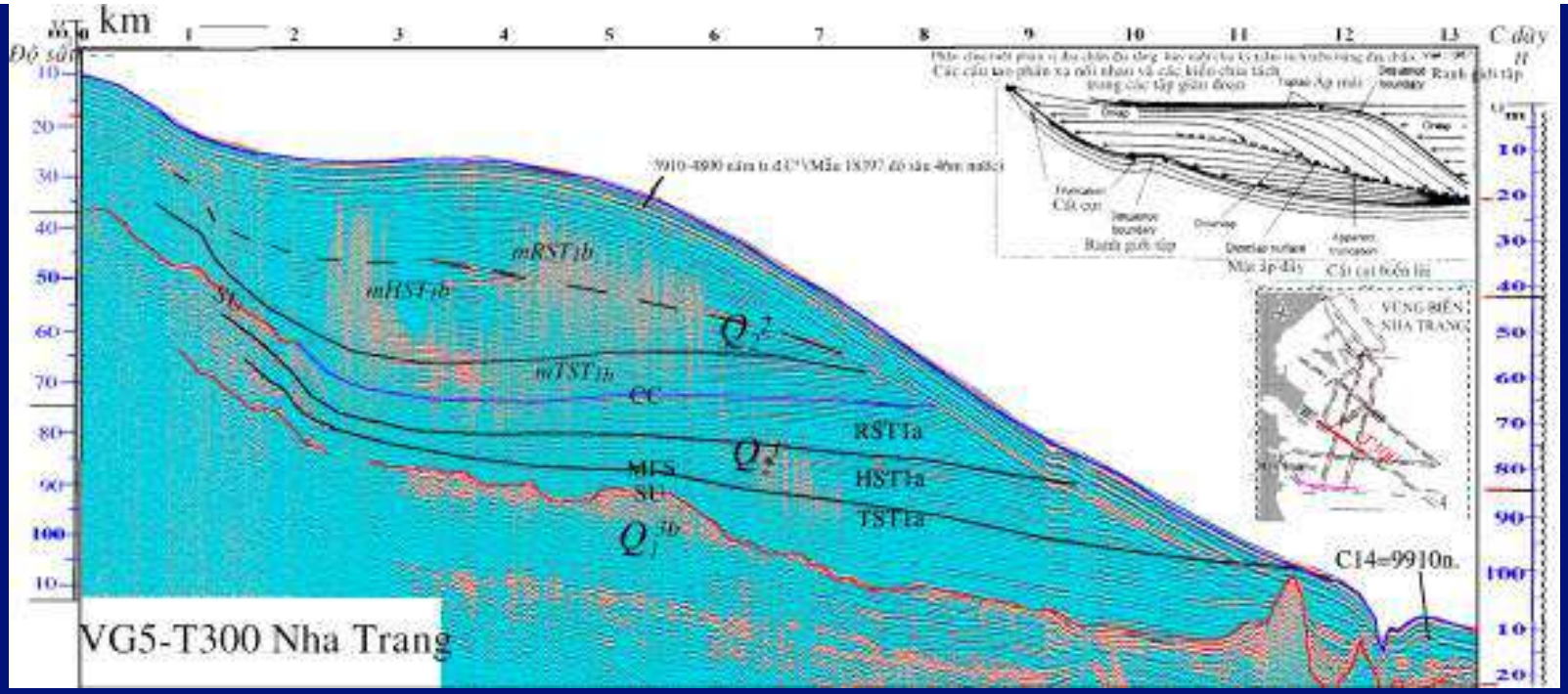
H *Hòn Đeo (ĐG F4)*

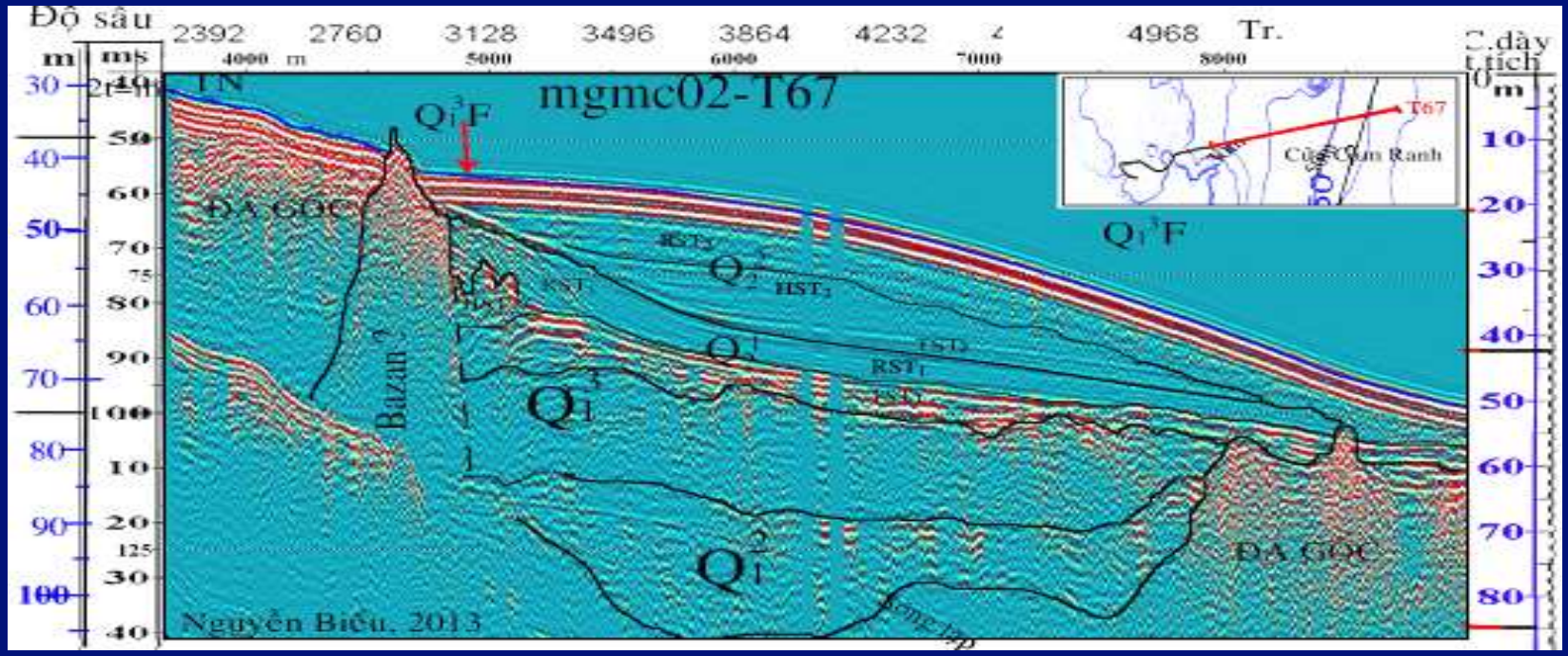

F4
NHÀ MÁY
NINH THUẬN 2
HÒN ĐEO

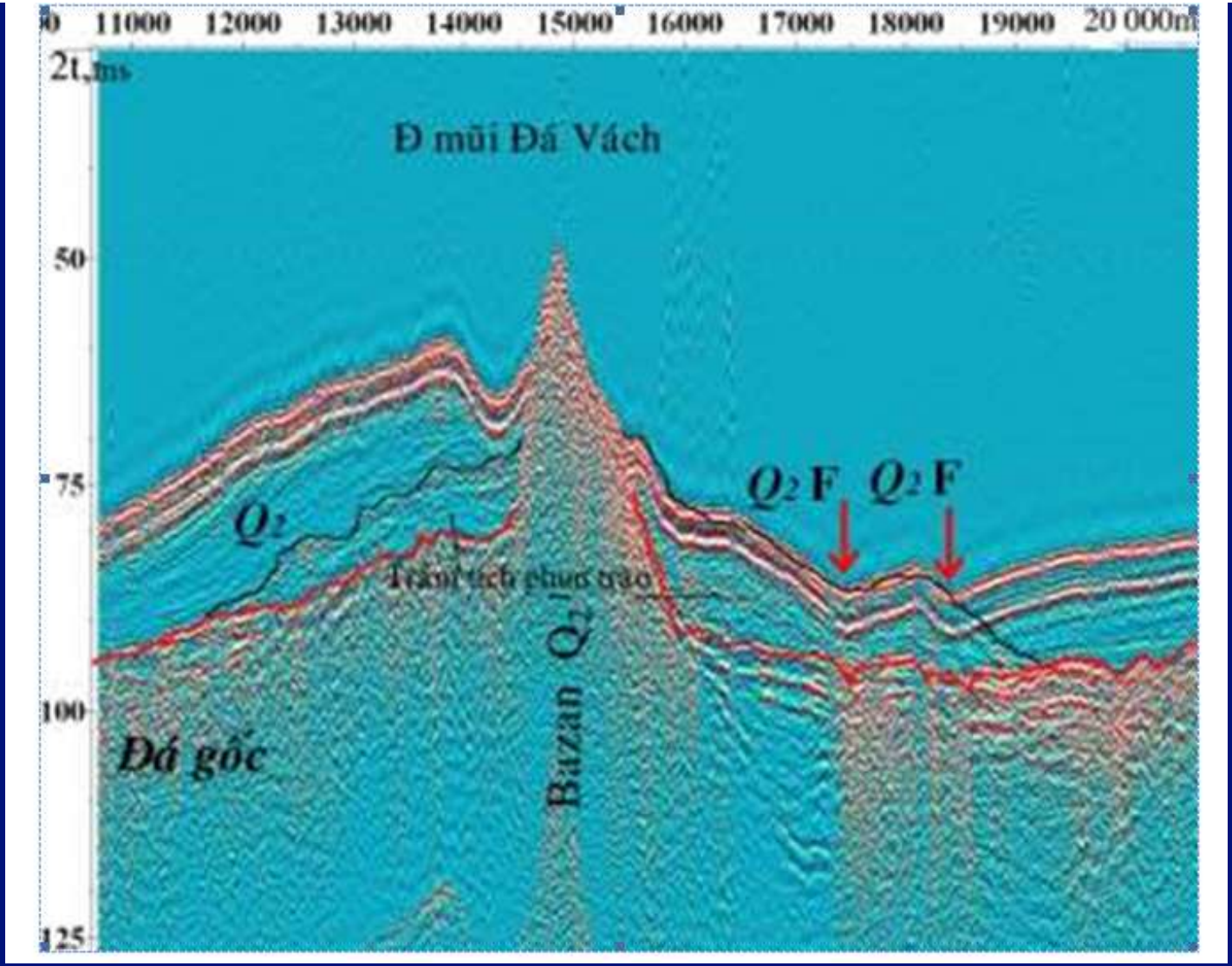



NHÀ MÁY
NINH THUẬN 2
HÒN ĐEO

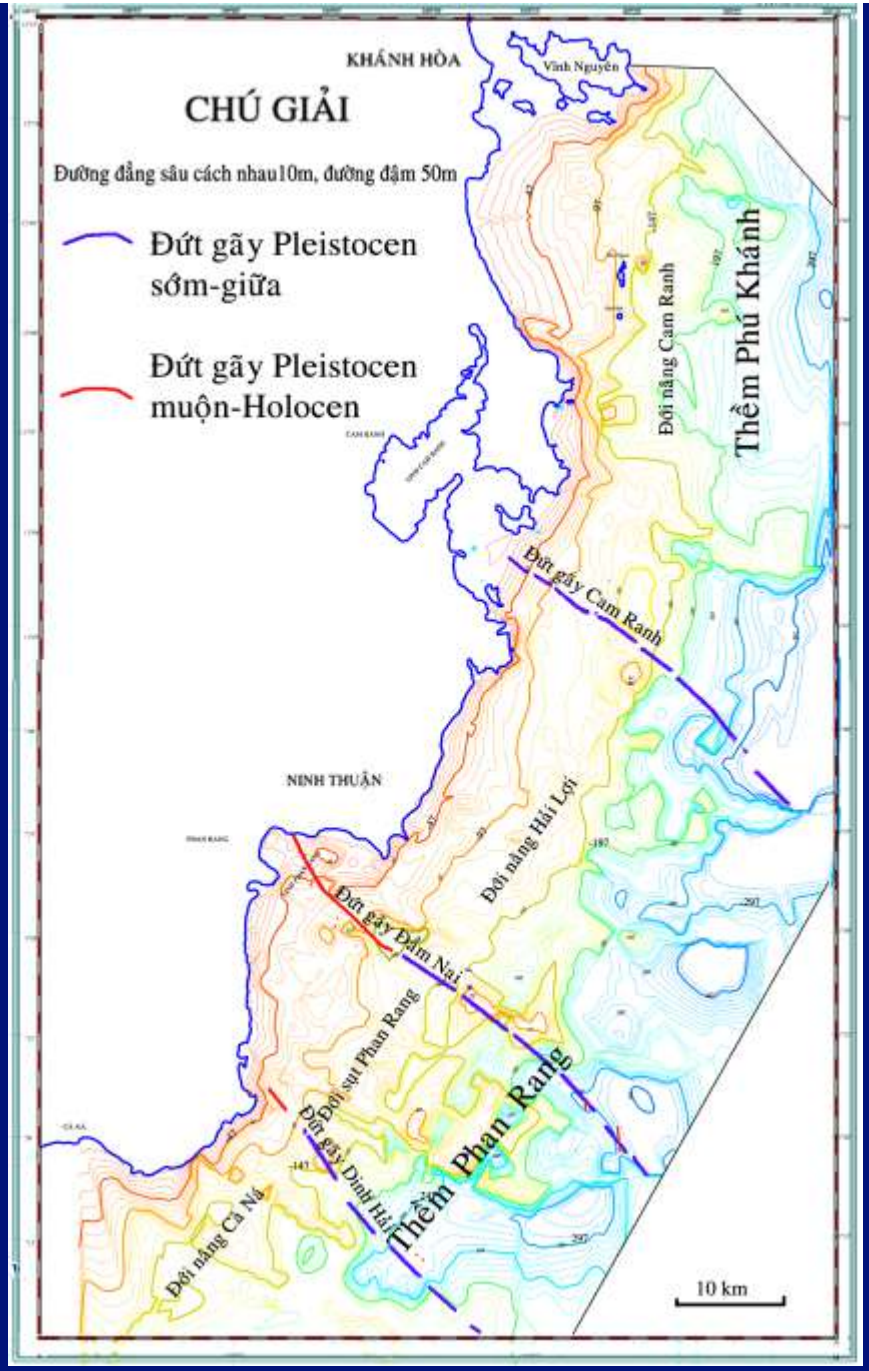

NINH THUẬN
CP09-T79
CP09-T80
CP09-T81
T86
BIỂN ĐÔNG
T93
T94
CP09-T1107
CP09-TKT03
T220


km
Độ sâu
C.dày
mRST1b
mHST1b
mTST1b
SU
CC
RST1a
HST1a
TST1a
MFS
SU
C14=9910n.
VG5-T300 Nha Trang

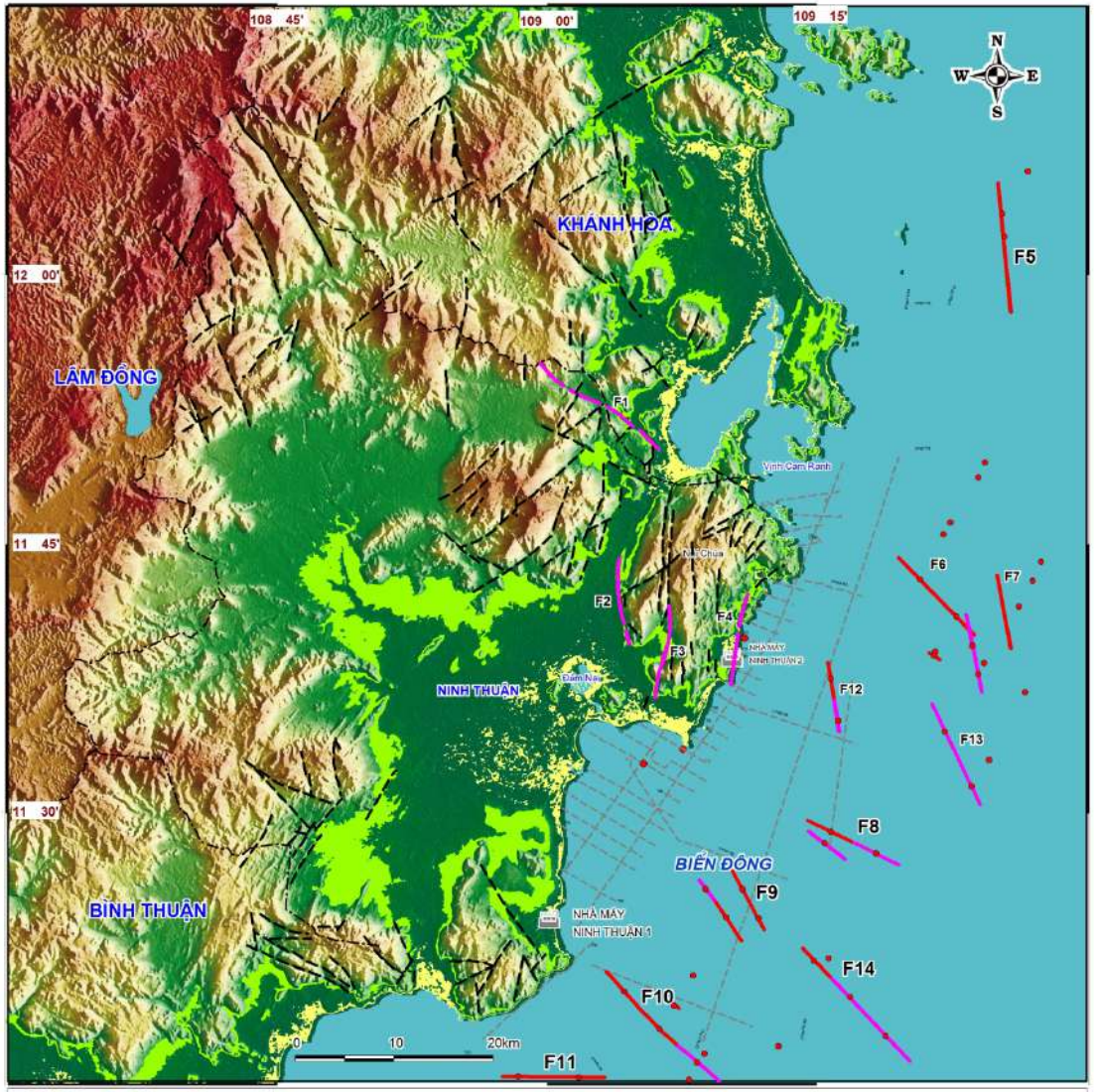

Độ sâu
2392
2760
3128
3496
3864
4232
4968
Tr.
C.dày t.tích
TN
mgmc02-T67
ĐÁ GỐC
Bazan
RST3
HST3
TST3
RST2
TST2
RST1
TST1
Nguyên Biểu, 2013



Existance of young bazan ? Or existance of coral to east of Da Vach.



Map of Quaternary sediment bottom.



Đứt gãy hoạt động

Đứt gãy (chưa xác định được tuổi)
a.- Xác định; b.- Dự đoán

Đứt gãy cổ:
a.- Xác định; b.- Dự đoán

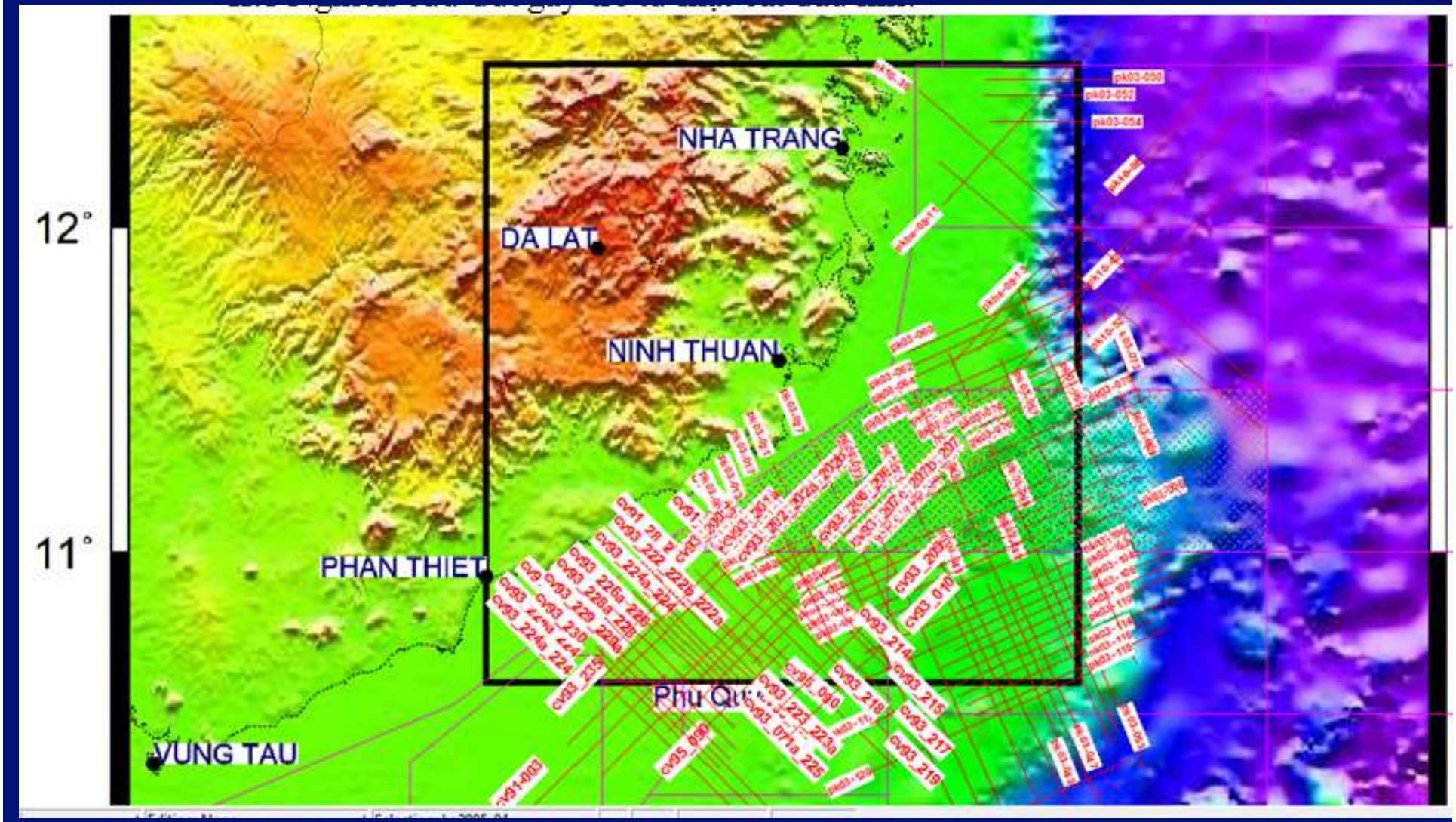
Tuyến mặt cắt
địa chấn nông phân giải cao

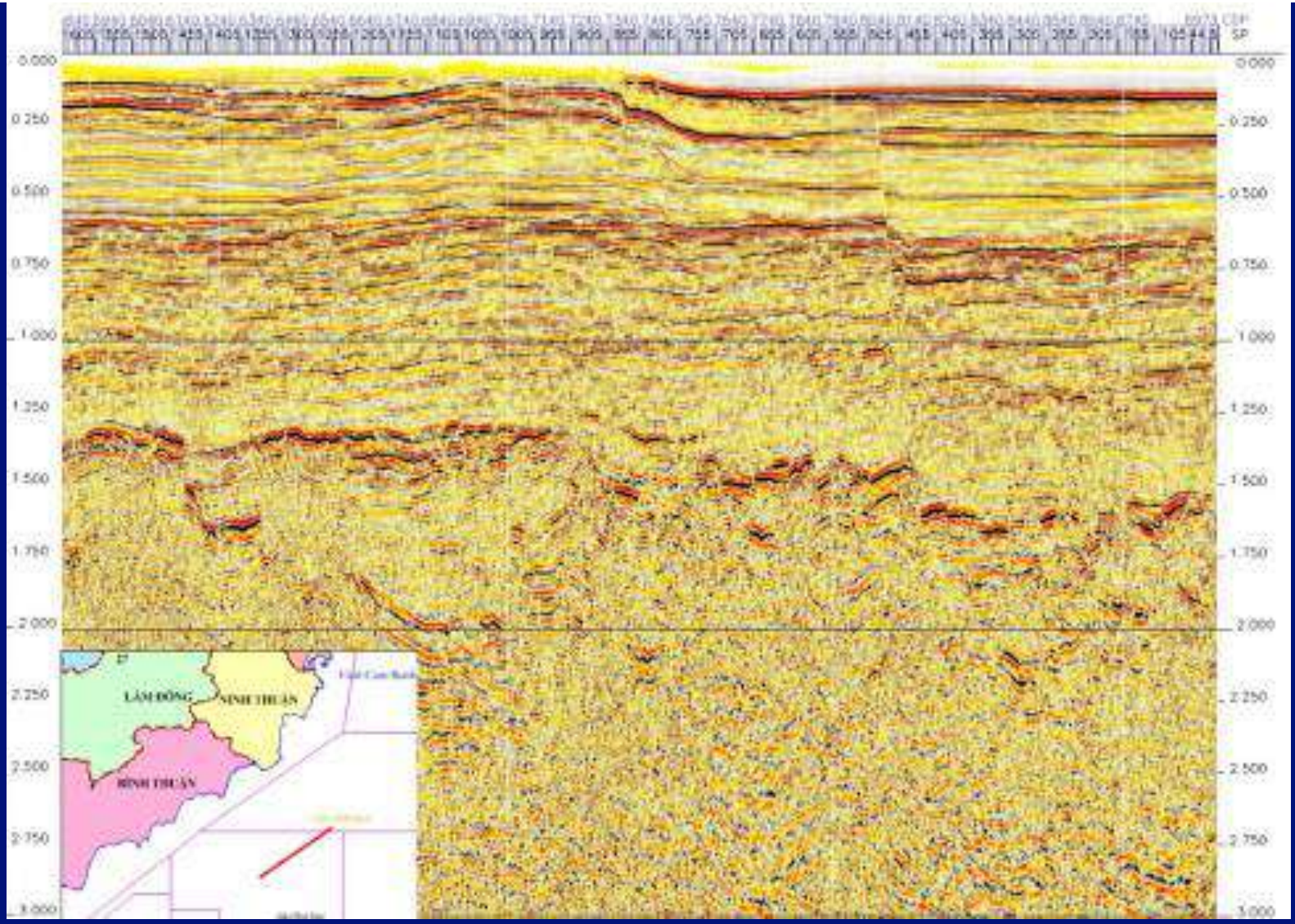
Điểm quan sát thấy biến dạng
trên mặt cắt địa chấn

Bề mặt biển tiến Holocen (0-6m)

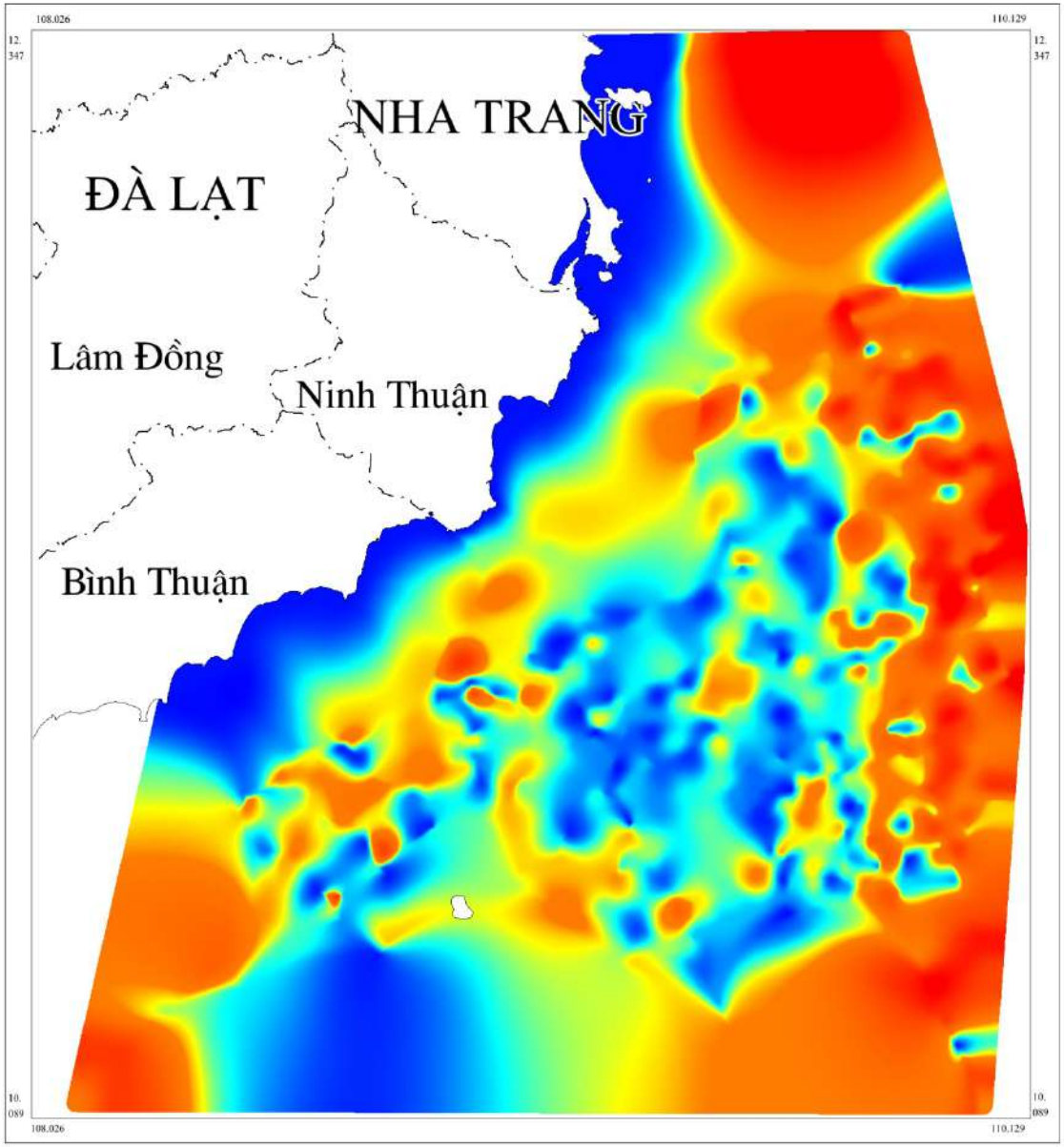
Bề mặt có sự hiện diện của
hệ tầng Maviec

3.3.2. phân tích tài liệu địa chấn dầu khí





- *Profile cv91-005-5a-2. source : project NT 03/2012*



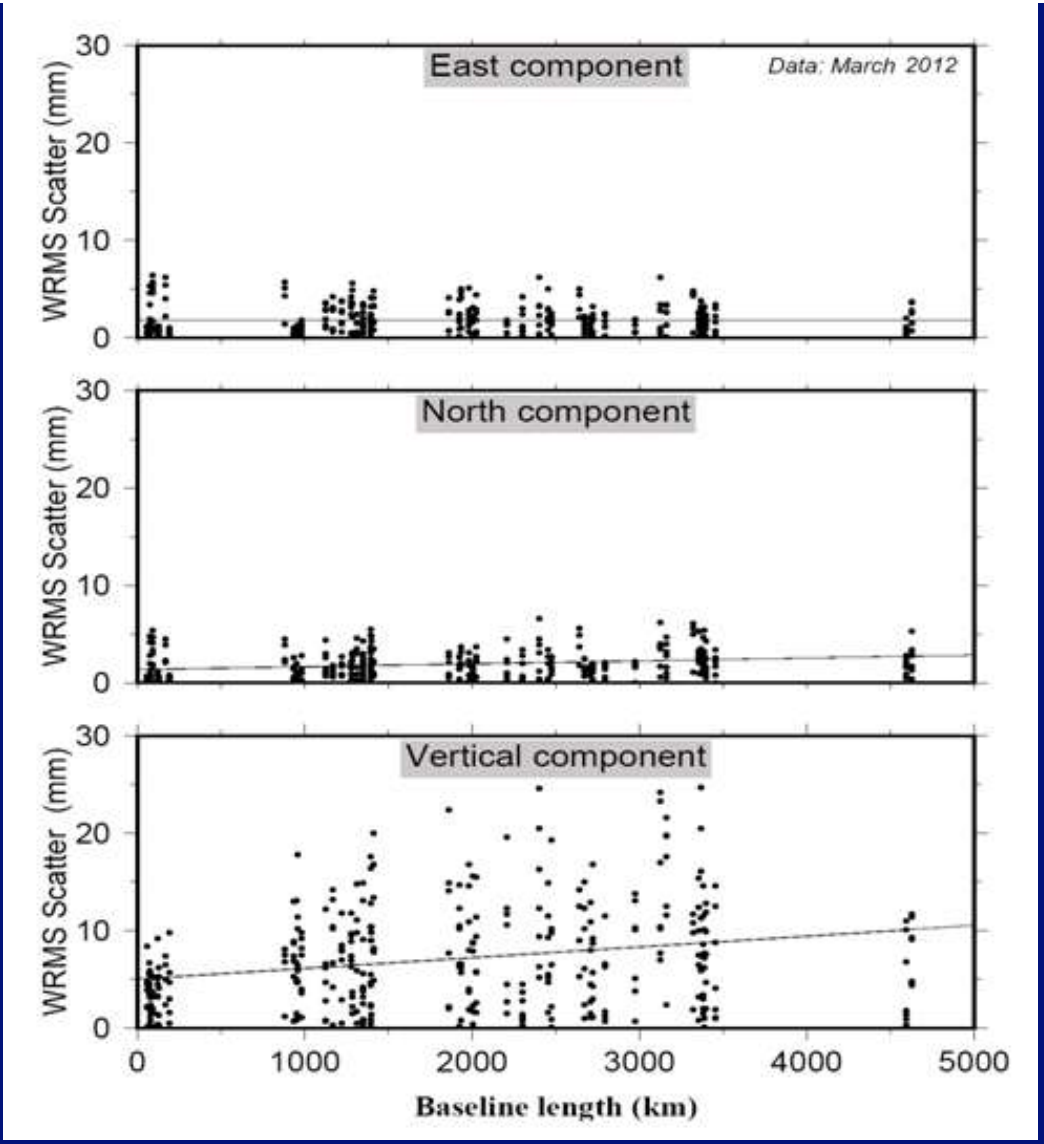
Tectonic gradient calculated from petrol seismic profile

present day tectonics

Bảng 4.1: Lịch đo của chiến dịch tháng 3, 4 năm 2012

Ngày GPS	CAD1	NHAT	DALA	TUYP	PQUY	CUSV
59			x			x
60			x			x
61			x			x
62			x			x
…						
102	x	x	x	x	x	x
103	x	x	x	x	x	x
104	x	x	x	x	x	x
105	x	x	x	x	x	x
106	x	x	x	x	x	x
107	x	x	x	x	x	x

- Campagne in march , 2012

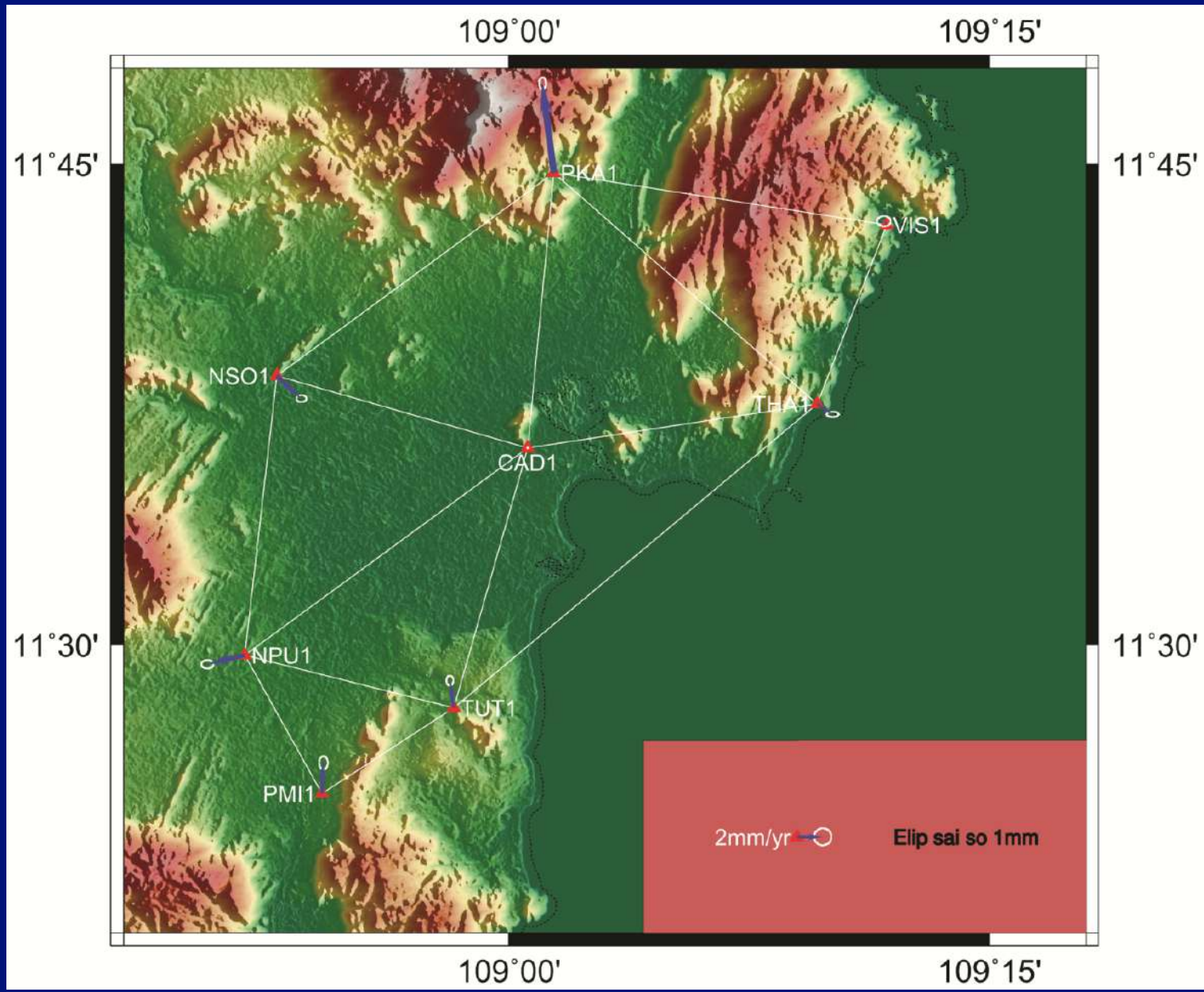


WRMS scatter in the campagne 3-4 /2012

	Station	Lon	Lat	VE	VN	VU	RMS_E	RMS_N	RMS_U
1	**CAD1**	109° 00' 36"	11° 36' 8.7"	**23.9**	**-7.1**	**6.3**	0.3	0.2	1.1
2	**DALA**	108° 26' 44.3"	11° 57' 10.5"	**23.2**	**-4.4**	**-6.1**	0.3	0.3	1.2
3	**NHAT**	121° 4' 39.8"	14° 38' 8.6"	**24.7**	**-8.4**	**-4.7**	0.3	0.2	1.1
4	**PQUY**	108° 55' 55.2"	10° 30' 58.7"	**25.3**	**-7.4**	**-3.4**	0.3	0.2	1.1
5	**TUYP**	108° 42' 54.3"	11° 10' 50.6"	**22.5**	**-7.2**	**0.2**	0.3	0.2	1.1
6	**CUSV**	100° 32' 2.1"	13° 44' 9.3"	**21.8**	**-2.5**	**-8.2**	0.3	0.2	1.0

Absolute rate determined by GPS between compagne 3-4/2012, 3/2013 và 10/2013

Station name	Typ	A priori value	Estimated value	Correction	RMS error	3-D ellipsoid		2-D ellipse	
NPU1	X	-2021005.2974	-2021005.2909	0.0065	0.0008				
	Y	5915382.2898	5915382.2837	-0.0061	0.0014				
	Z	1262652.2890	1262652.2864	-0.0026	0.0006				
	U	48.1248	48.1165	-0.0083	0.0015	0.0015	1.3		
	N	11 29 39.780303	11 29 39.780272	-0.0010	0.0005	0.0003	144.4	0.0003	144.4
	E	108 51 46.303232	108 51 46.303096	-0.0041	0.0007	0.0008	0.7	0.0008	
NSO1	X	-2021692.2314	-2021692.2236	0.0078	0.0008				
	Y	5911727.7443	5911727.7151	-0.0292	0.0018				
	Z	1278427.9311	1278427.9225	-0.0086	0.0005				
	U	41.2030	41.1718	-0.0313	0.0018	0.0019	3.1		
	N	11 38 23.871099	11 38 23.871022	-0.0024	0.0004	0.0004	13.5	0.0004	13.3
	E	108 52 46.770140	108 52 46.770209	0.0021	0.0007	0.0007	-0.2	0.0007	

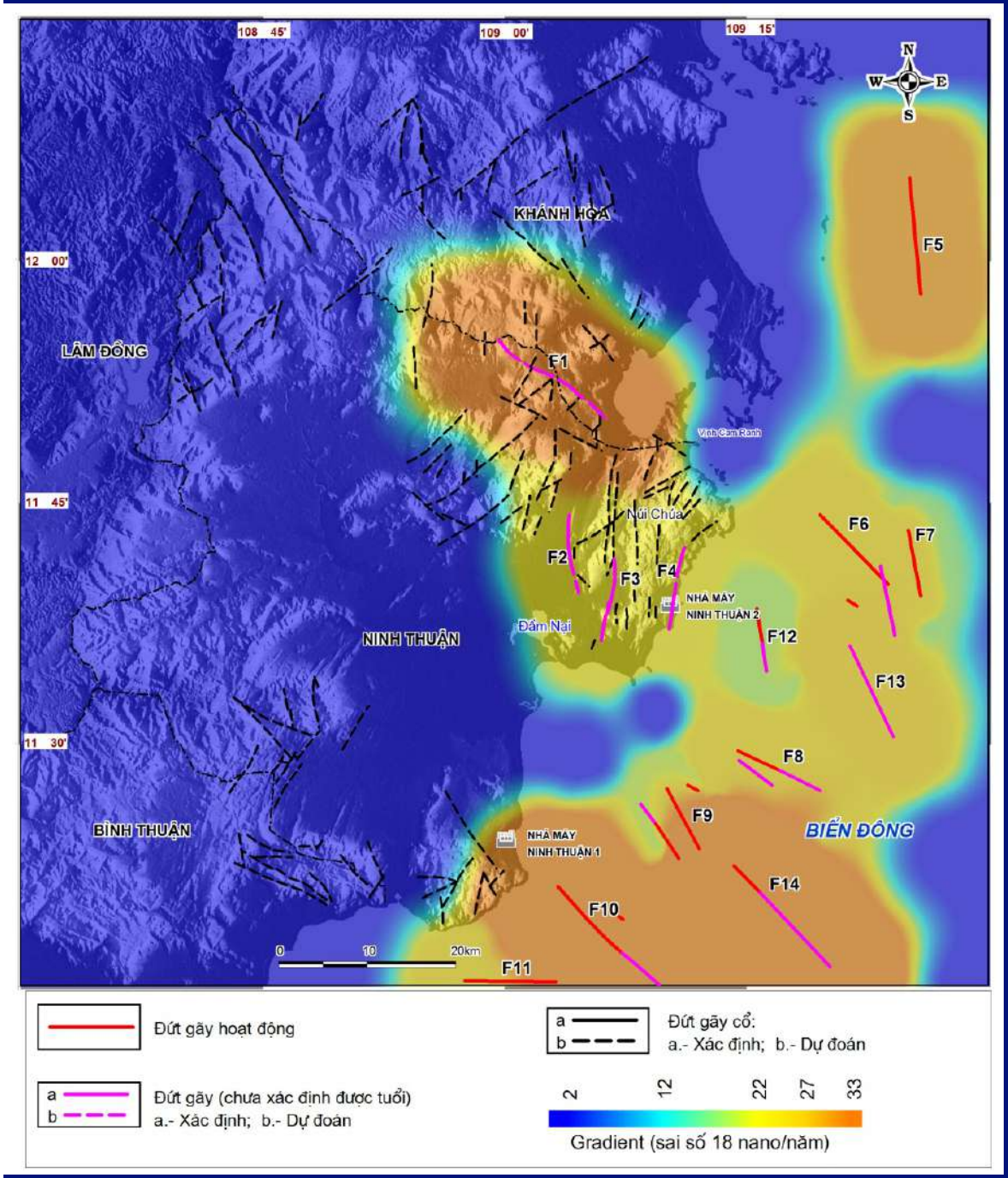

109°00'
109°15'
11°45'
11°30'
PKA1
VIS1
NSO1
THA1
CAD1
NPU1
TUT1
PMI1
2mm/yr
Elip sai so 1mm

gradient

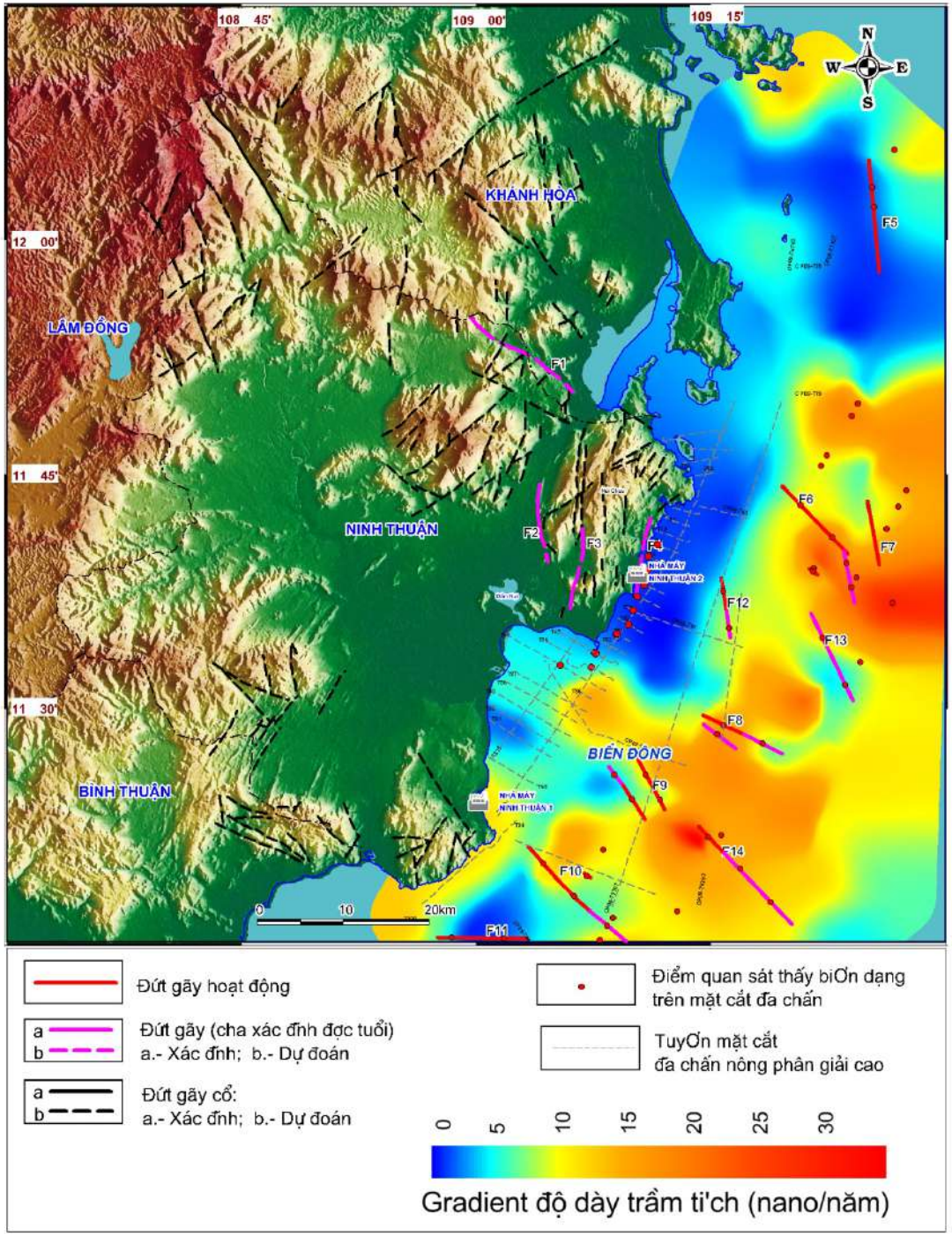
5.1. estimation of tectonic graient from geological data

TT	Tên ĐG	Chiều dài (km)	Tốc độ (mm/năm)	Gradient
1	F1	15,0	0.24	32.10^{-9}
2	F2	9,5	0.11	23.10^{-9}
3	F3	9,6	0.11	23.10^{-9}
4	F4	9,5	0.11	23.10^{-9}
5	F5	13,4	0.20	30.10^{-9}
6	F6	11,0	0.14	25.10^{-9}
7	F7	7,6	0.07	18.10^{-9}
8	F8	10,3	0.13	25.10^{-9}
9	F9	7,7	0.08	20.10^{-9}
10	F10	16,0	0.26	33.10^{-9}
11	F11	10,3	0.13	25.10^{-9}
12	F12	7,2	0.07	19.10^{-9}
13	F13	11,5	0.15	26.10^{-9}
14	F14	15,9	0.26	33.10^{-9}

Fault length, slip rate and tectonic gradient . Error of slip rate is estimated ~ 0.07 so error of tectonic gradient is of 18.10^{-9}



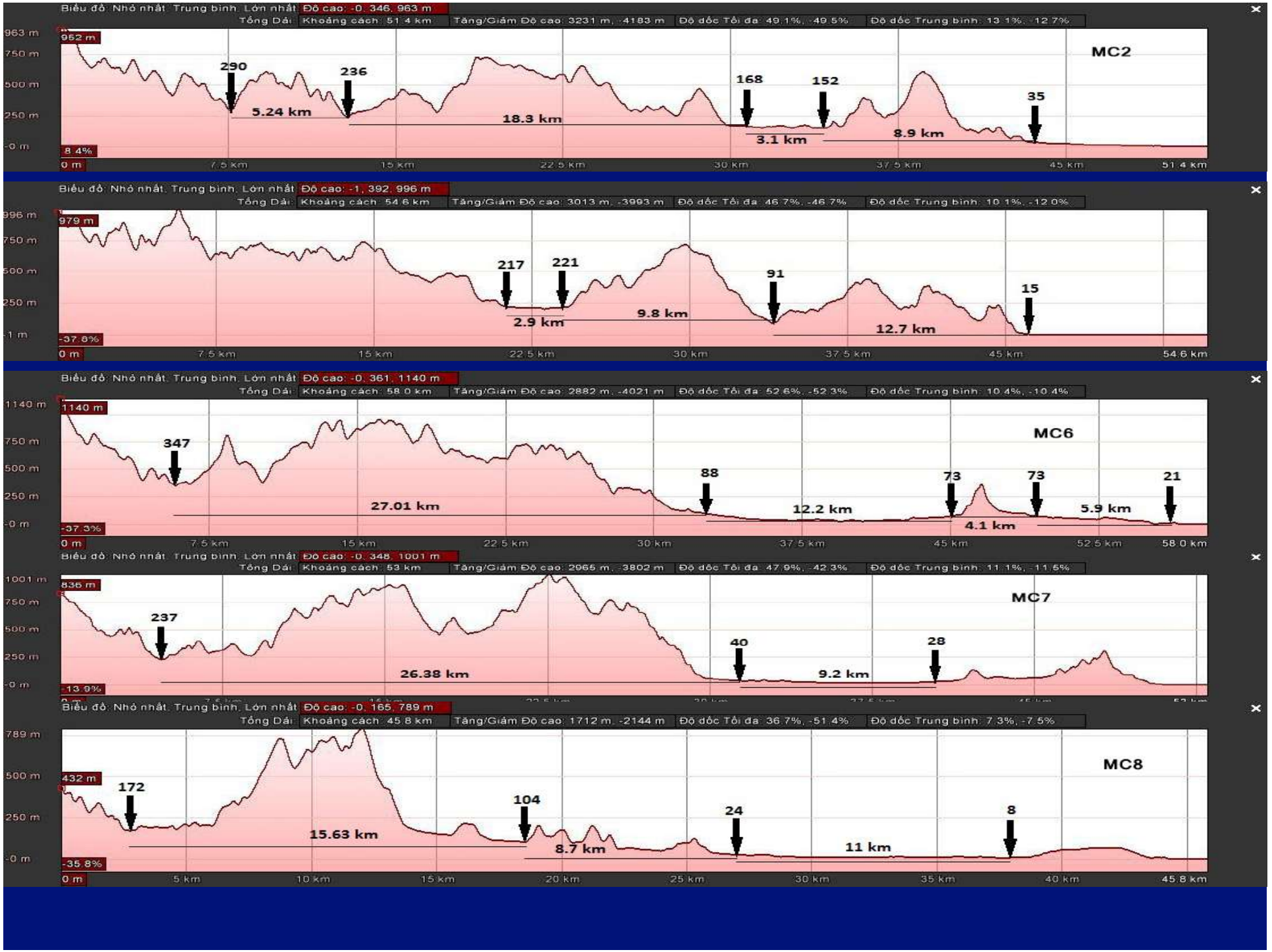
5.1.1. Gradient kiến tạo pleistocen tính từ chuyển dịch đứt gãy



sketch map of the gradient of rate of Quaternary sediment acumulation

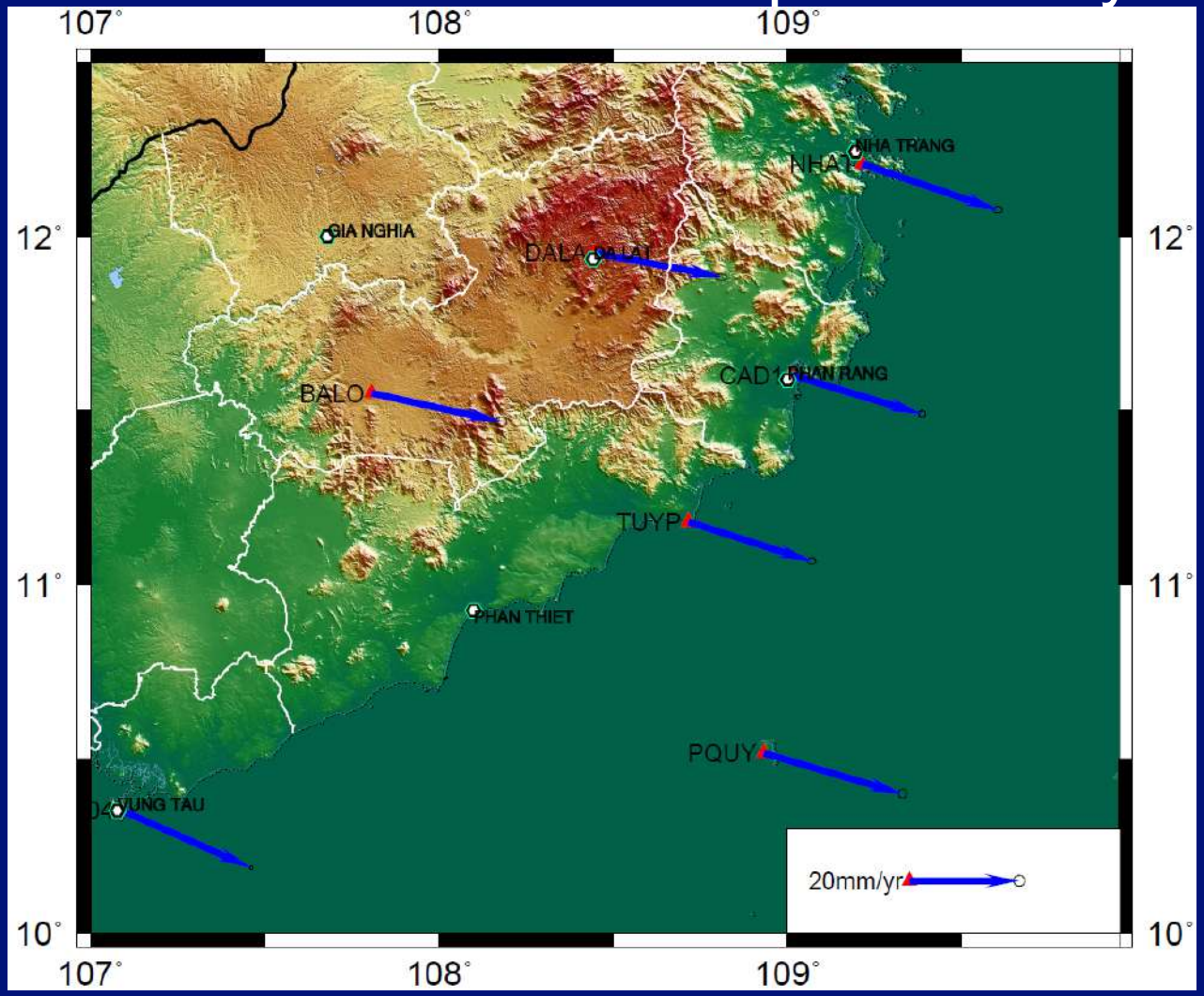
The deviation in height of the surface is 47 m. The lower surface corresponds to the terrace of second order assumed to be 12000 - 120000 years. Then the vertical deformation rate is from 25x 10-8 to 25 x 10-9.

I feel its assessed value is too high. If the assumptions of the uplif from the past 1 million years, then strain rate is 30x10-9

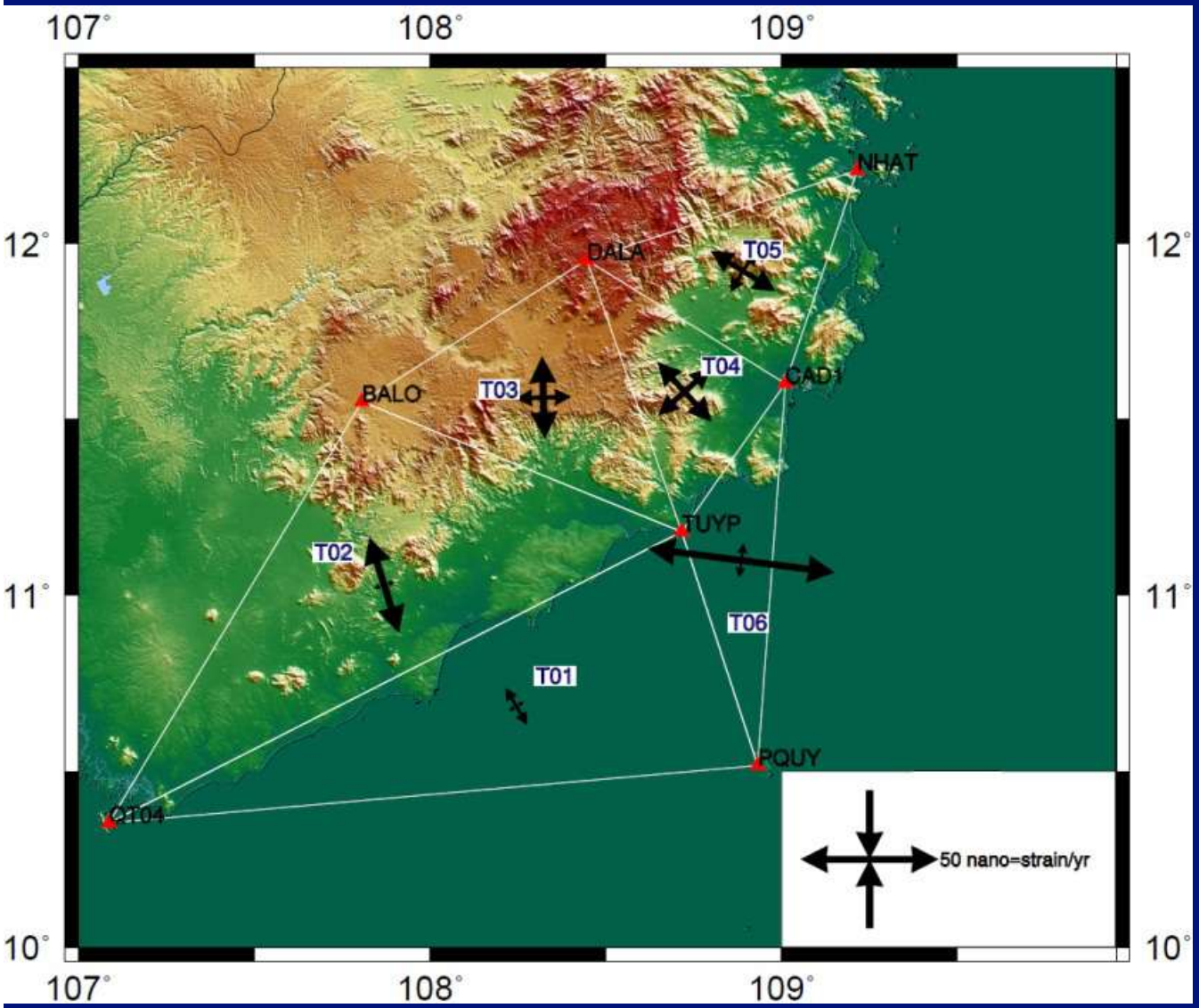

Biểu đồ: Nhỏ nhất, Trung bình, Lớn nhất Độ cao: -0, 346, 963 m
Tổng Dài: Khoảng cách: 51.4 km Tăng/Giảm Độ cao: 3231 m, -4183 m Độ dốc Tối đa: 49.1%, -49.5% Độ dốc Trung bình: 13.1%, -12.7%
963 m
750 m
500 m
250 m
-0 m
952 m
MC2
290
236
168
152
35
5.24 km
18.3 km
3.1 km
8.9 km
8.4%
0 m
7.5 km
15 km
22.5 km
30 km
37.5 km
45 km
51.4 km
Biểu đồ: Nhỏ nhất, Trung bình, Lớn nhất Độ cao: -1, 392, 996 m
Tổng Dài: Khoảng cách: 54.6 km Tăng/Giảm Độ cao: 3013 m, -3993 m Độ dốc Tối đa: 46.7%, -46.7% Độ dốc Trung bình: 10.1%, -12.0%
996 m
750 m
500 m
250 m
-1 m
979 m
217
221
91
15
2.9 km
9.8 km
12.7 km
-37.6%
0 m
7.5 km
15 km
22.5 km
30 km
37.5 km
45 km
54.6 km
Biểu đồ: Nhỏ nhất, Trung bình, Lớn nhất Độ cao: -0, 361, 1140 m
Tổng Dài: Khoảng cách: 58.0 km Tăng/Giảm Độ cao: 2882 m, -4021 m Độ dốc Tối đa: 52.6%, -52.3% Độ dốc Trung bình: 10.4%, -10.4%
1140 m
750 m
500 m
250 m
-0 m
1140 m
MC6
347
88
73
73
21
27.01 km
12.2 km
4.1 km
5.9 km
-37.3%
0 m
7.5 km
15 km
22.5 km
30 km
37.5 km
45 km
52.5 km
58.0 km
Biểu đồ: Nhỏ nhất, Trung bình, Lớn nhất Độ cao: -0, 348, 1001 m
Tổng Dài: Khoảng cách: 53 km Tăng/Giảm Độ cao: 2965 m, -3802 m Độ dốc Tối đa: 47.9%, -42.3% Độ dốc Trung bình: 11.1%, -11.5%
1001 m
750 m
500 m
250 m
-0 m
836 m
MC7
237
40
28
26.38 km
9.2 km
-13.9%
Biểu đồ: Nhỏ nhất, Trung bình, Lớn nhất Độ cao: -0, 165, 789 m
Tổng Dài: Khoảng cách: 45.8 km Tăng/Giảm Độ cao: 1712 m, -2144 m Độ dốc Tối đa: 36.7%, -51.4% Độ dốc Trung bình: 7.3%, -7.5%
789 m
500 m
250 m
-0 m
432 m
MC8
172
104
24
8
15.63 km
8.7 km
11 km
-35.8%
0 m
5 km
10 km
15 km
20 km
25 km
30 km
35 km
40 km
45.8 km

N	Profile	High L1 (m)	High L2 (m)	Distance (L1-L2) (km)	Gradient 100.000 năm (10^{-9} /yr)	Gradient 120.000 năm (10^{-9} /yr)	Gradient 140.000năm (10^{-9}/yr)
1	MC4	24	23	4.1	2.4	2.0	1.7
2	MC5	88	41	15.4	30.5	25.4	21.8
3	MC6	88	73	12.2	12.3	10.2	8.8
4	MC7	40	28	9.2	13.0	10.9	9.3
5	MC8	24	8	11	14.5	12.1	10.4
6	MC9	43	3	21.1	19.0	15.8	13.5
7	MC10	13	4	10.2	8.8	7.4	6.3
8	MC11	57	5	23.5	22.1	18.4	15.8
9	MC12	51	16	13.4	26.1	21.8	18.7
10	MC13	25	23	2.5	8.0	6.7	5.7
11	MC14	41	27	1.42	98.6	82.2	70.4
12	MC15	16	14	2.06	9.7	8.1	6.9
13	MC16	5	4	1.75	5.7	4.8	4.1

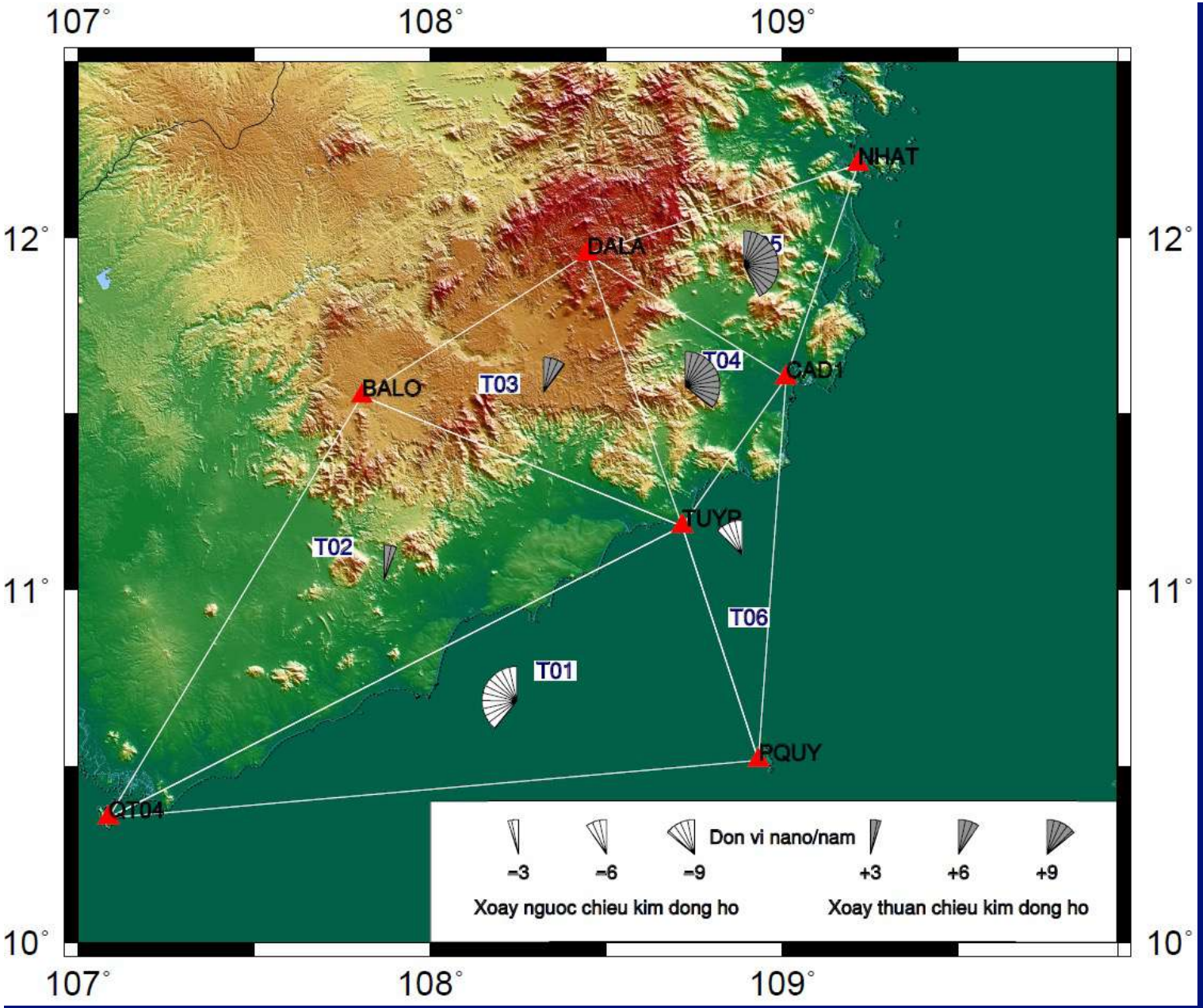
strain rate of the present day tectonics



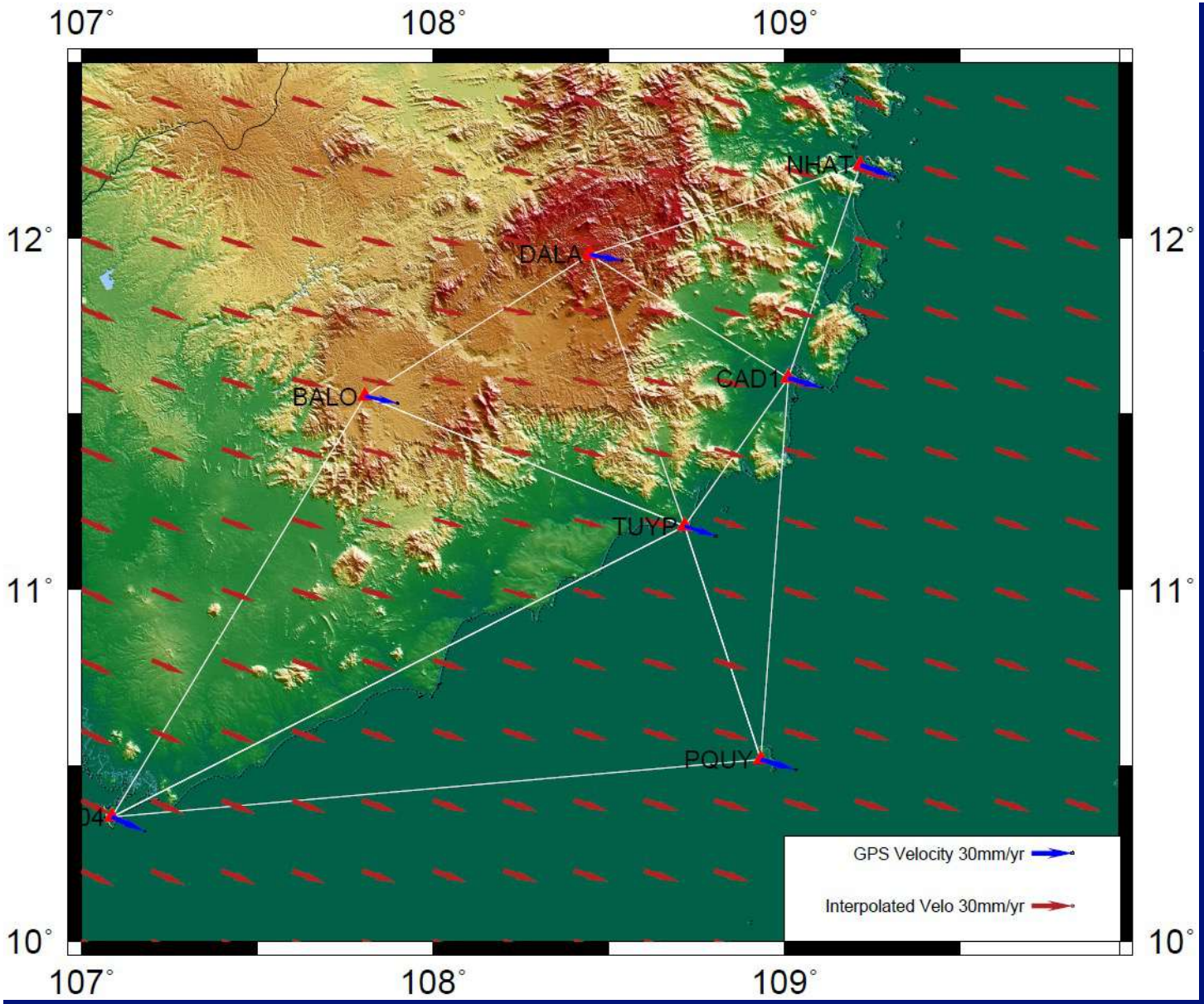
- Displacement in ITRS 08 frame determined GPS measurement from 3/2012 – 9/2013



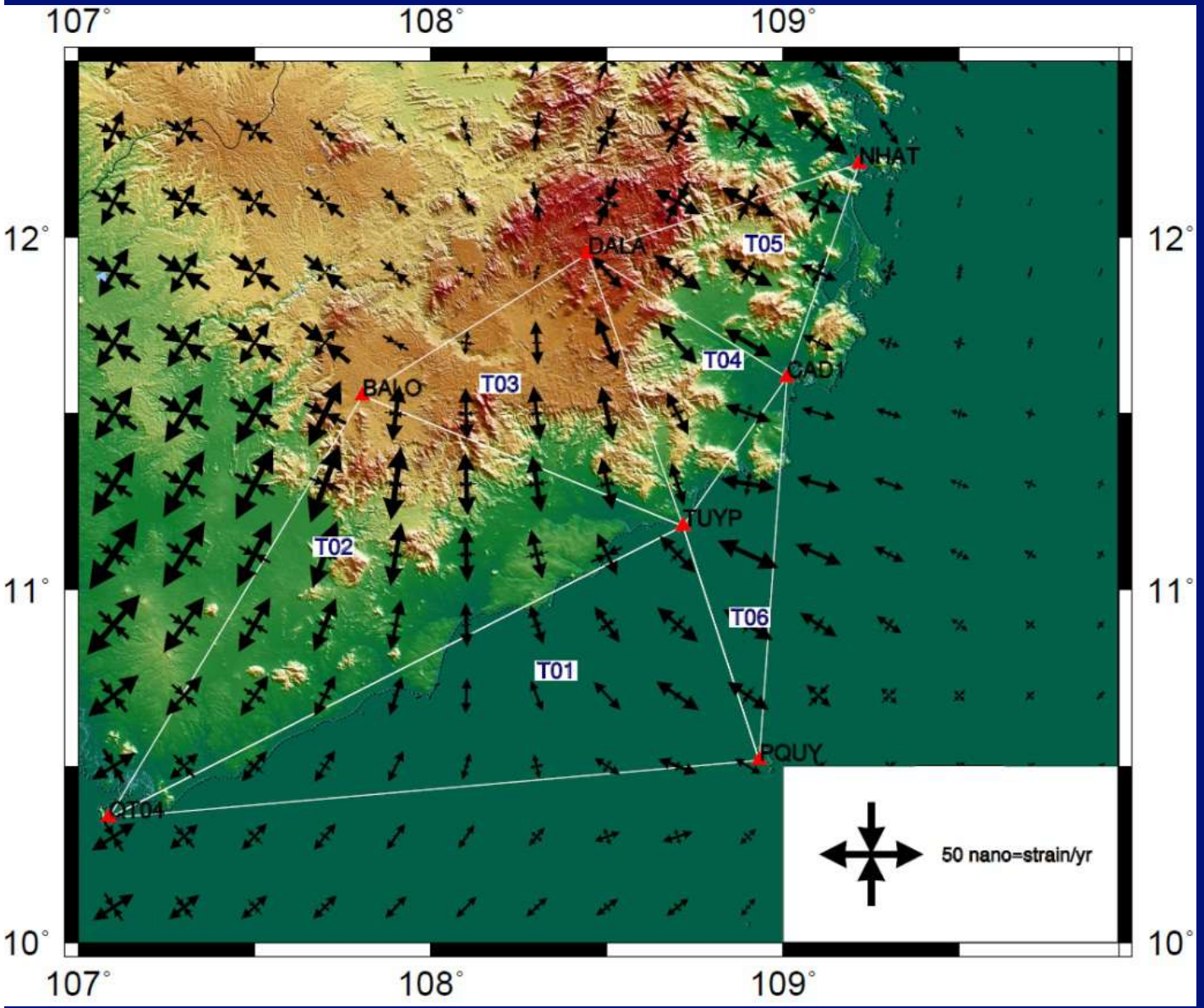
Principal strain rate.



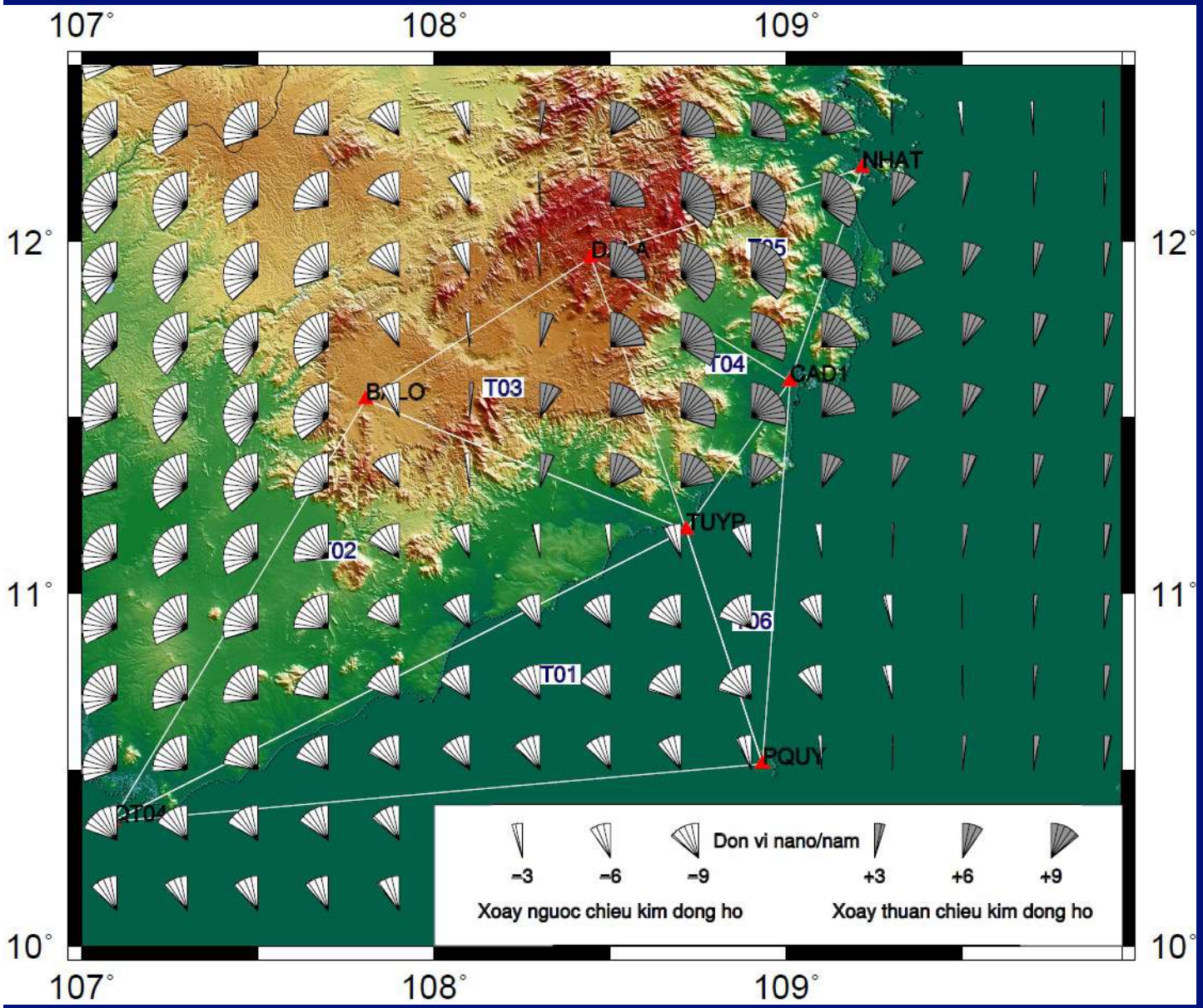
rotation
strain
rate



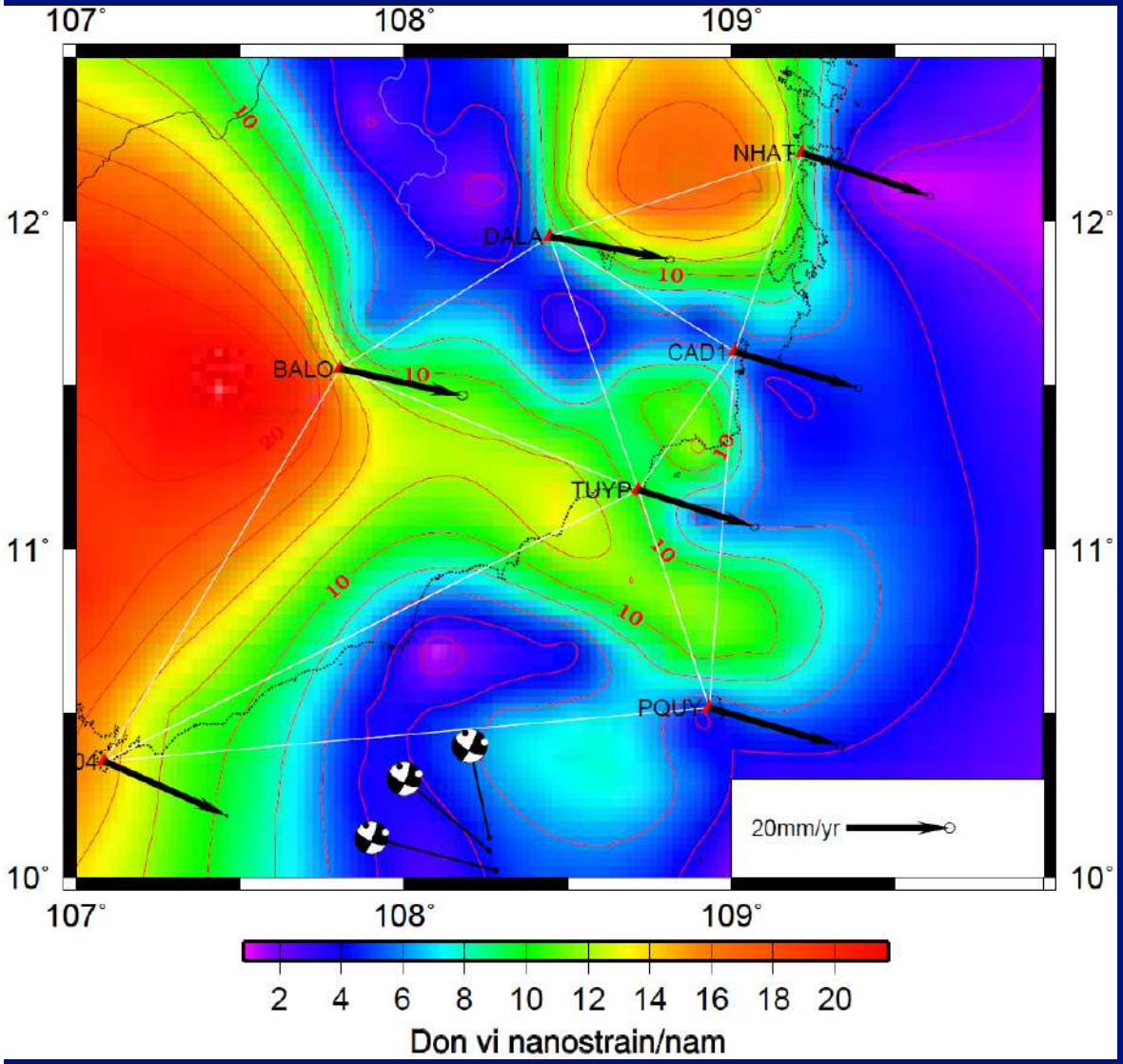
Interporation of tectonic rate in the network $0.2^o \times 0.2^o$



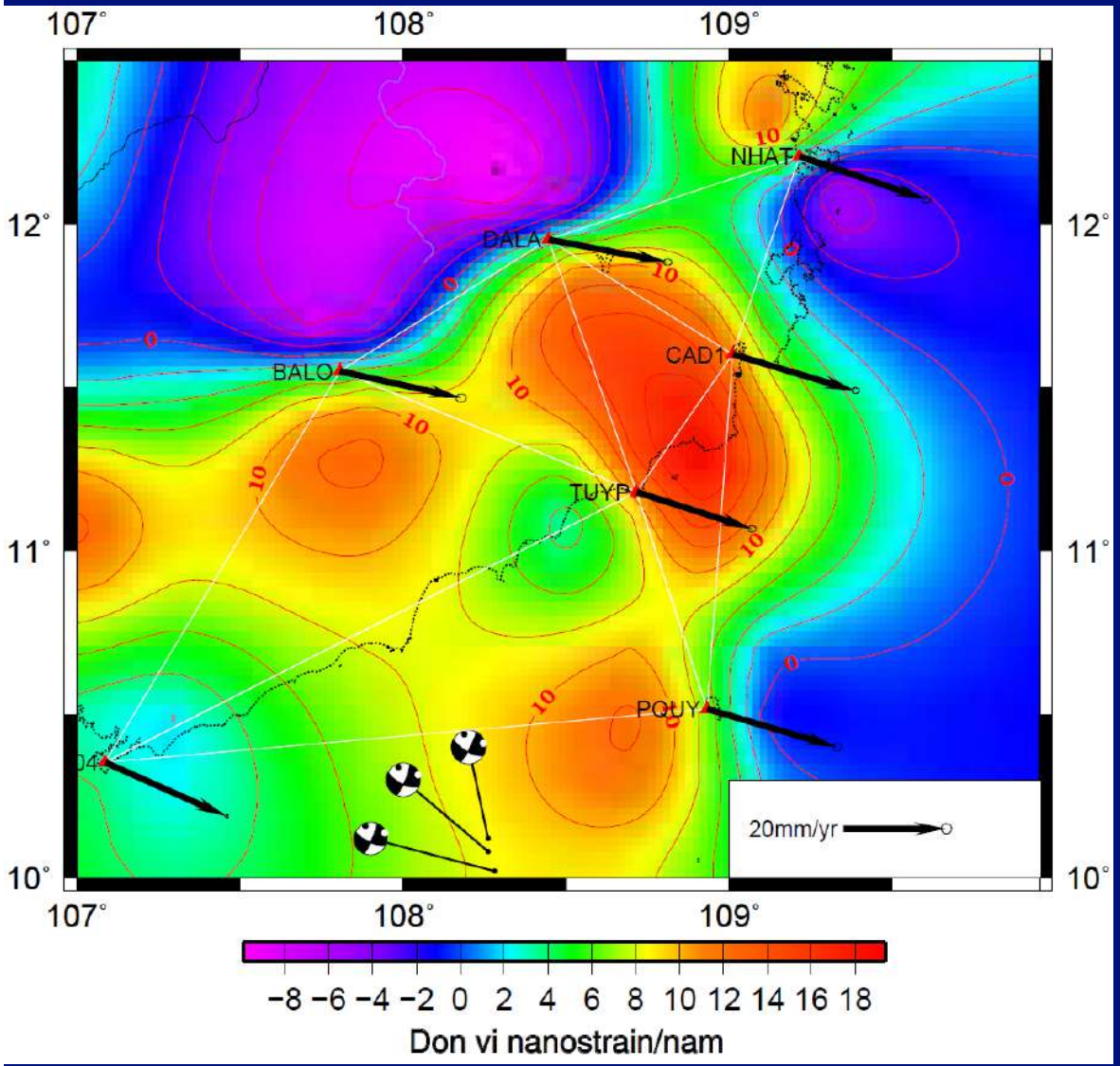
Interpolation of principal strain rate



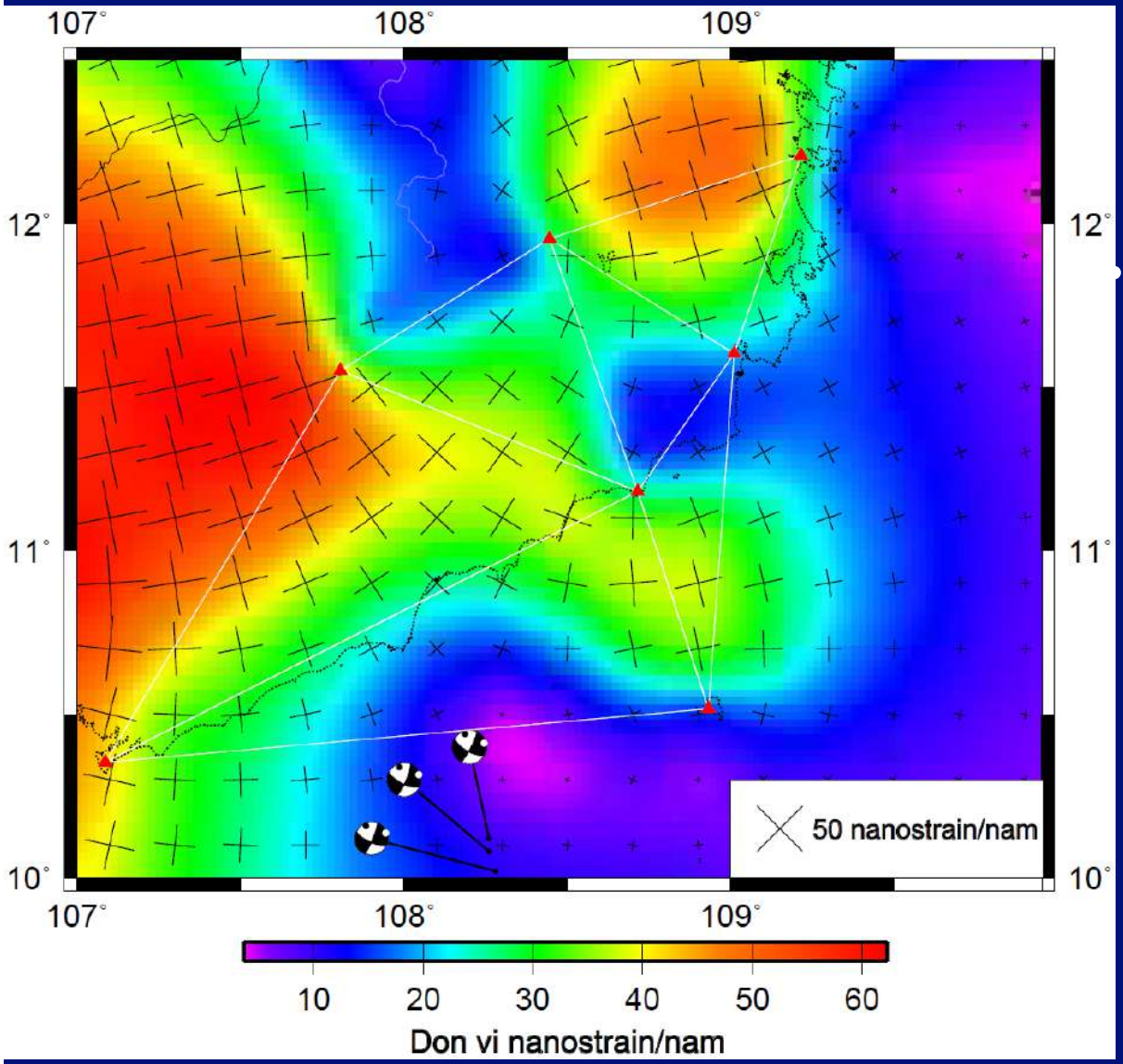
Interpolation of rotation rate



- *Magnitude of Strain rate determined from invariant of second order*



- *Magnitude of Strain rate determined from invariant of first order*



- *Maximum Shear strain rate*

4. Capable fault locate near NPP Ninh Thuan 1

- Intepretation seismic profile of JAPC indicate the existance of a fault
- Russian consuler is not observed active fault from Seismic profile

Average Maximum Earthquake at NPP Ninh Thuan 1

Length (km)	Depth(km)	Dip	Displacement (m)	State of stress
16.000	15.000	90.000	.400	2.000 Strike-slip

Magnitude theo Slemmons,1982 cho ch/ dai dut gay: 6.3

Magnitude theo Well-coppersmith cho ch/ dai dut gay: 6.5

Magnitude theo Well-coppersmith cho mat dut gay: 6.4

Magnitude theo Wyss, 1979 cho mat dut gay: 6.6

Magnitude theo Woodward-clyde,1983 cho mat d-gay: 6.5

Magnitude theo moment dong dat, Hanks- Kanamori: 6.3

Displacement (m) du doan theo Slemmons, 1982: 0.15

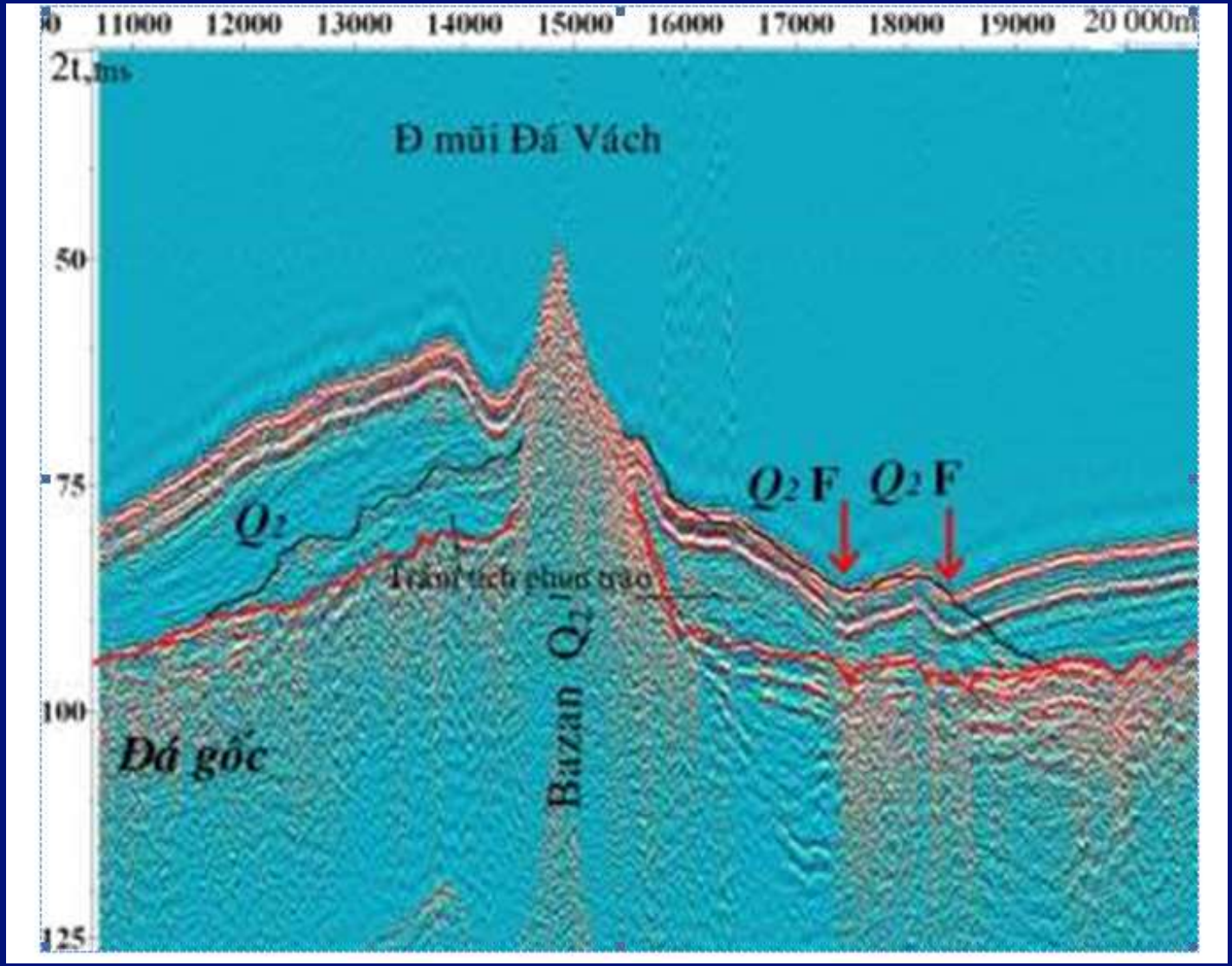
Slip rate (mm) from Woodward-clyde, 1983: 0.26

Maximum displacement(m) from Well-Coppersmith,1994: 0.40

Mean displacement (m) from Well-Coppersmith,1994 : 0.50

PGA OF F10 FAULT

Magnitude	Distance	Seismogenic depth	fault dip	
6.5	8.0	5.0	90	
Model 1 of Cambell,, 1981:				0.23
Model 2 of Cambell, 1981:				0.24
Model 3 of Cambell,,1981:				0.24
Model 4 of Campell, 1988:				0.25
Model of Cambell - Bozorgnia, 2008				0.22
Model Boore -Atkinson, 2008				0.22
Model of Boore, 1982:				0.15
Model of Idriss , 1982:				0.32
Model of Xiang Jianguang and Gao Dong, 1989:				0.20
Model of Woodward - clyde, 1983:				0.27
Model of Cornell, 1979:				0.40
Model of McGuire, 1980:				0.59
Model of Estena & Rosenblueth, 1974:				0.42
Model of Hung and Kiyomiya, 2012:				0.30


11000
12000
13000
14000
15000
16000
17000
18000
19000
20 000m
Đ mũi Đá Vách
50
75
100
125
Q_2
Q_2 F
Q_2 F
Đá gốc
Bazan Q_2^1

CONCLUSION

- In Ninh Thuan, strain rate is estimated from various data of gemorphology, seismic profiles, geology and GPS. Line rate is mostly less than 50 nanostrain that indicate the deformation in this region is very depressed. This request the study in late Pleistocene even in Quaternary.
- We have to pay attention to 4 faults: F2, F3 and F4 on the land and F10 on off shore. F3 is limited in dimension of 10 kilometre.
- We cannot confirm these faults F3 and F4 are active but not either inactives. The geological evidence of F4 fault is clearer than F3. One has to study more detail F4 fault due to this fault locates near to the No2 nuclear site.

- One need to determine the age of deformation in the fault gouge, especially for F4.
  - The F10 located a nearly No1 nuclear site that can produce a PGA of 0.22 – 0.30 g. This request to check the existence of the fault F14 by seismic profile of high resolution.
- Re-interpretation of seismic profile to check the existence of recent vocanisms near NPP1