Università di Trieste
LAUREA MAGISTRALE IN GEOSCIENZE
Curriculum Geofisico
Curriculum Geologico Ambientale

Anno accademico 2016 – 2017

Geologia Marina

Parte I

Modulo 5.3 Mari Italiani – Adriatico

Docente
Valentina Volpi

ADRIATIC REGION and ADRIA PLATE

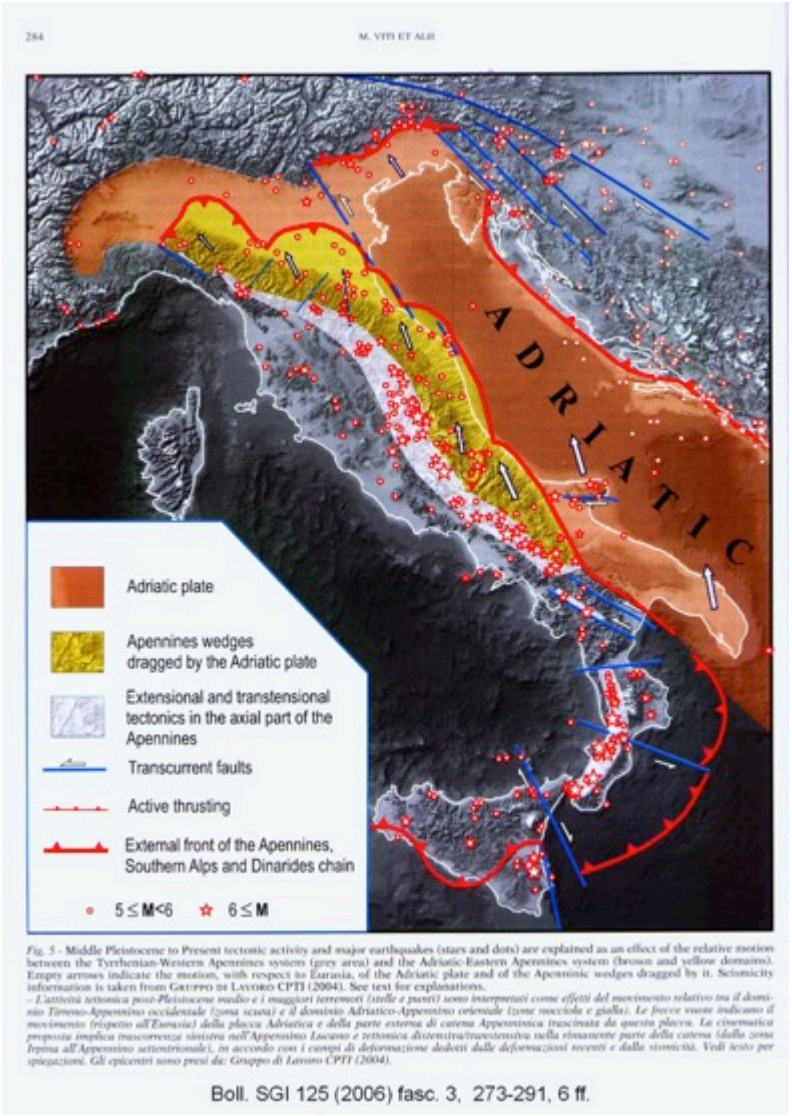
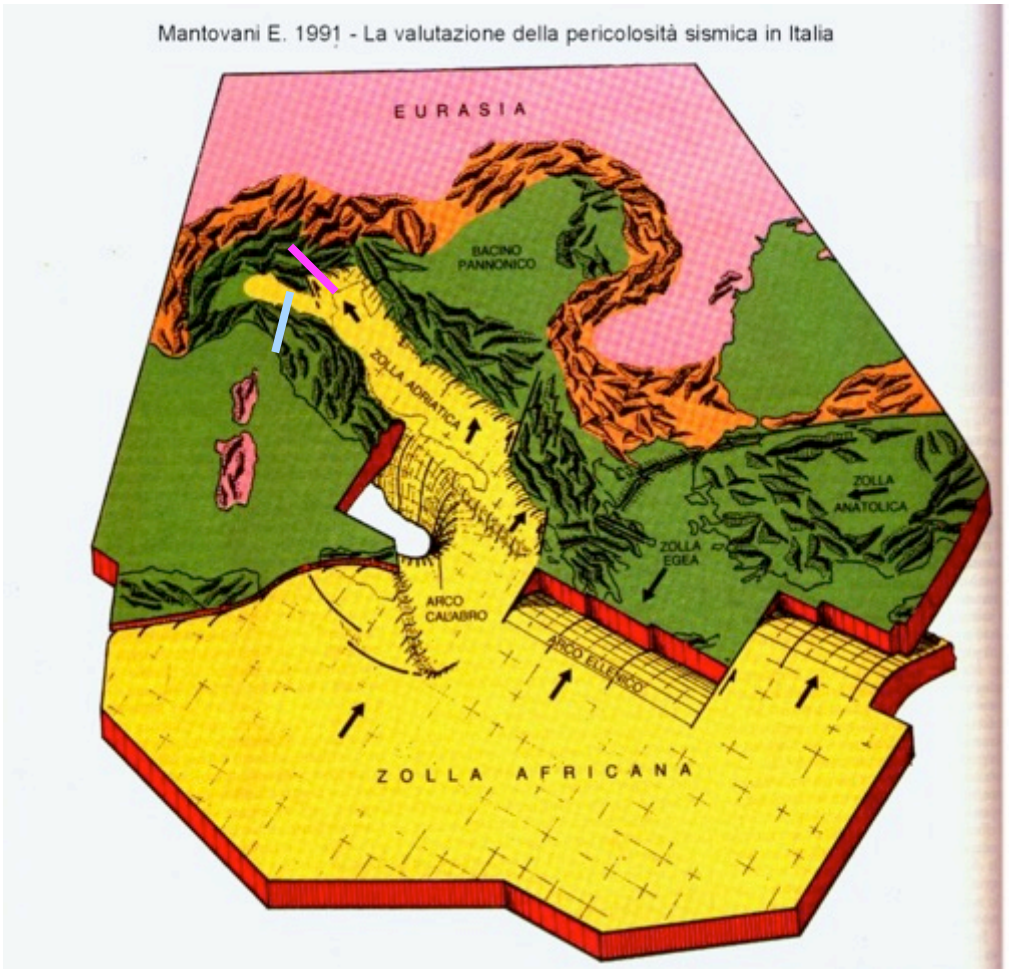


Fig. 5 - Middle Pleistocene to Present tectonic activity and major earthquakes (stars and dots) are explained as an effect of the relative motion between the Tyrrhenian-Western Apennines system (grey area) and the Adriatic-Eastern Apennines system (brown and yellow domains). Empty arrows indicate the motion, with respect to Eurasia, of the Adriatic plate and of the Apenninic wedges dragged by it. Seismicity information is taken from GRUPPO DI LAVORO CPTI (2004). See text for explanations.
– L'attività tettonica post-Pleistocene medio e i maggiori terremoti (stelle e punti) sono interpretati come effetti del movimento relativo tra il dominio Tirreno-Appennino occidentale (zona scura) e il dominio Adriatico-Appennino orientale (zone nocciola e gialla). Le frecce vuote indicano il movimento (rispetto all'Eurasia) della placca Adriatica e della parte esterna di catena Appenninica trascinata da questa placca. La cinematica proposta implica trascorrenze sinistre nell'Appennino Lucano e tettonica distensiva/transtensiva nella rimanente parte della catena (dalla zona Irpina all'Appennino settentrionale), in accordo con i campi di deformazione dedotti dalle deformazioni recenti e dalla sismicità. Vedi testo per spiegazioni. Gli epicentri sono presi da: Gruppo di Lavoro CPTI (2004).

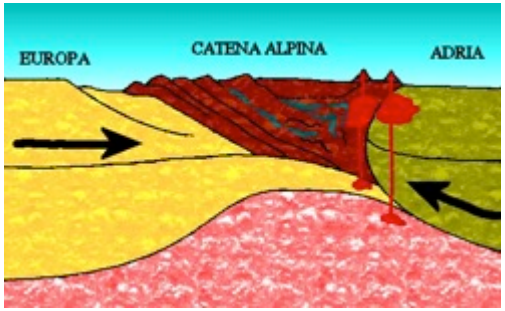
Boll. SGI 125 (2006) fasc. 3, 273-291, 6 ff.

(Viti et al., 2006)

PLATE MARGINS CONFIGURATION IN THE MEDITERRANEAN REGION



1)



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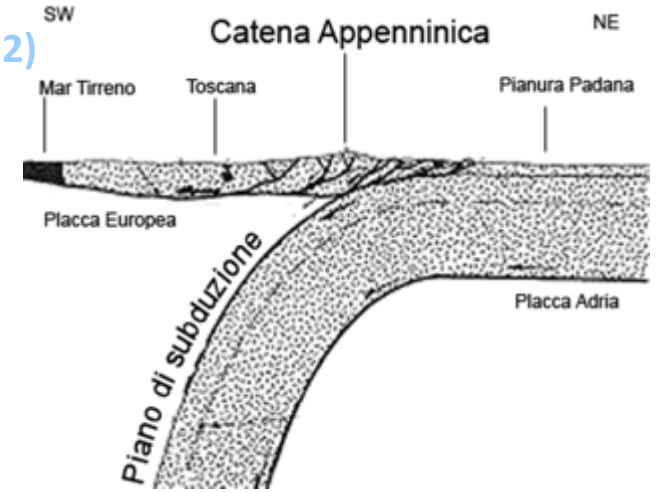
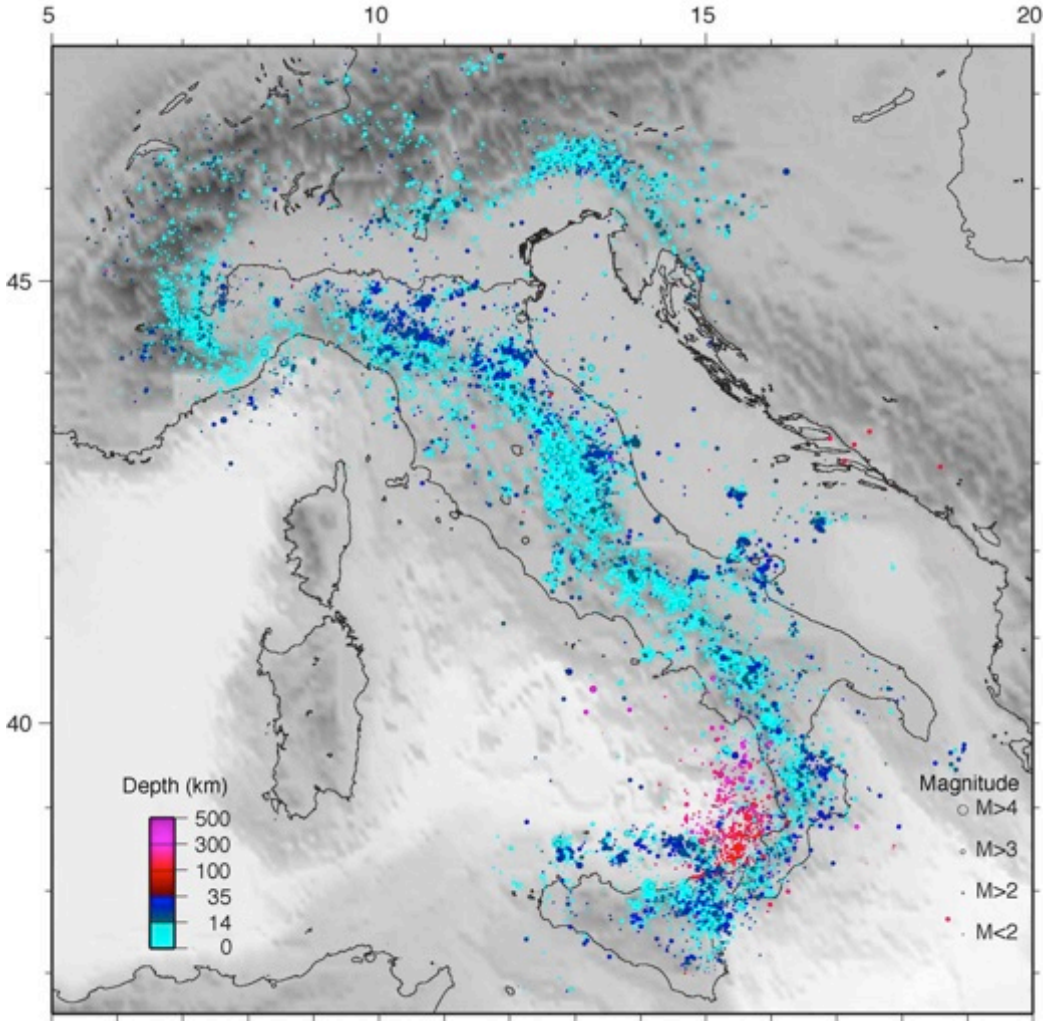


EARTHQUAKES LOCATIONS LIMIT THE BORDER OF THE ADRIA PLATE



(Chiarabba et al., 2005)

Upper Paleozic - Early Mesozoic (250 M.A.)

FIGURA 2 **Carbonifero superiore.** 300 milioni di anni fa.

At the end of the Paleozoic era, with the collision between Laurasia and Gondwana, the continents were included in the so-called single mass called “Pangea”.

FIGURA 3 **Triassico.** 250 milioni di anni fa.

At the Equator latitude, an ocean (Tetide – Tethys) separated the Asia from the Southern lands (Africa, India, Australia). The Italian region was located at the centre of this “supercontinent”, between Africa And Europe, just at the western end of the Tethys.

150 M.A - Middle Mesozoic

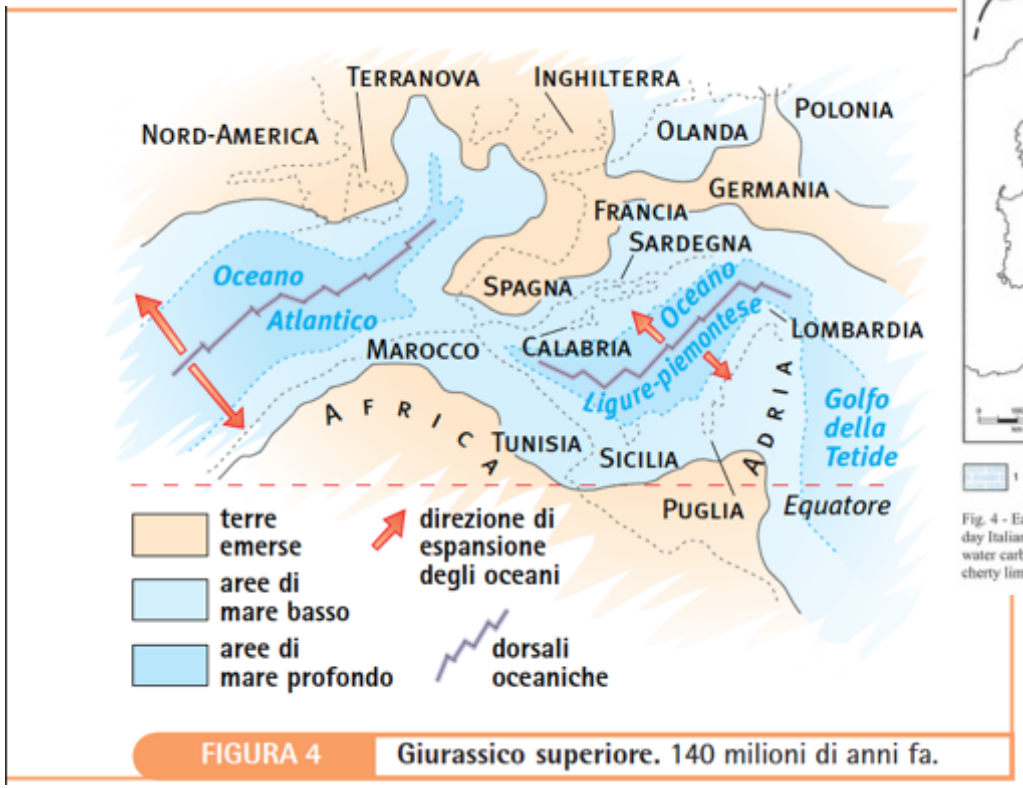


FIGURA 4 Giurassico superiore. 140 milioni di anni fa.

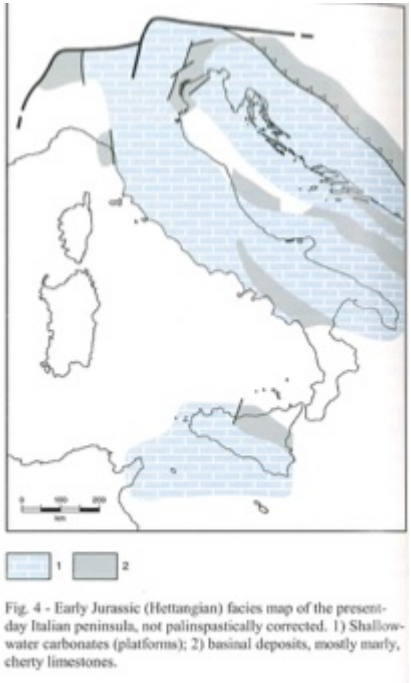


Fig. 4 - Early Jurassic (Hettangian) facies map of the present-day Italian peninsula, not palinspastically corrected. 1) Shallow-water carbonates (platforms); 2) basinal deposits, mostly marly, cherty limestones.

Starting from Triassic, the Atlantic ocean started to open, separating Africa from America. This process induced the formation of a small ocean (Liguro-Piemontese). It separated Europe from Africa: Sardinia and Calabria were on the Europen side, while Sicilia, and mainland Italy were part of the Africa continent.

The Italian region was in part formed by a deep sea of the Liguro-Piemontese ocean and in part by a shallow water areas coincident with the north Africa margin, whose border presented an indentation called “Adria”. It still remains the deep substratum of the Italian peninsula and of the Adriatic basin.

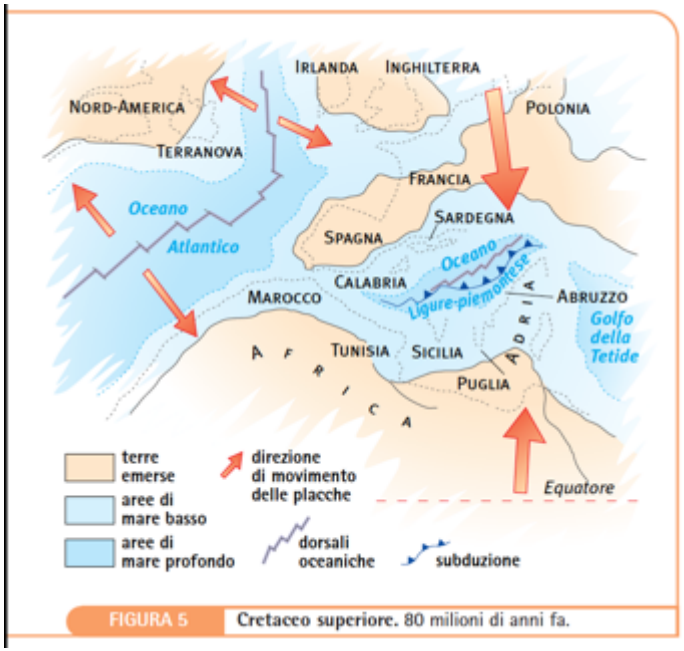


FIGURA 5 Cretaceo superiore. 80 milioni di anni fa.

100 M.A. – Alpine orogenesis

At the end of Mesozoic (Cretaceous) the Ligure-Piemontese Ocean started to close, due to the convergence between Africa and Eurasia that produced the Alpine orogenesis.
The oceaninc crust, interposed between the continental blocks was then subducted and swallowed up in the mantle

FIGURA 6 Eocene. 50 milioni di anni fa.

65 – 30 M.A. – Early Cenozoic

The closure of the Ligure-Piemontese ocean was completed, and the African and European continental blocks started to collide.
The Alpine chain originated from the convergent movements between the two colliding plates, and the metamorphic and sedimentary blocks of the European and Africa crust were piled up.
Adria and the other southern Italian region were still in a quite marine environemnt, deep (Marche, Toscana) or shallow (Abruzzo, Puglia and Sicily).

Last 30 M.A – Apennine orogenesis

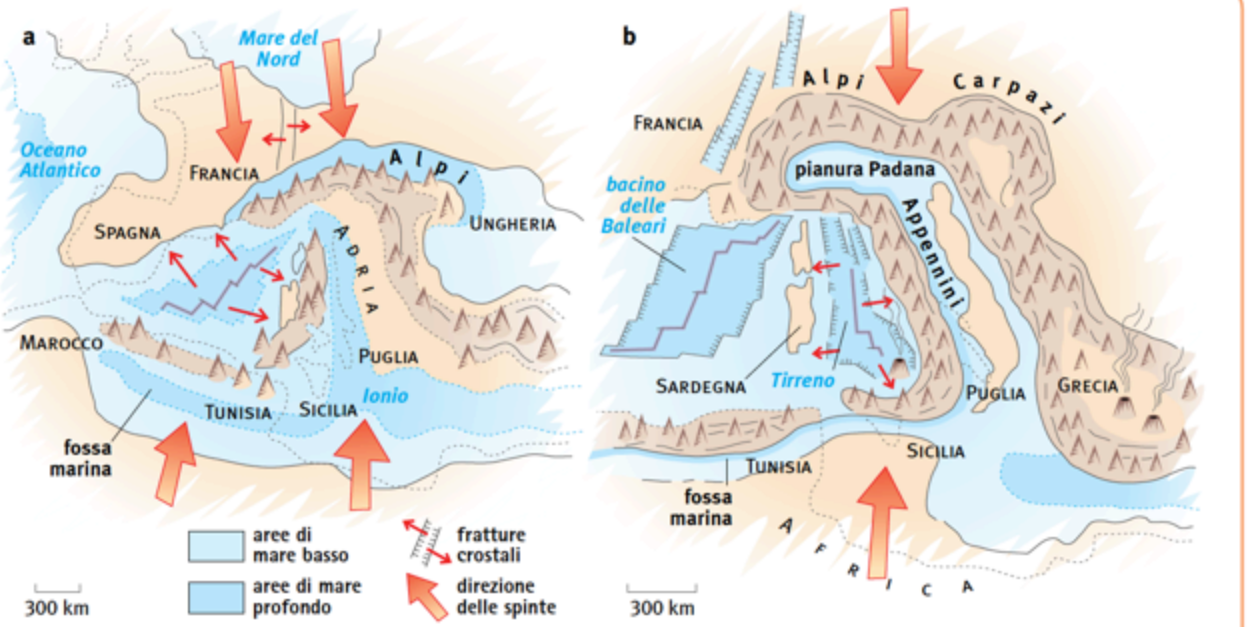


FIGURA 7 **Pliocene.** 5 milioni di anni fa.

The collision between Africa and Europe has continued for the next 30 MA up to Present, forming the complicated structural setting. Some deep crustal fractured formed (Balearic and Thyrrenian basins) which guided the Apennines orogenesis. Apennines extends from Northern Italy to Sicily and northern Africa (Tunisia, Marocco, Atlante mountains).
The Apennine formation occured in two main phases: the first related to the opening of the Balearic basin and the second phase, from 10 MA, the opening of the Thyrrenian Sea.

6 MA: the closure of the Strait of Gibraltar led to the isolation of the Mediterranean and in a few tens of years it remained isolated and came close to drying up; at the seafloor layers of chalk, limestones and salt were deposited.

Last 2 M.A. - Glaciation

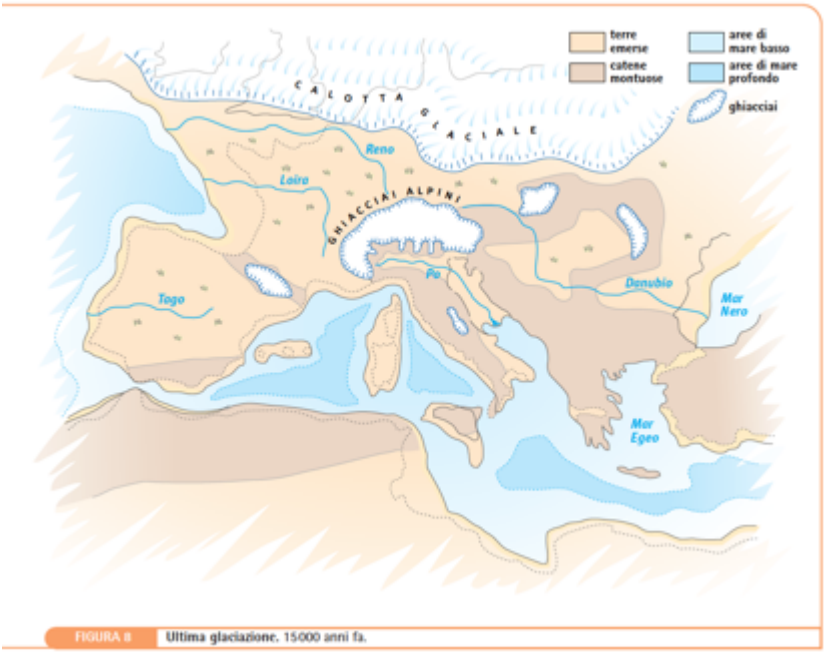


FIGURA 8 Ultima glaciazione, 15.000 anni fa.

Present

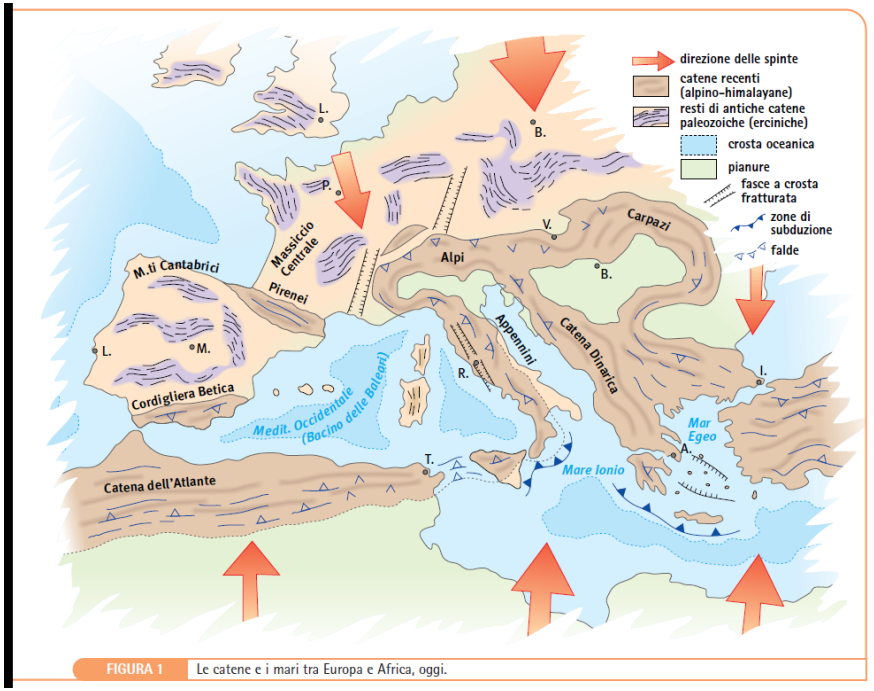
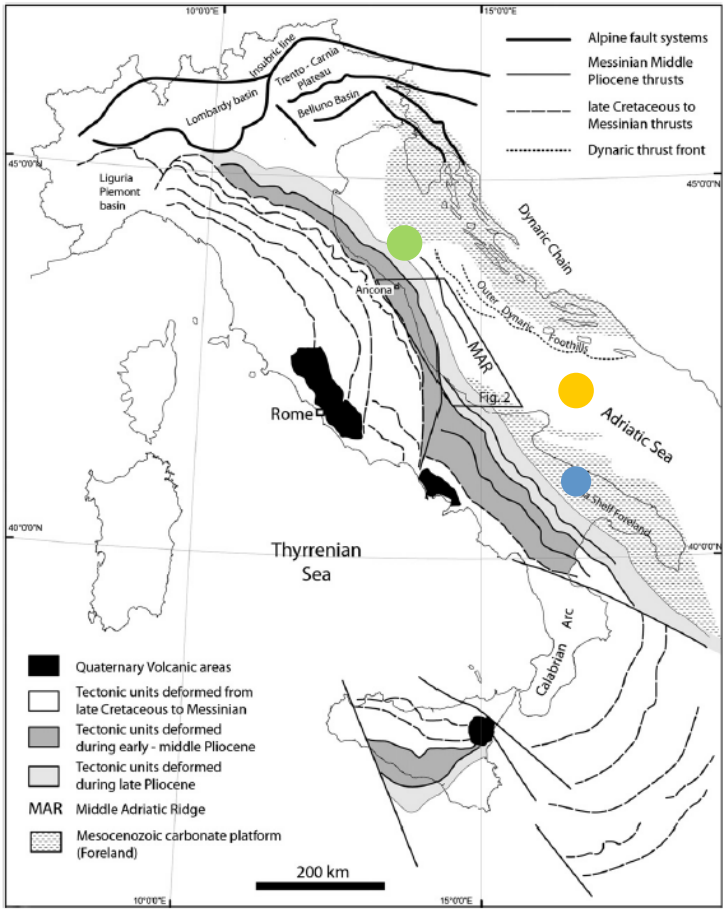


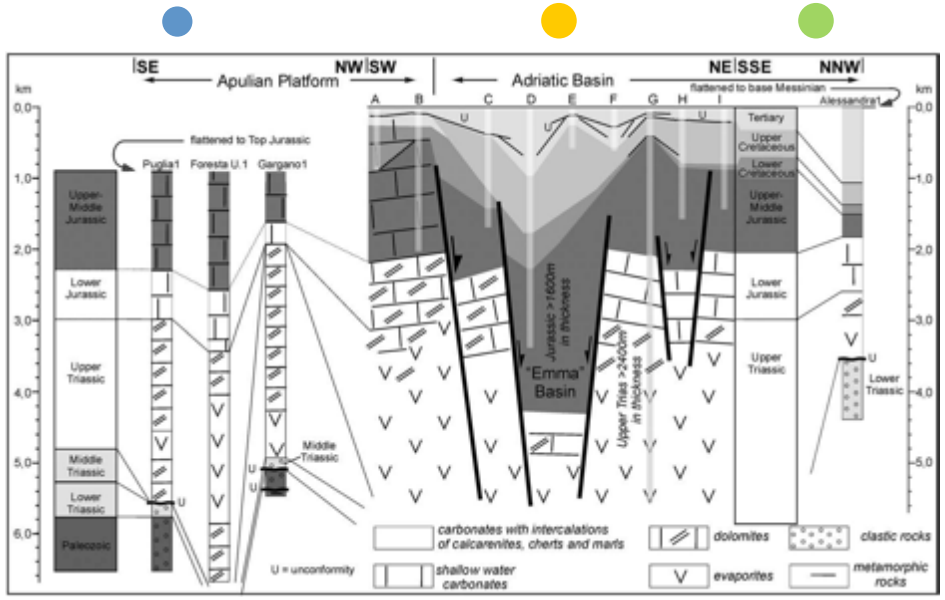
FIGURA 1 Le catene e i mari tra Europa e Africa, oggi.

In the past 2 MA and in particularly, the configuration of the Italian region has not changed significantly, except for the uplifting of the Apennines and the filling of the marine deep around the chain with sediments coming from the Alps and Apennines that formed the Po Plain and the the southern Adriatic basin, which were both partly involved in the orogenesis. The South Adriatic was also influenced by the Dinaric chain, caused by the subduction of the Adria below Europe, to to its eastern border.
Over the last 800.000 years, erosional activities included effect of glaciers transport. Great glaciers were common during the coldest phases of the glaciations (see the U shaped Alpine valley)

STRATIGRAPHY OF THE APULIAN PLATFORM AND ADRIATIC BASIN
(calibrated from wellbore data)



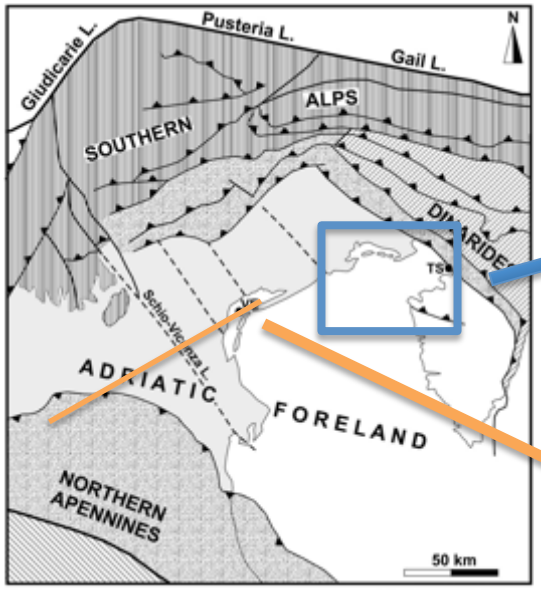
(Casero e Bigi, 2013)

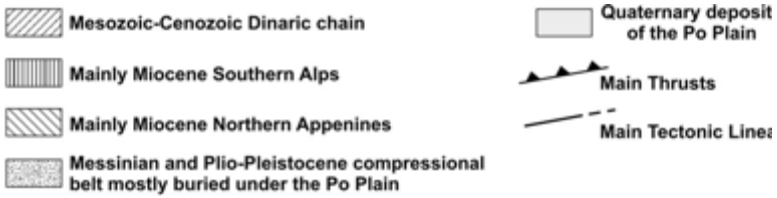


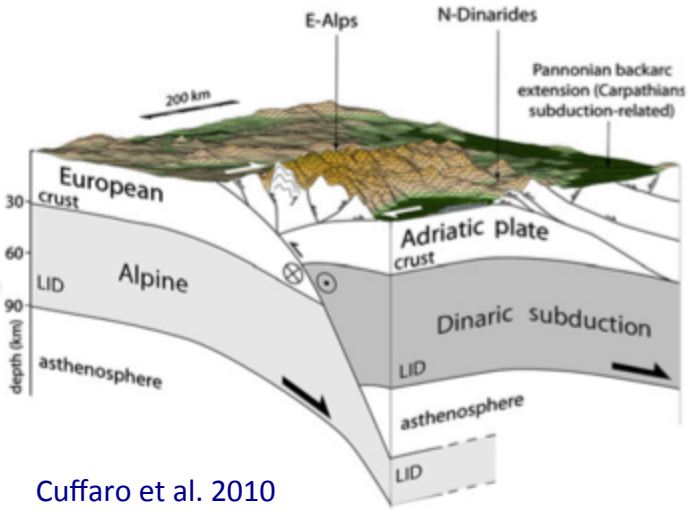
(Scisciani & Calamita, 2009)

NORTHERN ADRIATIC

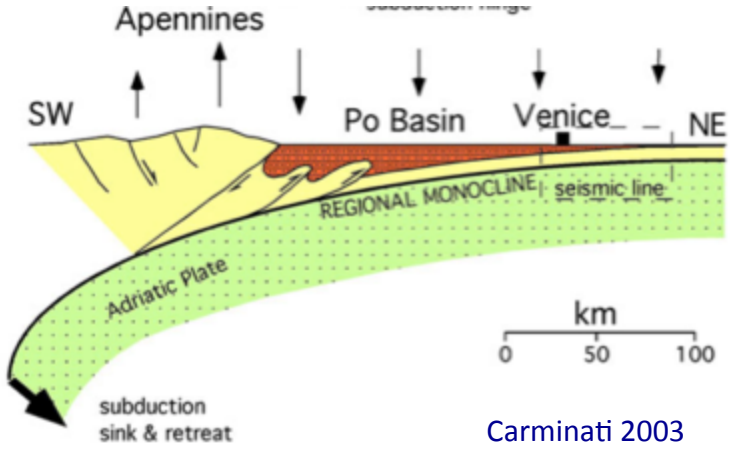
Structural map of the Northern Adriatic Sea region (modified from Castellarin et al., 2006).





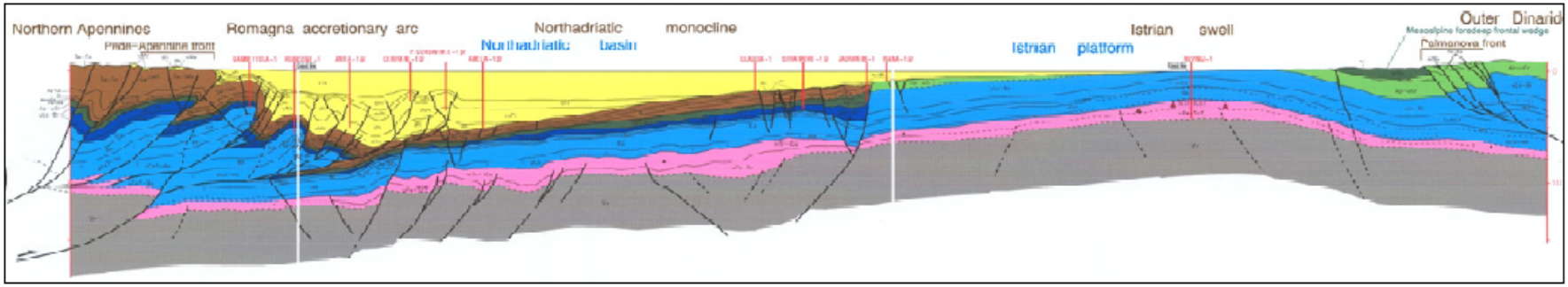


Cuffaro et al. 2010



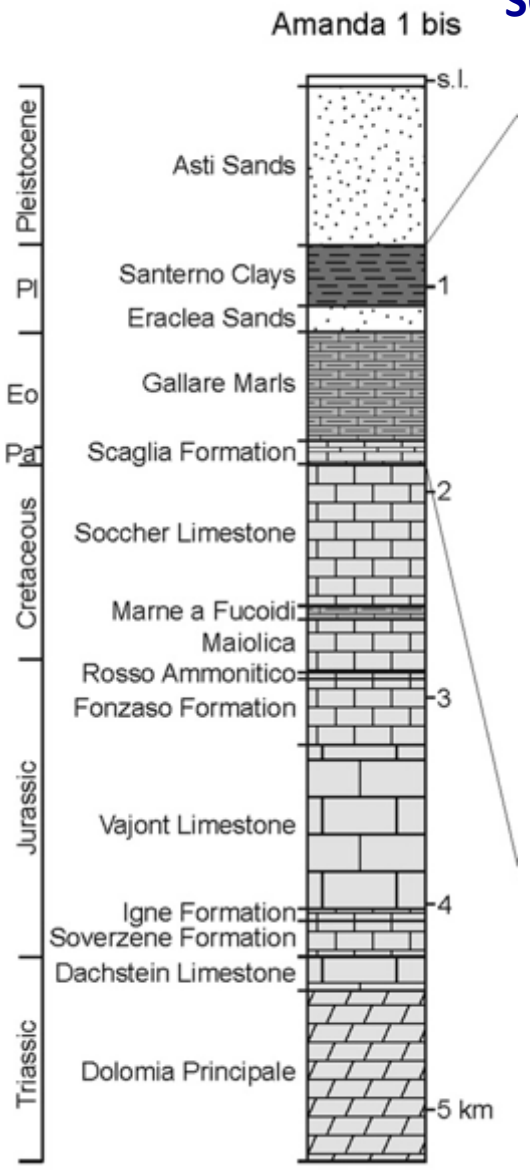
Carminati 2003

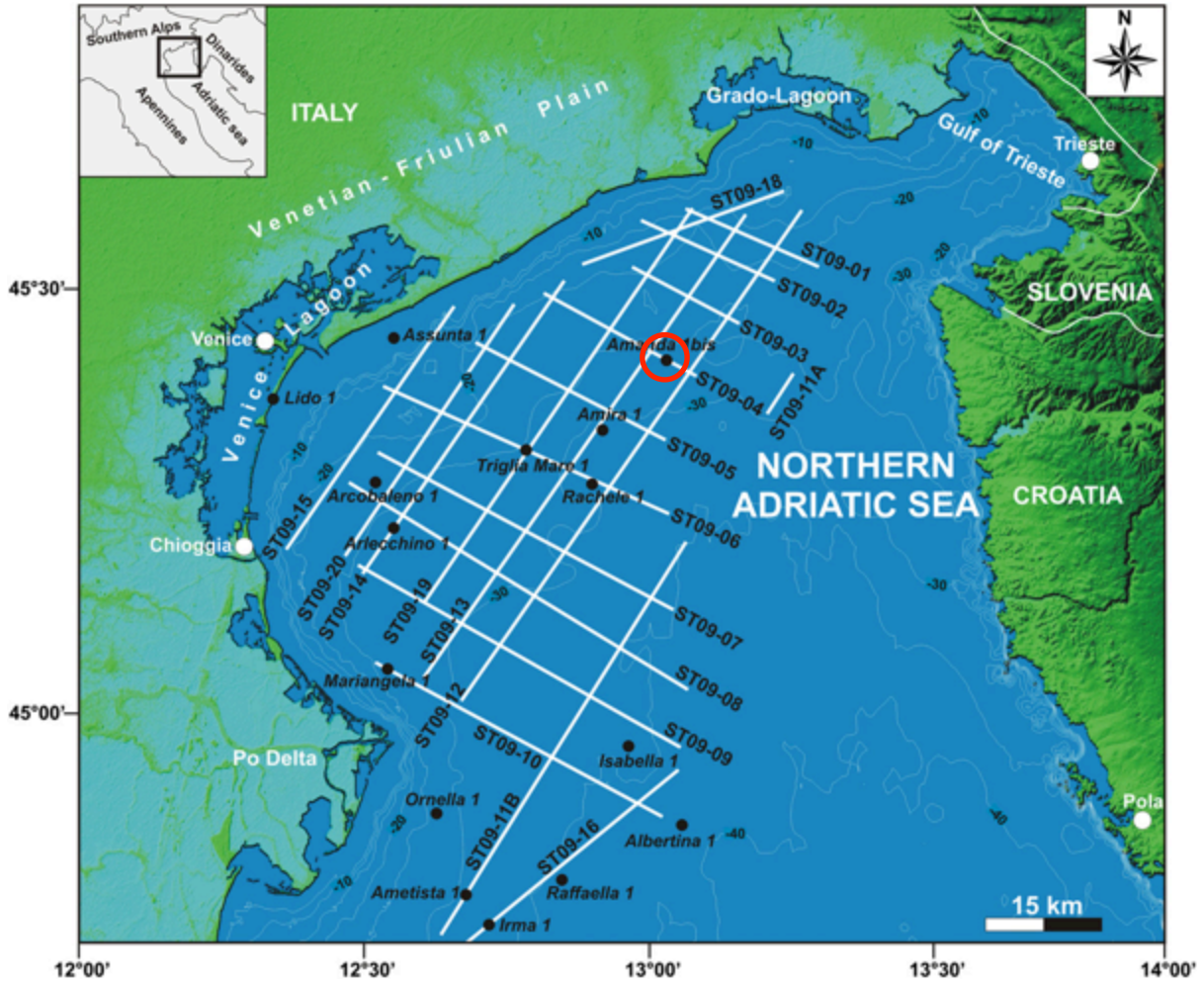
MORPHOLOGY AND PRESENT STRUCTURAL SETTING – NORTHERN ADRIATIC



(Fantoni & Franciosi, 2010)

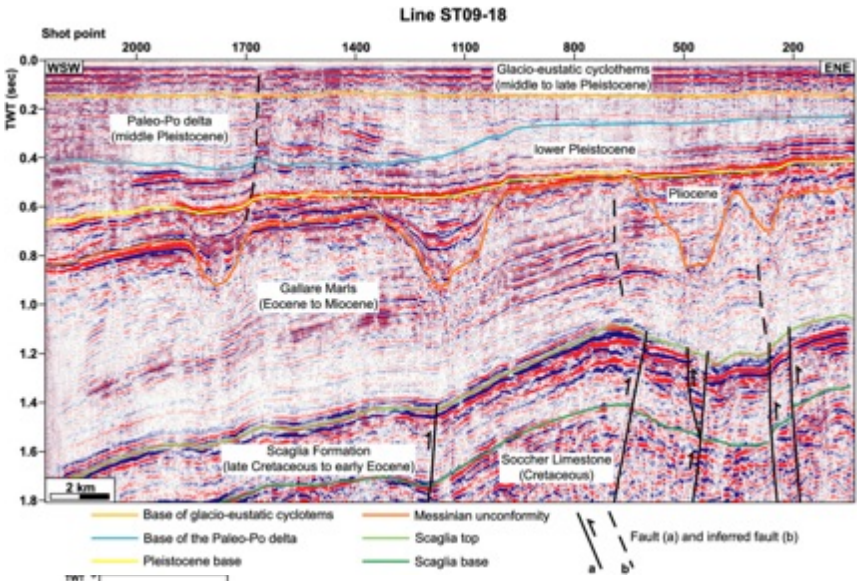
SCHEMATIC STRATIGRAPHY from AMANDA well data

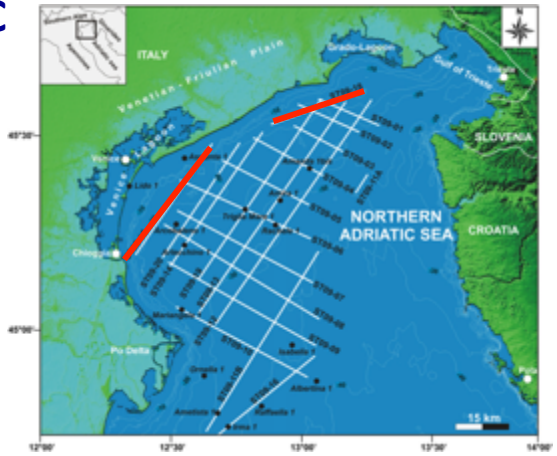




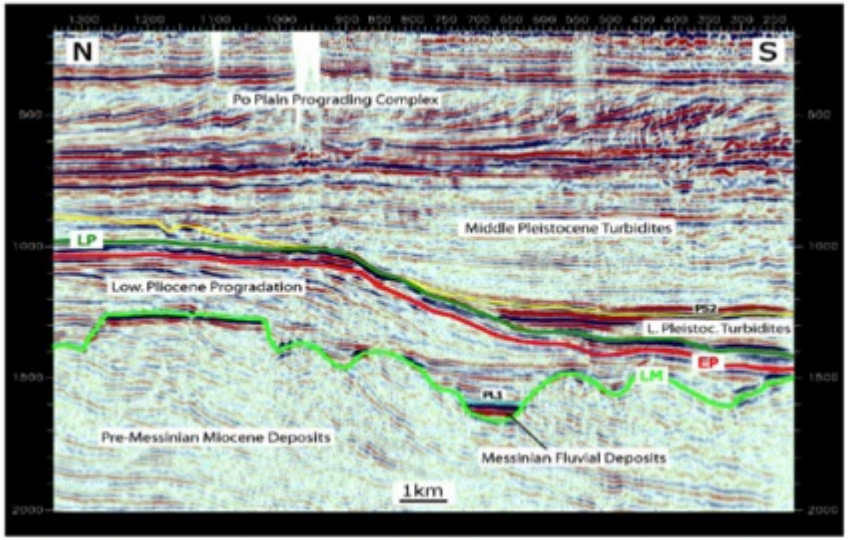
Donda et al., 2014. Deep-sourced gas seepage and methane-derived carbonates in the Northern Adriatic Sea. Basin Research (2014) 1–15, doi: 10.1111/bre.12087

SEISMOSTRATIGRAPHY – NORTHERN ADRIATIC



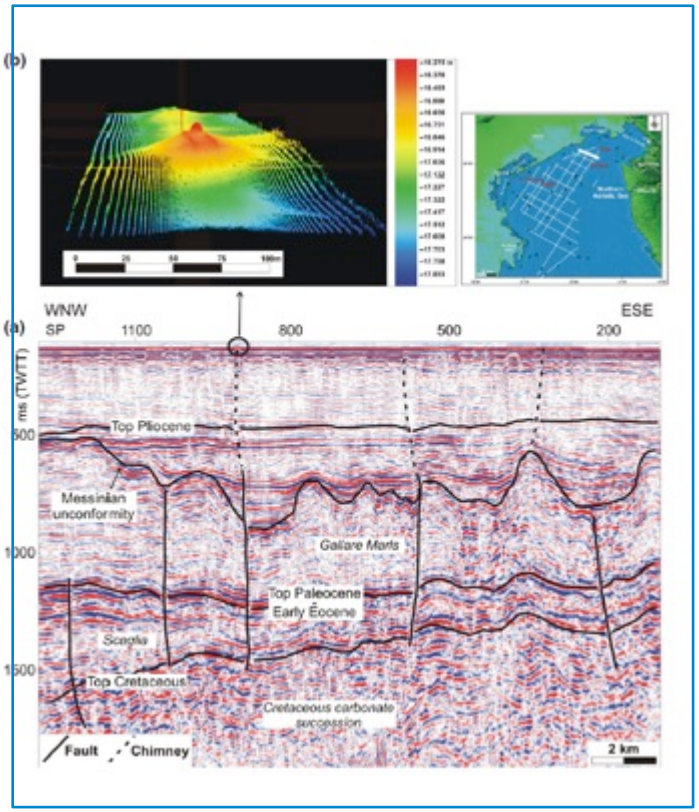


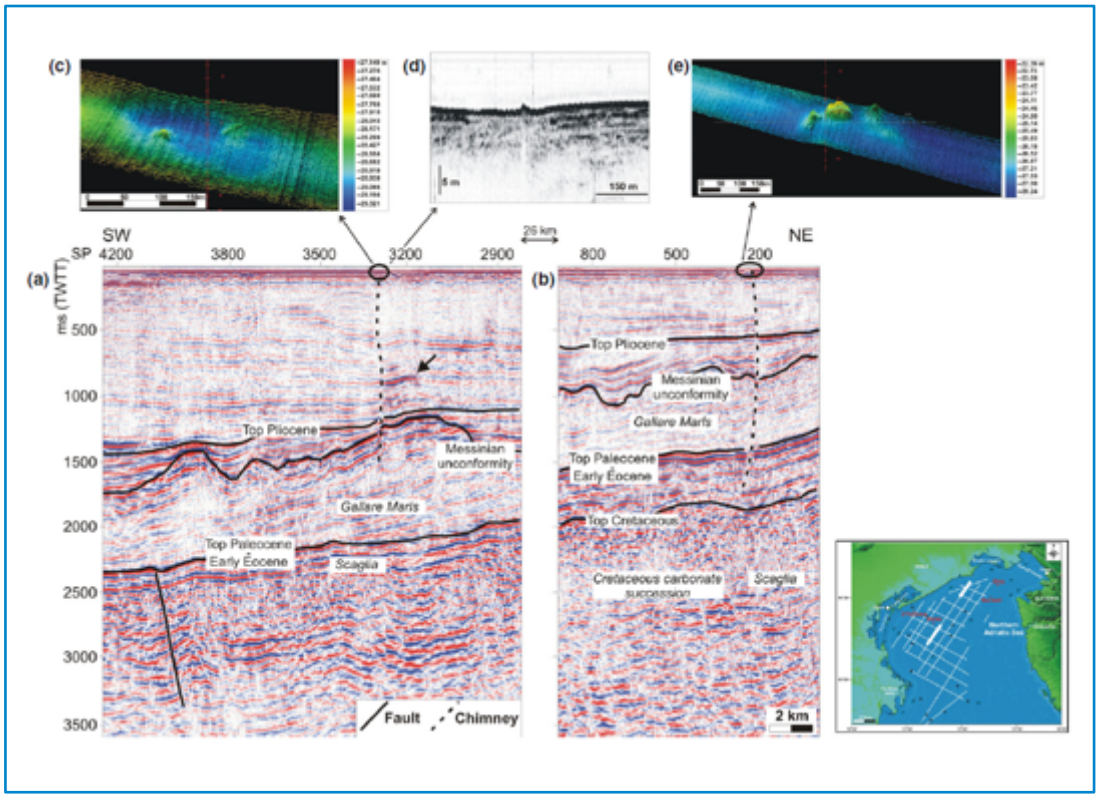
Donda et al., 2014. Deep-sourced gas seepage and methane-derived carbonates in the Northern Adriatic Sea. Basin Research (2014) 1–15, doi: 10.1111/bre.12087



Ghielmi, M., Minervini, M., Nini, C., Rogledi, S., Rossi, M., Vignolo, A., 2010. Sedimentary and tectonic evolution in the eastern Po-Plain and northern Adriatic Sea area from the Messinian to Middle Pleistocene (Italy). Rendiconti Scienze Fisiche e Naturali Accademia Lincei 21, 131e166

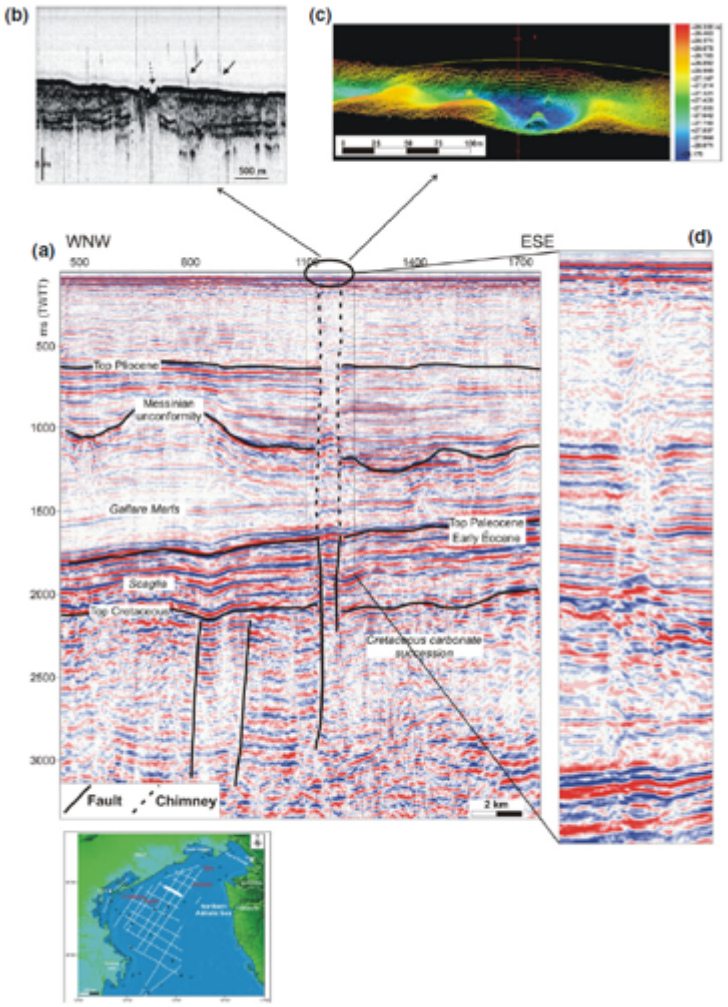
GAS SEEPS IN THE NORTHERN ADRIATIC

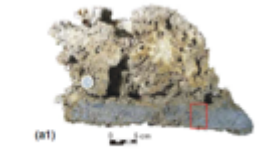


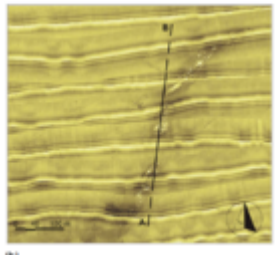


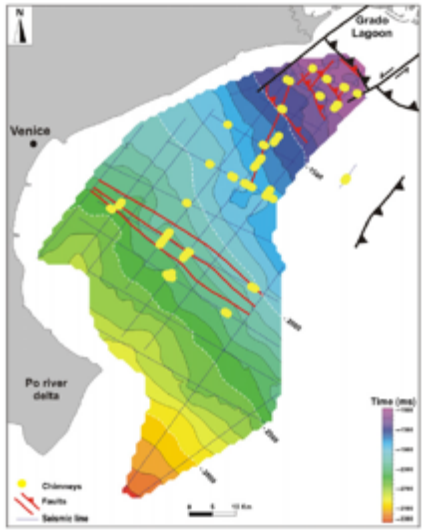
(Donda et al., 2014)

GAS SEEPS IN THE NORTHERN ADRIATIC





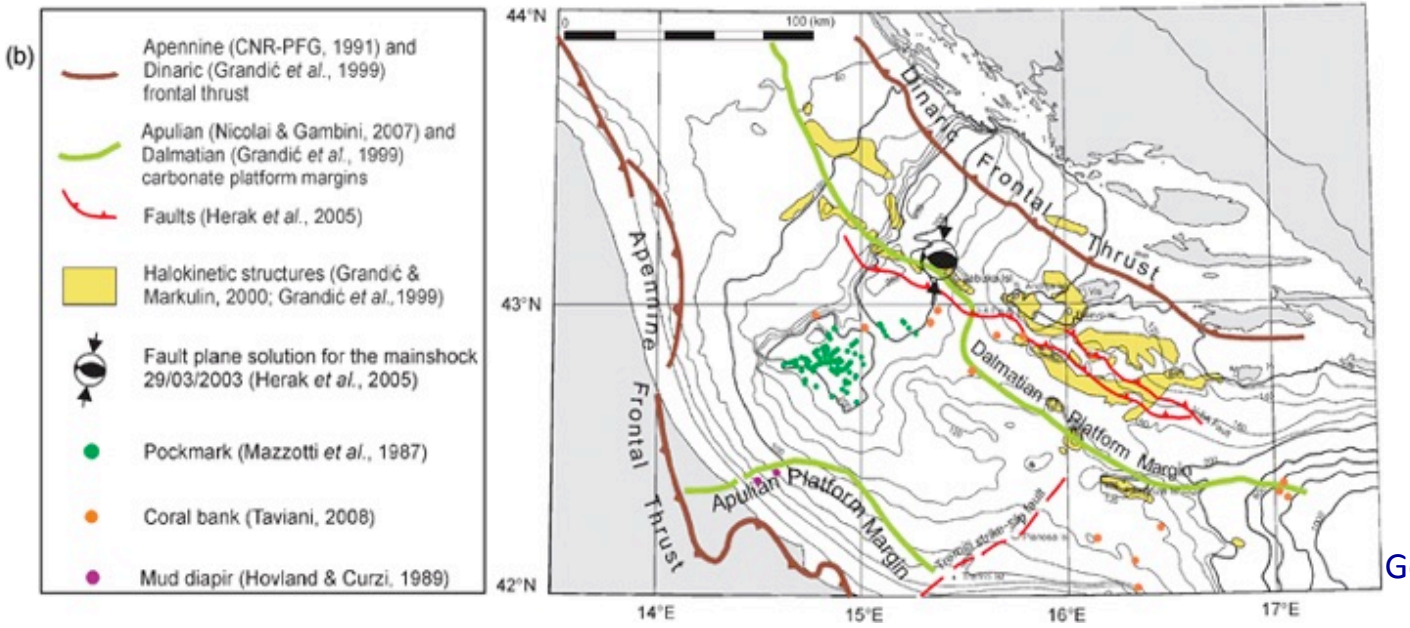




(Donda et al., 2014)

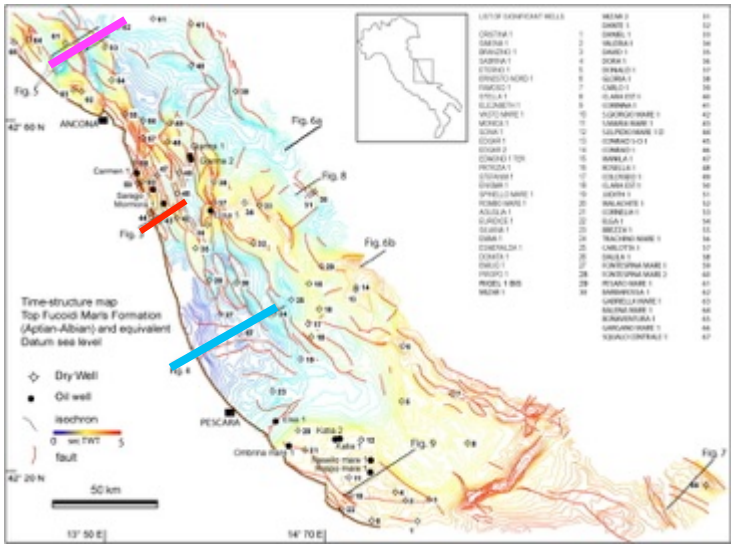
CENTRAL ADRIATIC
Structural setting

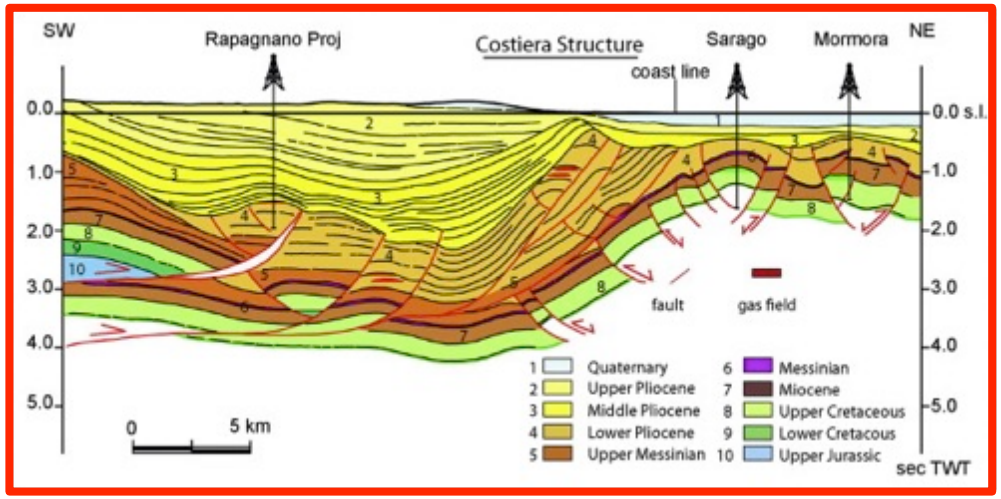
<u>3 main deformation phases</u>:
- extensional in the late Jurassic
- contractional/transtensional in the late Cretaceous
- compressional in the middle-late Pliocene and re-activation of pre-existing tectonic features

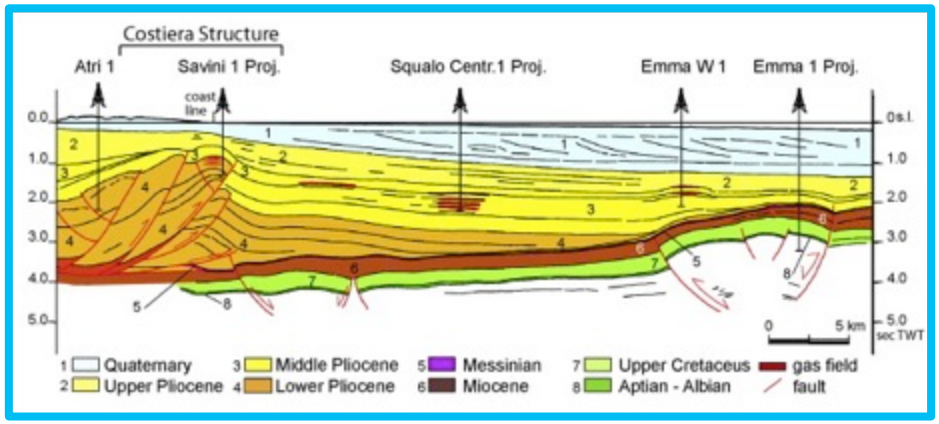


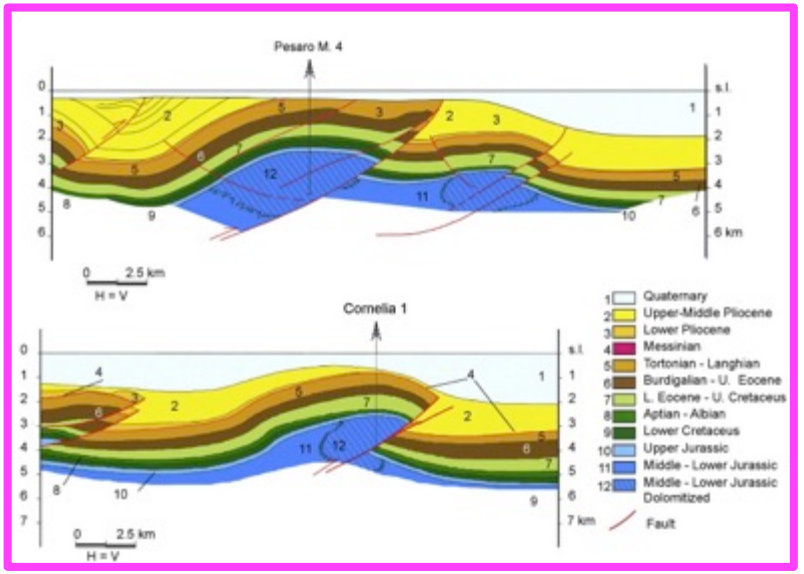
Geletti et al., 2008

CENTRAL ADRIATIC – Tectonic style





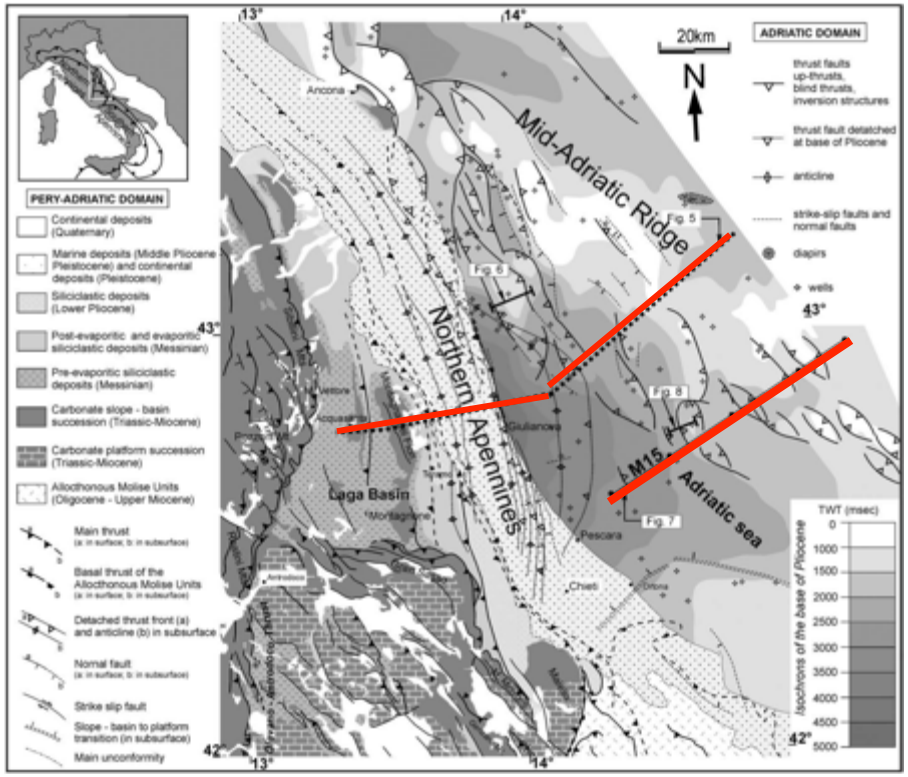


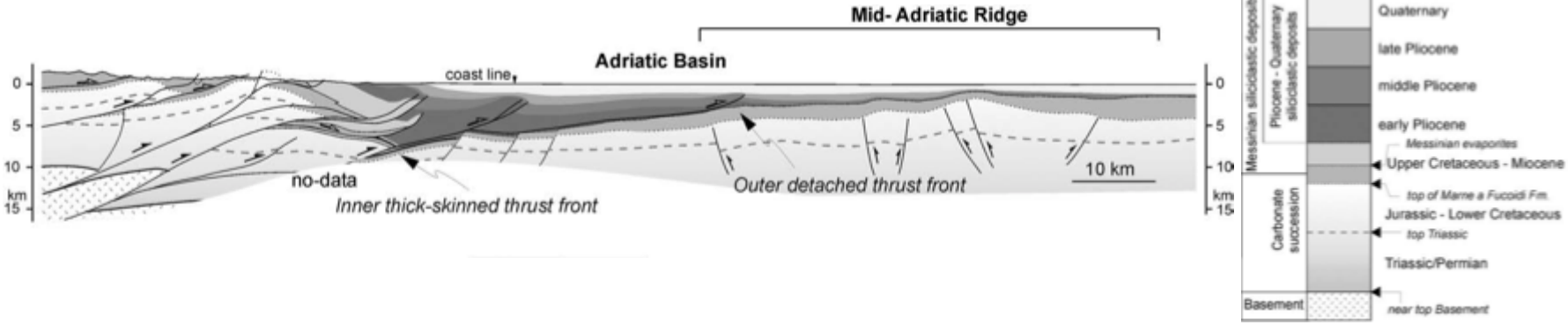


(Casero e Bigi, 2013)

CENTRAL ADRIATIC

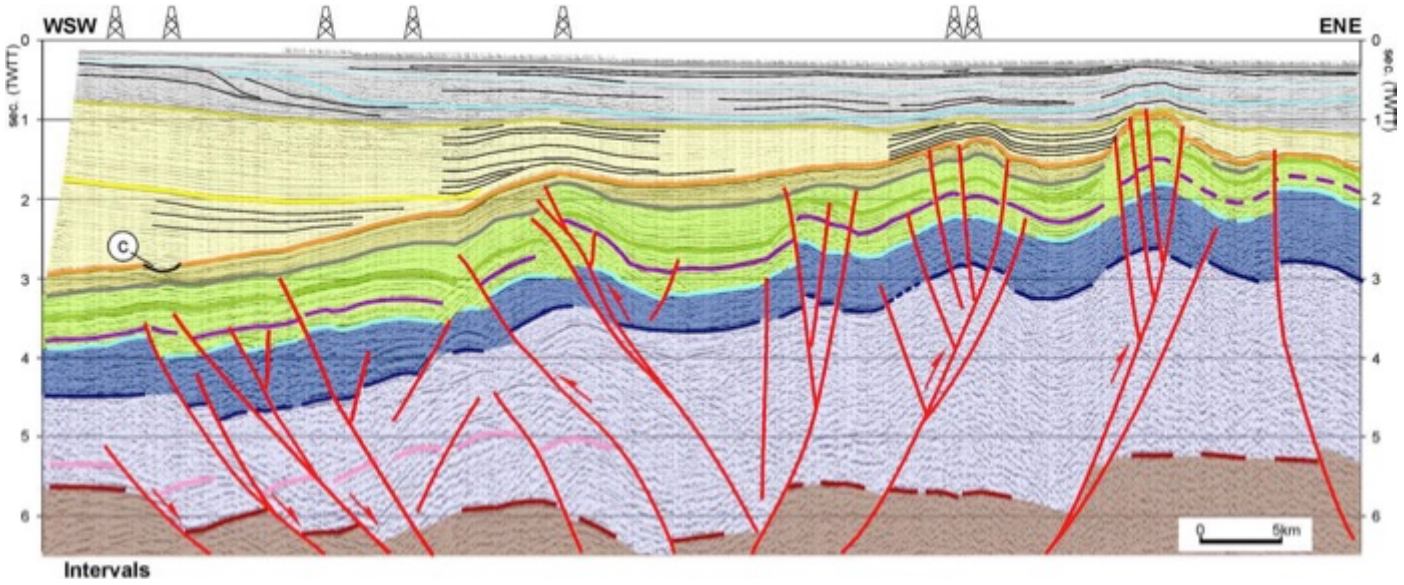
Mid-Adriatic Ridge

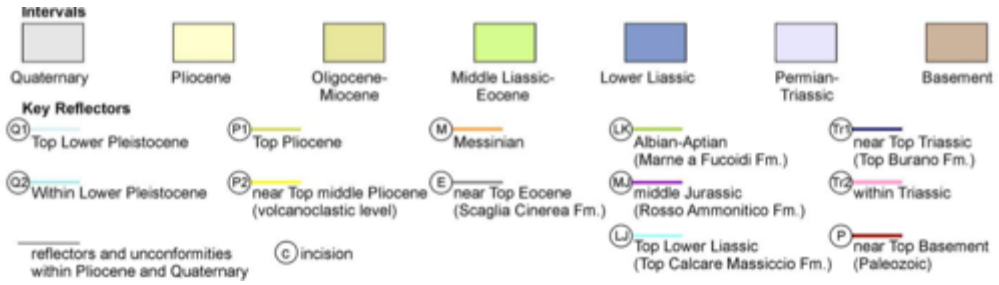


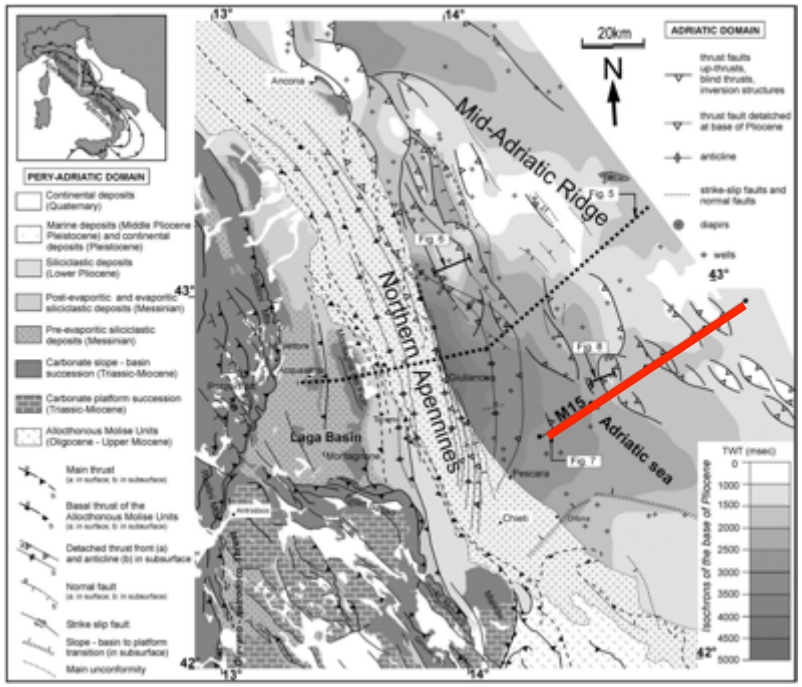


CENTRAL ADRIATIC

Mid-Adriatic Ridge

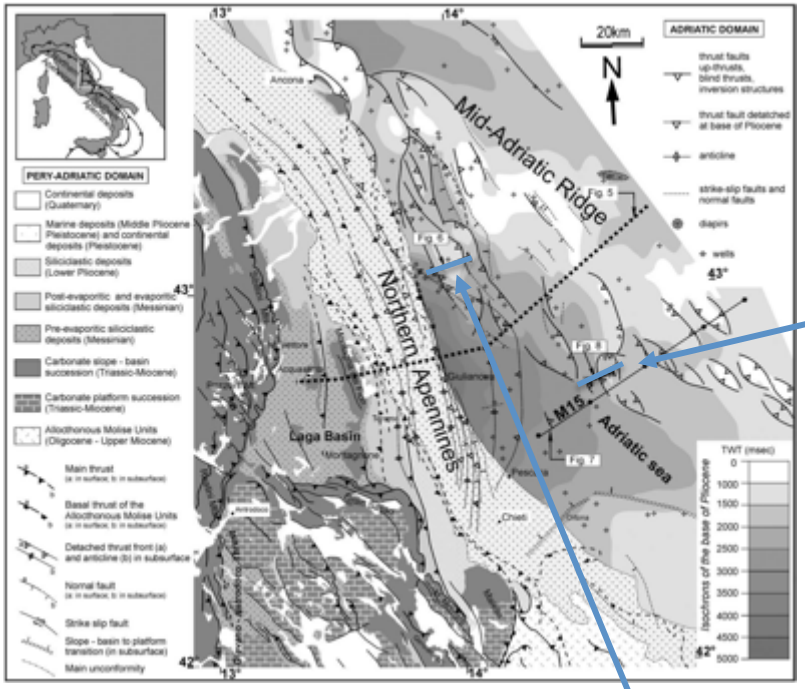


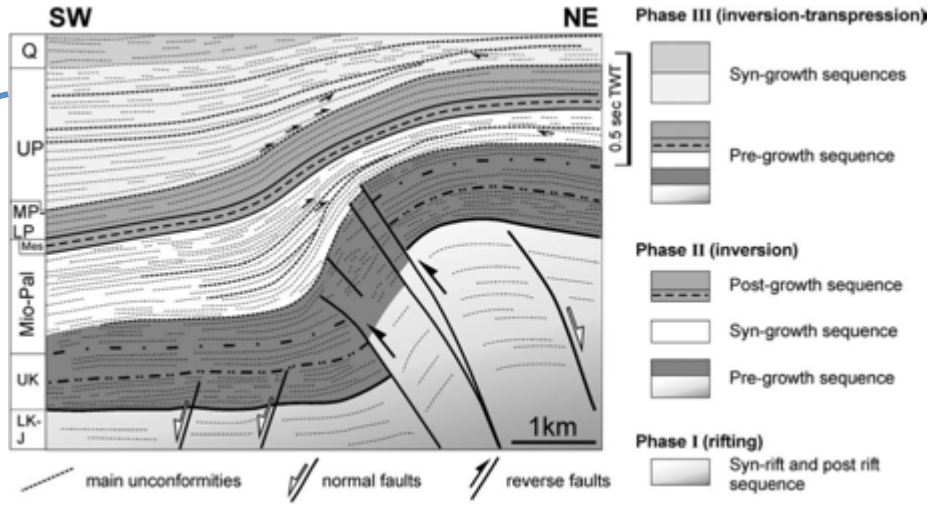


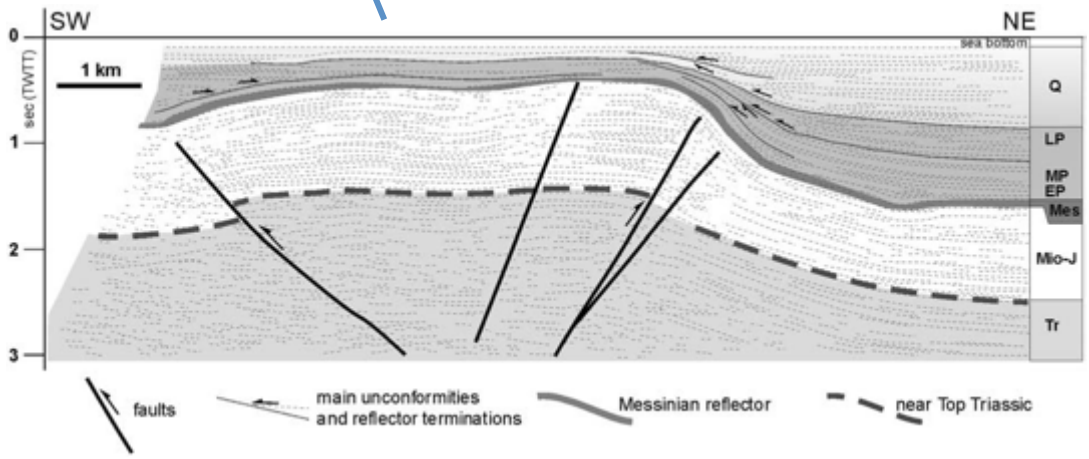


CENTRAL ADRIATIC

Mid-Adriatic Ridge

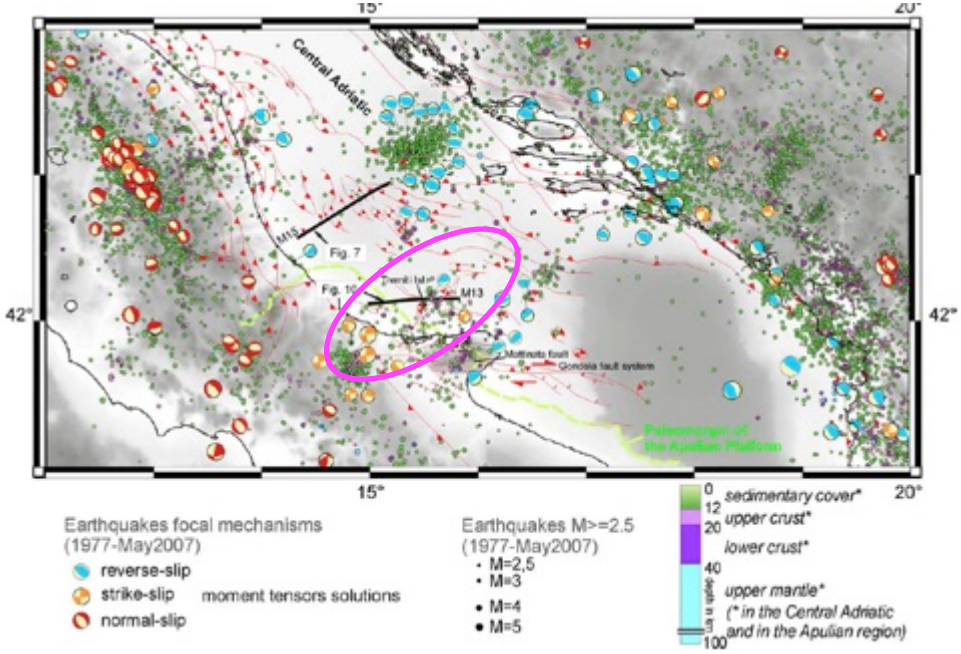


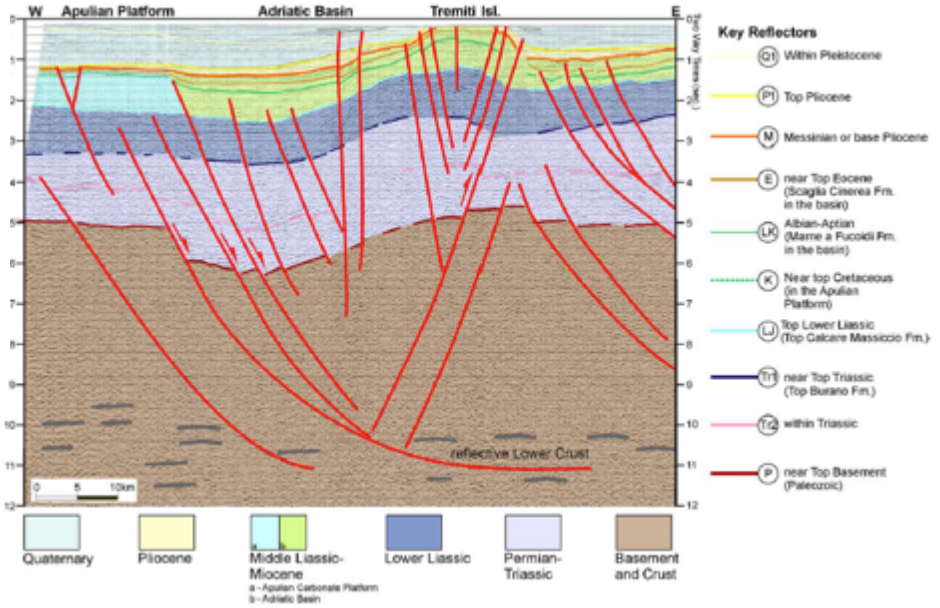




CENTRAL ADRIATIC

Tremiti Ridge





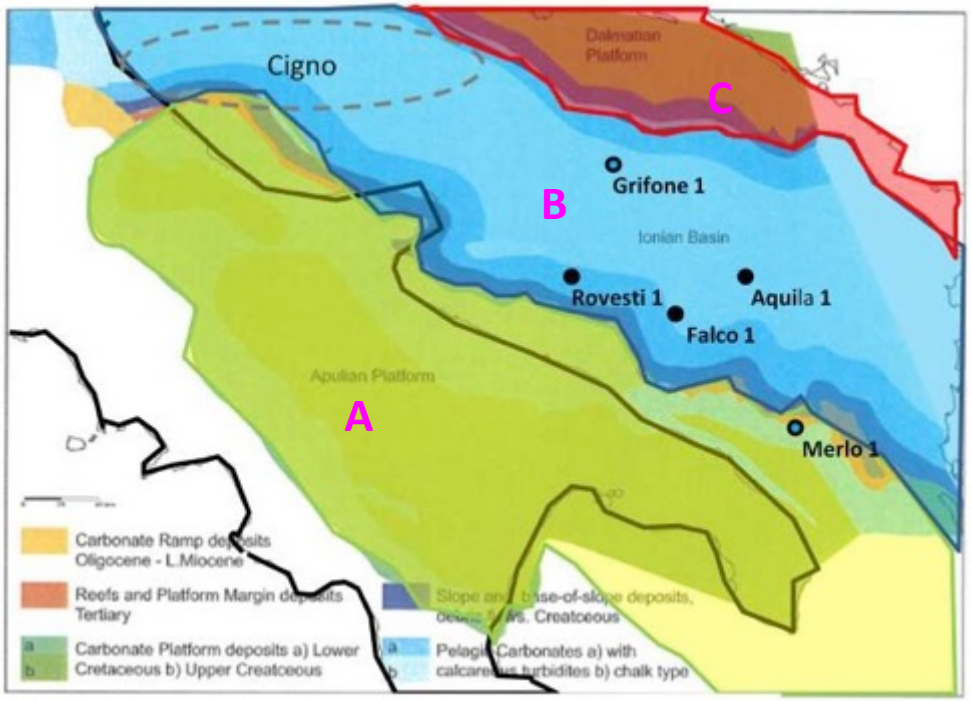
SOUTHERN ADRIATIC

Bathymetry

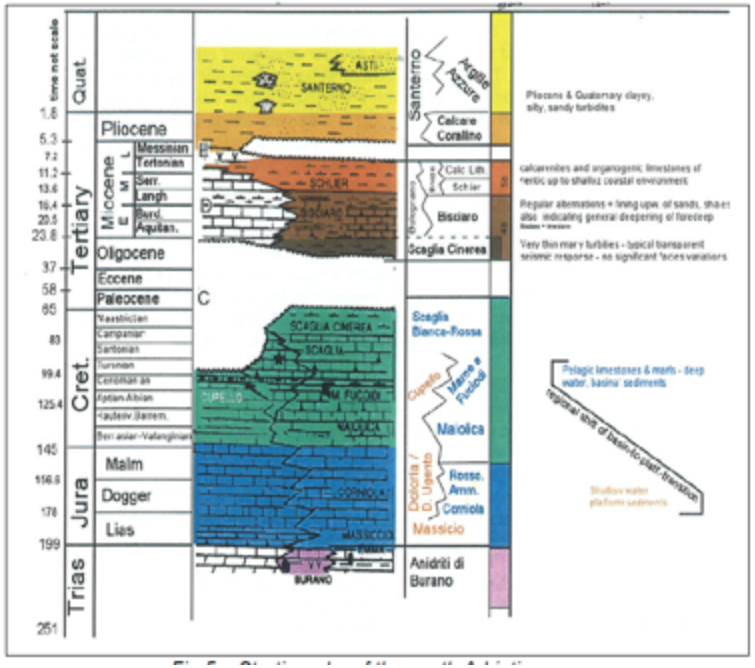
Structural sketch

SOUTHERN ADRIATIC

Stratigraphy



Modified after Nicolai & Gambini 2007

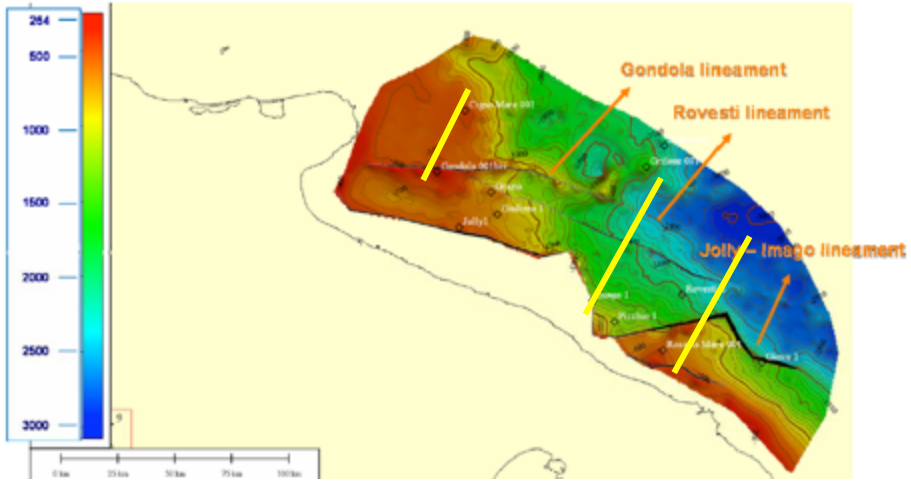


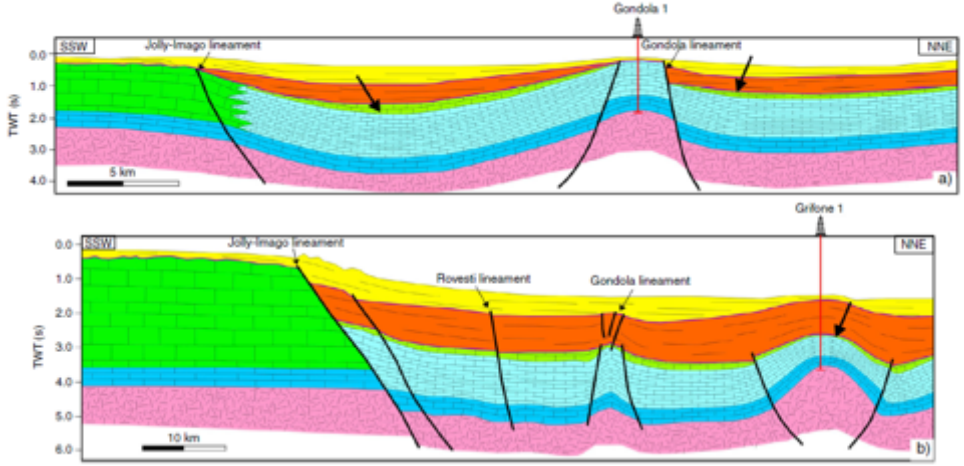
The Apulian zone (A), extending from Puglia region to the external sector of the Ionian islands (pre Apulian area), and characterized by thick carbonate Triassic to Miocene neritic sequences (> 6000 m).

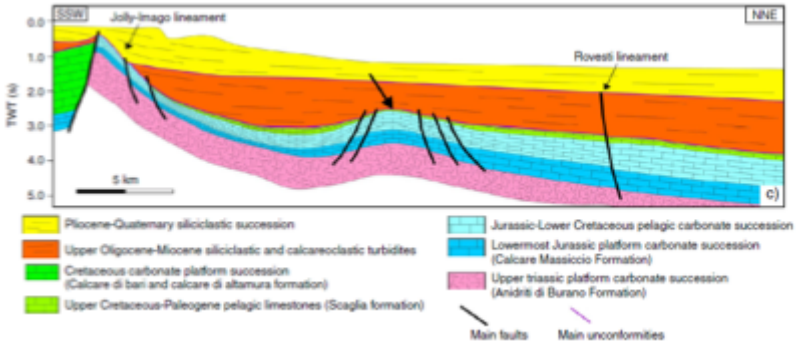
The Ionian zone, (B) It occupies the Southern Adriatic Sea area. Going further north it joins the Umbria-Marche Apennines, whereas to the west it outcrops in the eastern sector of the Gargano. It features neritic sediments up to the Early Jurassic (Early-Middle Lias), becoming pelagic up to the Middle-Late Eocene and finally terrigeneous (flysch) up to the Early Miocene.

The Dalmatian zone, (C) outcrops along the Montenegro coastline, with neritic facies from the Triassic to the Middle Eocene and becoming flyshoidal from the Oligocene to the Early Miocene (Aquitanian).

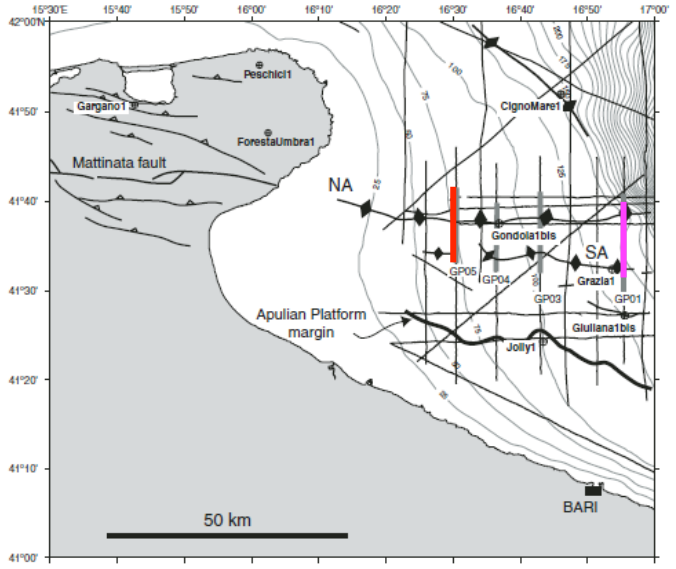
SOUTHERN ADRIATIC
Structural setting

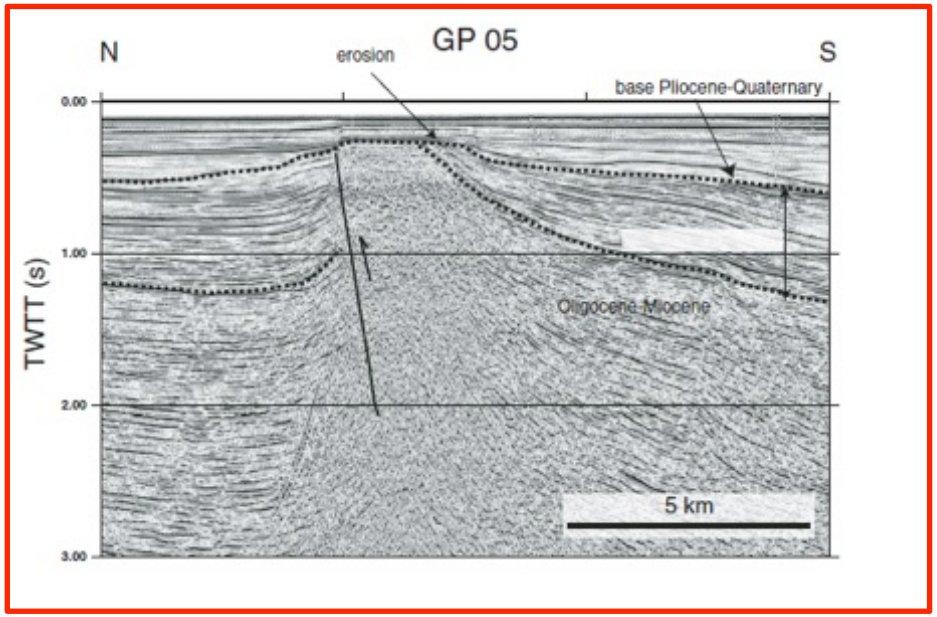


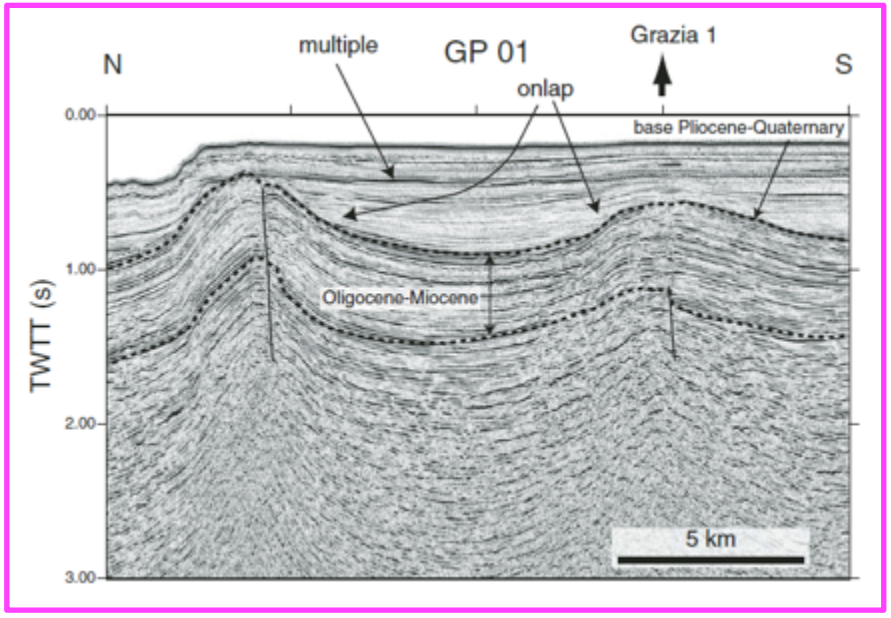


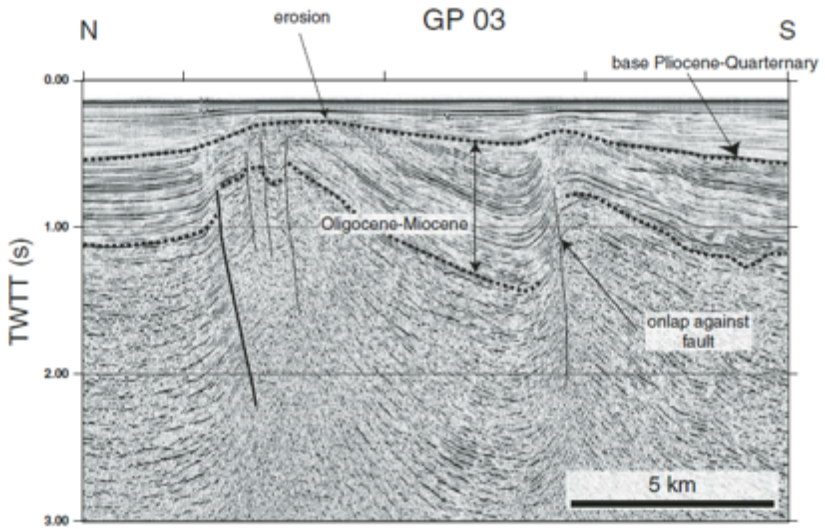


Volpi et al., 2014







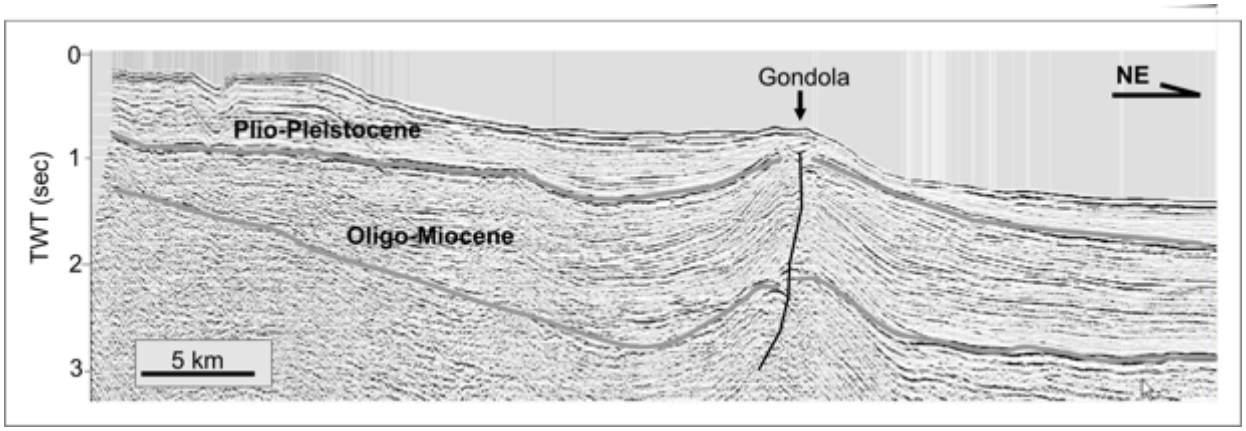


(Argnani et al., 2012)

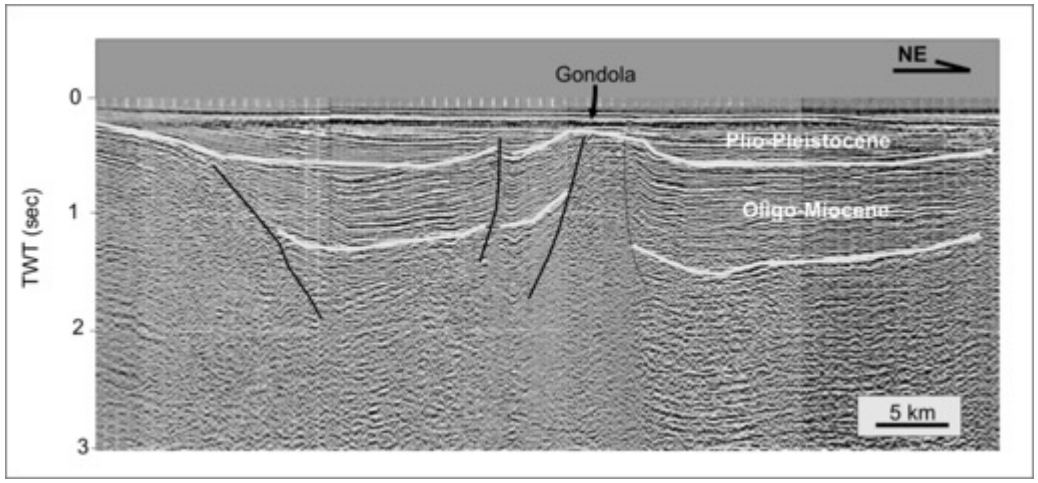
SOUTHERN ADRIATIC

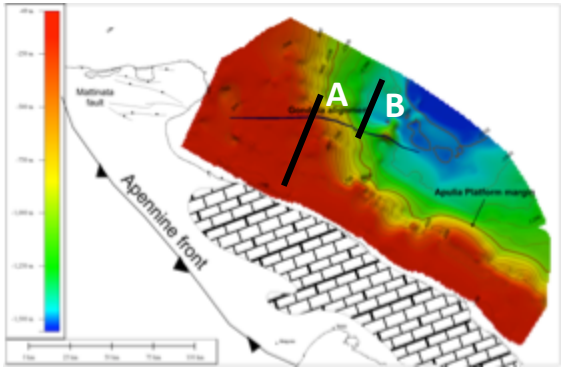
Gondola fault system

A



B

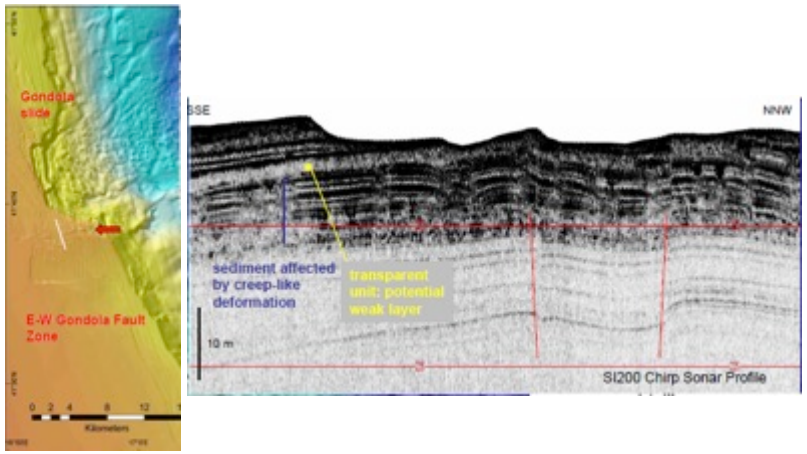


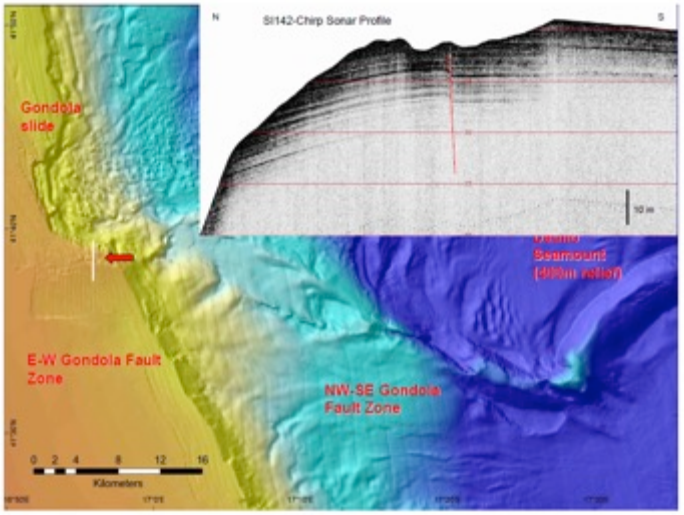


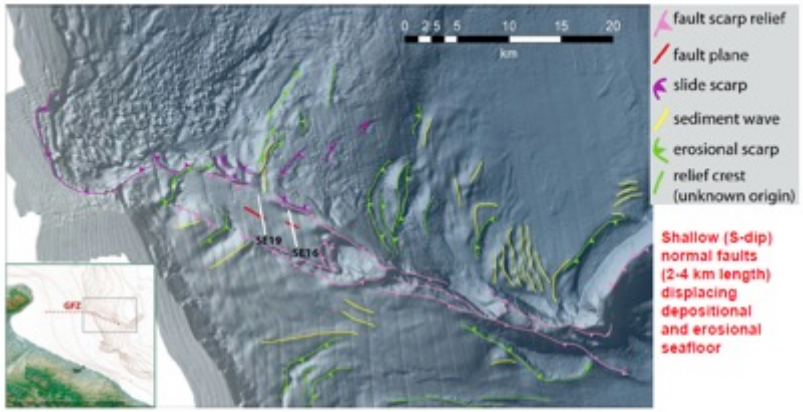
SOUTHERN ADRIATIC

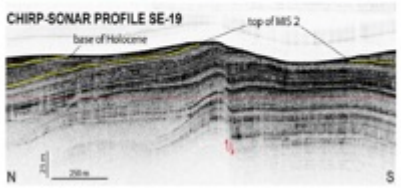
Gondola fault system

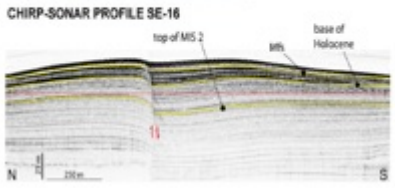
Seafloor evidence and shallow deformation





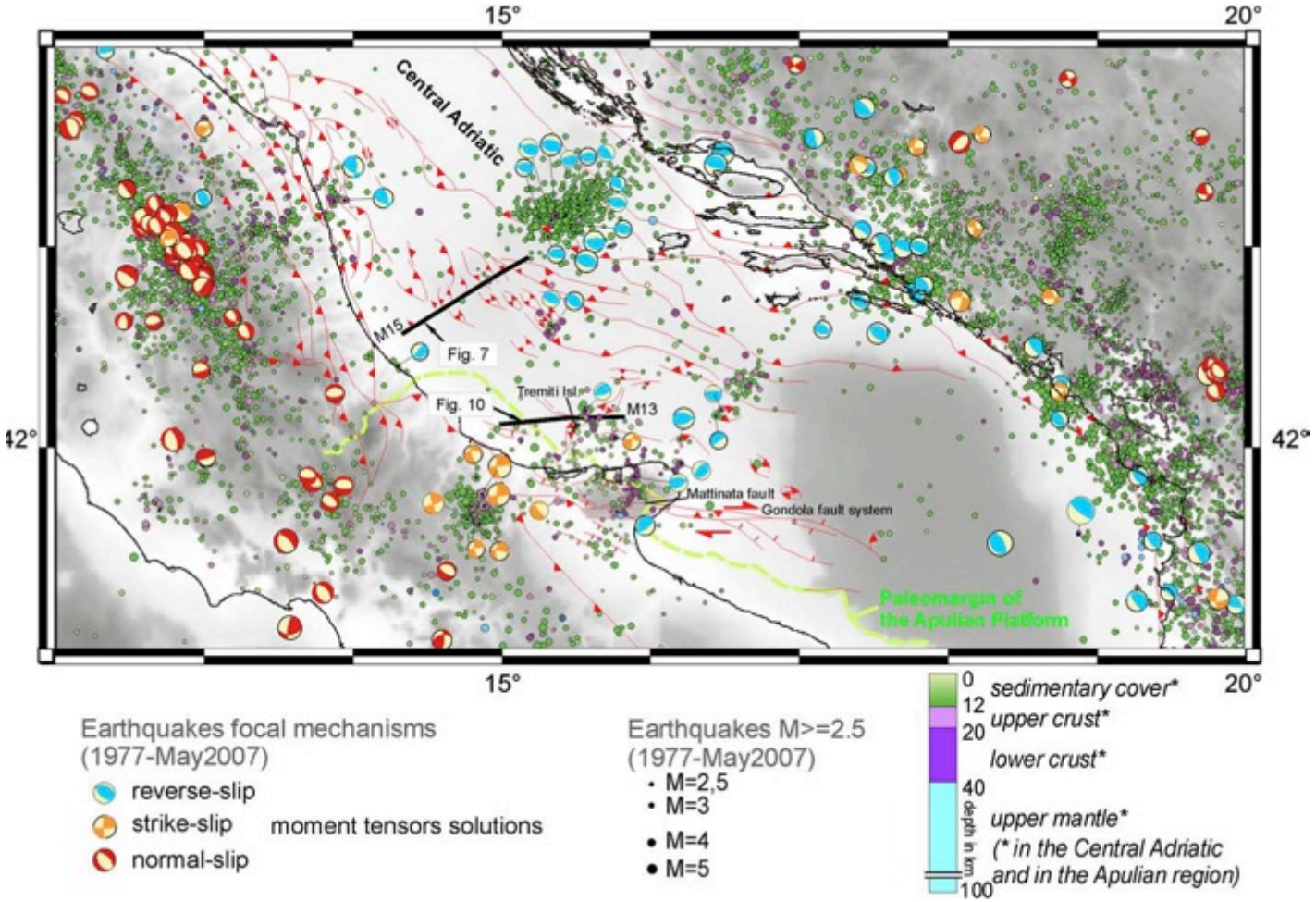






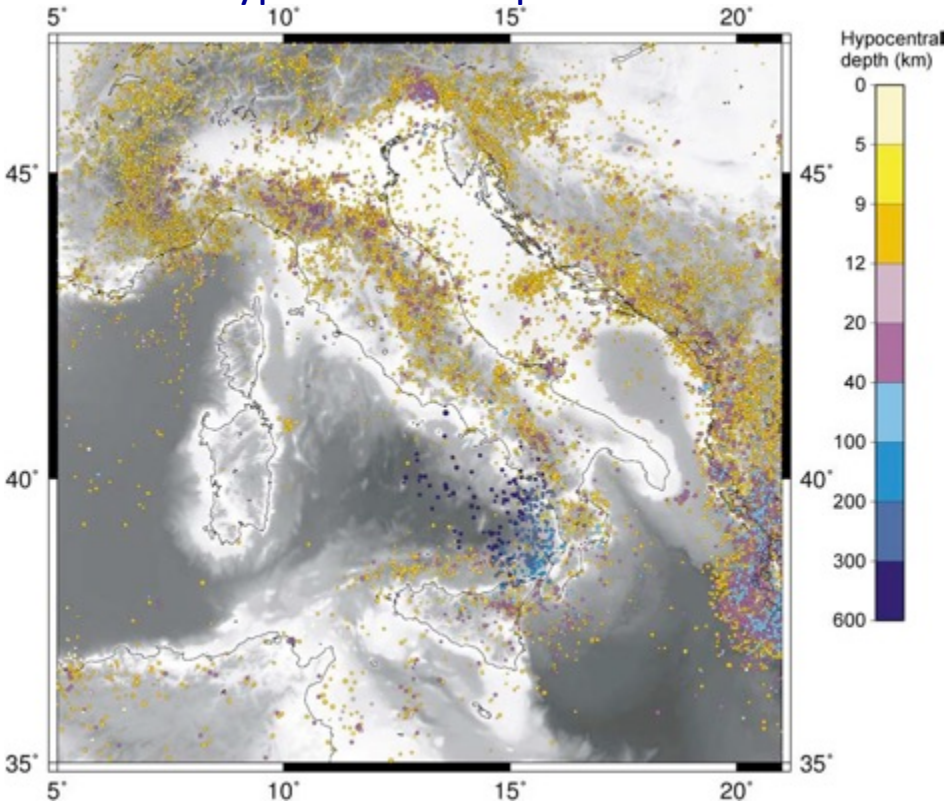
Ridente et al., 2010

SEISMICITY OF THE ADRIATIC REGION

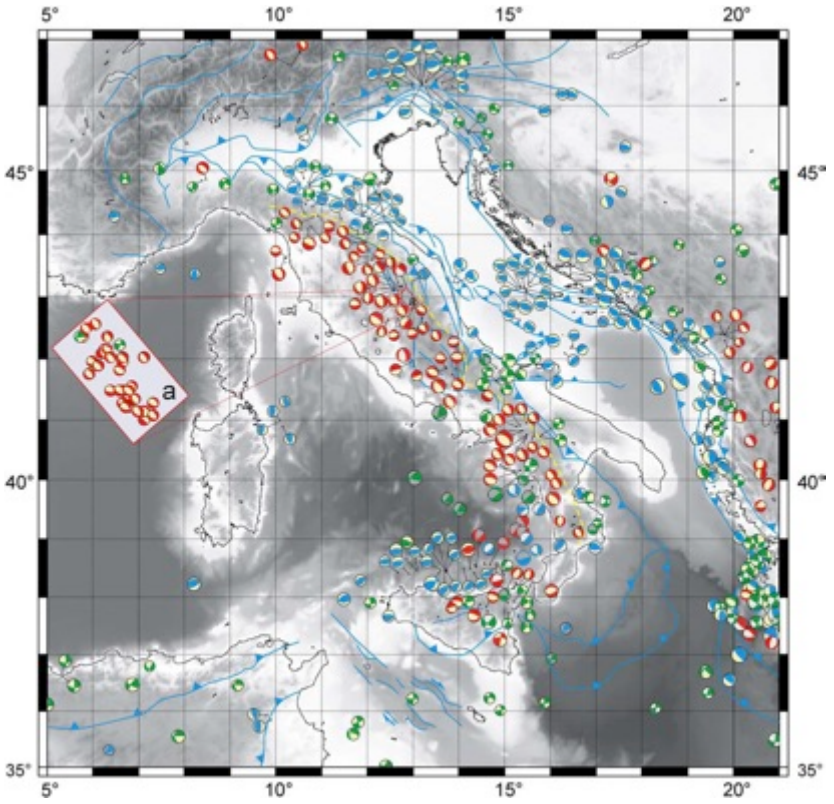


SEISMICITY OF THE ADRIATIC REGION

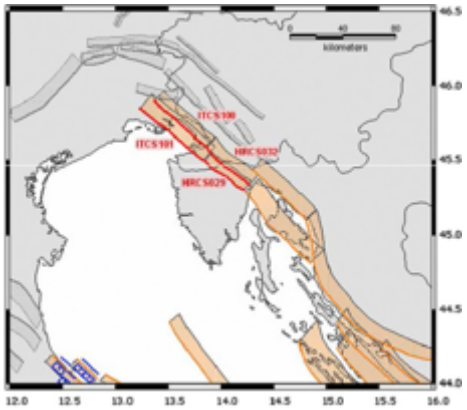
Hypocentral depth



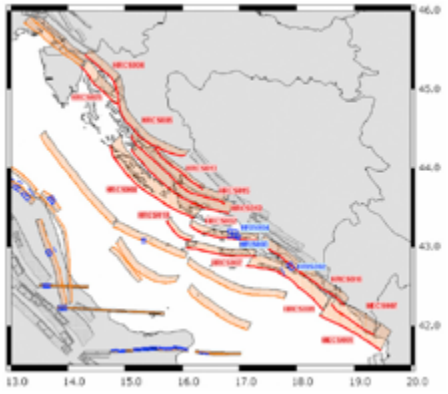
Focal mechanisms



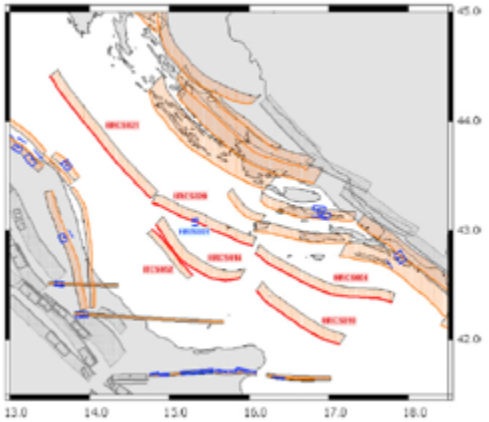
DISS INGV – Italian seismicity catalogue



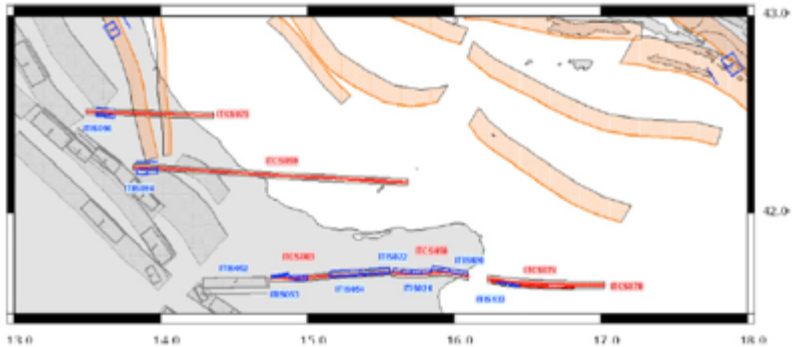
Region name	North-Eastern Adriatic
Region code	AD1
Structural setting	External Dinarides thrust belt
Principal faulting style	reverse to reverse-dextral strike slip
Largest Earthquake	14.08.1574 M_w 5.6 Lupoglav earthquake
Largest Tsunami	26.03.1511 I 2 Venice/Trieste tsunami



Region name	Eastern Adriatic
Region code	AD2
Structural setting	Internal and central part of External Dinarides thrust belt
Principal faulting style	thrusting, reverse to reverse-dextral strike slip
Largest Earthquake	06.04.1667 M_w 7.2 Dubrovnik earthquake
Largest Tsunami	06.04.1667 I 4 Dubrovnik tsunami



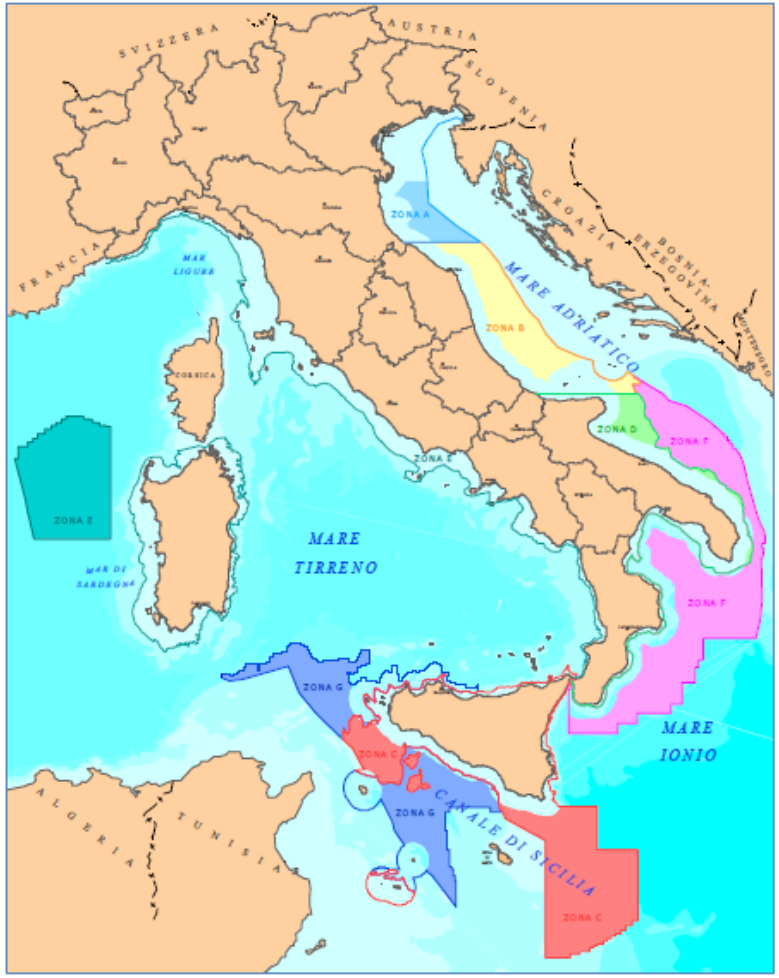
Region name	Central Adriatic
Region code	AD3
Structural setting	External parts of the External Dinarides and Apennines, Middle Adriatic
Principal faulting style	thrusting
Largest Earthquake	02.07.1844 M_w 5.6 Adriatic earthquake
Largest Tsunami	unknown



Region name	Southern Western Adriatic
Region code	AD4
Structural setting	Apulian foreland shear zone
Principal faulting style	dextral strike-slip
Largest Earthquake	30.07.1627 M_w 6.7 Gargano earthquake
Largest Tsunami	30.07.1627 I 5 Gargano tsunami

HYDROCARBON EXLORATION

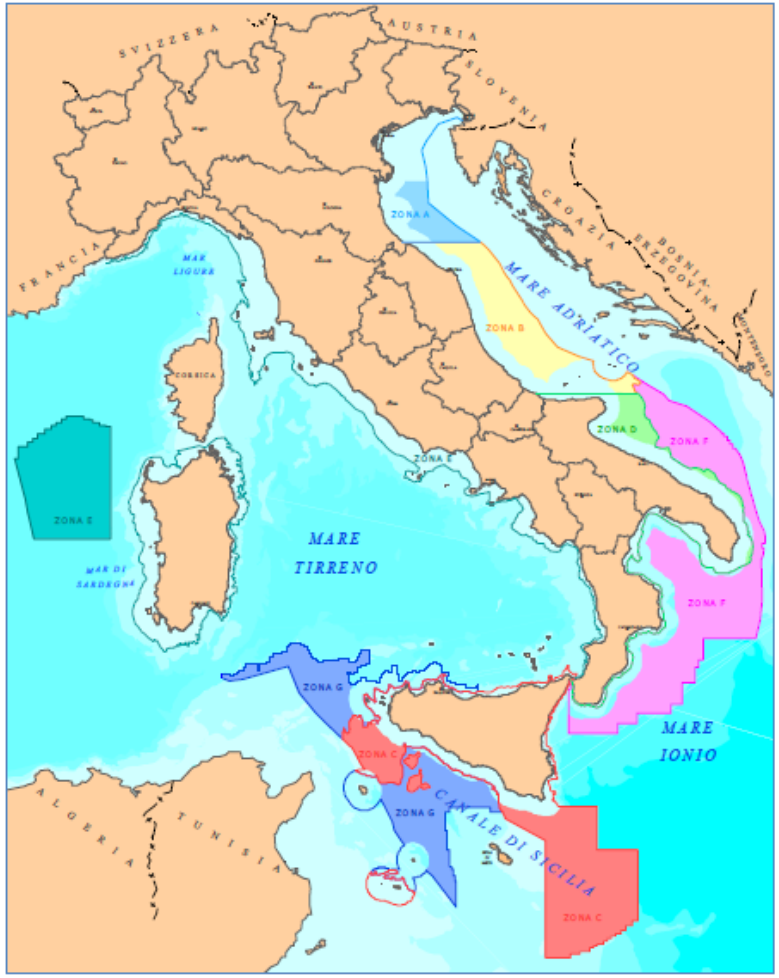
Zone marine originariamente aperte alle attività minerarie (Elaborazione dell'Ufficio cartografia della DGRME)



Zone marine aperte alle attività minerarie e rimodulate con D.M. 8/08/2013 (Elaborazione dell'Ufficio cartografia della DGRME)

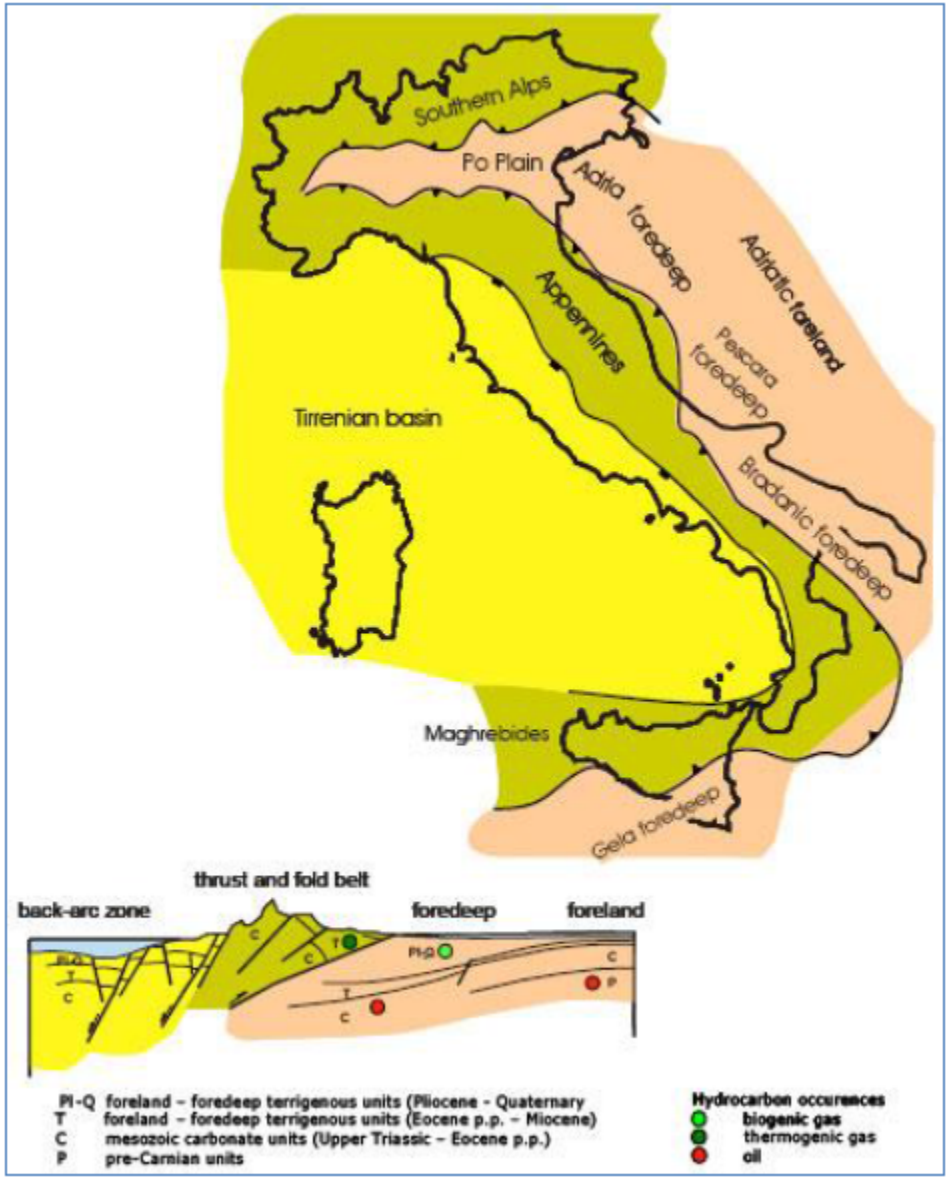
HYDROCARBON EXLORATION

Zone marine originariamente aperte alle attività minerarie (Elaborazione dell'Ufficio cartografia della DGRME)

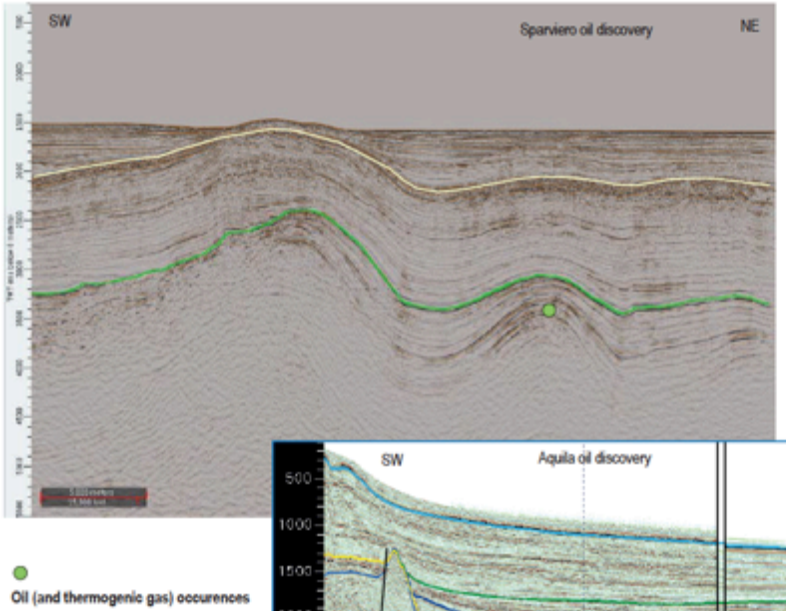


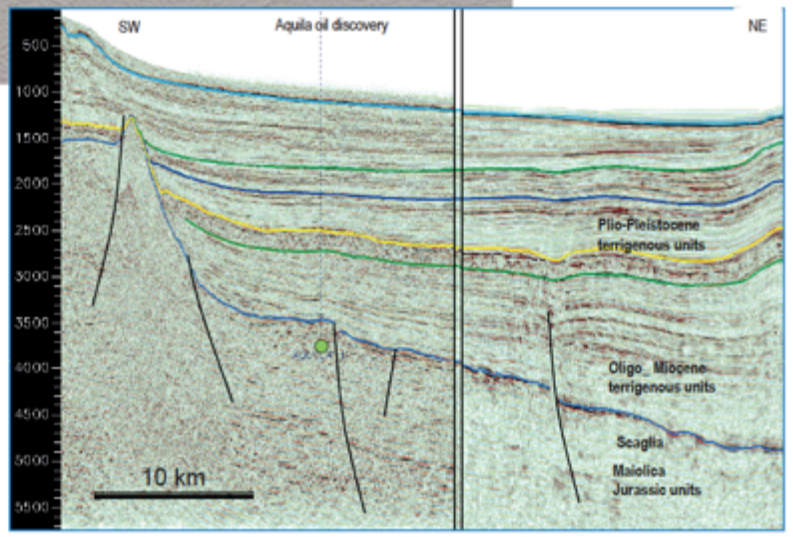
Zone marine aperte alle attività minerarie e rimodulate con D.M. 8/08/2013 (Elaborazione dell'Ufficio cartografia della DGRME)

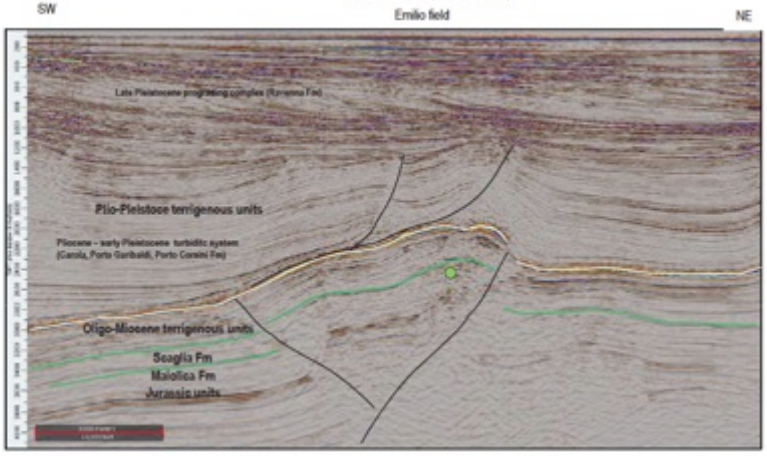
LOCATION OF THE MAIN HYDROCARBON FIELDS AND STRUCTURAL SETTING



HYDROCARBON EXLORATION



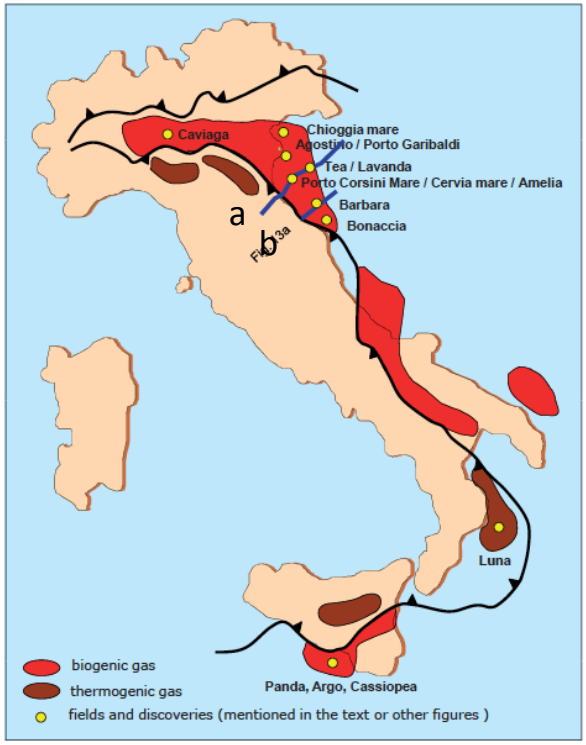


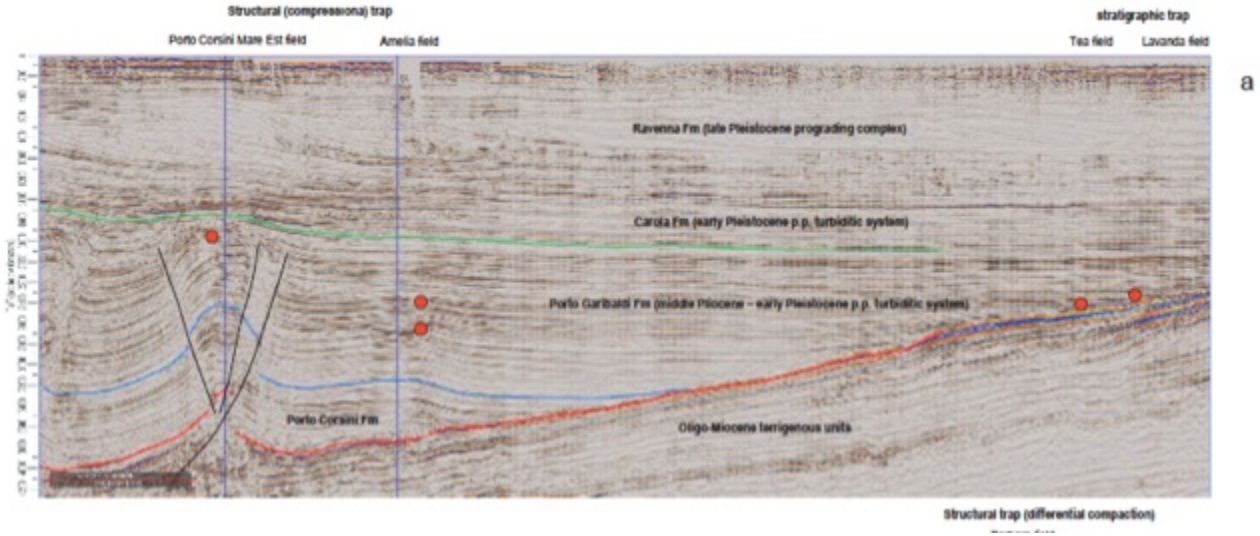


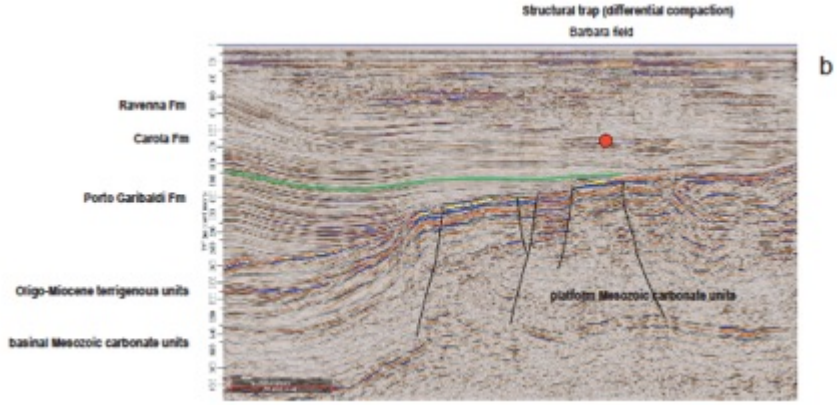
a

Cazzini et al., Journal of Petroleum Geology, Vol. 38(3), July 2015, pp 255-279

HYDROCARBON EXLORATION



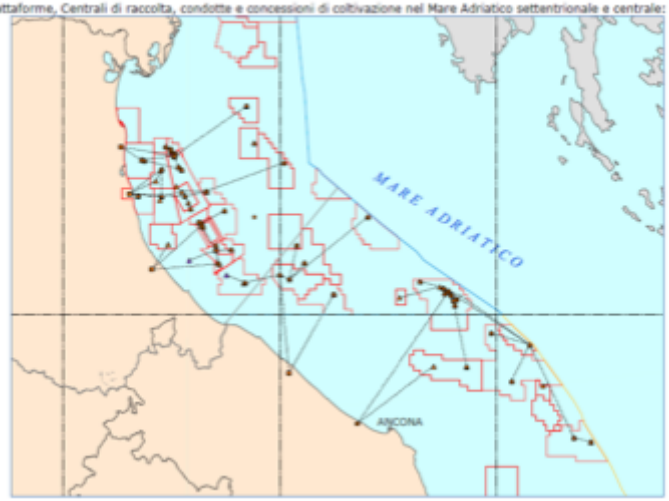




Cazzini et al., Journal of Petroleum Geology, Vol. 38(3), July 2015, pp 255-279

CARTE DEGLI IMPIANTI ATTIVI IN MARE - SITUAZIONE AL 31 DICEMBRE 2014

Piattaforme, Centrali di raccolta, condotte e concessioni di coltivazione nel Mare Adriatico settentrionale e centrale:

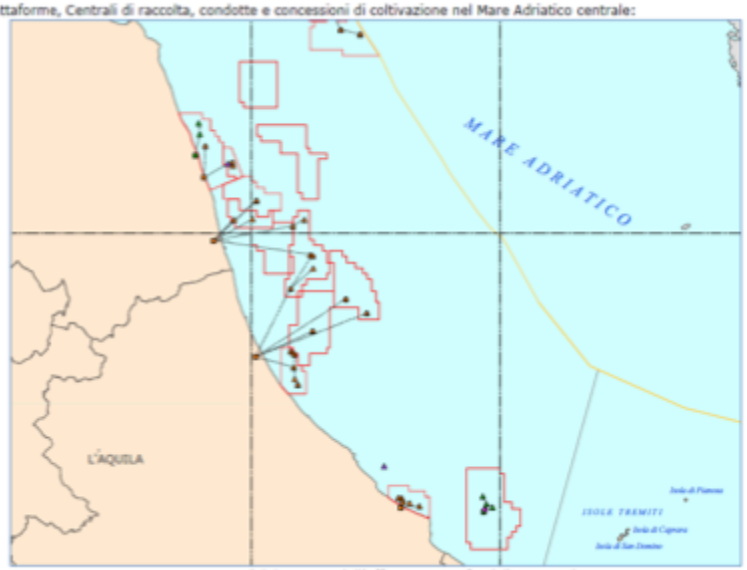


POZZI ATTIVI NELL'OFFSHORE ITALIANO AL 31 DICEMBRE 2014

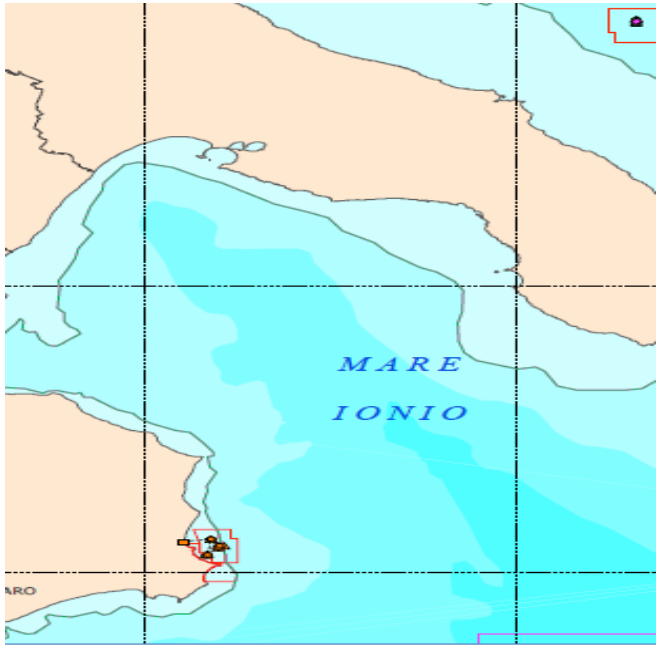
	Zona A	Zona B	Zona C	Zona D	Zona F	Zona G	Totale
Produttivi	230	79	22	28	2	0	361
Potenzialmente produttivi	253	68	22	1	1	4	349
Altra utilizzo	10	3	1	0	0	0	14
Totale	493	150	45	29	3	4	724

	Zona A	Zona B	Zona C	Zona D	Zona F
Gas naturale	230	47	0	28	0
Olio greggio	0	32	22	0	2
Totale	230	79	22	28	2

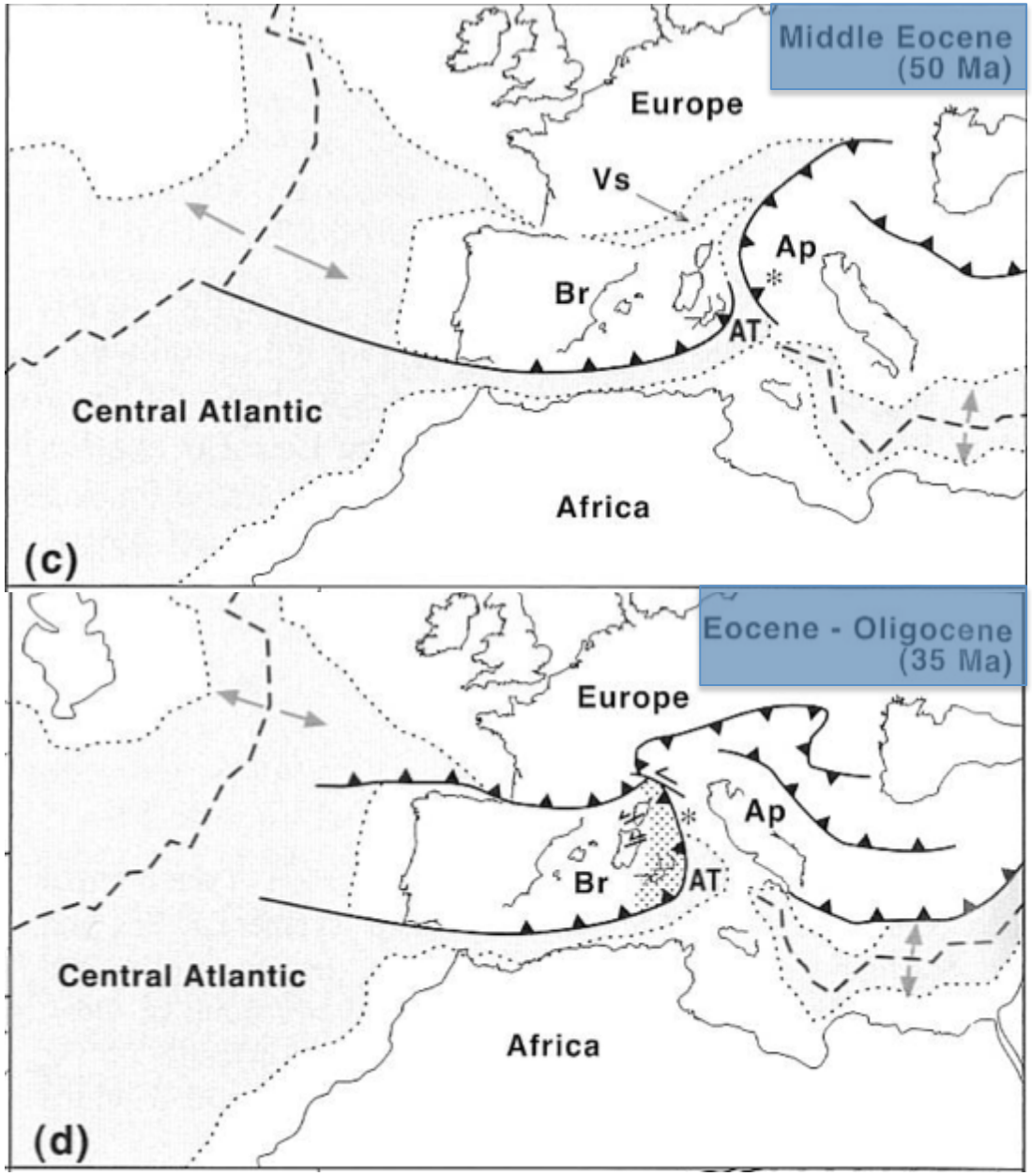
Piattaforme, Centrali di raccolta, condotte e concessioni di coltivazione nel Mare Adriatico centrale:



(Elaborazioni dell'Ufficio cartografia della DGRME)

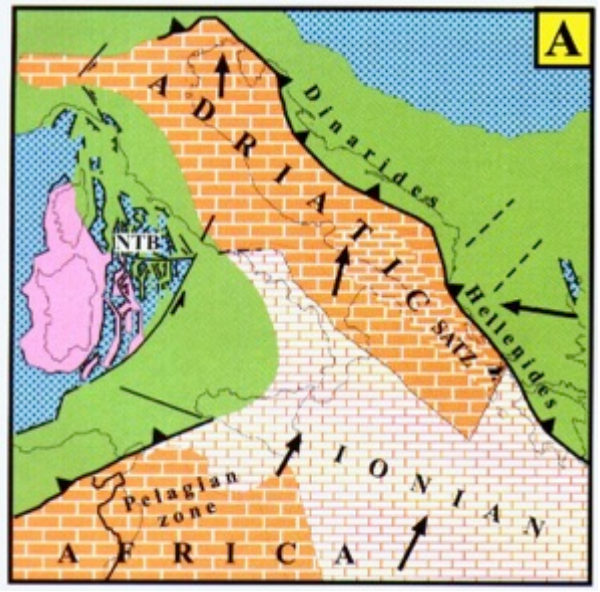


STRUCTURAL SKETCH OF MEDITERRANEAN AREA (from Middle Eocene)

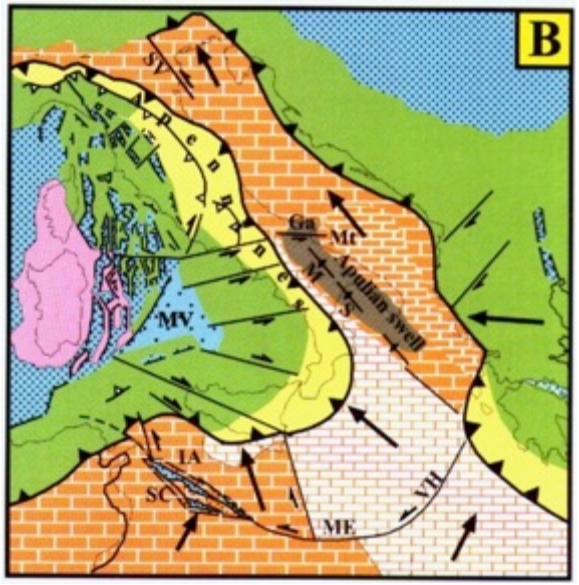


PLIO-QUATERNARY EVOLUTION OF THE MEDITERRANEAN REGION

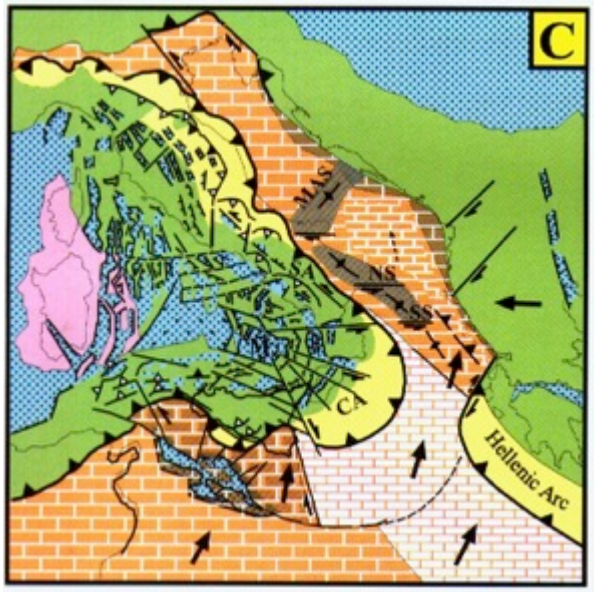
Upper Miocene (8 Ma)



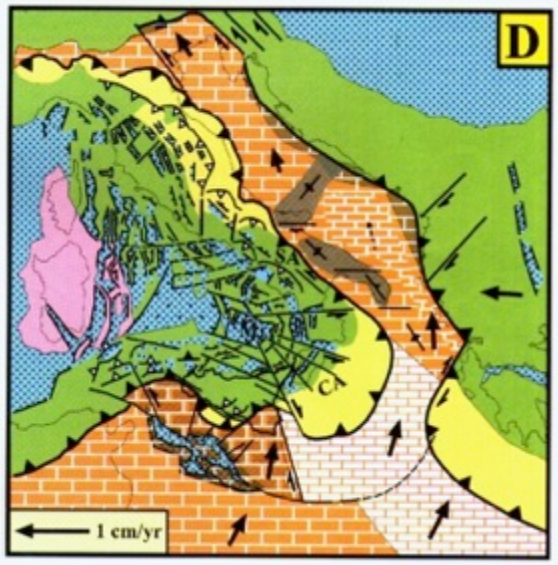
Pliocene (4Ma)



Lower Pleistocene (1,5 Ma)



Upper Pleistocene (0,11 Ma)



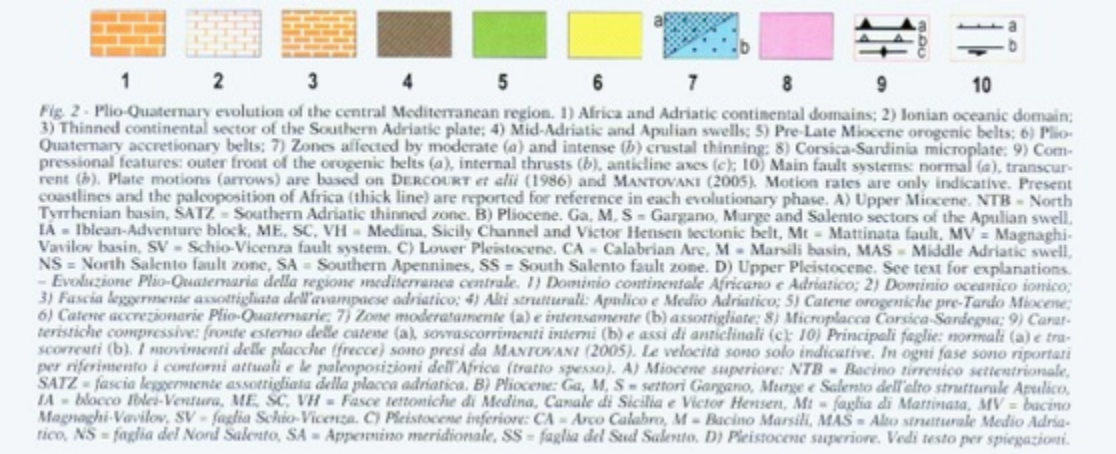


Fig. 2 - Plio-Quaternary evolution of the central Mediterranean region. 1) Africa and Adriatic continental domains; 2) Ionian oceanic domain; 3) Thinned continental sector of the Southern Adriatic plate; 4) Mid-Adriatic and Apulian swells; 5) Pre-Late Miocene orogenic belts; 6) Plio-Quaternary accretionary belts; 7) Zones affected by moderate (*a*) and intense (*b*) crustal thinning; 8) Corsica-Sardinia microplate; 9) Compressional features: outer front of the orogenic belts (*a*), internal thrusts (*b*), anticline axes (*c*); 10) Main fault systems: normal (*a*), transcurrent (*b*). Plate motions (arrows) are based on DERCOURT *et alii* (1986) and MANTOVANI (2005). Motion rates are only indicative. Present coastlines and the paleoposition of Africa (thick line) are reported for reference in each evolutionary phase. A) Upper Miocene. NTB = North Tyrrhenian basin, SATZ = Southern Adriatic thinned zone. B) Pliocene. Ga, M, S = Gargano, Murge and Salento sectors of the Apulian swell, IA = Iblean-Adventure block, ME, SC, VH = Medina, Sicily Channel and Victor Hensen tectonic belt, Mt = Mattinata fault, MV = Magnaghi-Vavilov basin, SV = Schio-Vicenza fault system. C) Lower Pleistocene. CA = Calabrian Arc, M = Marsili basin, MAS = Middle Adriatic swell, NS = North Salento fault zone, SA = Southern Apennines, SS = South Salento fault zone. D) Upper Pleistocene. See text for explanations. – *Evoluzione Plio-Quaternaria della regione mediterranea centrale. 1) Dominio continentale Africano e Adriatico; 2) Dominio oceanico ionico; 3) Fascia leggermente assottigliata dell'avampaese adriatico; 4) Alti strutturali: Apulico e Medio Adriatico; 5) Catene orogeniche pre-Tardo Miocene; 6) Catene accrezionarie Plio-Quaternarie; 7) Zone moderatamente* (a) *e intensamente* (b) *assottigliate; 8) Microplacca Corsica-Sardegna; 9) Caratteristiche compressive: fronte esterno delle catene* (a)*, sovrascorrimenti interni* (b) *e assi di anticlinali* (c)*; 10) Principali faglie: normali* (a) *e trascorrenti* (b)*. I movimenti delle placche (frecce) sono presi da MANTOVANI (2005). Le velocità sono solo indicative. In ogni fase sono riportati per riferimento i contorni attuali e le paleoposizioni dell'Africa (tratto spesso). A) Miocene superiore: NTB = Bacino tirrenico settentrionale, SATZ = fascia leggermente assottigliata della placca adriatica. B) Pliocene: Ga, M, S = settori Gargano, Murge e Salento dell'alto strutturale Apulico, IA = blocco Iblei-Ventura, ME, SC, VH = Fasce tettoniche di Medina, Canale di Sicilia e Victor Hensen, Mt = faglia di Mattinata, MV = bacino Magnaghi-Vavilov, SV = faglia Schio-Vicenza. C) Pleistocene inferiore: CA = Arco Calabro, M = Bacino Marsili, MAS = Alto strutturale Medio Adriatico, NS = faglia del Nord Salento, SA = Appennino meridionale, SS = faglia del Sud Salento. D) Pleistocene superiore. Vedi testo per spiegazioni.*

(VITI ET AL., 2006)

MAIN STRUCTURAL TECTONIC FEATURES OF THE PERI-ADRIATIC AREAS

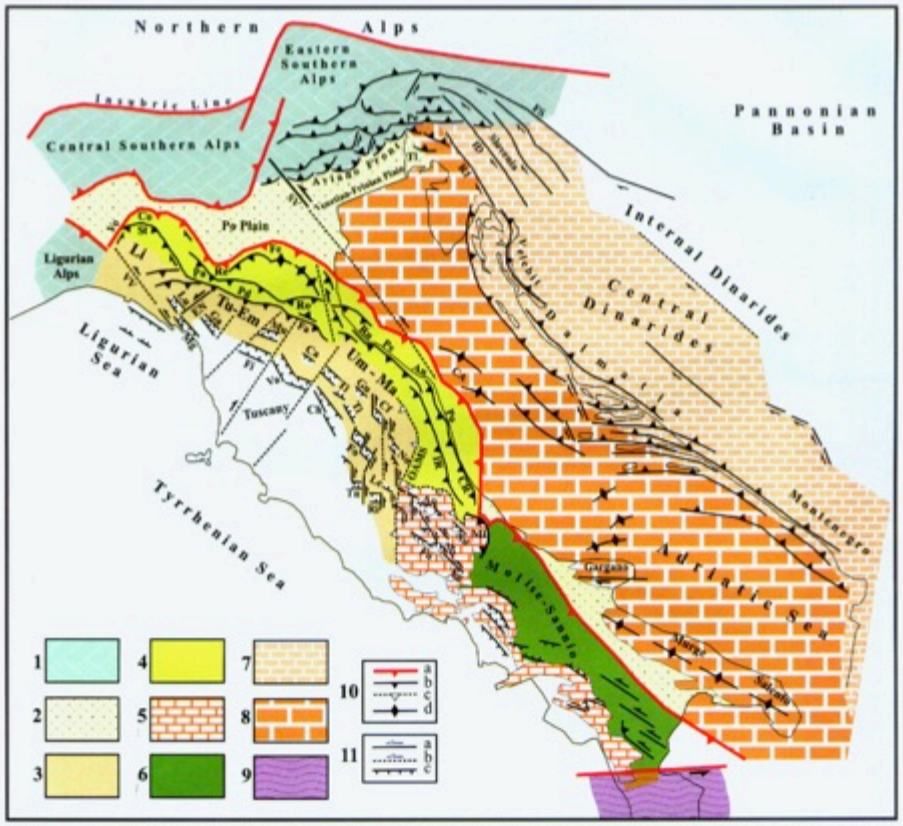
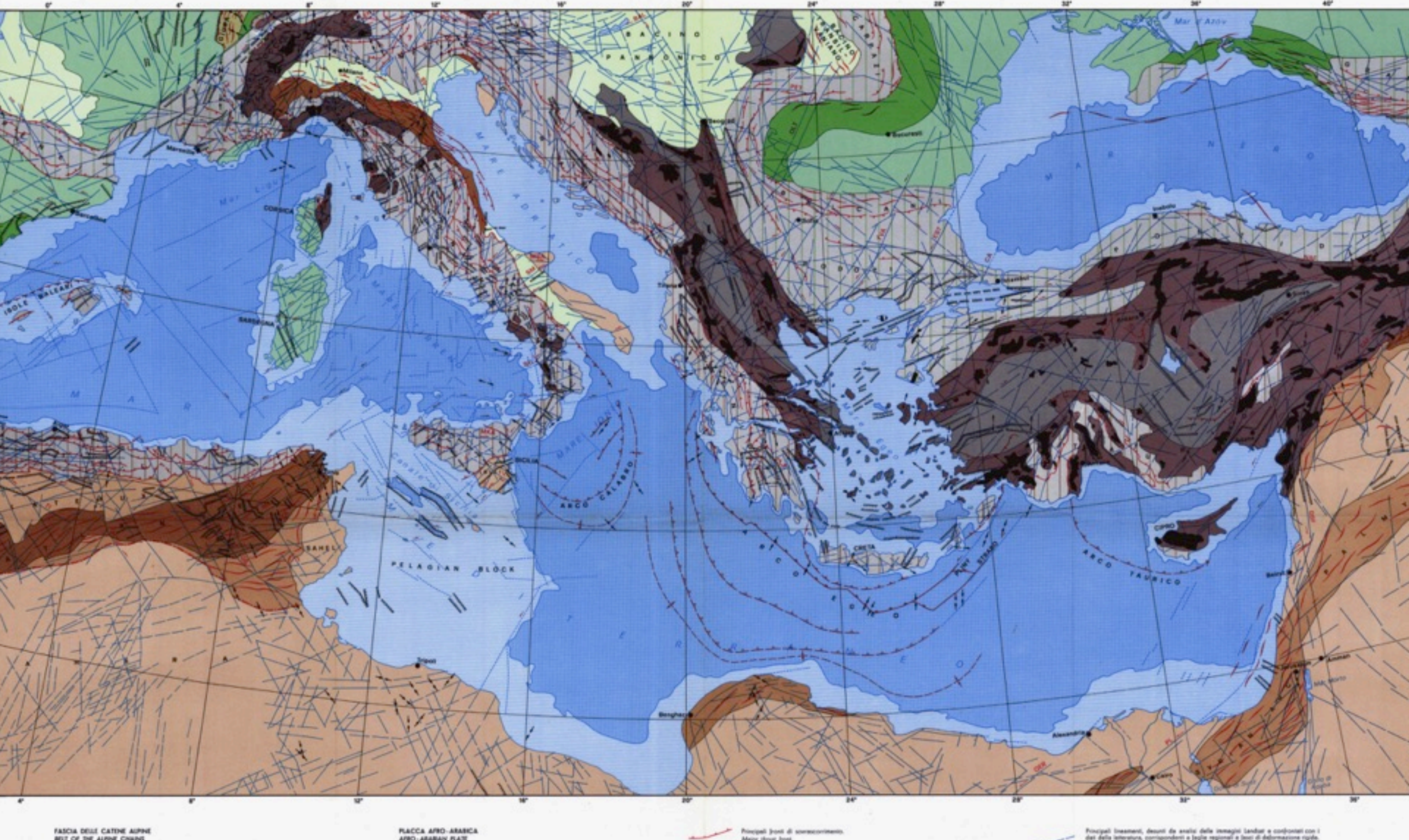


Fig. 4 - Main structural and tectonic features in the Central-Northern Apennines and the northern peri-Adriatic zones. 1) Ligurian and Southern Alps; 2) Foredeep basins; 3, 4) Axial and outer belts of the Northern Apennines; 5) Latium-Abruzzi and Southern Apennines carbonate platforms; 6) Outer belt of the Southern Apennines; 7) Dinarides carbonate platforms; 8) Adriatic foreland; 9) Calabrian Arc; 10) Compressional features: a = outer front of the Alps and Apennines; b,c = active and inactive thrusts, d = fold axes; 11) Transcurrent and extensional features: a, b = active and presumably active strike-slip faults; c = normal faults. Main compressional features: CA = central Adriatic folds; Co = San Colombano-Cremona; CR = Coastal Ridge; Fa = Faenza; Fe = Ferrara; IR = Internal Ridge; OAMS = Olevano-Antrodoco-Monti Sibillini lineament; Pa = Parma; Pd = Pedeapennine; Pe = Periadriatic; Po = Porto S. Giorgio, Re = Reggio Emilia; Ro = Romagna; Rn-Pe-An = Rimini-Pesaro-Ancona; St = Stradella-Fiorenzuola d'Arda; Vo = Voghera-Pavia. Main strike-slip features: EN = Enza; FS = Fella-Sava; ID = Idrija; RJ = Rijeka; SV = Schio-Vicenza; VV = Villalvernia-Varzi. Main extensional/transtensional basins: Aq = Aquila; Ca = Casentino; Ch = Chiana; Cf = Colfiorito; Fi = Firenze-Pistoia; Fo = Foligno-Spoleto; Fu = Fucino; Ga = Garfagnana; Gu = Gubbio; Le = Leonessa; Lu = Lunigiana; Mg = Magra; Mu = Mugello; No = Norcia; Ri = Rieti; Sg = Upper Sangro; Su = Sulmona; Ti = Tiber; Tn = Terni; Va = Valdarno; Li = Ligurian Apennines; Ml = Maiella; Tl = Tagliamento river; Tu-Em = Tuscany-Emilia Apennines; Um-Ma = Umbria-Marche Apennines. Details on tectonic features in the Southern Apennines are given in Figs 1 and 3. See text for explanations.

– Principali caratteristiche strutturali e tettoniche nell'Appennino centro settentrionale e sulle zone periAdriatiche settentrionali. 1) Alpi liguri e meridionali; 2) Avanfosse; 3, 4) Parti assiali ed esterne dell'Appennino settentrionale; 5) Unità di piattaforma carbonatica dell'Appennino centrale e meridionale; 6) Parte esterna dell'Appennino meridionale; 7) Unità di piattaforma carbonatica delle Dinaridi; 8) Avampaese adriatico; 9) Arco Calabro; 10) Strutture compressive: a = fronte esterno delle Alpi e dell'Appennino, b,c = raccorciamenti attivi ed inattivi, d = assi di pieghe; 11) Faglie trascorrenti e normali: a,b = faglie trascorrenti attitive e probabilmente attive; c = faglie normali. Principali strutture compressive: CA = pieghe nell'Adriatico centrale; Co = San Colombano-Cremona; CR = Ridge Costiero; Fa = Faenza; Fe = Ferrara; IR = Ridge interno; OAMS = lineamento Olevano-Antrodoco-Monti Sibillini; Pa = Parma; Pd = Pedeappennino; Pe = Periadriatico; Po = Porto S. Giorgio, Re = Reggio Emilia; Ro = Romagna; Rn-Pe-An = Rimini-Pesaro-Ancona; St = Stradella-Fiorenzuola d'Arda; Vo = Voghera-Pavia. Principali strutture trascorrenti: EN = Enza; FS = Fella-Sava; ID = Idrija; RJ = Rijeka; SV = Schio-Vicenza; VV = Villalvernia-Varzi. Principali bacini estensionali/transtensionali: Aq = Aquila; Ca = Casentino; Ch = Chiana; Cf = Colfiorito; Fi = Firenze-Pistoia; Fo = Foligno-Spoleto; Fu = Fucino; Ga = Garfagnana; Gu = Gubbio; Le = Leonessa; Lu = Lunigiana; Mg = Magra; Mu = Mugello; No = Norcia; Ri = Rieti; Sg = Alto Sangro; Su = Sulmona; Ti = Tevere; Tn = Terni; Va = Valdarno. CA = pieghe Centro Adriatiche; Li = Appennino Ligure; Ml = Maiella; Tl = Tagliamento; Tu-Em = Appennino Tosco-Emiliano; Um-Ma = Appennino Umbro-Marchigiano. Dettagli sulle caratteristiche tettoniche nell'Appennino meridionale sono riportati nelle figg. 1 e 3. Vedi testo per spiegazioni.

(VITI ET AL., 2006)



FASCIA DELLE CATENE ALPINE
BELT OF THE ALPINE CHAINS

Elementi delle catene del margine euro-asiatico (Betica, Alpi, Carpazi, Balcani, Pontidi, Caucaso, Alborz), inclusi i Pirenei e la Provenza.
Elements of the Euro-Asiatic margin chains (Betics, Alps, Carpathians, Balkans, Pontids, Caucasus, Alborz), including Pyrenees and Provence.

Fasce di affioramento dei resti di zone oceaniche (flysch, ofioliti, mélange, etc.), inclusi elementi continentali.
Belts of outcropping oceanic remnants (flysch, ophiolites, mélange, etc.) including continental elements.

Massicci intermedi: zona Pelagoniana, massicci centro-anatolici e massa mediana centro-iraniana.
Intermediate massifs: Pelagonian zone, central-Anatolian massifs and central-Iranian median mass.

Elementi delle catene del margine afro-arabico (Rif, Tell, Appennini, Alpi Meridionali ed Orientali, Dinaridi esterne, Ellenidi esterne, Tauridi, Alta Catena degli Zagros).
Elements of the Afro-Arabian margin chains (Rif, Tell, Apennines, Southern and Eastern Alps, external Dinarides, external Hellenides, Taurids, High Zagros Chain).

PLACCA AFRO-ARABICA
AFRO-ARABIAN PLATE

Catene dell'avampaese (Atlante, Zagros) e zone corrugate sepolte padano-adriatiche.
Foreland chains (Atlas, Zagros) and Po plain-Adriatic buried folded zones.

Coperture della piattaforma più o meno deformate nelle fasi neogenico-quaternarie (Zona atlasica esterna, Cirenaica, Syrian Arc, Catene di Palmyra, Border Folds nord-arabiche).
Platform covers, more or less deformed in the Neogene-Quaternary phases (external Atlasic zone, Cyrenaica, Syrian Arc, Palmyra range, north-Arabian Border Folds).

Hauts Plateaux e Mesete Marocchine.
Hauts Plateaux and Moroccan Mesets.

Avampaese non deformato durante l'orogenesi alpina.
Foreland, undeformed during the Alpine orogenesis.

Principali fronti di sovrascorrimento.
Major thrust front.

Sistema della fossa Ellenica.
Hellenic trench system.

Sistemi di accavallamento collegati agli archi.
Thrust systems related to the arcs.

Avanfossa Calabra e Avanfossa Jonico-levantina.
Calabrian foretrough and Ionian-Levantine foretrough.

Principali piegamenti delle zone esterne e di avampaese.
Major folds of the external zones and of the forelands.

Flessura Sud-Atlasica.
South-Atlasic flexure.

Principali bacini neogenico-quaternari.
Major Neogene-Quaternary basins.

Principali lineamenti, desunti da analisi delle immagini Landsat e confrontati con i dati della letteratura, corrispondenti a faglie regionali e fasci di deformazione rigida.
Major lineaments, deriving from analysis of Landsat imagery and compared with bibliographic data, corresponding to regional faults and rigid deformation belts.

Principali fratture nelle zone marine, desunte da dati geofisici e morfologici.
Major fractures in the marine areas, deriving from geophysical and morphological data.

Senso del movimento orizzontale lungo i lineamenti.
Direction of horizontal displacement along lineaments.

Principali masse ofiolitiche di età alpina.
Major ophiolitic masses of Alpine age.

Direzioni principali di compressione (a) e di estensione (b) plio-quaternarie, da misure in situ, analisi microtettoniche e meccanismi focali dei terremoti.
Principal directions of compressional (a) and tensional (b) Plio-Quaternary stresses, according to in situ measurements, microtectonic analyses and earthquake focal mechanisms.

Isobata di 1.000 metri.
1000 m bathymetric contour.