

Le rôle du bassin Sud Caspien dans la collision Arabie-Eurasie ?

Frédéric MASSON



Eurasia

Jackson & McKenzie
(1984, 1988)

SCB

Central
Iranian
Block

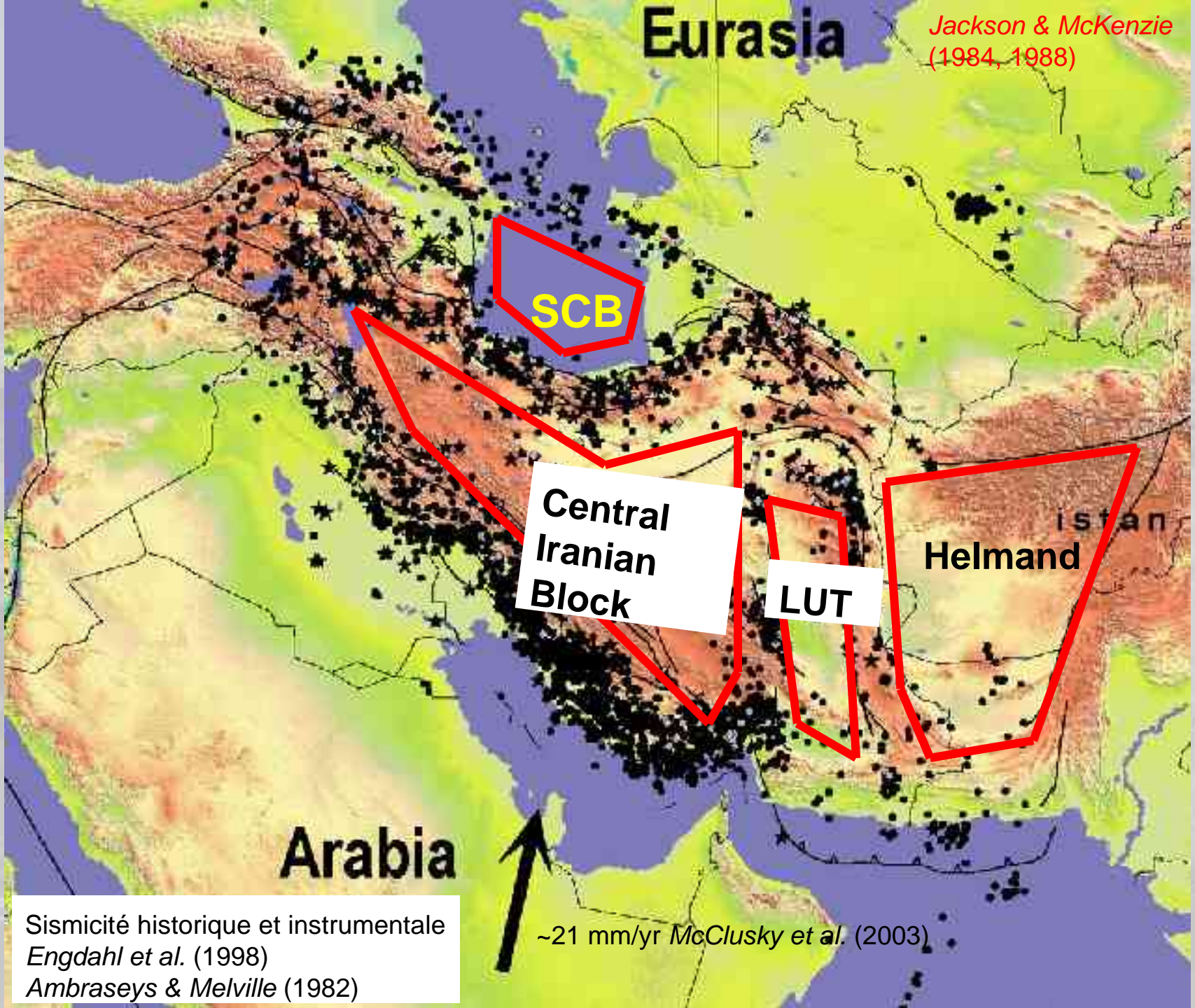
LUT

Helmand

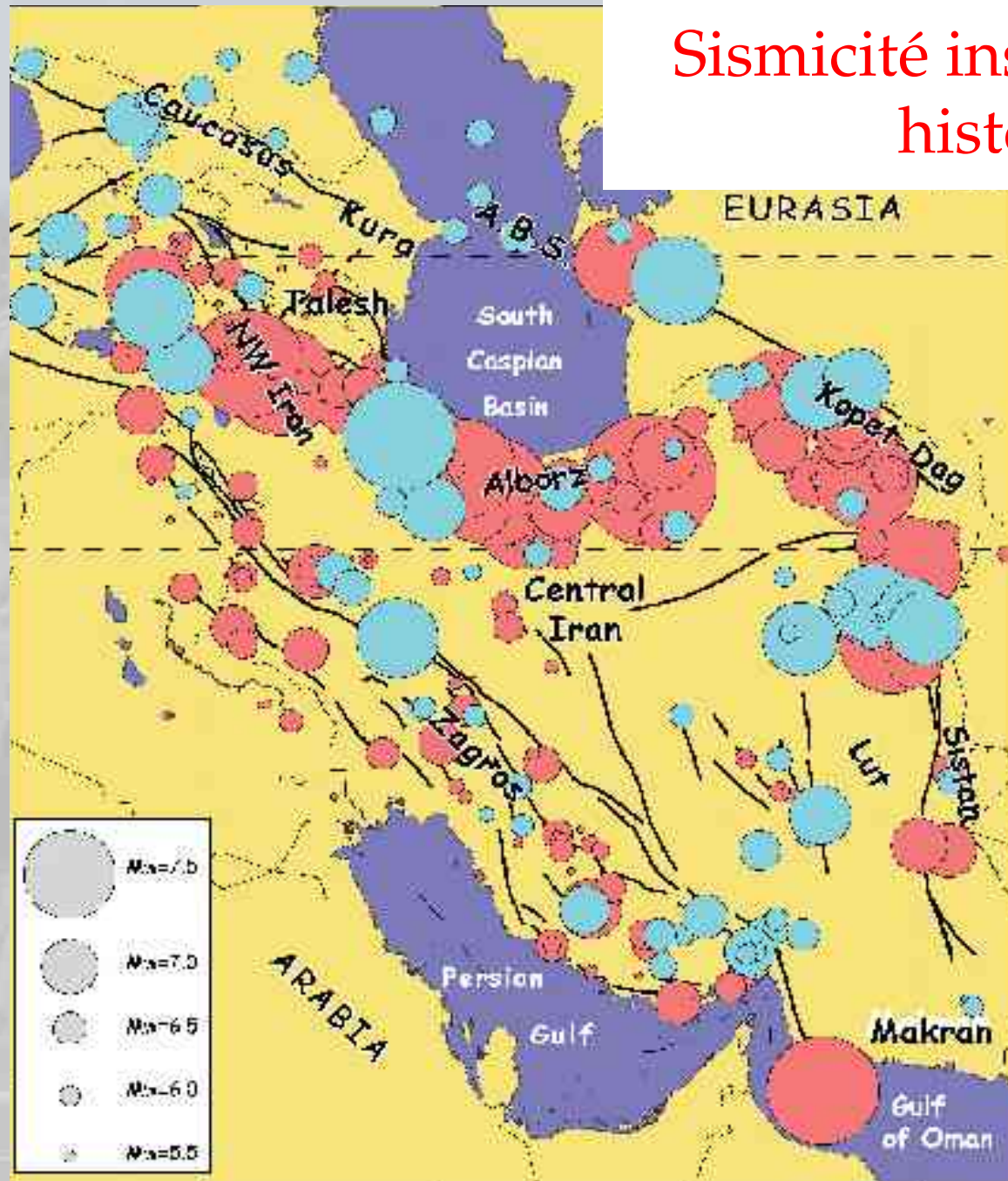
Arabia

Sismicité historique et instrumentale
Engdahl et al. (1998)
Ambraseys & Melville (1982)

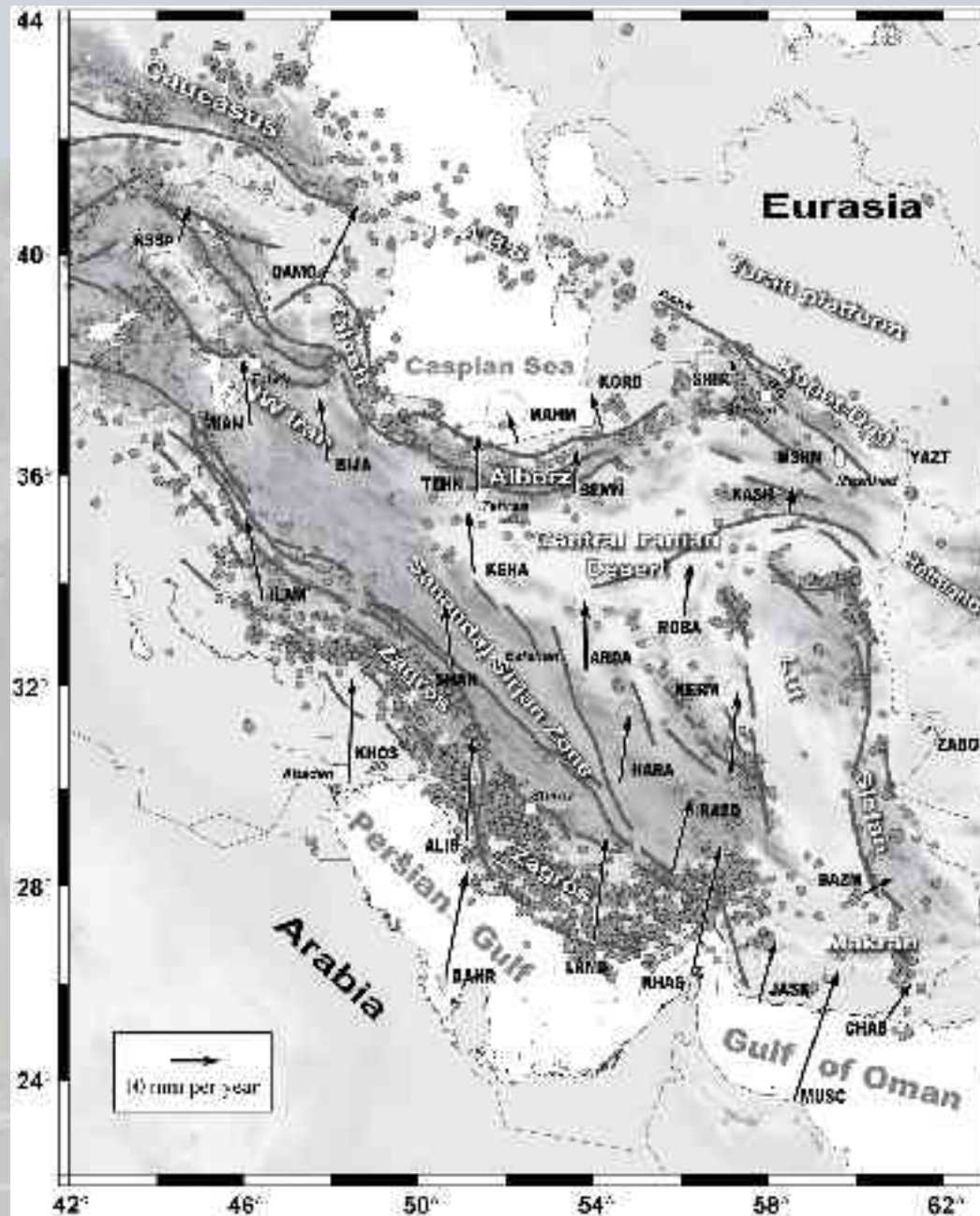
~21 mm/yr McClusky et al. (2003)



Sismicité instrumentale et historique



Résultats GPS : 1999-2001-2005



En collaboration avec...

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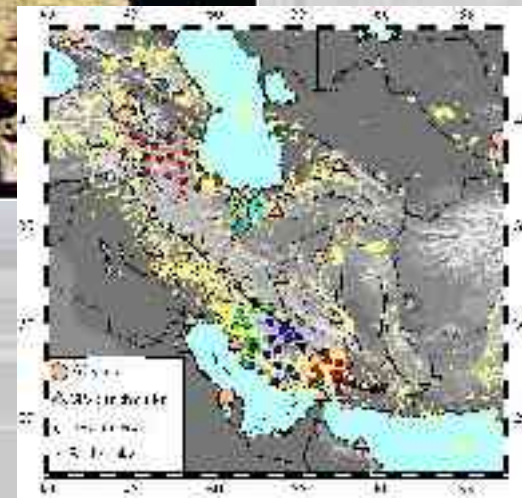
C. Vigny



Les mesures GPS : Exemples



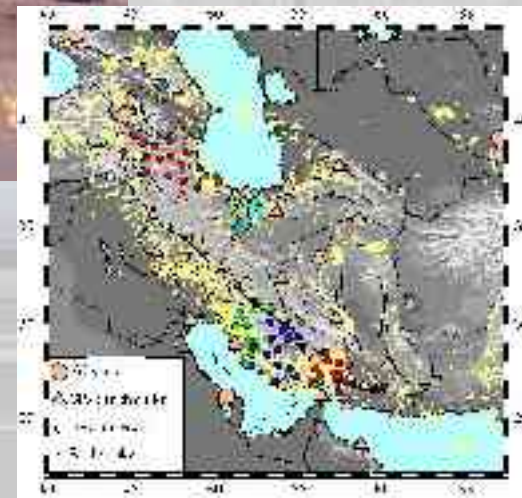
ROBA



Les mesures GPS : Exemples



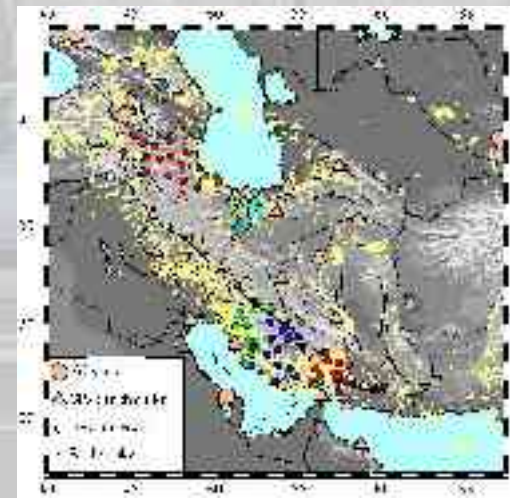
KHOS



Les mesures GPS : Exemples



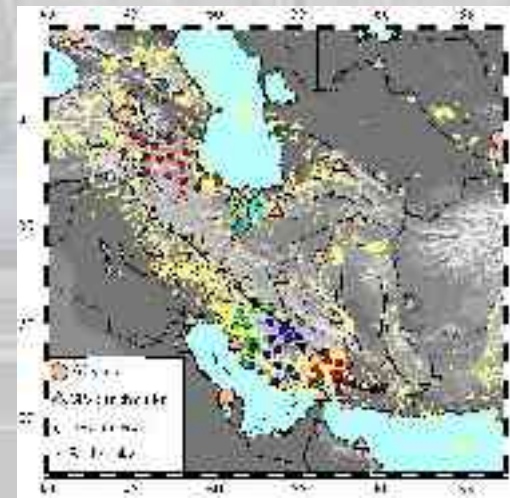
KASH



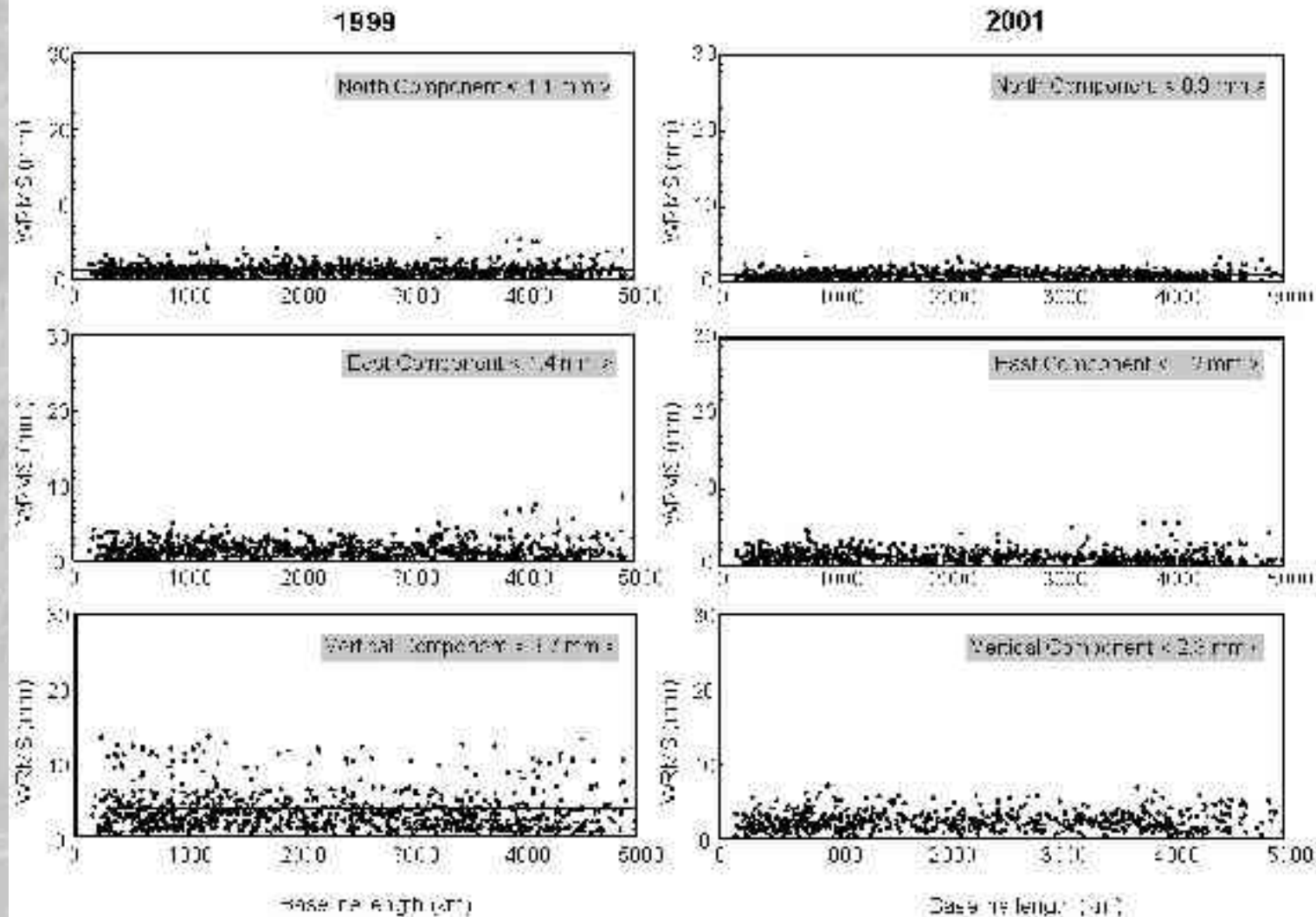
Les mesures GPS : Exemples



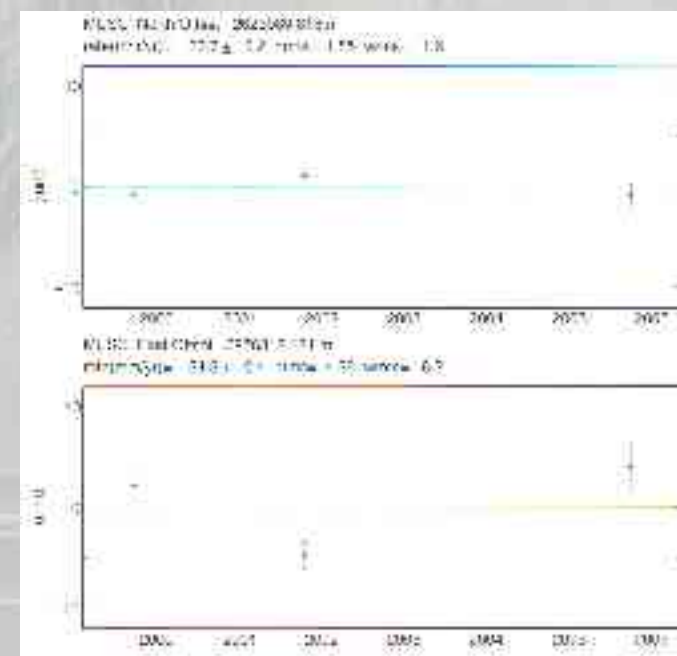
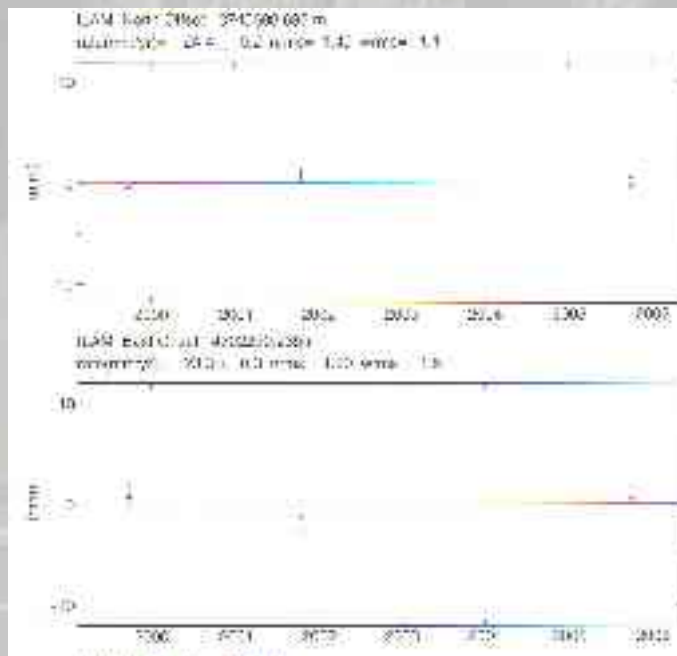
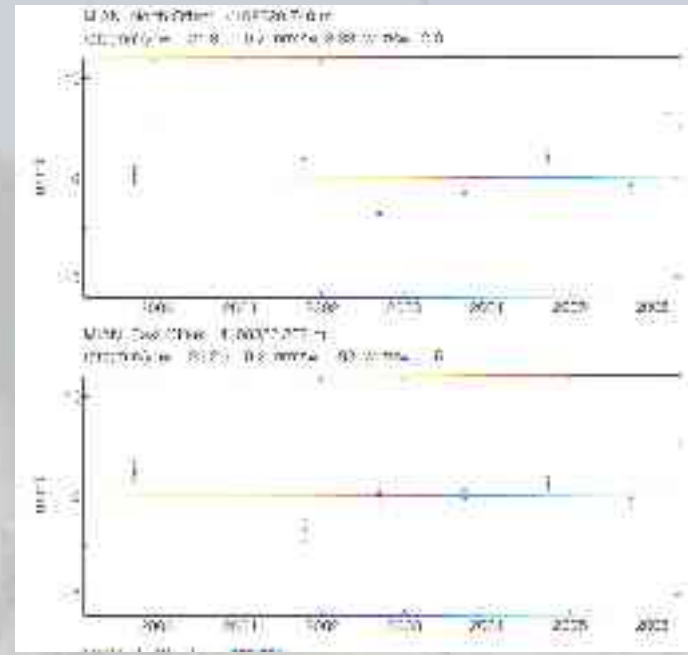
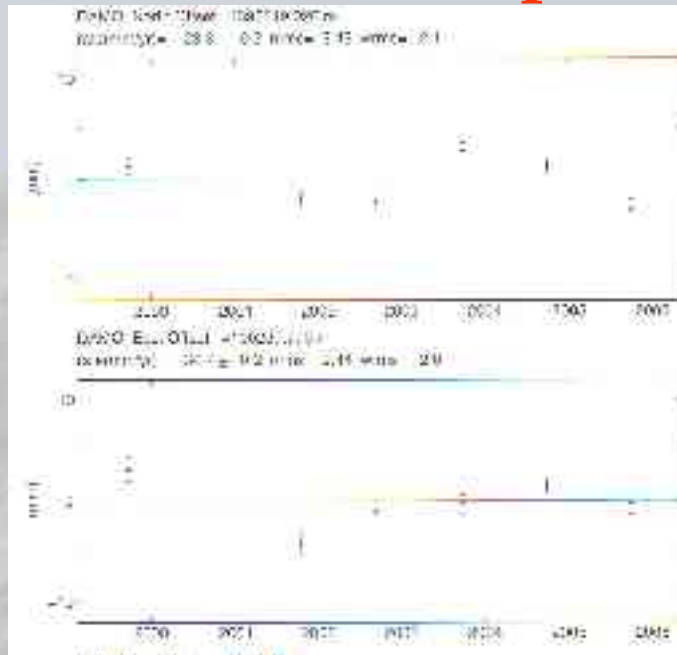
KHAS



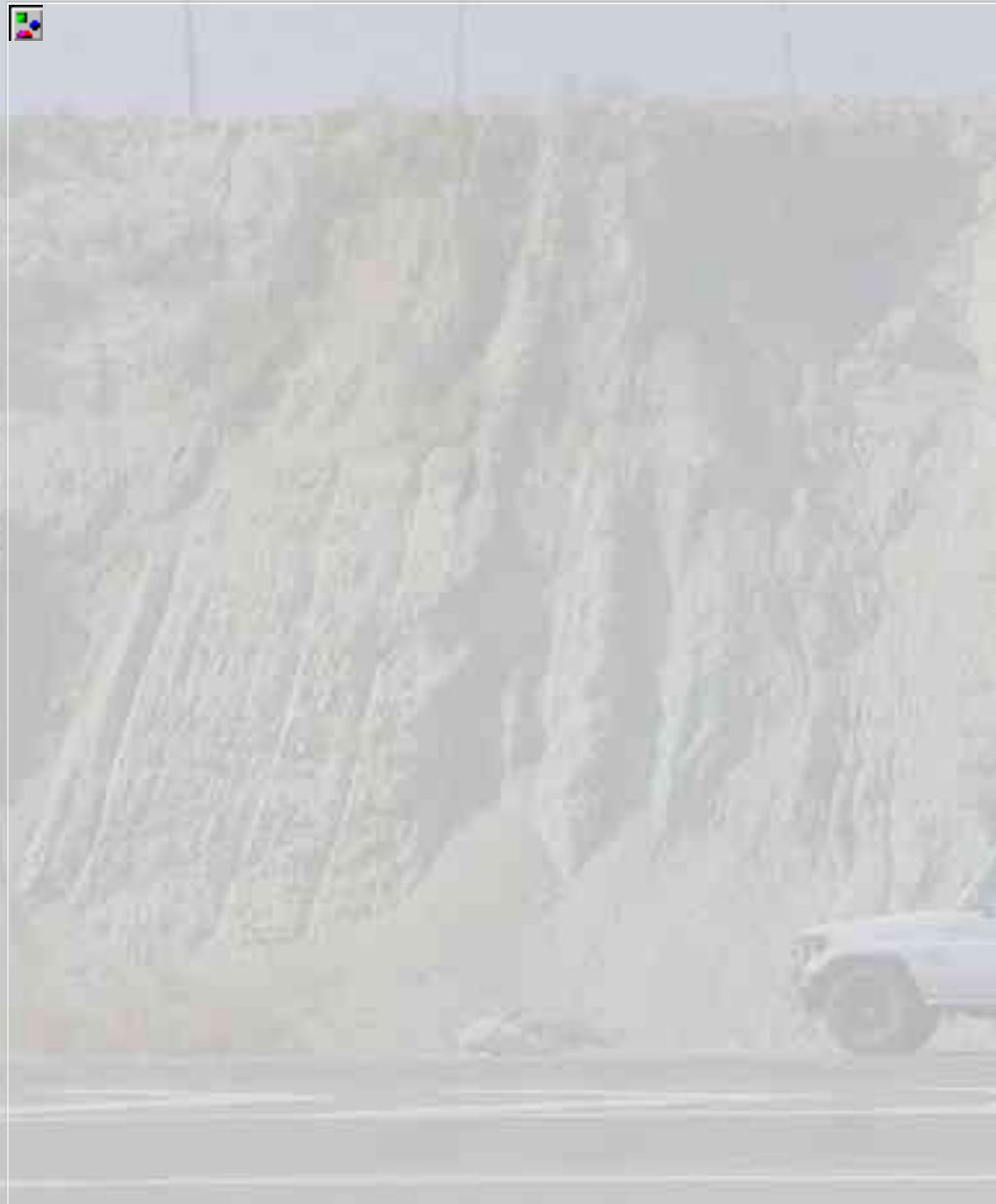
Traitement des données GPS



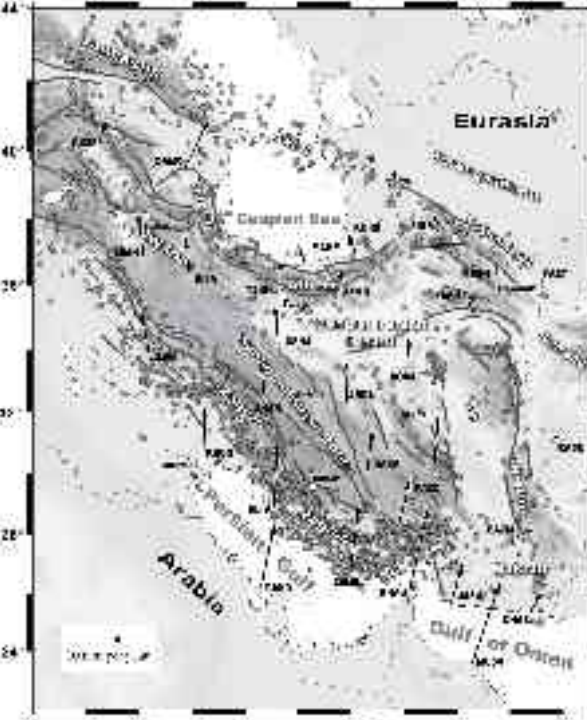
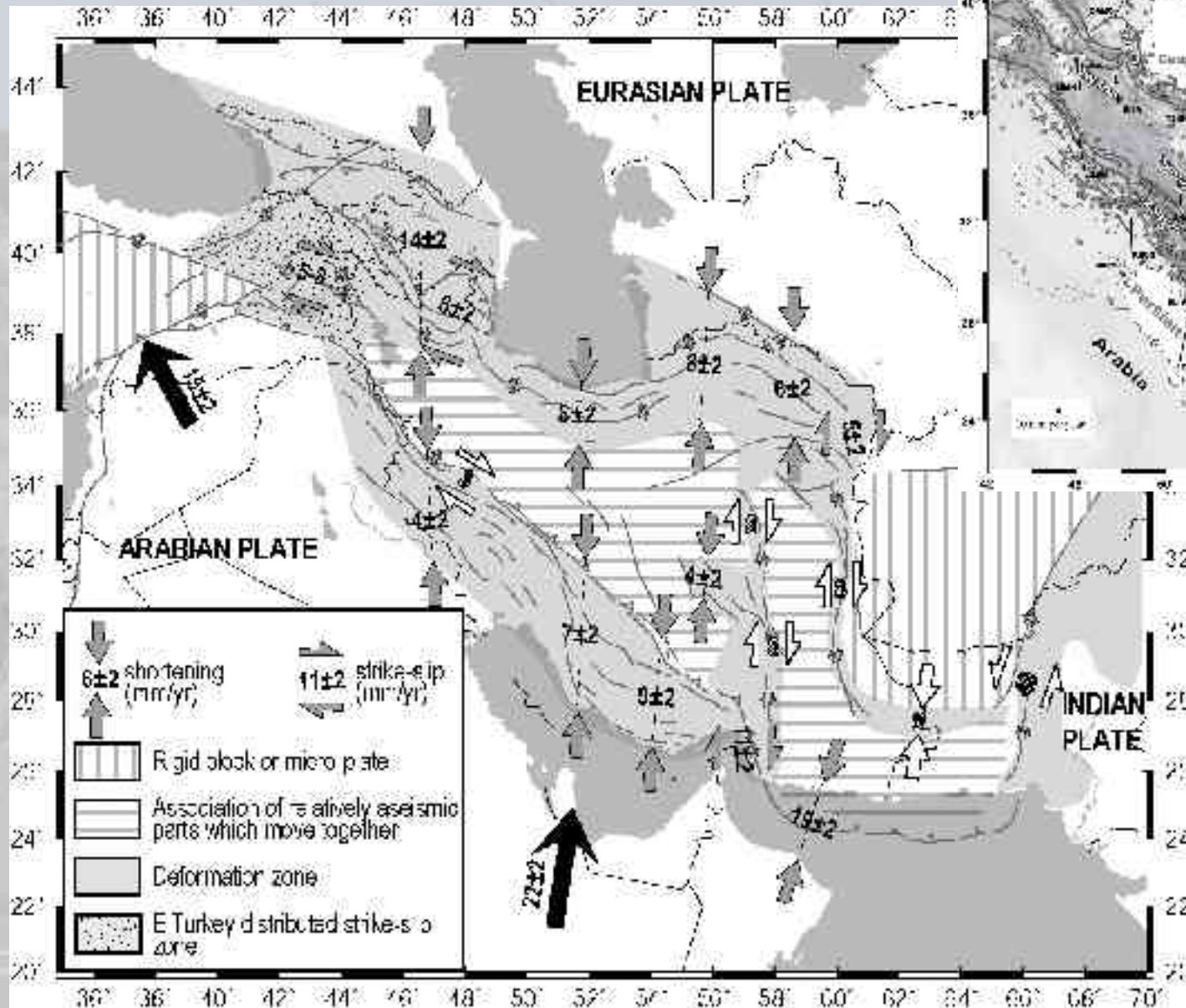
Séries temporelles 1999-2005



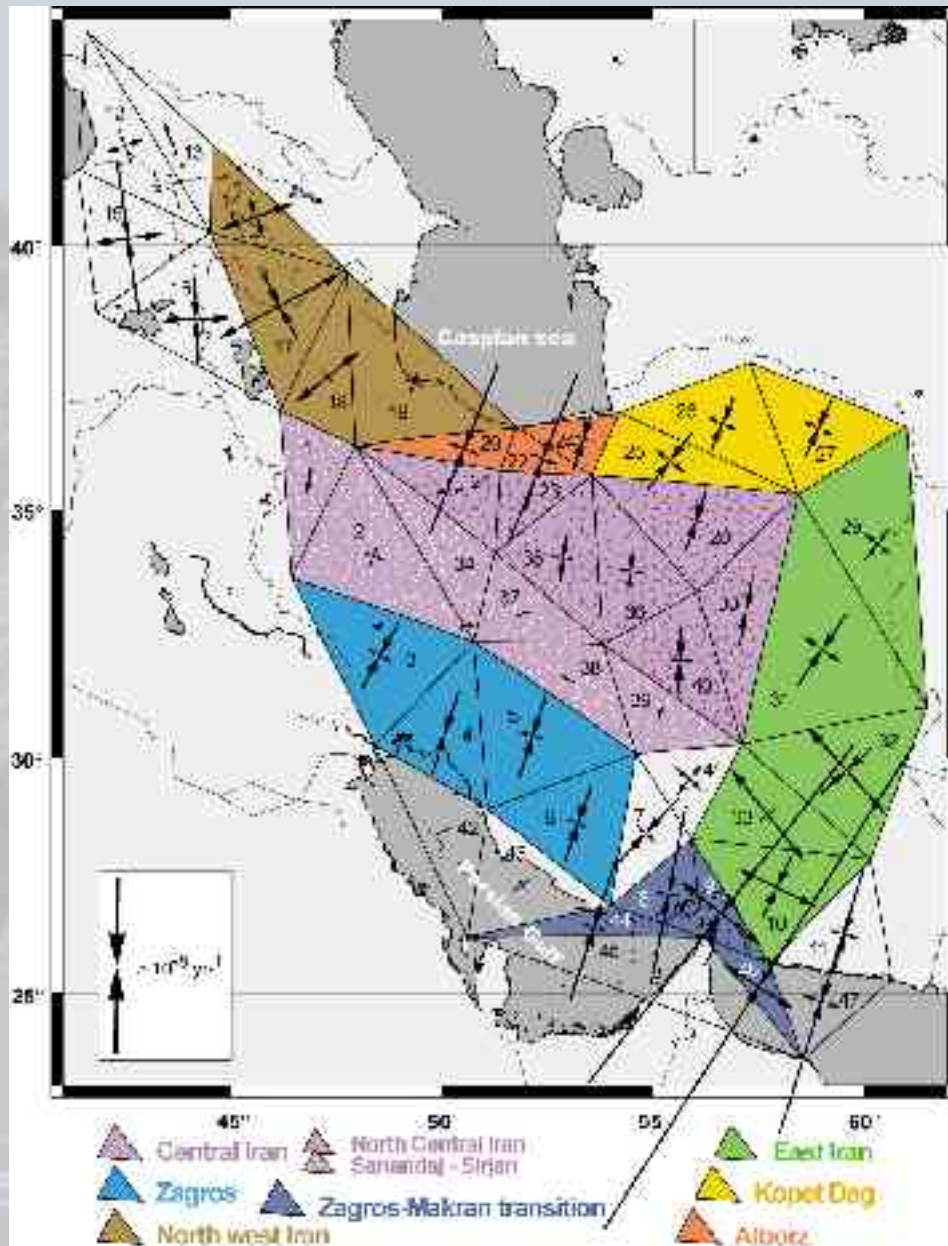
Comparaison 1999-2001 et 1999-2005



Synthèse tectonique



GPS Strain Rate

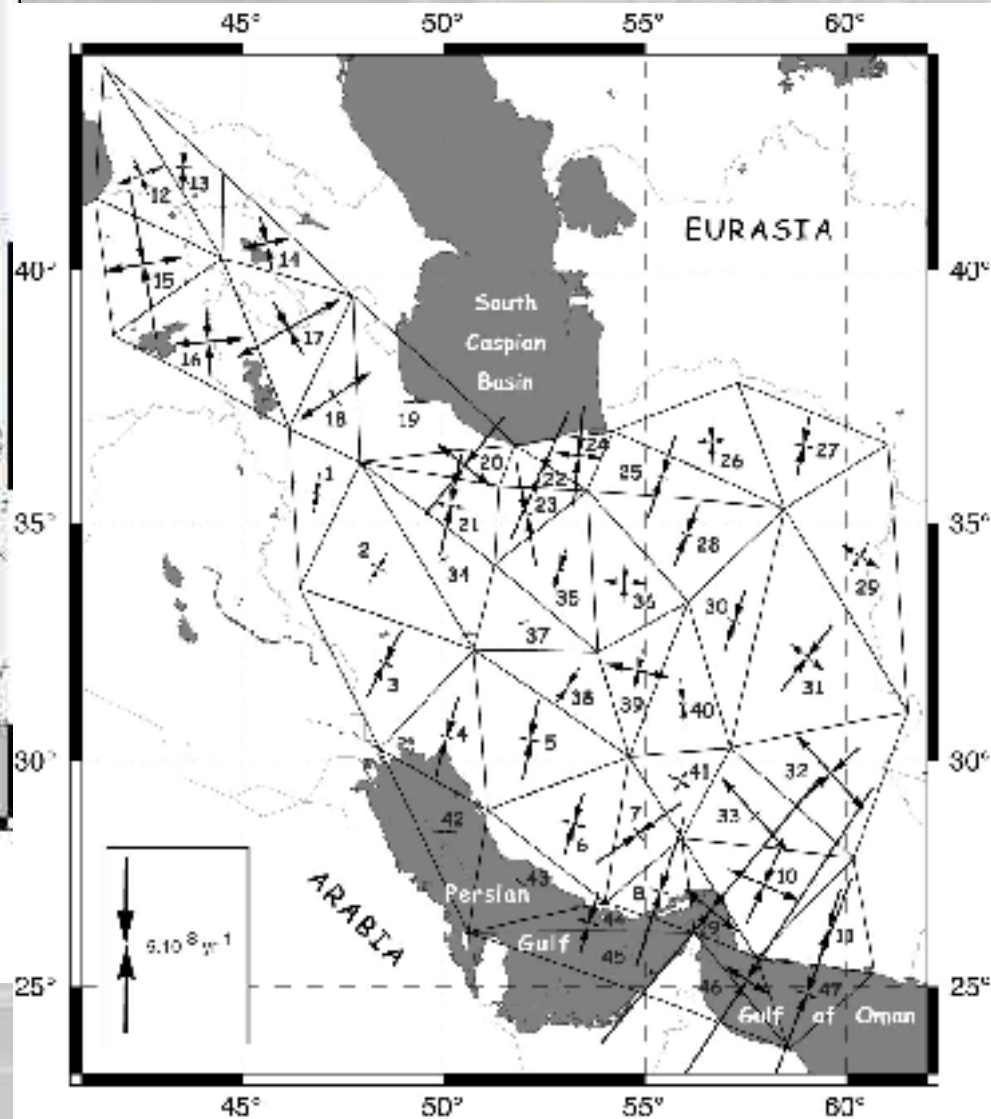
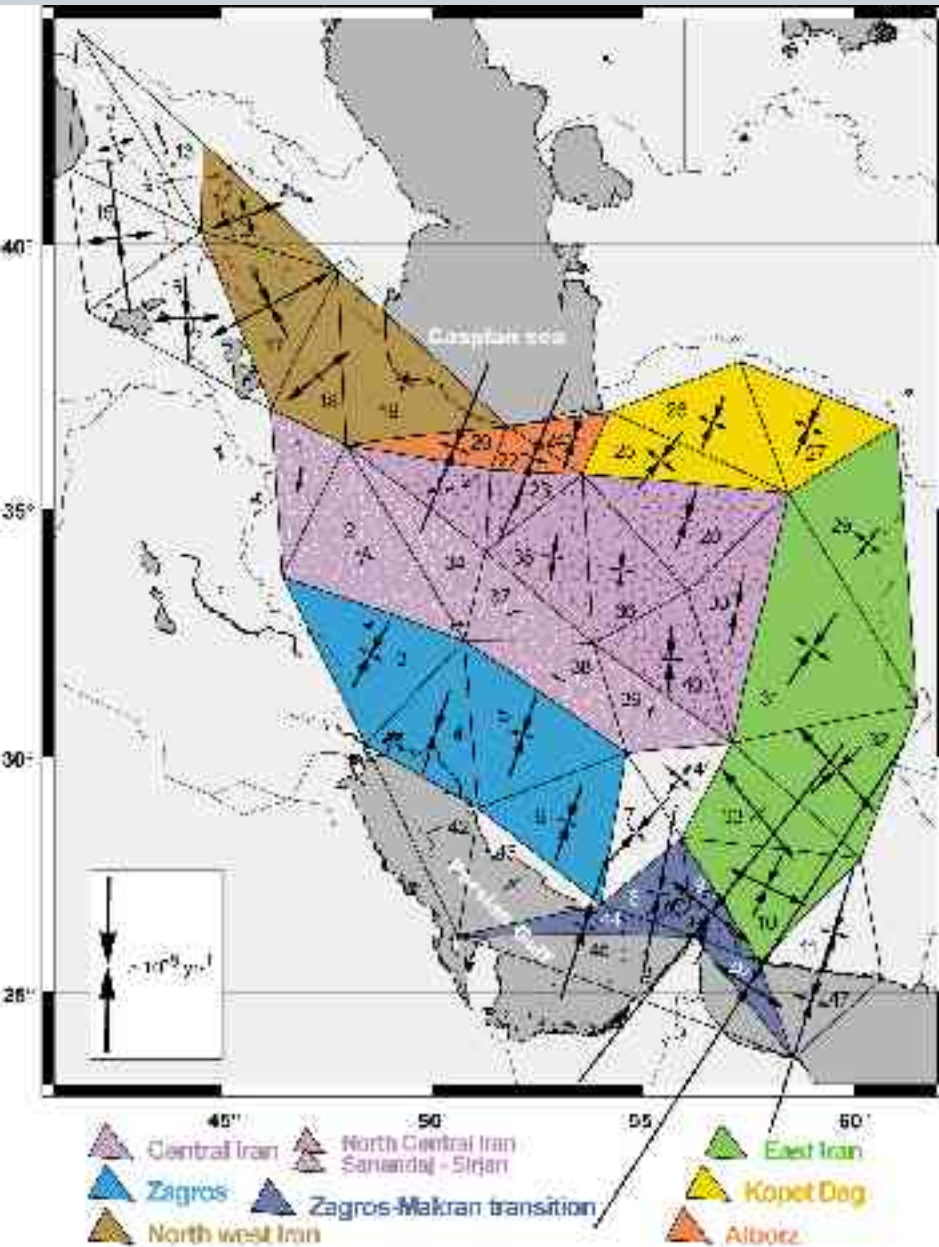


$$\bar{\nabla} V = \begin{pmatrix} \frac{\partial V_x}{\partial x} & \frac{\partial V_x}{\partial y} \\ \frac{\partial V_y}{\partial x} & \frac{\partial V_y}{\partial y} \end{pmatrix}$$

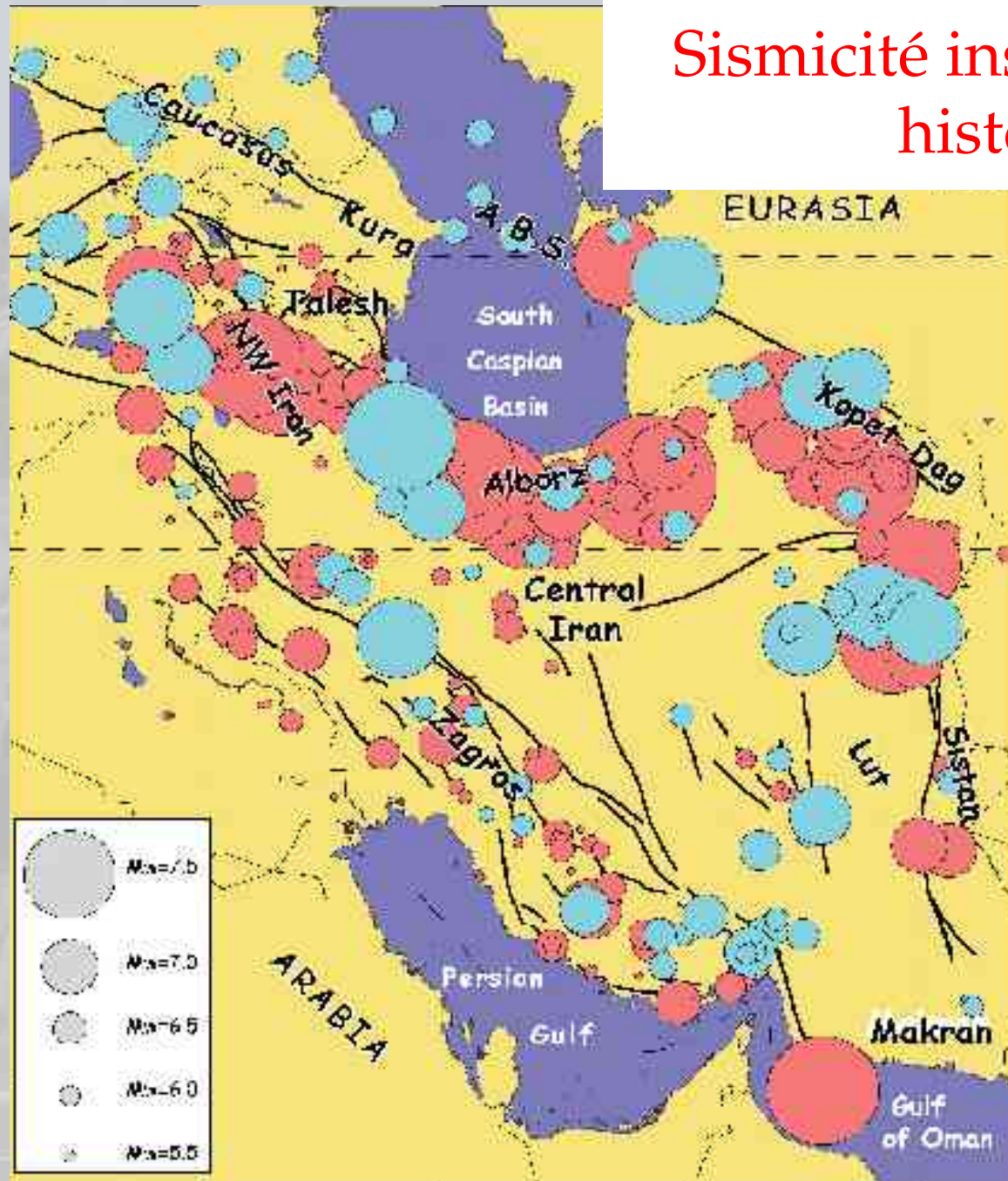
$$\bar{\nabla} V = \dot{E} + \dot{W} = \begin{bmatrix} E'_{11} & E'_{12} \\ E'_{21} & E'_{22} \end{bmatrix} + \begin{bmatrix} 0 & \dot{\omega} \\ \dot{\omega} & 0 \end{bmatrix}$$

- Long-term deformation
- Equivalent strain-rate in the south (Zagros) and in the north (Caucasus-Alborz-KopetDag).
- High strain-rate around the Zagros-Makran transition zone.
- Mainly shortening except around Tabriz.

GPS strain rate



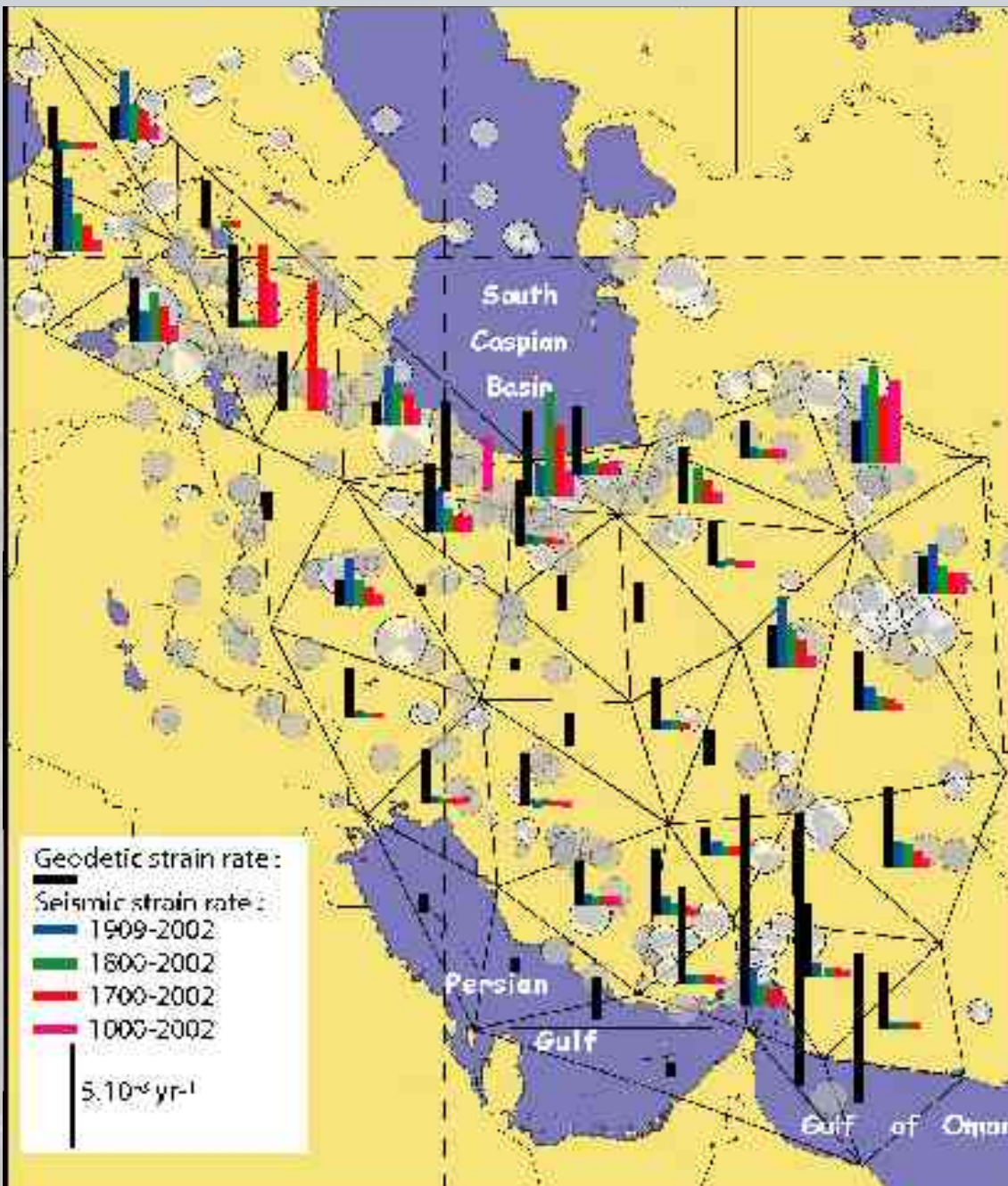
Sismicité instrumentale et historique



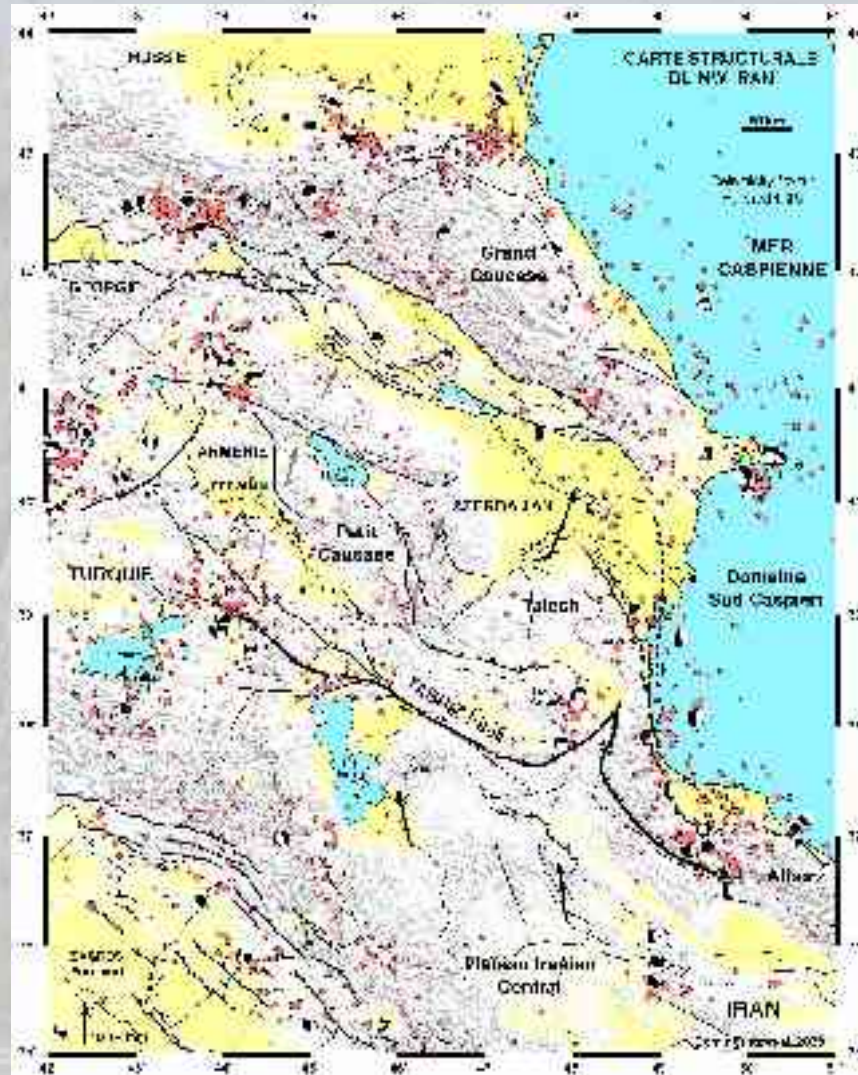
Seismic vs. Geodetic strain rate

Amplitudes :

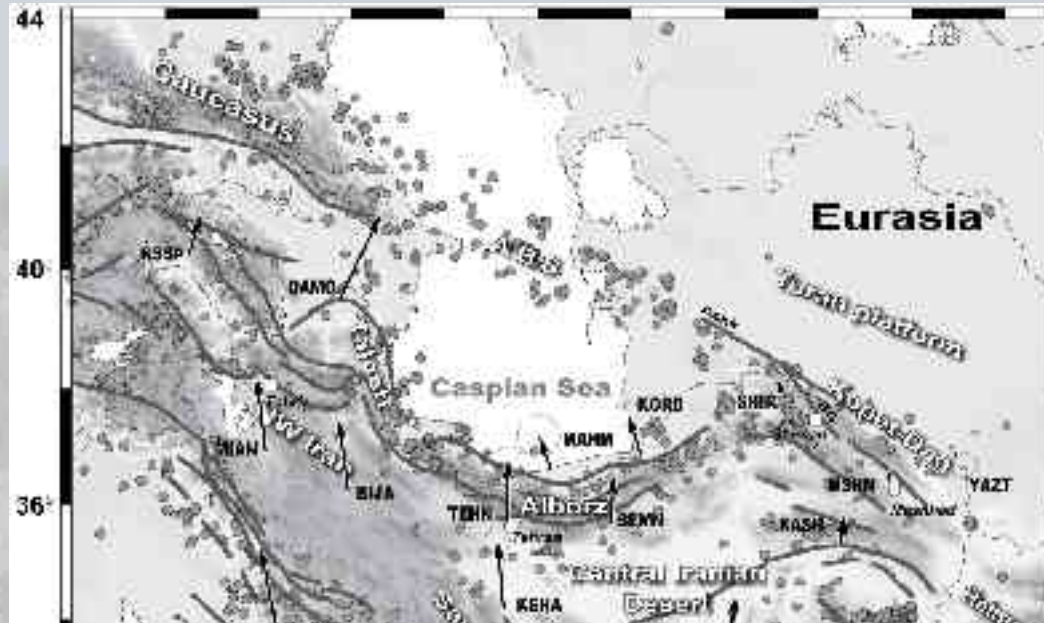
Déformation sismique élevée
autour du bassin Sud Caspien
(50-100%)



Carte tectonique du NW Iran (Dominguez et Philip, 2005)



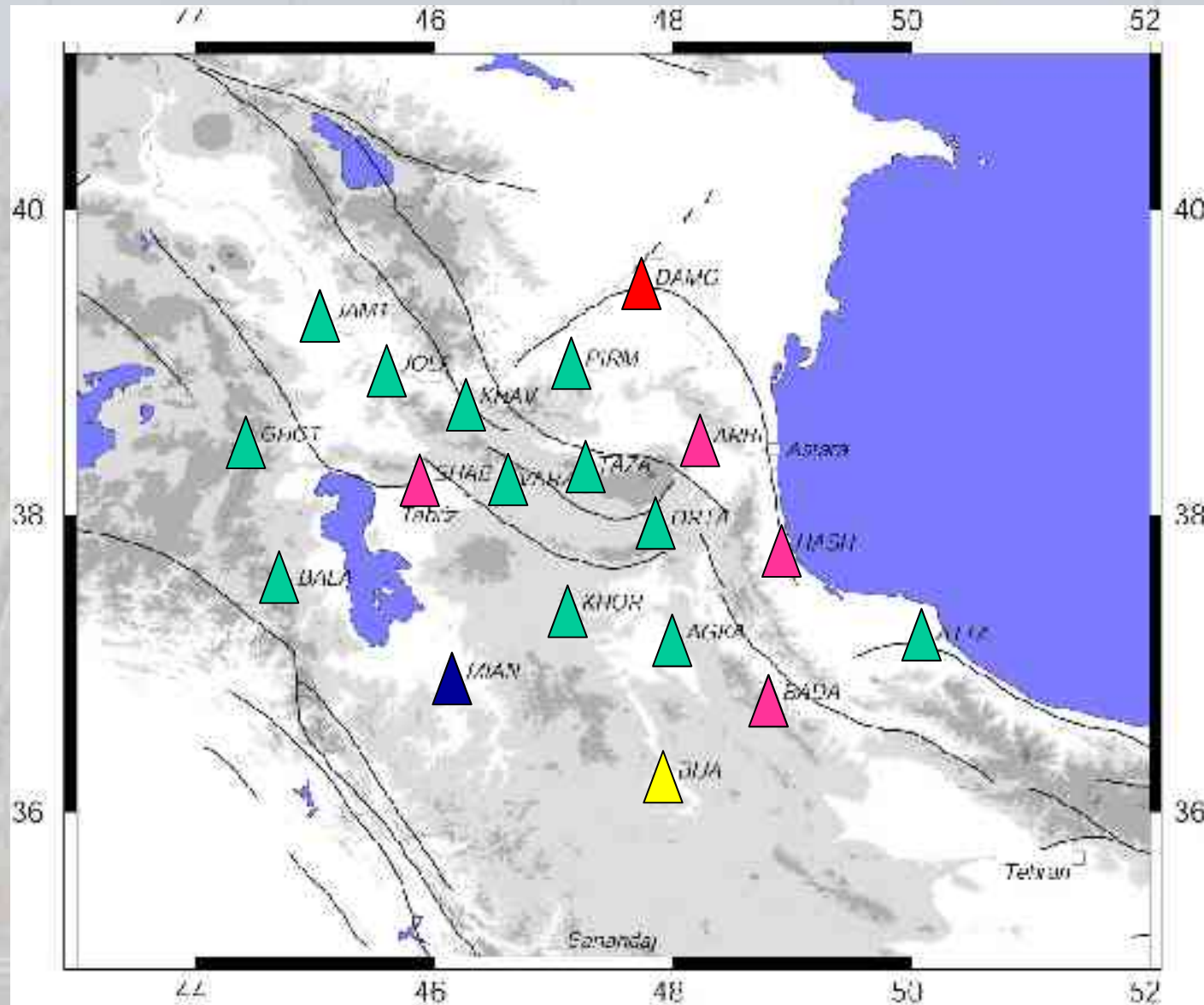
Questions



- Où se localise le décrochement entre le CIB et DAMO ?
- Quelles conséquences en terme d'aléa sismique ?
- Y-a-t-il de l'extension ? Et où ?
- Est-ce un phénomène isolé ?
- Quelle conséquence pour le bassin sud Caspien ?

GPS network

-  **Tabriz**
2002-2003-2004
-  **Khazar+Tabriz**
1999-2002-2003-2004
-  **Khazar+Global Iran**
1999-1999-2001-2004
-  **Tabriz+Global Iran**
1999-2001-2002
2003-2004
-  **Tabriz+Global Iran
+Khazar**
1999-1999-2001
2002-2003-2004



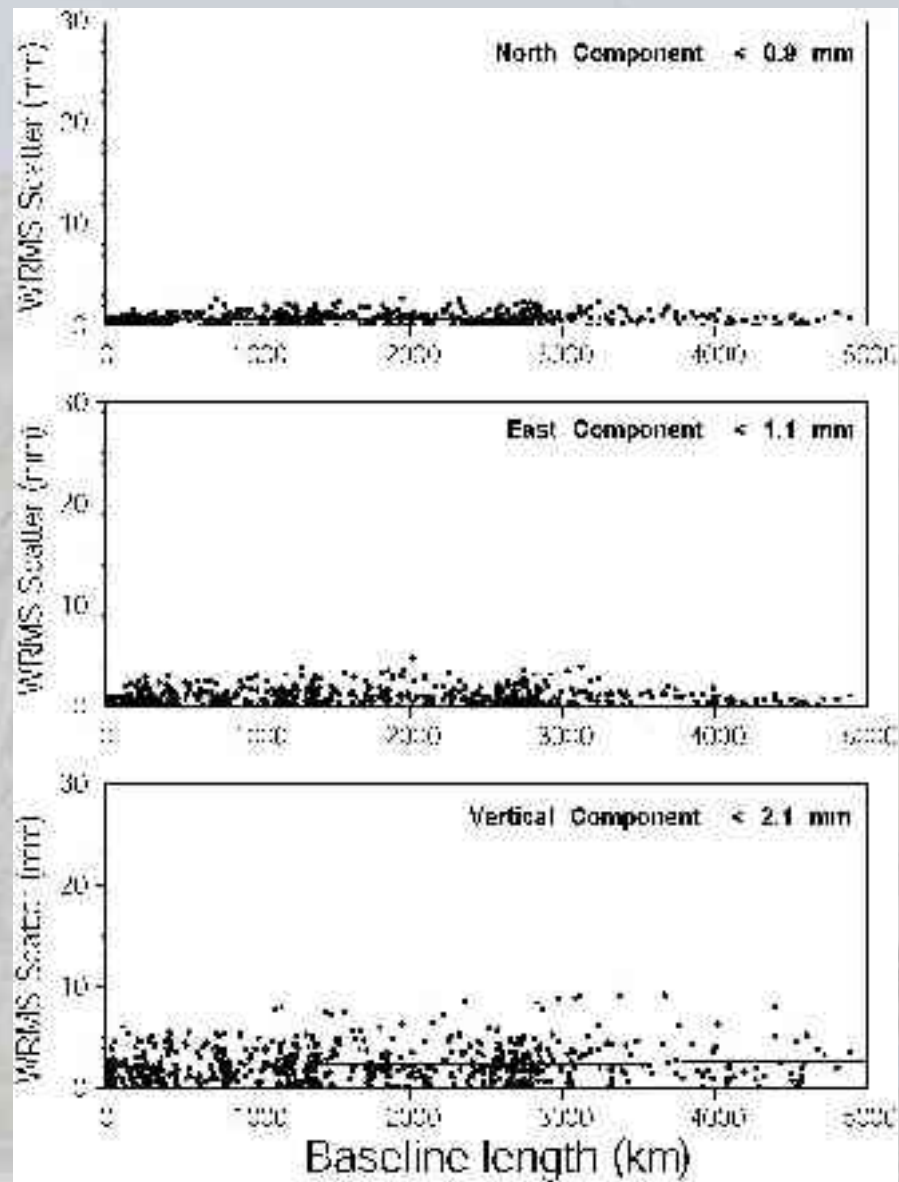
GPS benchmarks



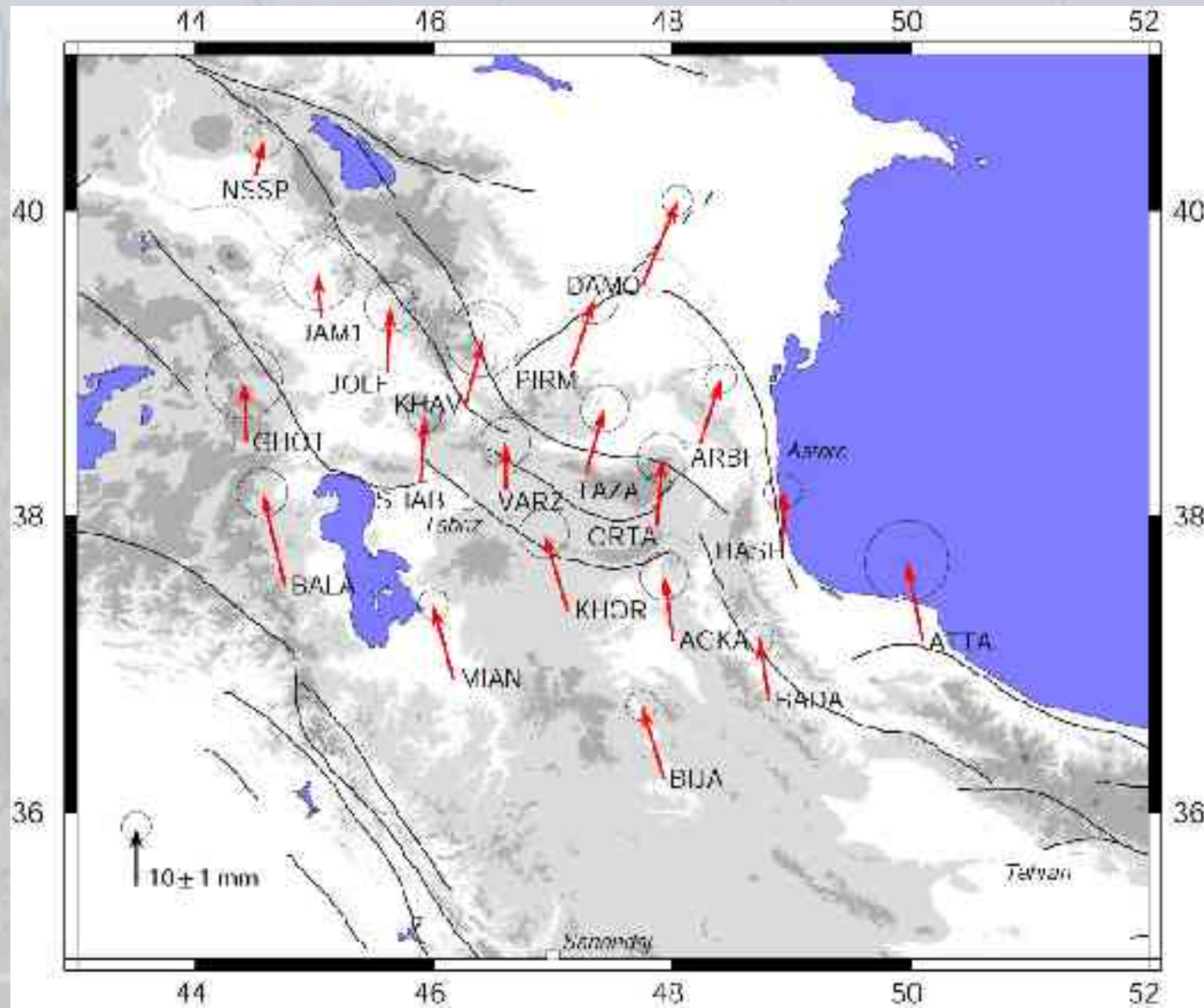
→ Centrage forcé

→ Piliers

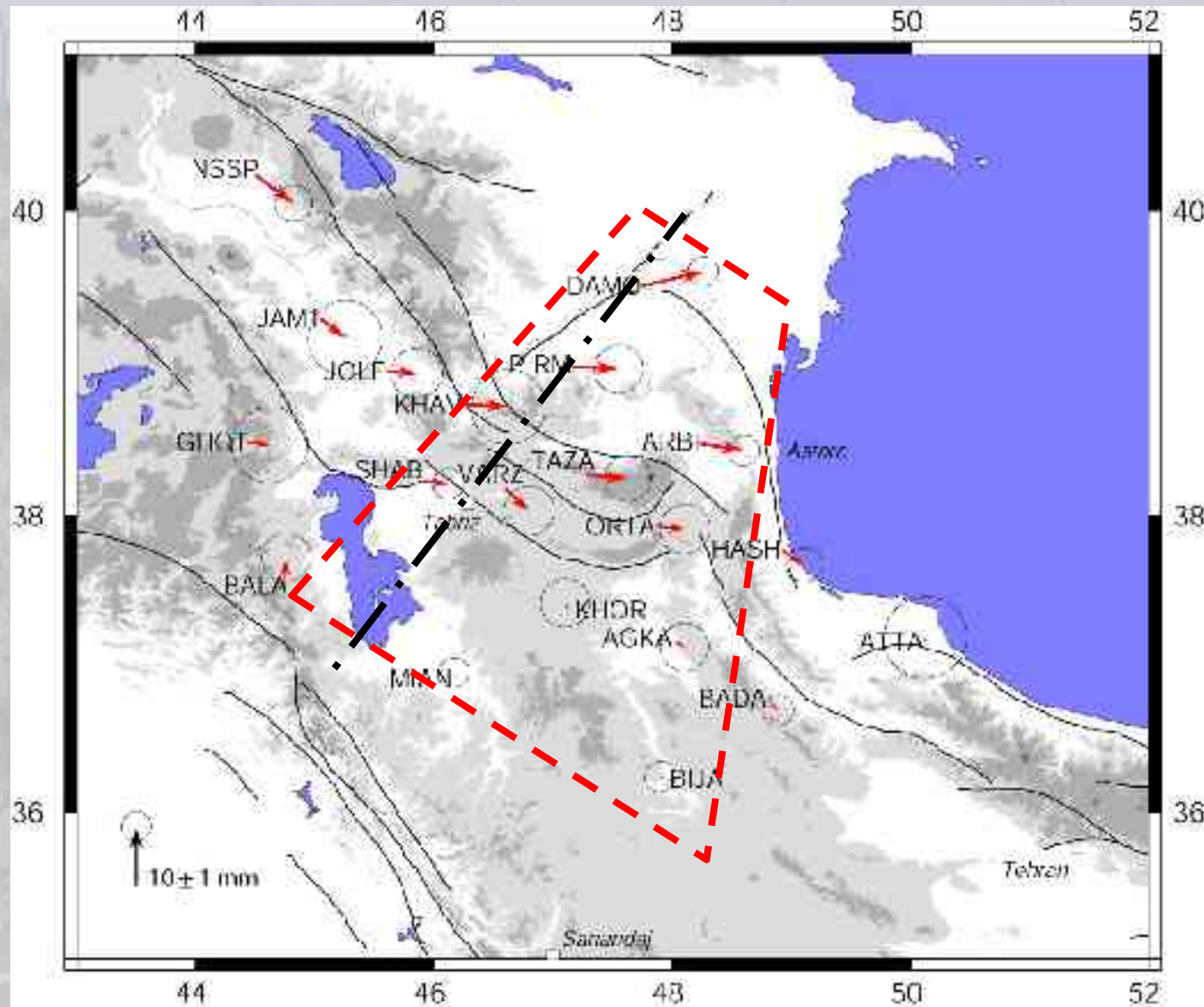




Champ de vitesse relativement à l'Eurasie



Champ de vitesse relativement à l'Iran centrale



-|-

Mouvement décrochant dextre le long de la faille de Tabriz

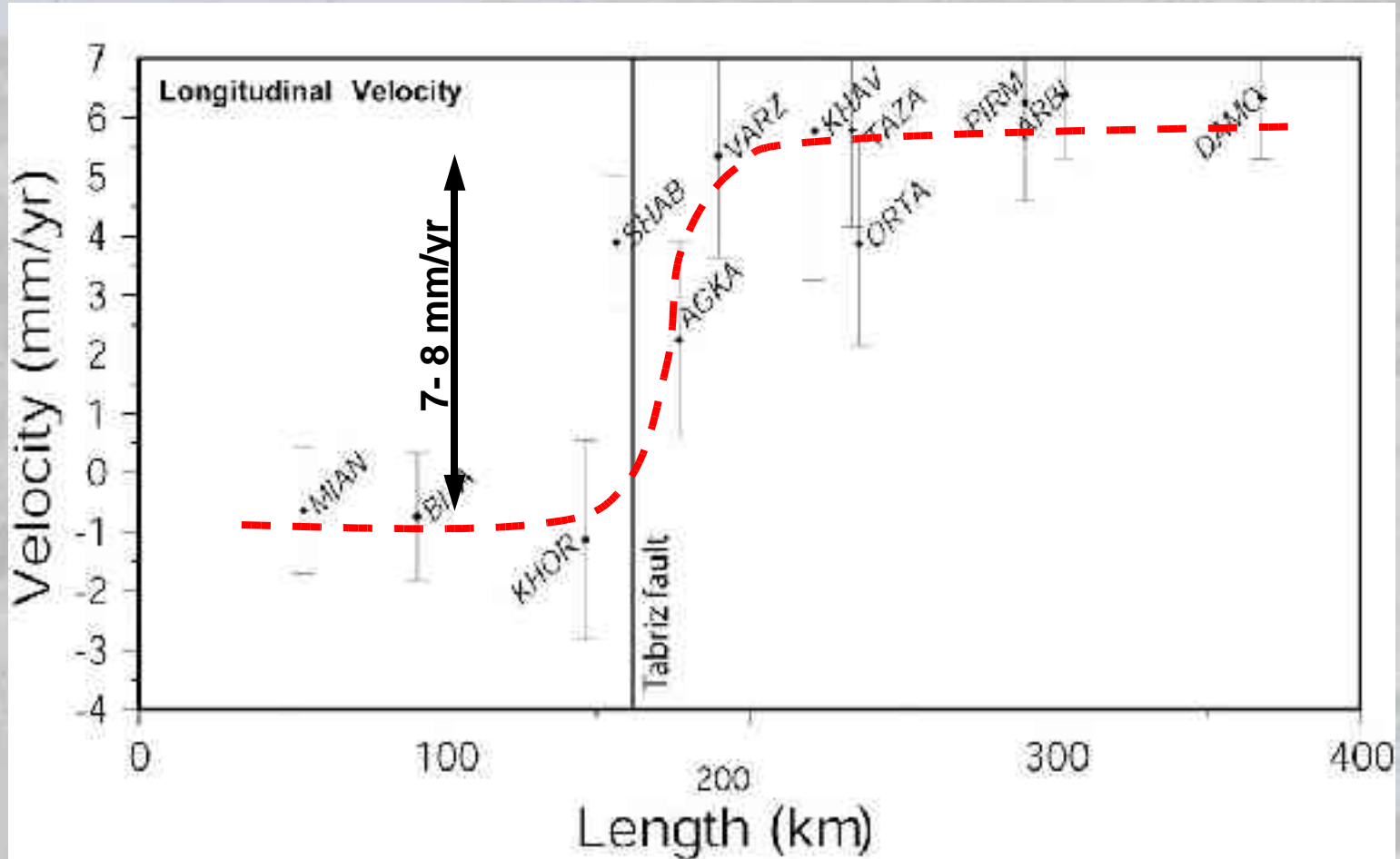


La faille de Tabriz

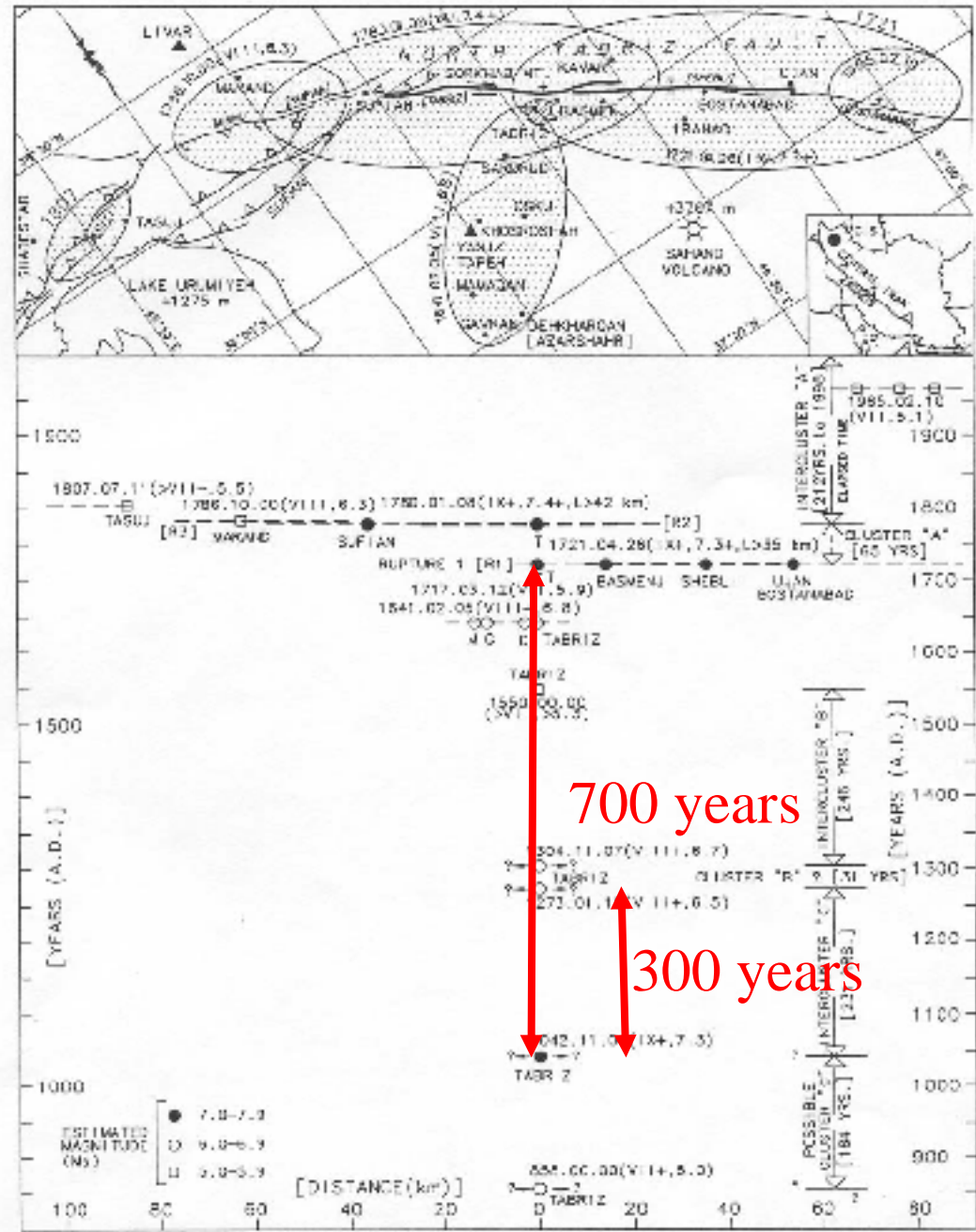
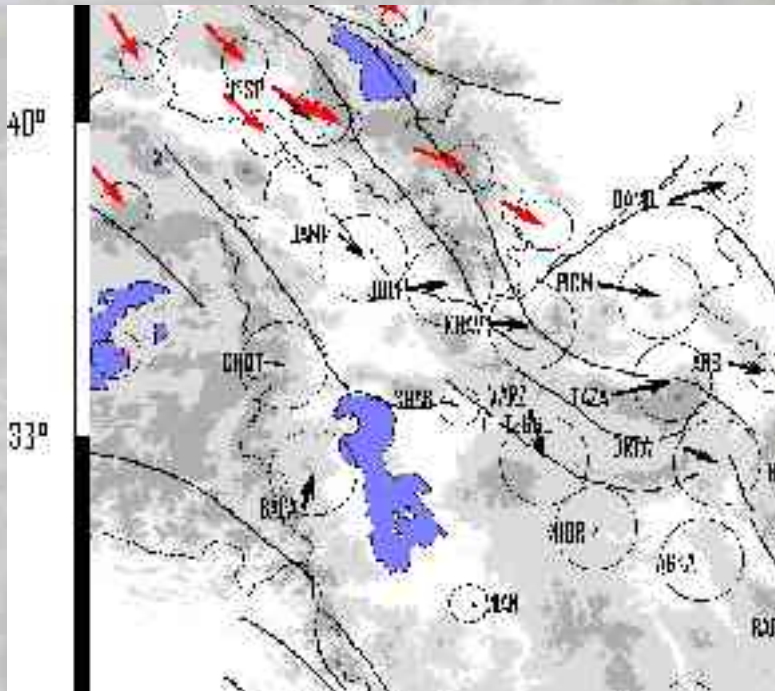


Profils de vitesse

→ Vitesse parallèle à la faille



Risque sismique



- If we assume that ~ 8 mm/yr of right-lateral displacement occurs along the Tabriz fault :
 - with a recurrence time interval of 250 years, the average displacement is ~ 2.00 m for each event. Using empirical relationship among moment magnitude and maximum displacement, the magnitude is ~ 7.3 .
 - with a recurrence time interval of 800 years, the average displacement is ~ 6.40 m for each event. Using empirical relationship among moment magnitude and maximum displacement, the magnitude is ~ 7.8 .
- To be in agreement with the magnitudes proposed by Berberian & Yeats [1999] which are around 7.3, the GPS measurements conduct to propose a recurrence interval time of 250-300 years.
- Paleoseismological studies by H. Philip and S. Dominguez from Montpellier (coll. IIEES) are in progress.

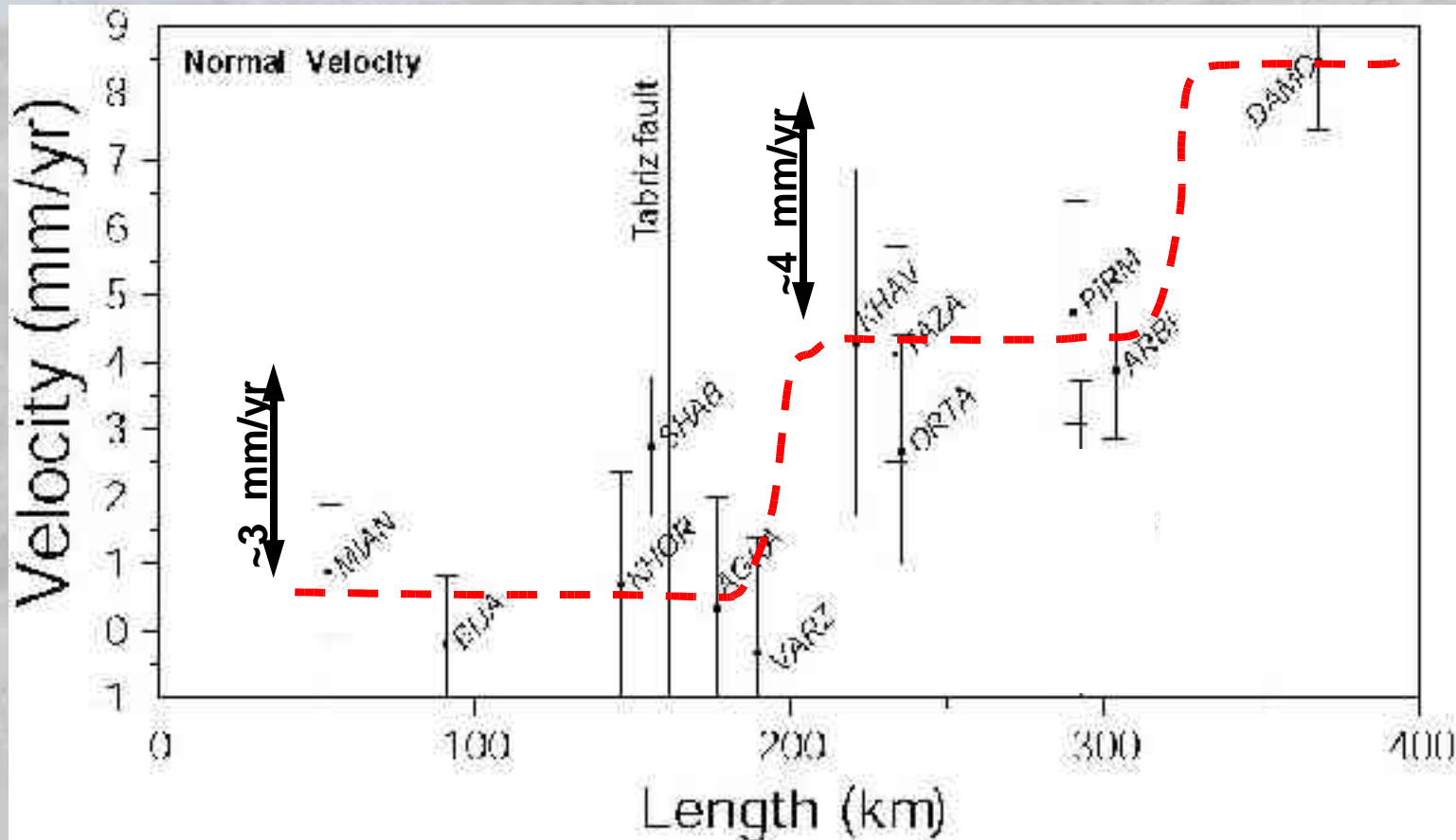
The background image shows a geological fault zone. A road with white lane markings runs horizontally across the bottom. A white SUV is parked on the right side of the road. A person in a dark jacket and hat stands next to the vehicle. The background is a steep, rocky hillside with visible fault lines and some sparse vegetation. The sky is overcast.

-II-

SW-NE extension au nord de la
faille de Tabriz

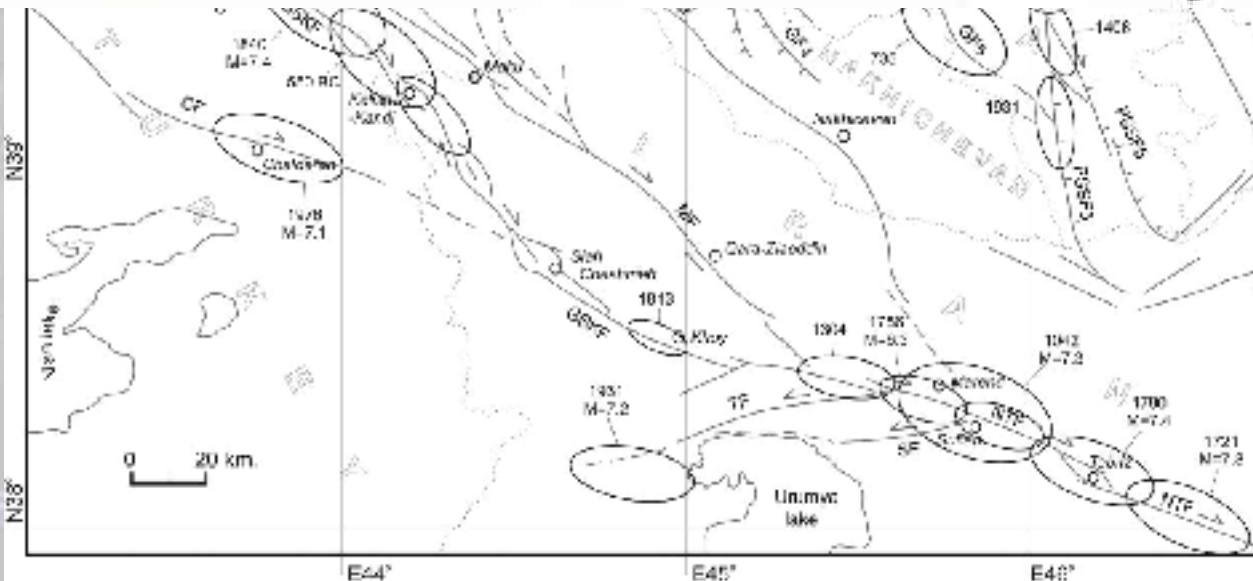
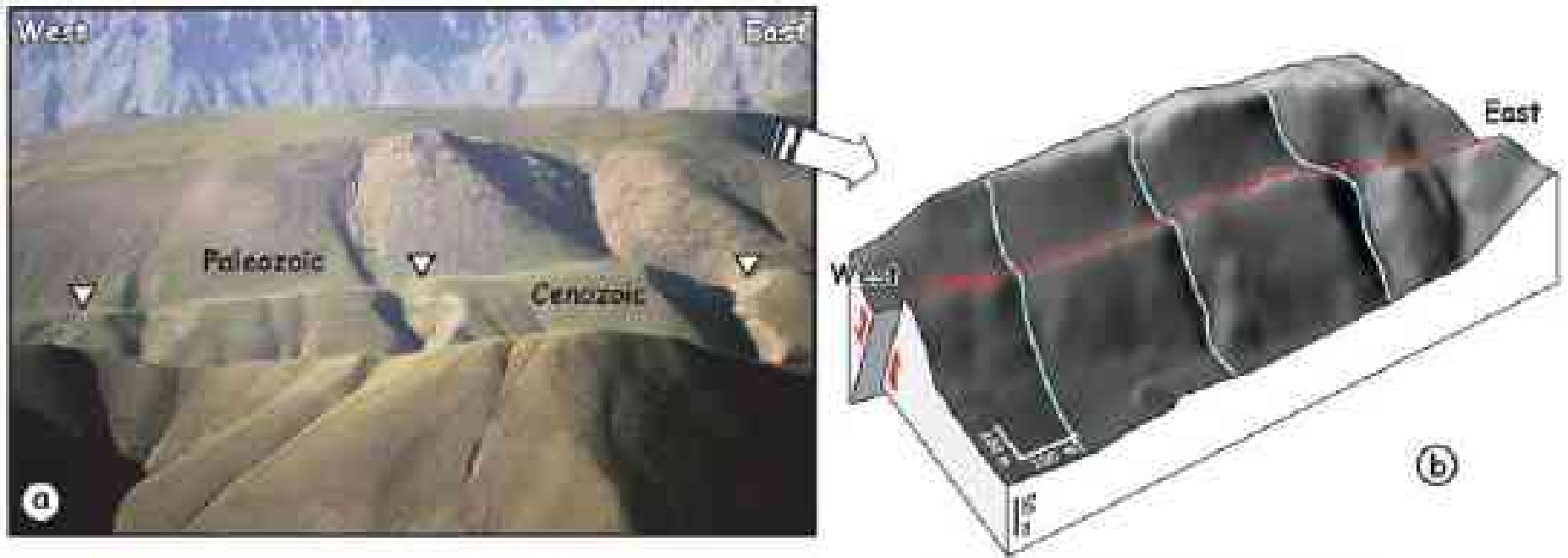
Velocity profiles

→ Velocity normal to NTF



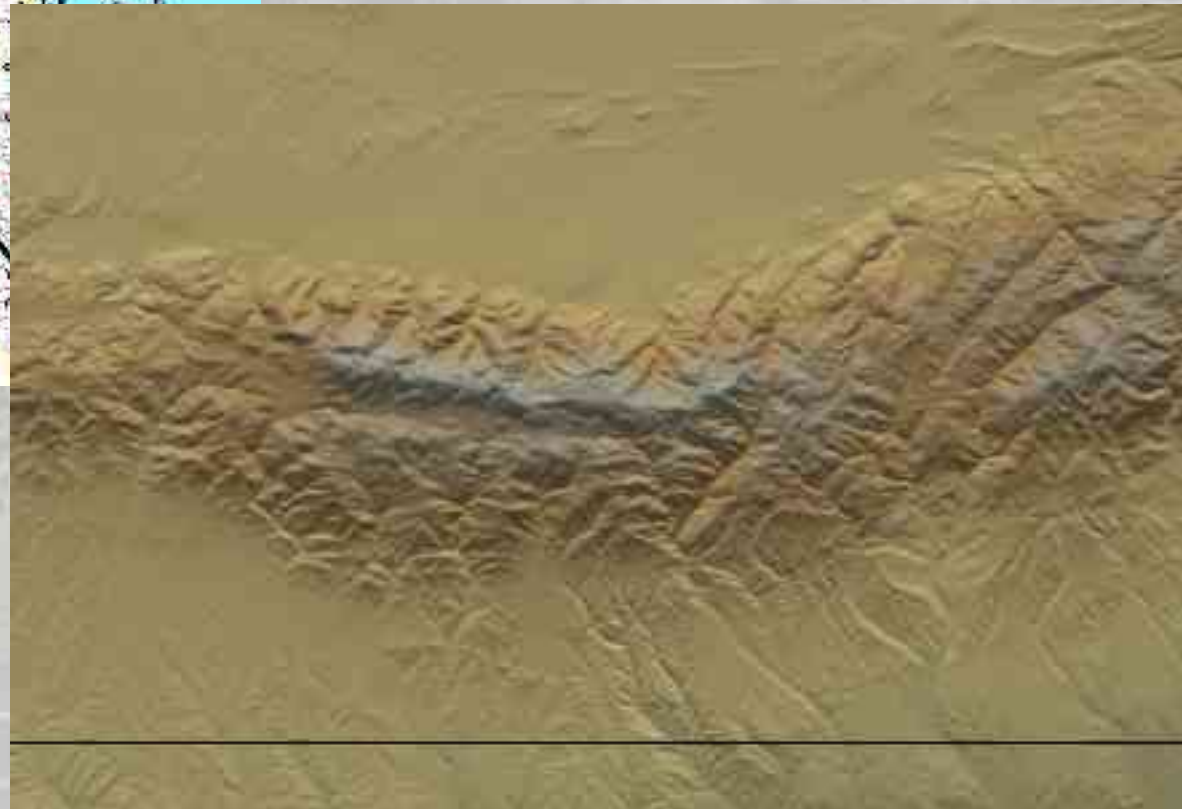
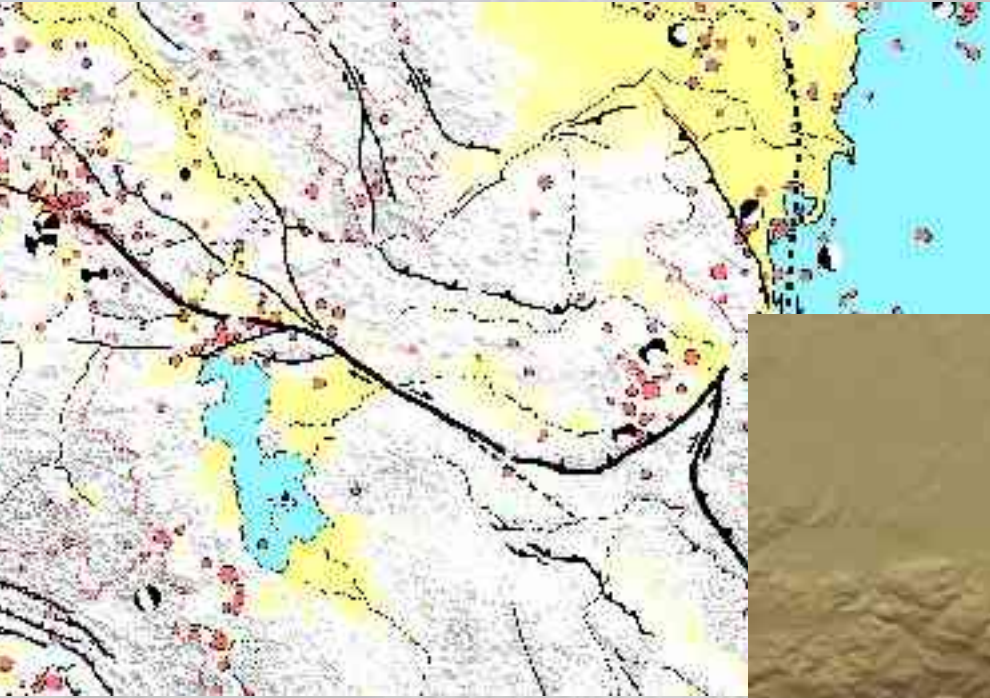
⇒ N30 extension of ~3-4 mm/yr in the Talesh

Pouvait-on s'attendre à de l'extension ?

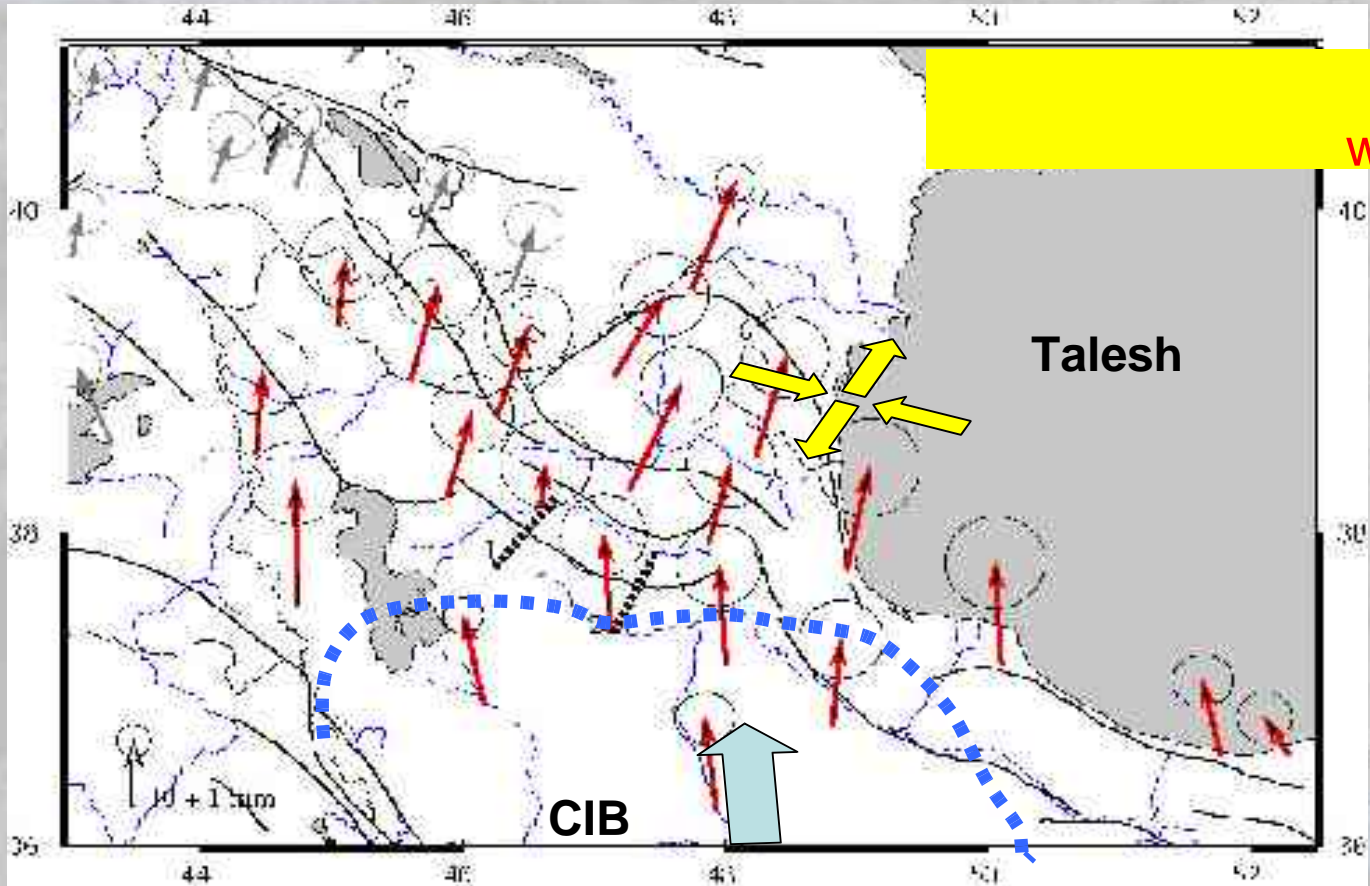


Ritz et al., 2004 :
Extension dans l'Alborz
(faille de Mofatteh)

Où pourrait-on en trouver des traces ?



Origine de l'extension ?



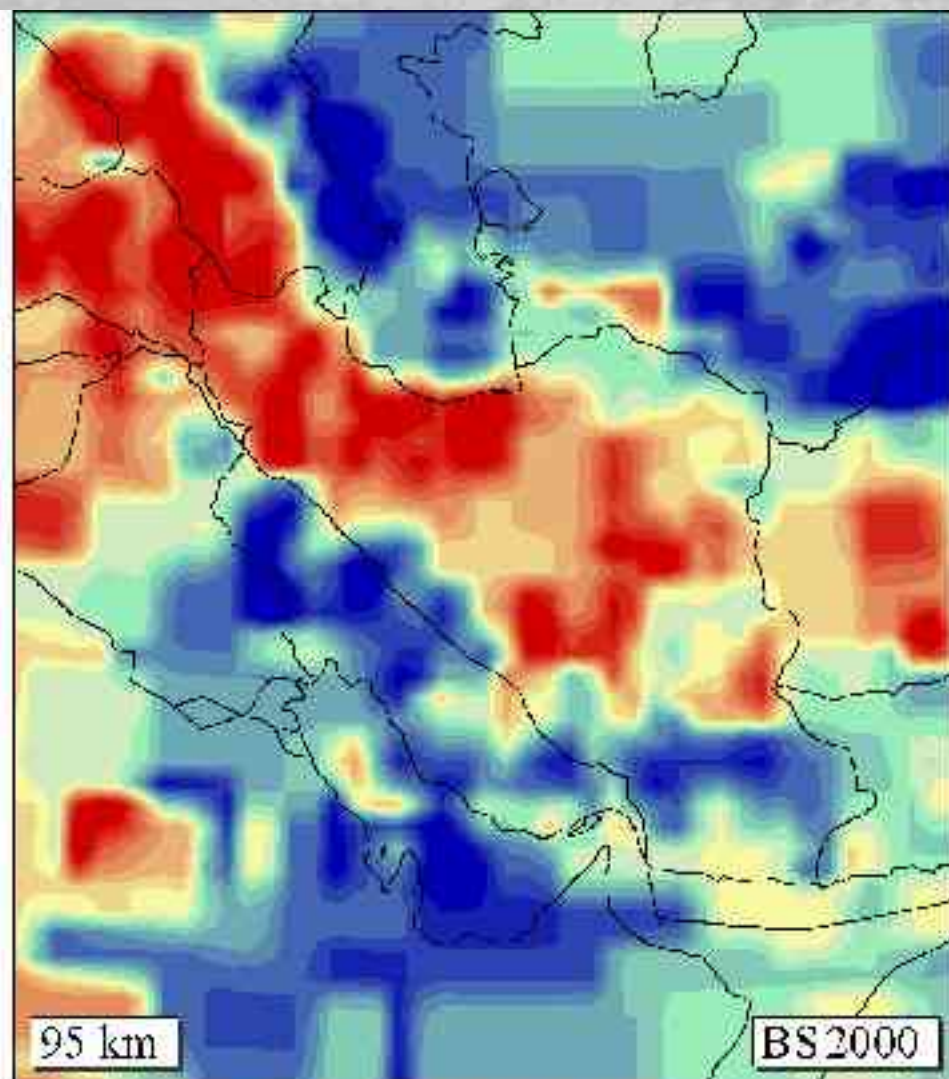
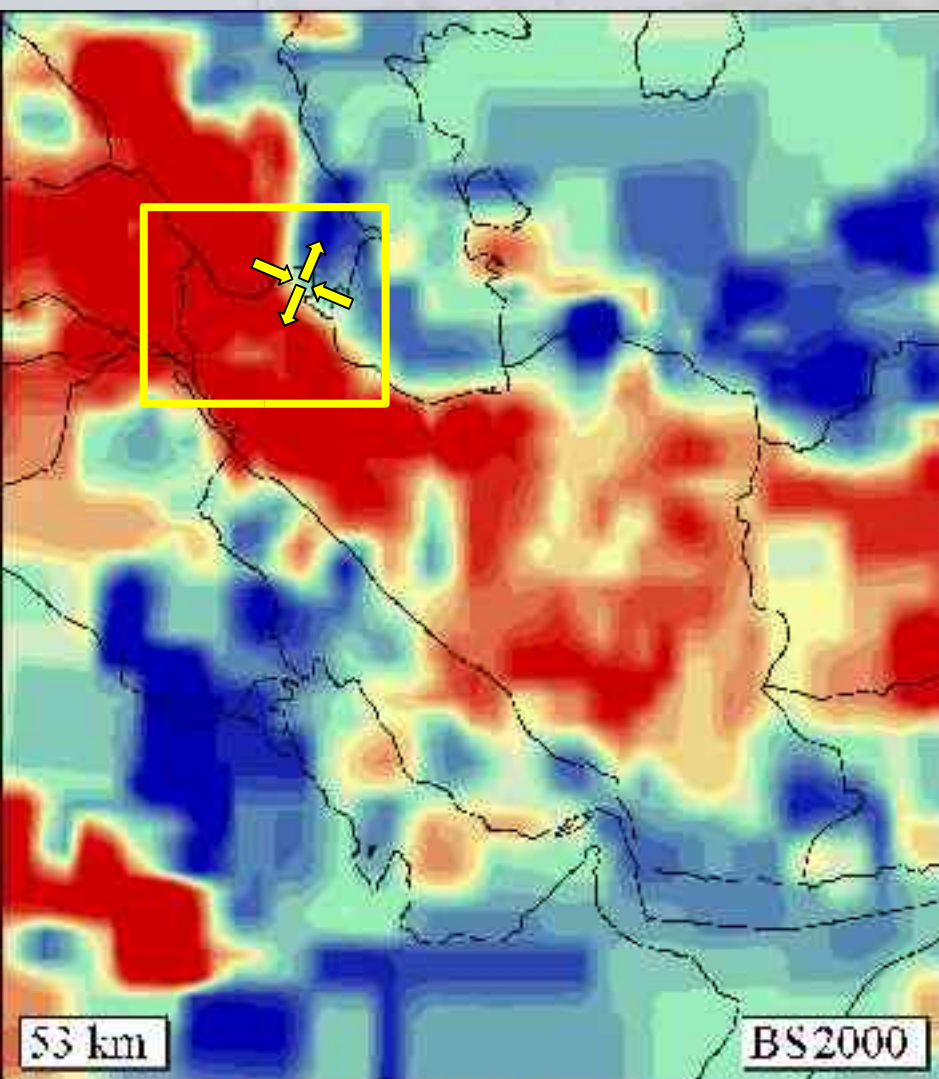
GPS v
with respect

Sou

Alborz

Subduction du bassin sud-caspien ?

W. Spakman



-3.0%

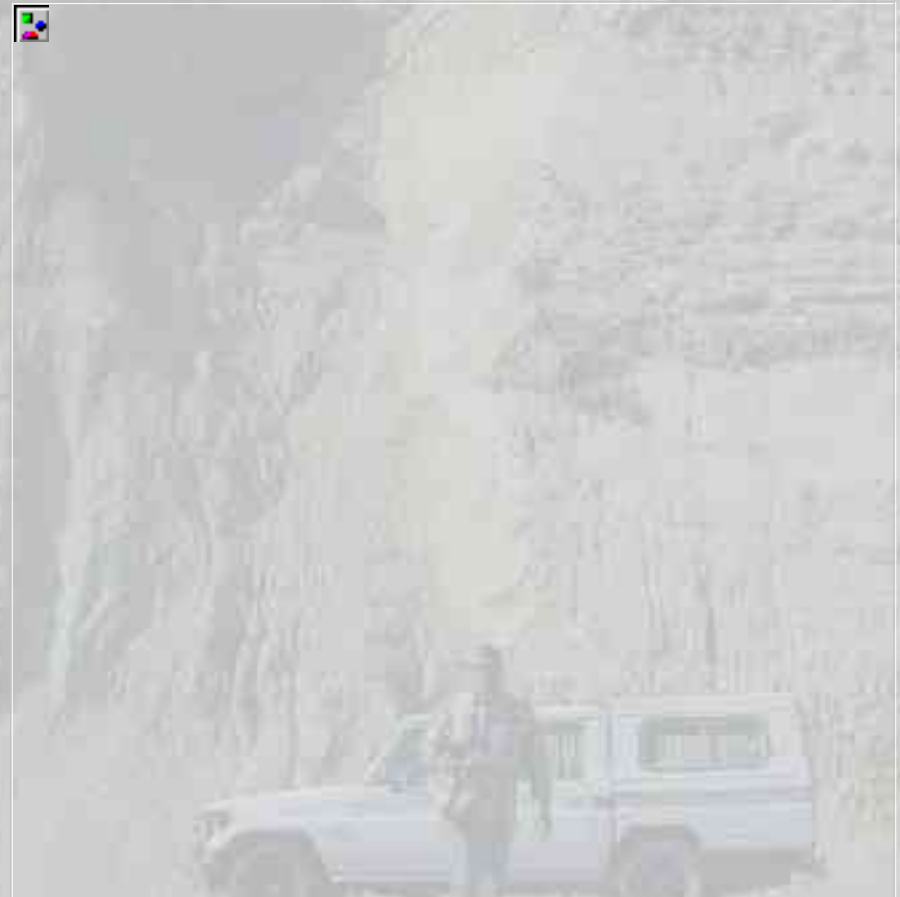
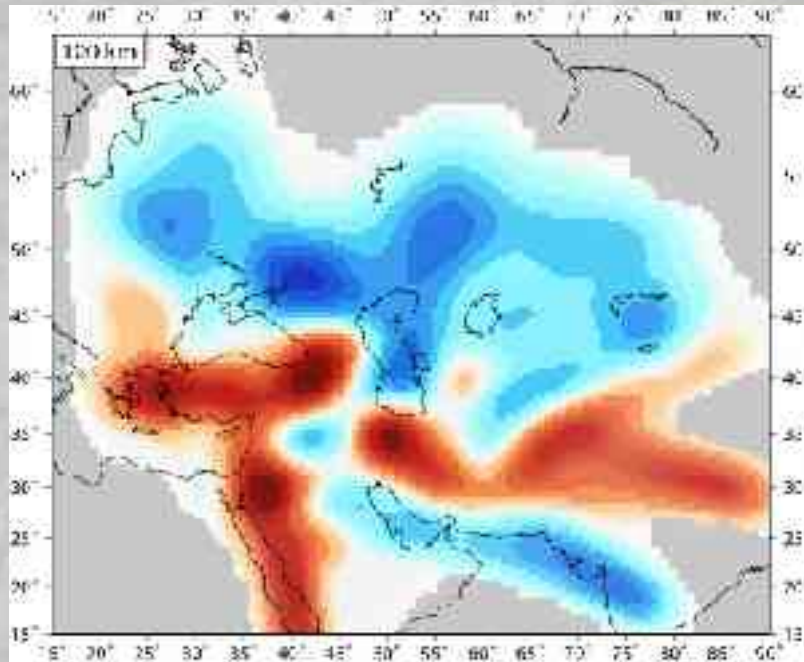
3.0%

-3.0%

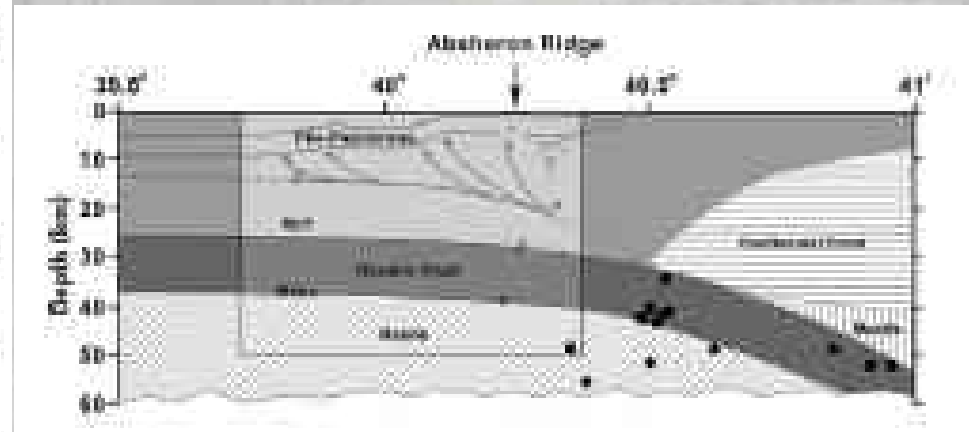
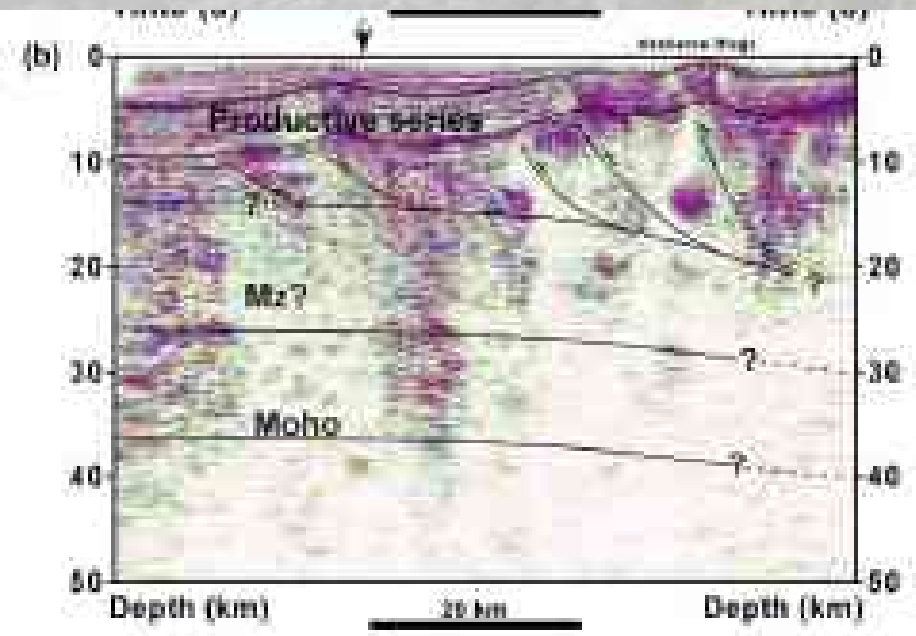
3.0%

Subduction du bassin sud-caspien ?

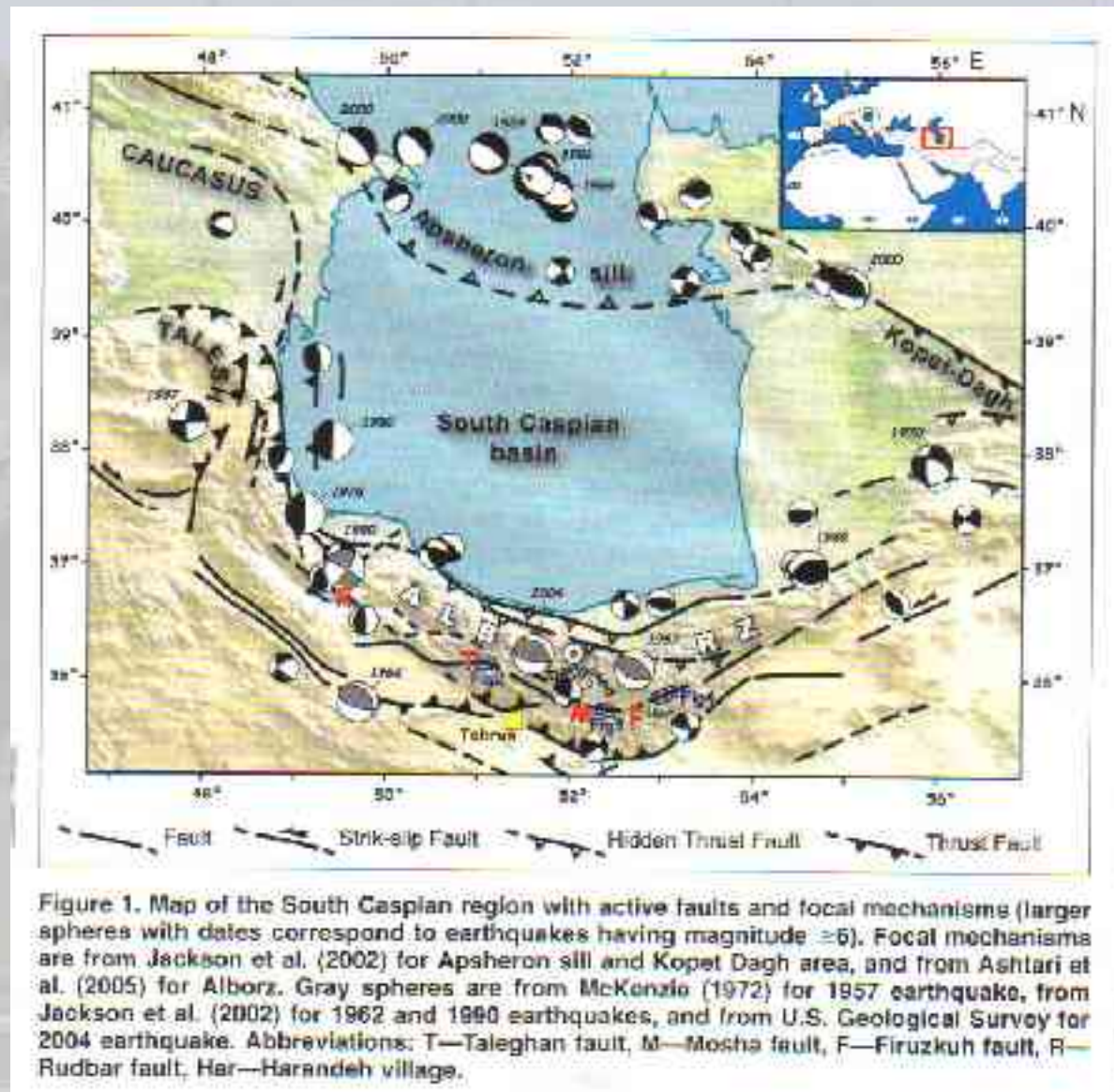
Maggi et Priestley, 2005



Imagerie sismique de l'ABS (Knapp et al., 2005)



Sismicité autour du bassin sud caspien (Ritz et al., 2006)



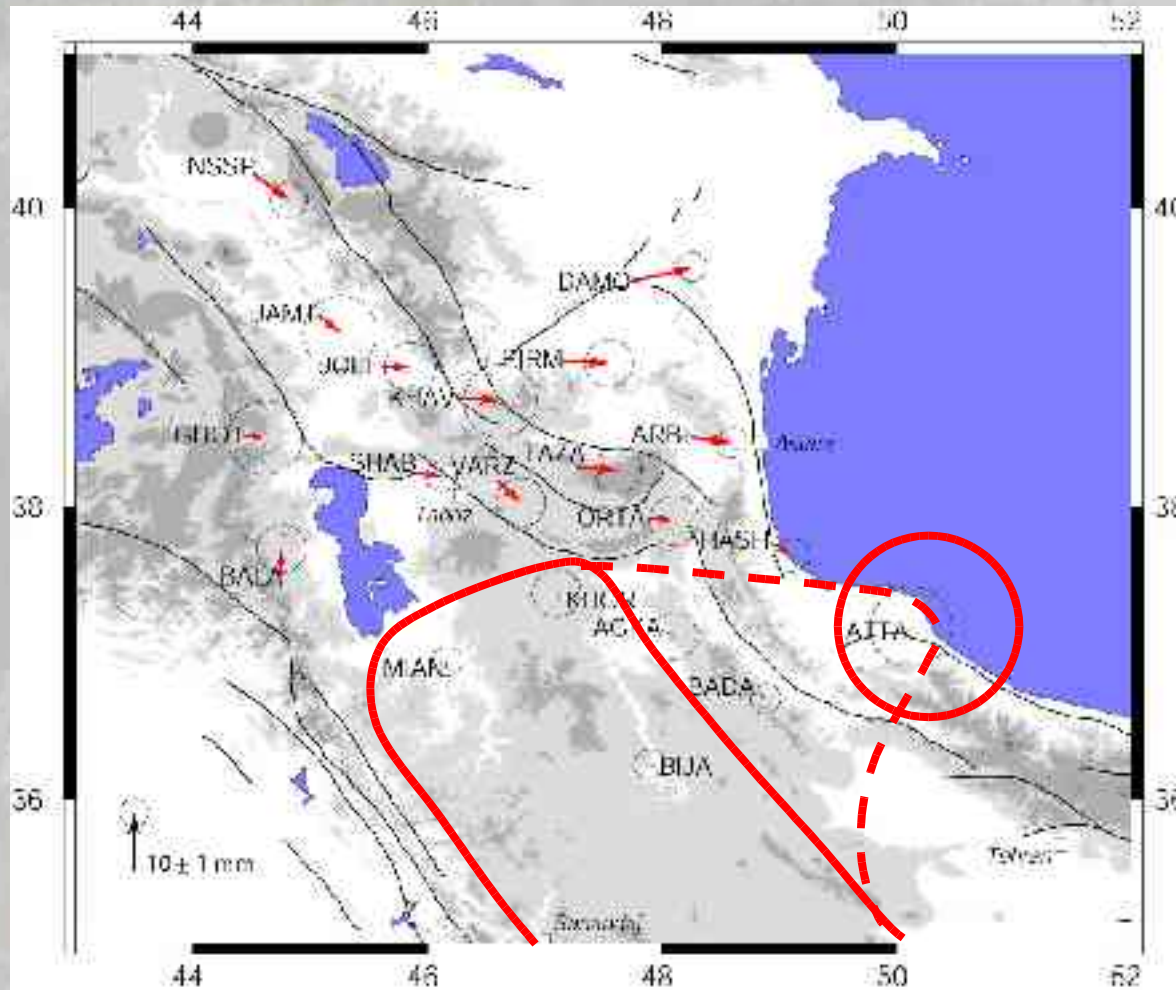
-III-

Du Talesh à l'Alborz

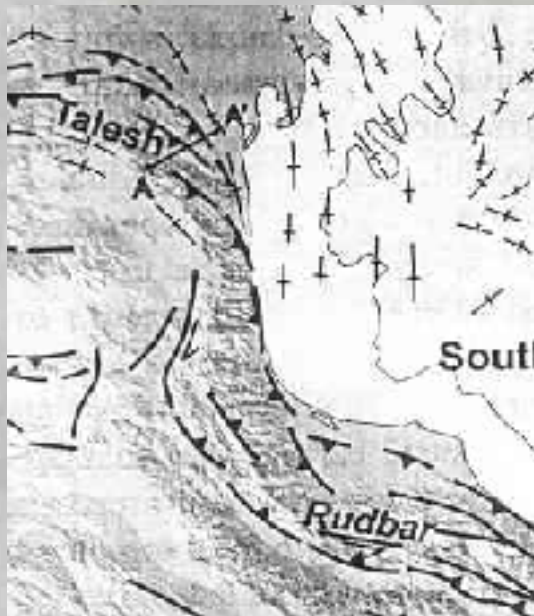


La limite du CIB ?

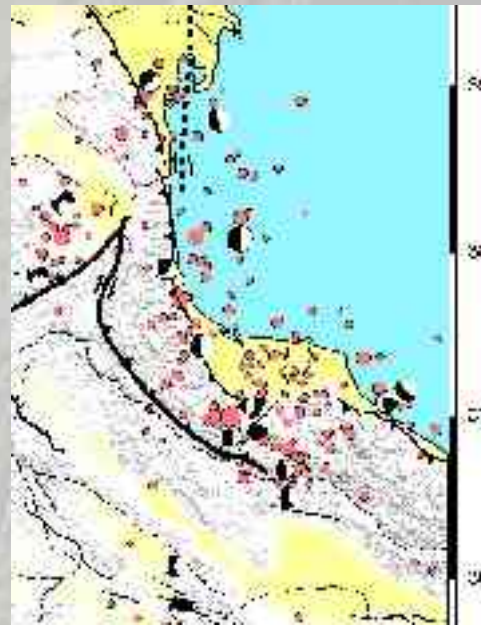
→ Mouvement de ATTA



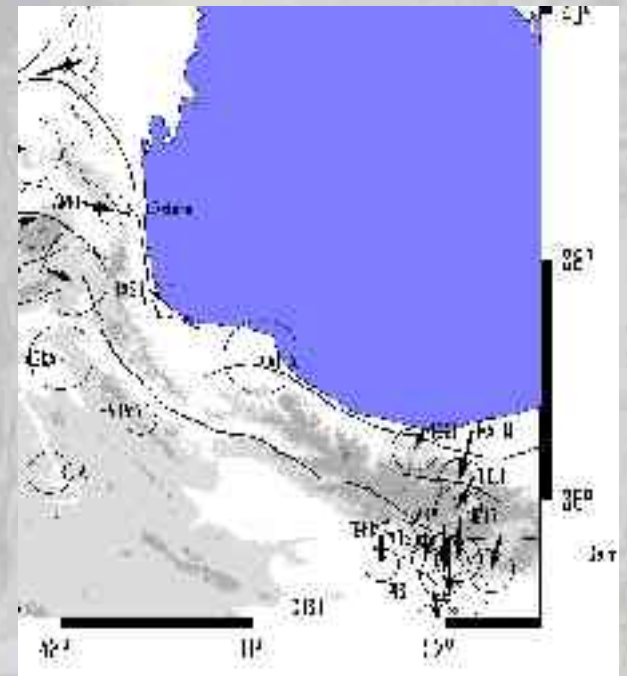
Du Talesh à l'Alborz



Jackson et al., 2002



Dominguez et al., in prep



Du Talesh à l'Alborz



Brunet et al., 2003



Du Talesh à l'Alborz

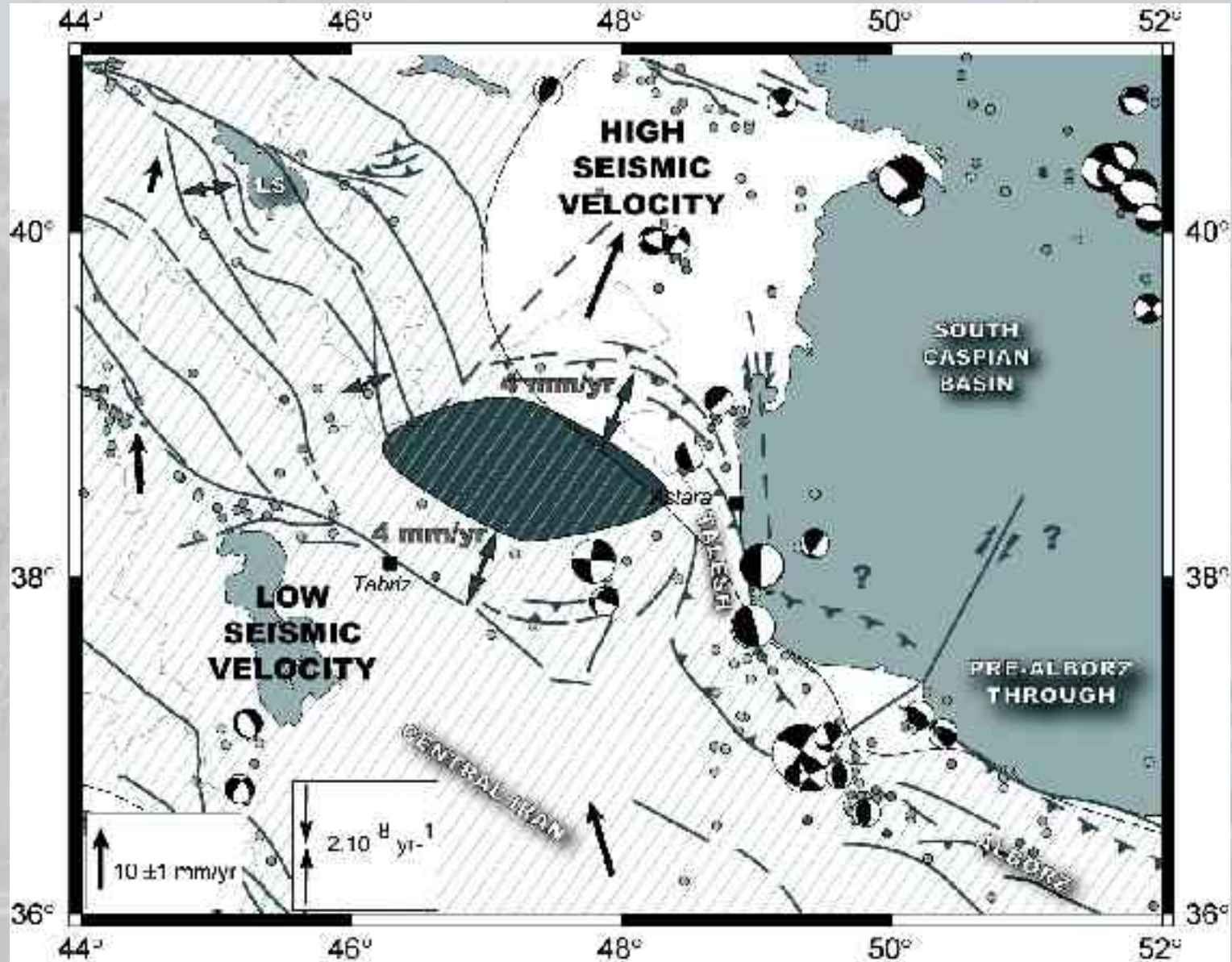


Brunet et al., 2003

Du Talesh à l'Alborz

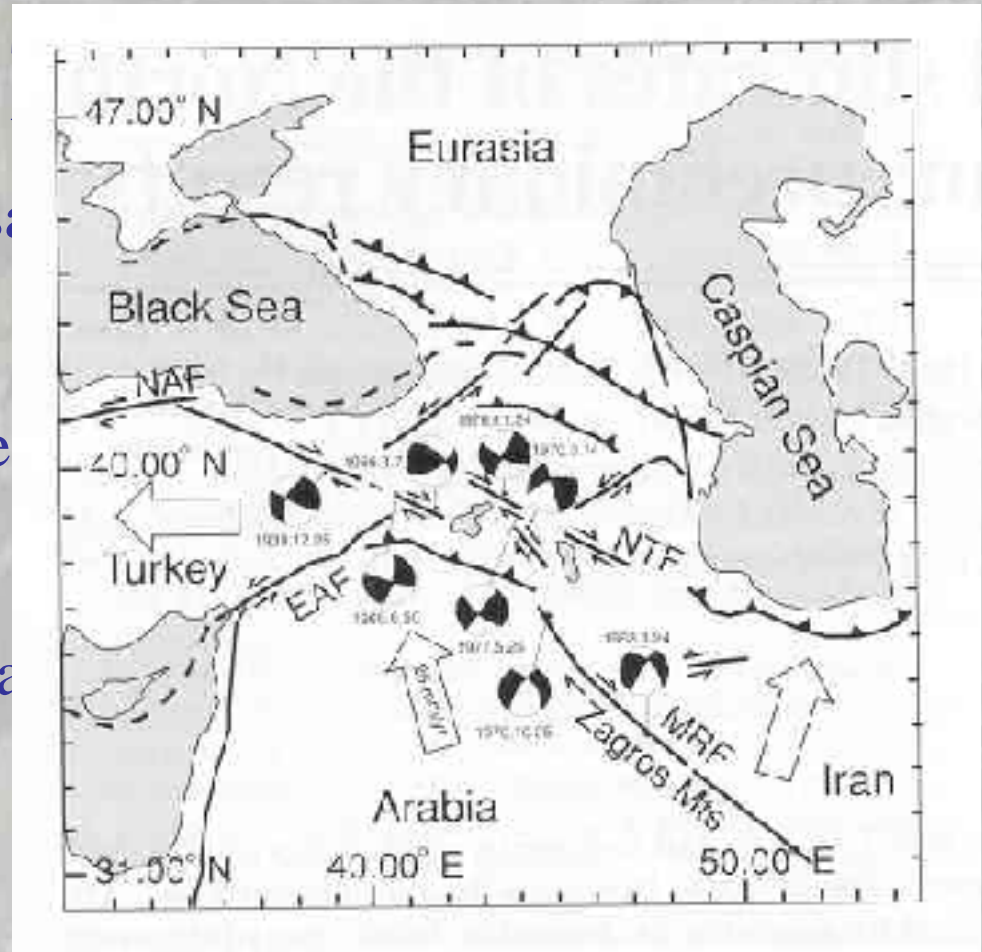


Synthèse tectonique

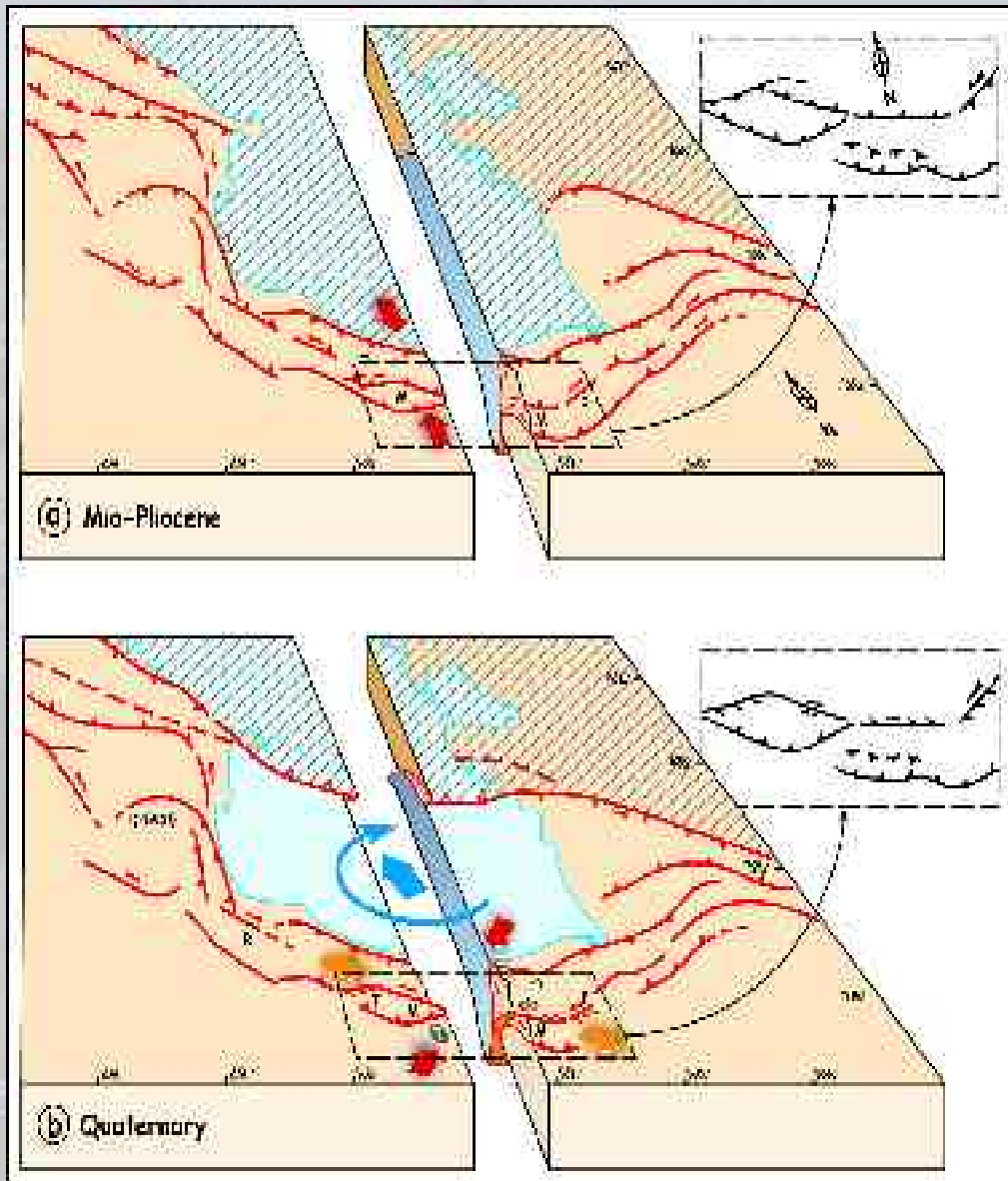


Conclusions

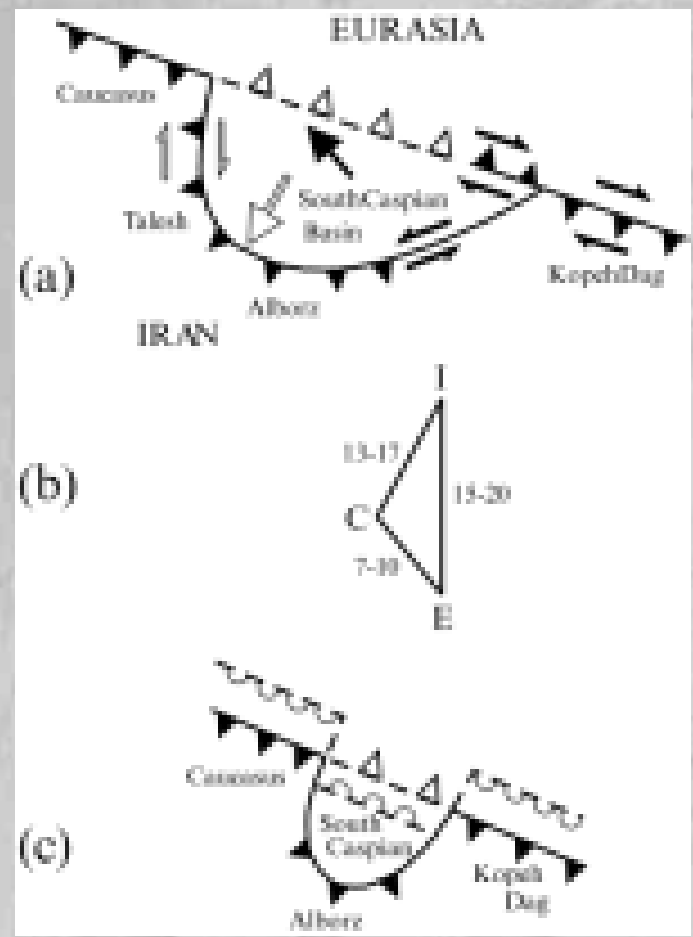
- ~8mm/yr sur la faille de historique (Berberian and paléosismologiques (Hess)
- Extension probablement
- En démontrer l'existence
- Modélisation
- Le modèle de poinçon arabe



Modèle cinématique

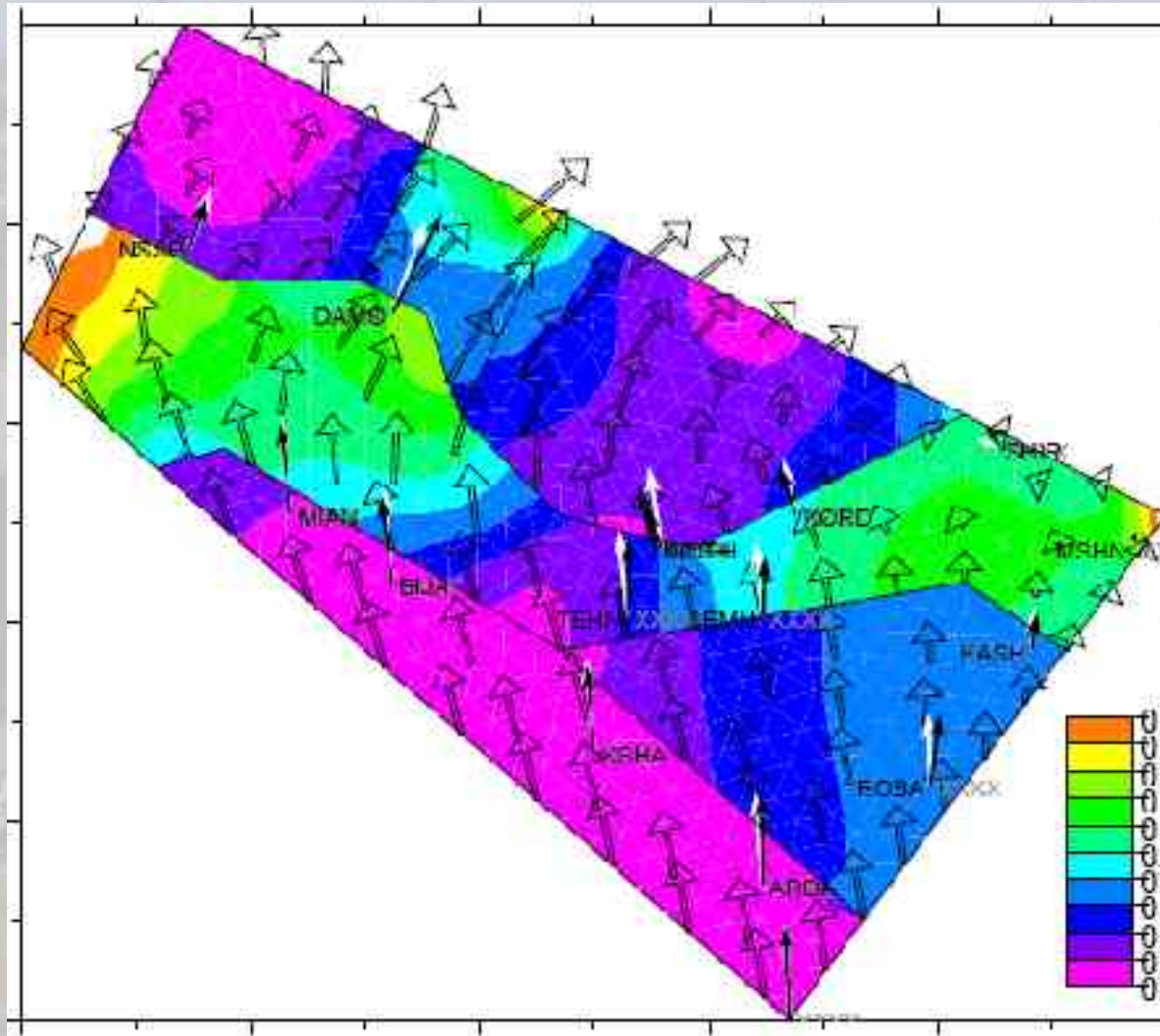


Ritz et al., 2006

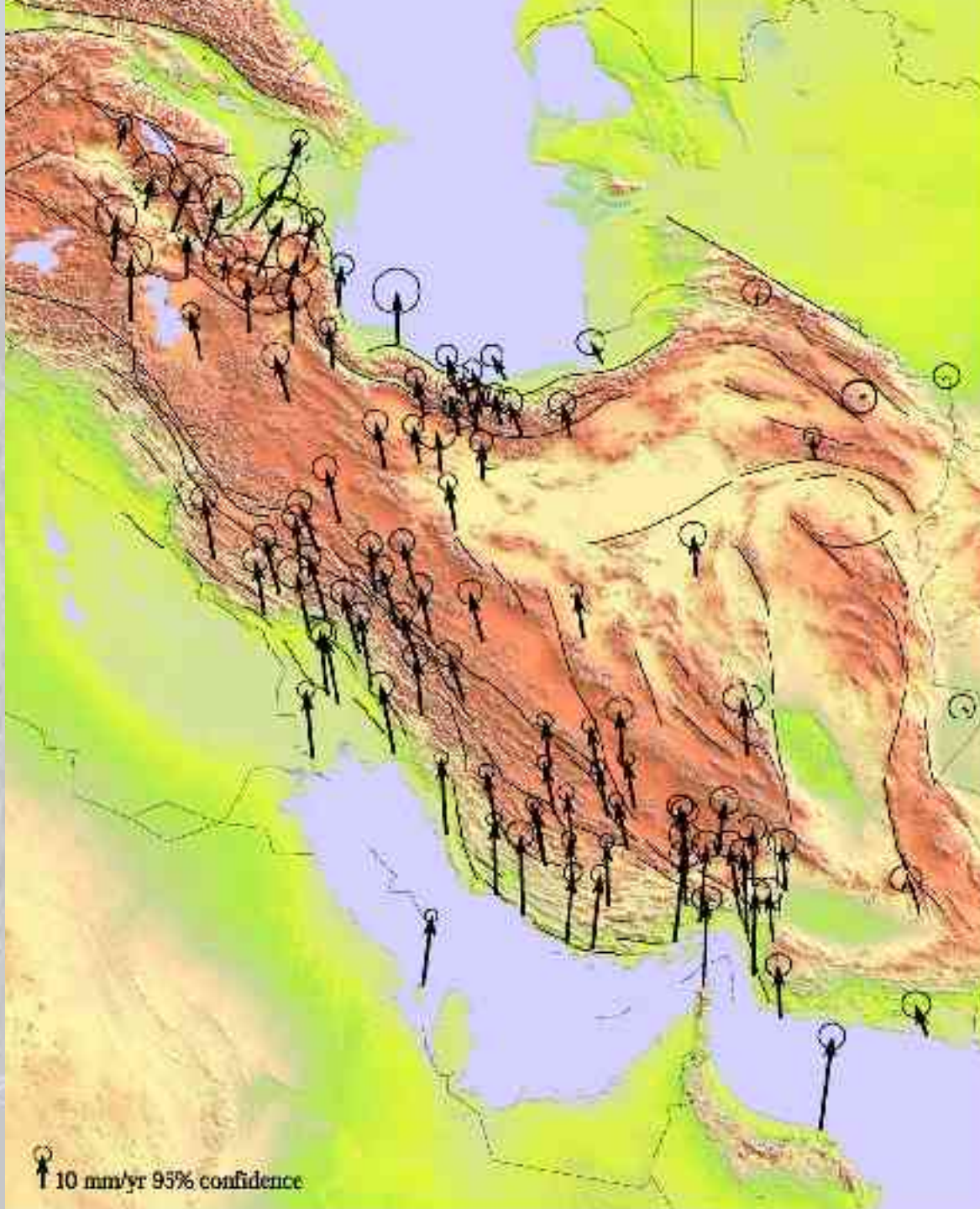


Jackson et al., 2002

Modélisation numérique (ULTRA préliminaire)



Champ de vitesse (référence : Eurasie)



↑ 10 mm/yr 95% confidence

Champ de vitesse (référence : Eurasie)

