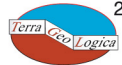




L. VEZZANI¹, A. FESTA¹ & F. GHISETTI²

GEOLOGICAL-STRUCTURAL MAP OF THE CENTRAL-SOUTHERN APENNINES (ITALY)

LEGEND



1. POST-OROGENIC DEPOSITS

Beach deposits and coastal plain alluvium (1s). Eluvial-colluvial deposits, red soils (1e). Recent and present-day river deposits (1f). Terrestrial and/or marine terraces. Terraced lacustrine, fluvio-lacustrine and fluvial deposits of the major, fault-bounded intramontane basins (e.g. Fucino, Sulmona and Aterno) (1t). Lacustrine, fluvio-lacustrine, swamp and tidal marsh deposits (1l). Travertines (1tv). Terraced terrestrial deposits of the Tavoliere delle Puglie (Foggia-Cerignola area) (1ft). Moraines and fluvio-glacial deposits (1g). Pyroclastites, tuffs, tuffites, interlayered pyroclastites and clastic deposits, volcanites of Mt. Vulture (1p) (*Holocene- Pleistocene*).

2. PLIO-PLEISTOCENE FOREDEEP

Mutignano Formation. Bluish claystones (2a) grading laterally and upwards to yellow sands (**Sands of Serracapirola**, 2s), to littoral, fluvio-deltaic and terrestrial conglomerates (**Campomarino Conglomerates**, 2sc) and to reddish fanglomerates and sands with travertines in the San Arcangelo Basin, in Basilicata (**Sands and Conglomerates of Serra Corneta**, 2cs). Basal conglomerates (**Turrivalignani Conglomerates**, 2c) and biocalcarenes are locally present (*early Pleistocene - late Pliocene*).

3. TOP-THRUST BASINS

Alessa Formation. Yellow sands (3as) grading upwards and laterally to bluish claystones with rare sandy interlayers (3aa) (*early Pleistocene - late Pliocene*).

Castilenti Formation (3ba). Prevailing bluish claystones with interbedded sands and conglomerates (*late - middle Pliocene*).

Mt. Coppe, Palombaro, Larino, Panni, Campobasso, Jelsi, Ariano Irpino, Ruvo del Monte, Potenza, Stigliano and Craco clastic successions. Basal calcarenites, conglomerates and calcirudites (3cc) grading upwards to bluish marly claystones (3ca) and to yellow sands and conglomerates (3cs) (*middle - early Pliocene*).

Mts. Frentani Clastic-Evaporitic Succession, Mt. Castello and Ariano Irpino scalo Evaporites, Bocche di Mezzana and Le Vicenne Conglomerates (3dg). Evaporites, gypsum arenites and conglomerates with gypsum clasts, sandstones and sands grading to claystones (*early Pliocene? - Messinian*). **Sandstones of Valli, San Bartolomeo in Gaido, Anzano di Puglia, San Giorgio la Mola, Villamaina and Altavilla Irpina. Claystones of Celenza Valfortore.** Coarse sandstones and conglomerates in thick beds (3ds) with intercalations of claystones, marly claystones and marls (Ufita River, 3da) (*Messinian - late Tortonian*).

Castelvetero, Gorgoglione, Perosa and Oriolo clastic succession (3ea). Alternating sandstones and claystones with channelled conglomerates and sandstones and with oolostromes of Liguride and Siclide units; calcareous olistoliths (ol) up to thousand cubic metres in size are locally present (Mt. Carruzzo) (*Tortonian - Serravallian - Langhian?*).

Albidona Formation (3fa). Alternating sandstones and claystones with dm-thick beds of whitish marls and polygenic conglomerates with prevailing sandy matrix (*Langhian - Burdigalian? - Oligocene - middle - early Eocene?*).

4. SICILIDE UNITS

Varicoloured Scaly Clays ("Argille Scagliose", 4av). Tectonic mélange of red, green and blackish claystones with internal chaotic structure, interbedded with flints and cherty limestones (4at), and tectonically interleaved with olistoliths of Mesozoic limestones and lower Miocene calcarenites derived from the units of the Lazio-Abruzzi and Campania-Lucania carbonate platforms (e.g. **Limestones of Punta d'Appesa** at the Calabria-Basilicata border). Along the eastern front of the Apennines the **"Argille Scagliose"** are cataclastically deformed (in blocks few dm to thousand cubic m in size) within the outermost and deepest thrust sheets of the Sannio-Molise units and are tectonically interleaved with gypsum and calcareous evaporites (Messinian) and with lower Pliocene calcarenites of the top-thrust basins. Repeated imbrication of these chaotic and detached tectonic units defines the frontal duplex of the Apenninic accretionary prism.

Numidian Flysch (4q). Yellowish quartzarenites in metric beds with thin interlayers of brown shales (*Langhian - Burdigalian*).

Morrone del Sannio and Corleto Perticara Formations (4bc). Alternating calcareous microbreccias, calcarenites, calcilutites, red-green marls and shales. Grey-pink calcareous mudstones with interbedded calcarenites and light-coloured turbiditic calcilutites and whitish clayey-silty marls with rare interlayers of dark shales, lithic sandstones and conglomerates (*early Miocene - Oligocene?*).

Tusa Tuffites and Corleto Perticara Formation (arenitic succession, 4at). Alternating sandstones, green tuffites, marls and white marly limestones (*early Miocene - late Oligocene*).

Mt. Sant'Arcangelo Formation and Nocera Flysch (4cm). Alternating white micritic limestones (**"Scaglia Bianca"** facies), marly limestones and mudstones with rare calciruditic interlayers; alternating sandstones, grey-greenish claystones and limestones. This succession includes the "Calcarei Cristallini" of Duronia (Molise region) and of Torrente Pietramonte (W of Basilice, Campania region) (*Eocene - Late Cretaceous*).

5. CALABRIDE UNITS

Undifferentiated Metamorphic Unit of Timpa Rotalupo (5gg). Garnet gneisses, biotite gneisses, amphibolites and marbles.

6. LIGURIDE UNITS

Saraceno Formation (6sa). Alternating calcarenites and calcilutites with rare tuffitic sandstones and thin interlayers of black-greenish and purple clayey marls (*Oligocene - Late Cretaceous*).

Crete Nere Formation (6cn). Blackish-bluish argillites with interlayers of light-green quartz siltites (*Early Cretaceous*).

Frido Formation (6fr). Black phyllites with interlayers of quartzites; grey calcareous schists with interlayers of marbles and quartzites. Black cataclastic serpentinites and greenish-bluish basalts (**ophiolites**, 6of). Disrupted blocks of the sedimentary succession originally deposited above oceanic pillow basalts are locally preserved (e.g. Mezzana, in the Basilicata region) with argillites, red and green radiolarites, red nodular limestones and white micritic limestones (**"Maiolica"** facies), overlain by red-green-black silty argillites with quartzites interlayers (*Early Cretaceous - Late Jurassic*).

7. LAZIO-ABRUZZI AND CAMPANIA-LUCANIA UNITS

Syntectonic deposits of the foredeep (7a): **Anversa degli Abruzzi and Tornimparte Flysch (Messinian); Val Roveto and Pietraraja Flysch** with megabreccias and basal calcareous conglomerates (**Renga and San Massimo Breccias**, 7ar) (*Messinian - late Tortonian*); **Frosinone Flysch (late Tortonian)**.

Lithotamnium and Bryozoan Calcarenes, Cusano, Longano, Cerchiara di Calabria, Bifurto and Piaggine-Raganello Formations (7bl). Grey bioclastic calcarenites with bryozoans and locally with basal horizons of purple and yellowish marls, grading upwards to alternating marly limestones and microbreccias with lenses of paraconglomerates and intercalations of marly-silty shales and marls (*Langhian - Burdigalian*).

Mts. Simbruini-Ernicci, Marsica, Mt. Velino-Sirente, Montagna Grande, Mt. Matese, Mt. Camposauro, Mt. Marzano, Muro Lucano, Mt. Raparo and Mt. Pollino Units. Undifferentiated calcareous-dolomitic deposits, in carbonate platform facies (7pc) (*Cretaceous - Late Triassic*).

Verbicaro Unit (7dv). Prevailing dolomites (*early Lias - Late Triassic*) overlain by cherty limestones interbedded with resedimented limestones (*Early Cretaceous - Lias*), basic volcanites (Mt. Cerviero) and marls in **"Scaglia"** facies (*Oligocene - Late Cretaceous*).

8. ABRUZZI AND UMBRIA-MARCHE UNITS

Syntectonic deposits of the foredeep: **Laga Flysch (8a), Gran Sasso, Tossicia, Rocca Pia and Scontrone Flysch (8aa).** Alternating turbiditic sandstones and claystones with resedimented horizons of gypsum arenites (g), calcirudites and calcareous conglomerates (*Messinian*).

Orbulina Marls. Hemipelagic marls and calcareous marls (*Messinian - late Tortonian*). **Bisciaro, "Marne con Cerrognà" and Monte Fiore Formation.** Marly limestones with cherts in thin beds and nodules, calcareous marls and bioturbated sandy marls, locally glauconitic, interlayered with calcarenites and calcirudites (8bc) (*middle - early Miocene*).

Mt. Meta, Mt. Genzana, Mt. Cappucciata, Gran Sasso, Montagnone-Montagna dei Fiori, Acquasanta and Mt. Sibillini Units. Undifferentiated Meso-Cenozoic carbonate deposits in facies of platform scarp edge-proximal basin (8sb) (*Paleogene - Late Triassic*).

9. LAGONEGRO-SANNIO UNITS

"Galestri" Formation (9ga). Alternating brown, thinly-bedded argillites and pink calcilutites with intercalations of grey marls and calcareous microbreccias (central-southern Basilicata region). Cherty calcarenites (**Beds of Bella**) with **olistoliths (ol)** of Mesozoic limestones (north-western Basilicata region) (*Early Cretaceous*).

"Scisti silicei" (9ss). Red-green radiolarites in cm-thick beds with thin interlayers of silicified microbreccias (Lagonegro-Mt. Sirino area). Radiolarites with interlayers of calcarenites in the Pignola-San Fele area (*Cretaceous - Jurassic*).

Cherty Limestones (9cs). Grey micritic limestones in cm-metre thick beds, with nodular cherts (Lagonegro-Mt. Sirino area). Well-bedded dolomites with cherts in the Pignola-San Fele area (*Jurassic - Late Triassic*).

Mt. Facito Formation (9mf). Alternating claystones, silty marls and sandstones with intercalations of reefal limestones (*Middle Triassic*).

10. SANNIO-MOLISE UNITS

Sant' Elena Flysch (10a2), Agnone Flysch (10a3) and Vallone Ferrato Flysch (10a4). Alternating claystones and sandstones with horizons of arenitic turbidites in metric beds, locally with calcarenitic-calciruditic intercalations and calcareous olistoliths (ol) (*early Messinian - late Tortonian*).

Orbulina Marls and Montenero Val Cocchiara Formation (10b1). Alternating white calcilutites, marly limestones and varicoloured pelites (*late Tortonian - Serravallian*). **Frosolone and Longano Formations (10b2).** Grey-greenish marls and marly shales with rare arenaceous-calcarenitic intercalations, grading downwards to alternating calcilutites, marly limestones and claystones (*early Messinian - Tortonian*). **Tufillo and Gamberale-Pizzoferrato Formations (10b3).** Prevailing calcirudites and thickly-bedded bioclastic calcarenites alternating with marly claystones and red-green marls (*Serravallian - Langhian*). **Faeto and Serra Palazzo Formations (marly-clayey-arenitic member, 10b4).** Alternating calcilutites and white marly limestones with intercalations of marls and sandstones and with basal layers of calcirudites and microconglomerates with nodular cherts (*Tortonian - Serravallian*).

Numidian Flysch (10q). Yellowish quartzarenites with rounded quartz grains and thin interlayers of grey-greenish and brown marly claystones (*Langhian - Burdigalian*).

Macchiagodena, Sepino, Cercemaggiore and Monaci Formations (10d). Calcareous microbreccias, bioclastic calcarenites and calcilutites with nodular cherts. **"Flysch Rosso", Serra Funaro, Mt. Sidone, Monte Malomo and Sant'Illario di Atella Formations (10d1).** Thinly bedded, alternating varicoloured marly claystones and grey-green-red marls with thin intercalations of silicified calcarenites (*early Miocene - Late Cretaceous*).

Coste Chiavarine and Mt. Calvello Formations (10e). Calcareous breccias and calcarenites with cherts in thin beds and nodules, grading upwards (Molise and Sannio regions) to polygenic calcirudites with Rudistid fragments (*Maastrichtian - Tortonian*). These formations are correlative with the cherty calcarenites (**Beds of Bella** in Basilicata) at the transition between the **"Scisti Silicei"** and **"Galestri" Formations"**.

Mt. Coppe Formation (10f). Flints and varicoloured siliceous limestones alternating with thick-bedded detritic limestones in the Montagnola di Frosolone and in the Sannio area (*early Tortonian - Albian*). This formation is correlative with the radiolarites with interlayers of calcarenites of the Pignola-San Fele area (**"Scisti Silicei"**).

Pesche Formation (10g). Dolomitic limestones and yellowish dolomites in beds 2-3 m thick, with thin interlayers of grey limestones with nodular cherts (Montagnola di Frosolone) (*Dogger - Late Triassic*). This formation can be correlated with the well-bedded dolomites with cherts of the Pignola-San Fele area.

11. OUTER ABRUZZI UNITS

Mt. Porrara Flysch (11ag). Claystones with intercalations of blackish, bituminous, gypsiferous marls, tripolaceous pelites, diatomitic siltites and gypsum arenites, grading upwards to alternating turbiditic sandstones and claystones with intercalations of conglomerates (*Messinian*).

Bryozoan and Lithotamnium Calcarenes (11bl). Detrital, bioclastic limestones with macroforaminifera, lithotamnium, bryozoans and corals, grading upwards to glauconitic marls (*middle - early Miocene*).

Mt. Morrone, Mt. Porrara, Pizzalto, Mt. Rotella, Mt. Arazzecca and "Rocchette" Units. Undifferentiated calcareous succession in carbonate platform facies in the southern Mt. Morrone, Mt. Porrara and Mt. Arazzecca, passing to facies of platform scarp edge-proximal basin in the northern Mt. Morrone (11pt) (*Cretaceous - late Lias*).

12. LA QUEGLIA-COLLE MADONNA-TERAMO UNIT

Teramo Flysch (12a). Alternating sandstones and claystones grading upwards to clayey marls (**Vomano Marls**) (*early Pliocene - post-evaporitic Messinian*). **Forca di Penne-La Queglia Flysch** and **"Gessoso-Solfifera" Formation (12b).** Diatomitic marls with silty-tuffitic layers and black gypsiferous clayey marls, overlain by alternating pelites and arenaceous turbidites (*early Pliocene? - Messinian*).

Orbulina Marls and Bolognano Formation (12c). Glauconitic biocalcarenes with bryozoans and lithotamnium, grading upwards to grey Orbulina bearing marls (*Messinian - Serravallian*). Calcareous succession in **"Scaglia"** and **"Maiolica"** facies, with intercalations of calcareous rudites (Colle Madonna) (12d). Magmatic dykes are present on the west flank of La Queglia (★) (*Eocene - Cretaceous*).

13. MAIELLA AND MT. ALPI UNITS (APULIA-ADRIATIC DEFORMED UNITS)

Montefino and Cellino Formations (13a). Turbiditic sandstones and claystones with intercalations of polygenic breccias, grading upwards to grey-bluish marly clays (shelf facies) in outcrop between the Pescara and Tordino Rivers only (*early Pliocene*).

Maiella Flysch (13f). Turbiditic succession of sandstones and claystones with basal conglomerates and calcareous breccias (**Roccacaramanico and Palena Conglomerates**) (*early Pliocene*).

"Gessoso-Solfifera" Formation (13gs). Marls and marly limestones, bituminous tripolaceous marls with intercalations of glauconitic calcarenites, gypsiferous tripolaceous marls grading upwards to graded siltites and pelites with oligotypical foraminifera assemblages and ostracods (**"Lago-Mare" marls**) (*Messinian*).

Mt. Alpi Calcarenes and Conglomerates (13ma). Grey biocalcarenes with intercalations of blackish calcilutites and clayey-silty marls (*early Messinian*), grading upwards to well-cemented polygenic conglomerates, calcarenites and quartz-rich sandstones with oblique lamination (*Messinian*).

Bolognano Formation (13bo). Bioclastic limestones, locally glauconitic, with bryozoans and oysters, grading upwards to marls and calcareous marls with Orbulina and to bioclastic calcarenites with lithotamnium (*Tortonian - early Miocene*).

Undifferentiated Meso-Cenozoic calcareous succession in carbonate platform facies in the Mt. Alpi and southern Maiella, passing to basinal facies in the northern Maiella (13pt) (*Oligocene - late Malm*).

14. CASOLI UNIT

Torrente Lajo Flysch (14a). Claystones and marly claystones with rare intercalations of turbiditic sandstones (*early Pliocene*).

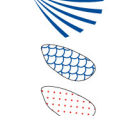
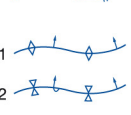
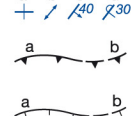
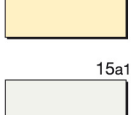
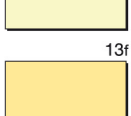
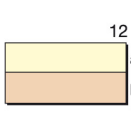
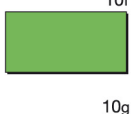
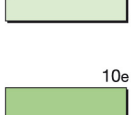
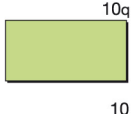
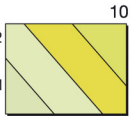
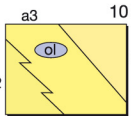
15. APULIA FORELAND

Gravina Calcarenes (15a1). Yellowish bioclastic calcarenites with rare clayey interlayers (*early Pleistocene*).

Apricena Calcarenes (15a2). Grey-yellowish bioclastic limestones (*late Miocene*).

Undifferentiated Mesozoic calcareous succession in carbonate platform facies (15pt) (*Cretaceous - Jurassic*).

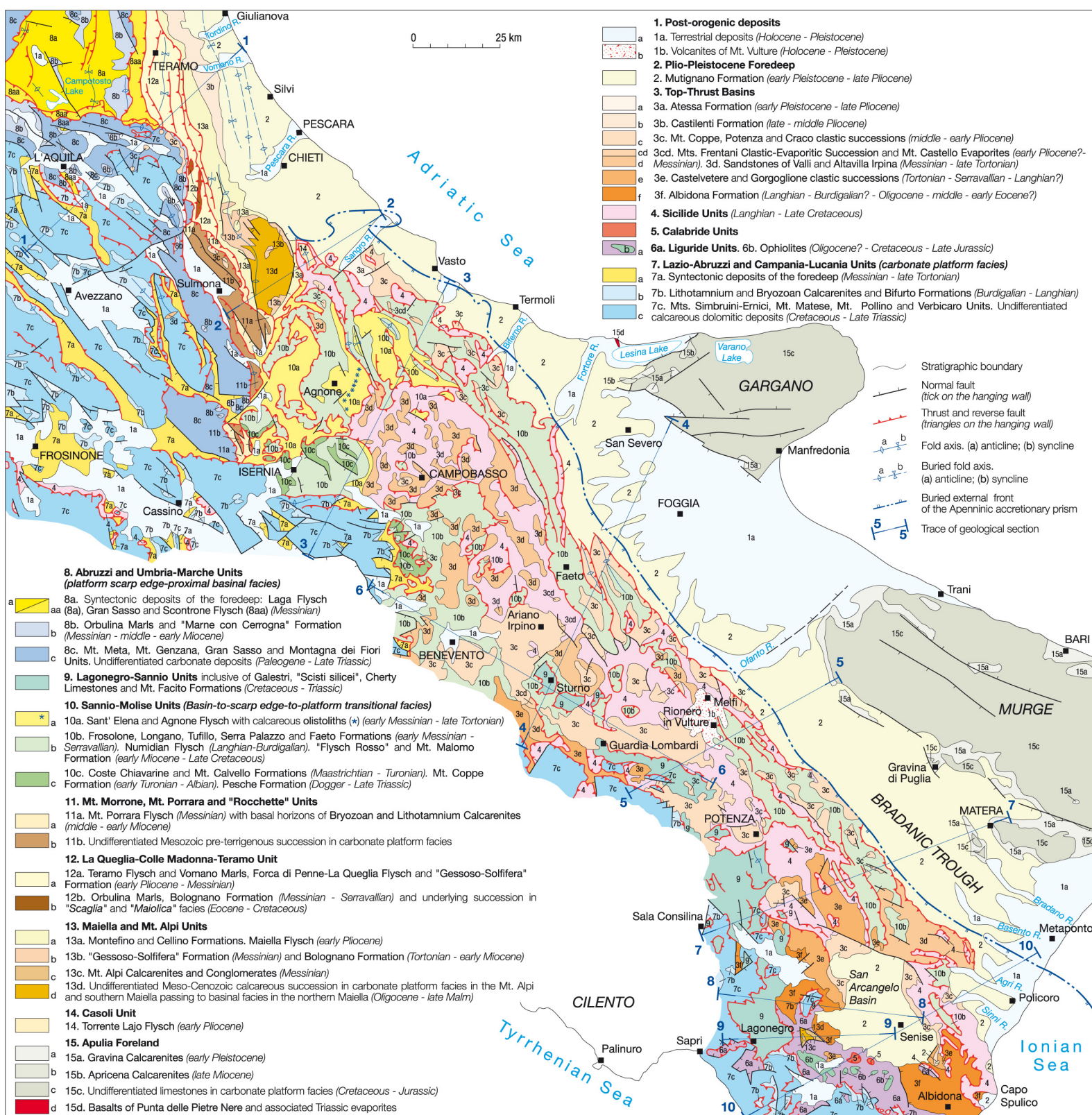
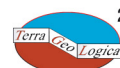
Basalts of Punta delle Pietre Nere (15pn). Basalts associated with anhydrites and evaporitic limestones (*Triassic?*).





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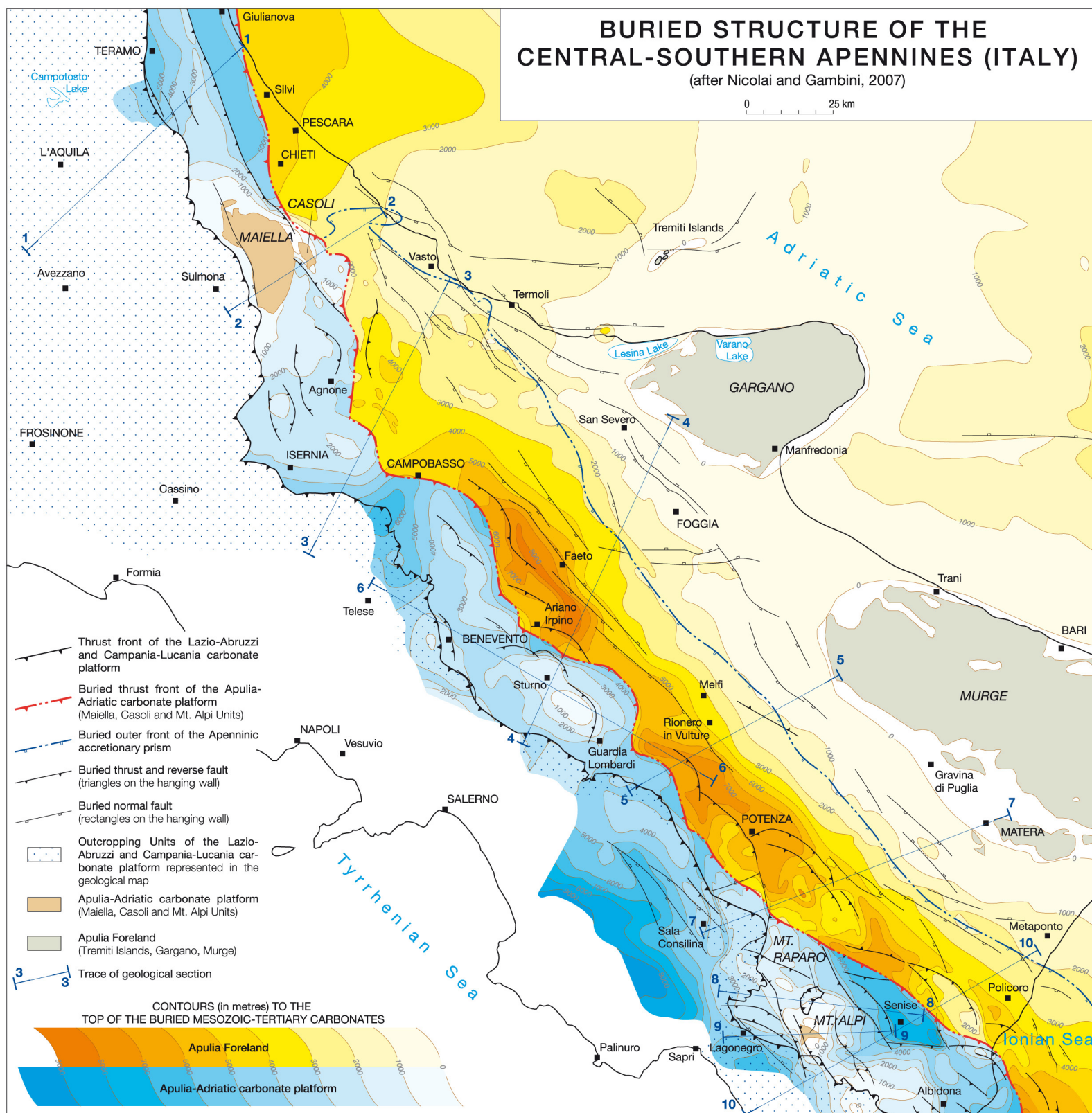
GEOLOGICAL-STRUCTURAL MAP OF THE CENTRAL-SOUTHERN APENNINES (ITALY) STRUCTURAL SCHEME





L. VEZZANI¹, A. FESTA¹ & F. GHISETTI²

GEOLOGICAL-STRUCTURAL MAP OF THE CENTRAL-SOUTHERN APENNINES (ITALY)



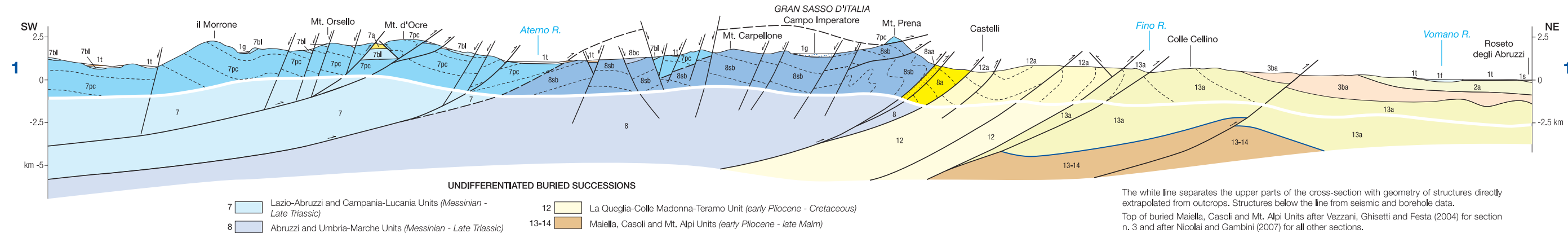
Section 1, *Geological-Structural Map of the Central-Southern Apennines (Italy)*

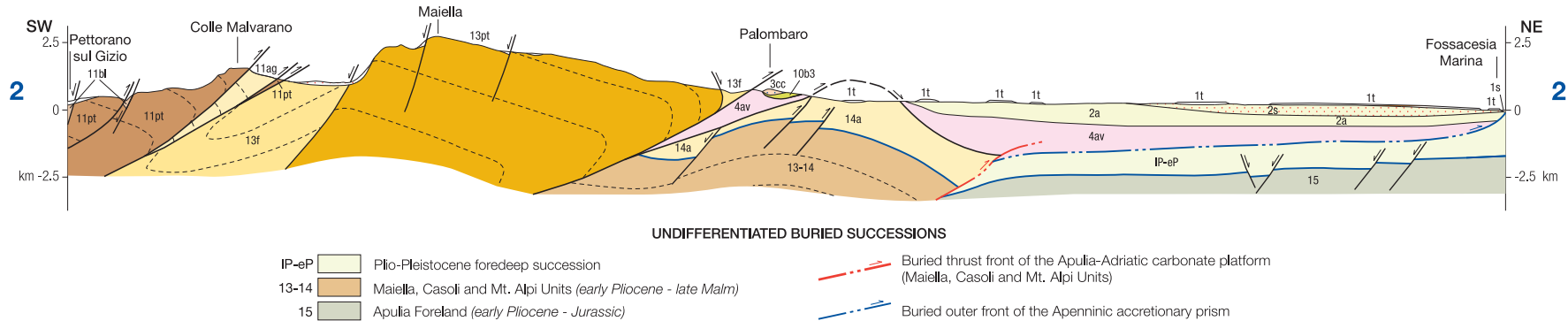
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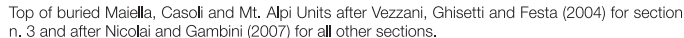
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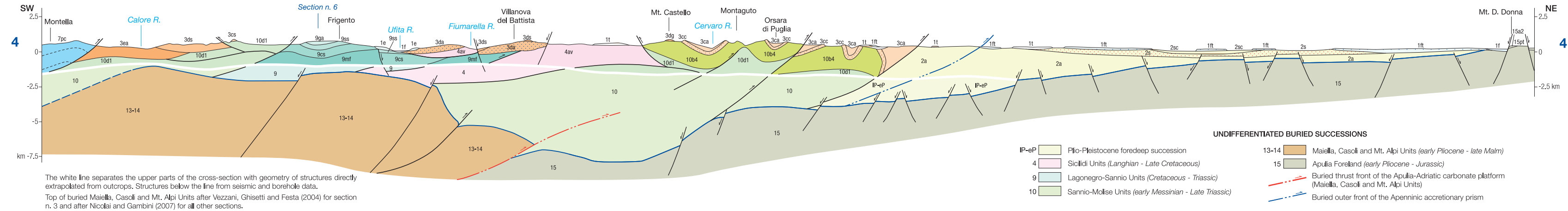


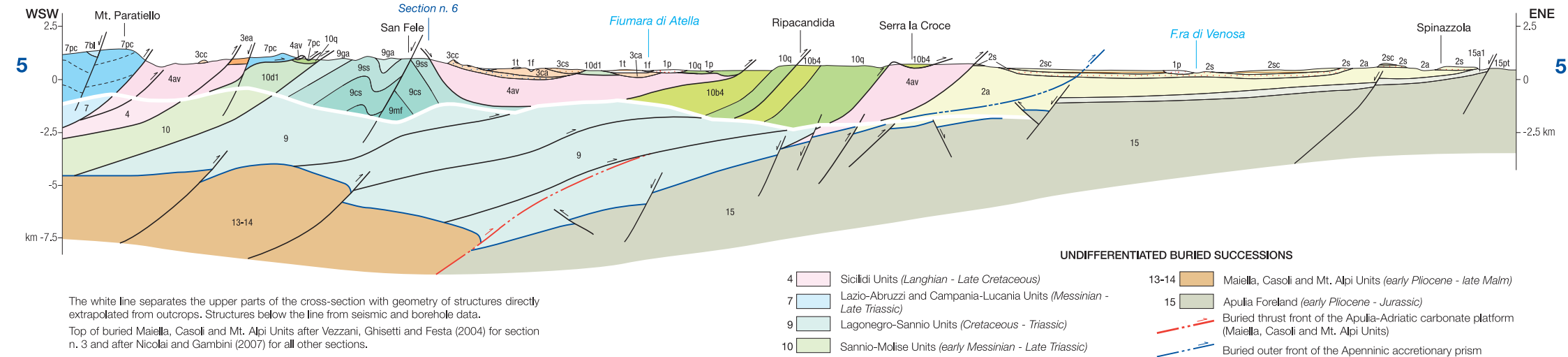


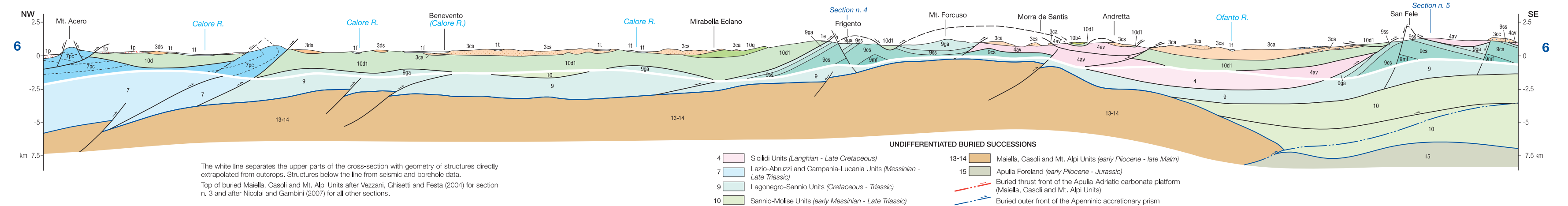
The white line separates the upper parts of the cross-section with geometry of structures directly extrapolated from outcrops. Structures below the line from seismic and borehole data.

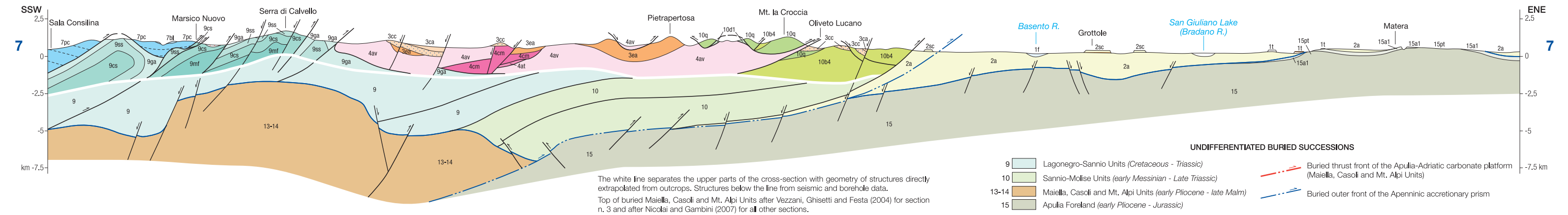
Top of buried Maiella, Casoli and Mt. Alpi Units after Vezzani, Ghisetti and Festa (2004) for section n. 3 and after Nicolai and Gambini (2007) for all other sections.











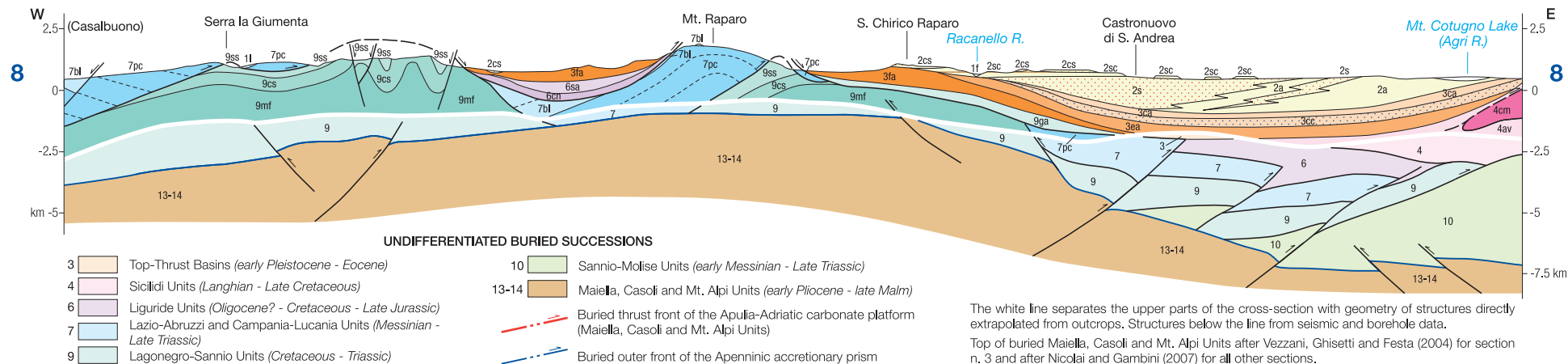
Section 8, *Geological-Structural Map of the Central-Southern Apennines (Italy)*

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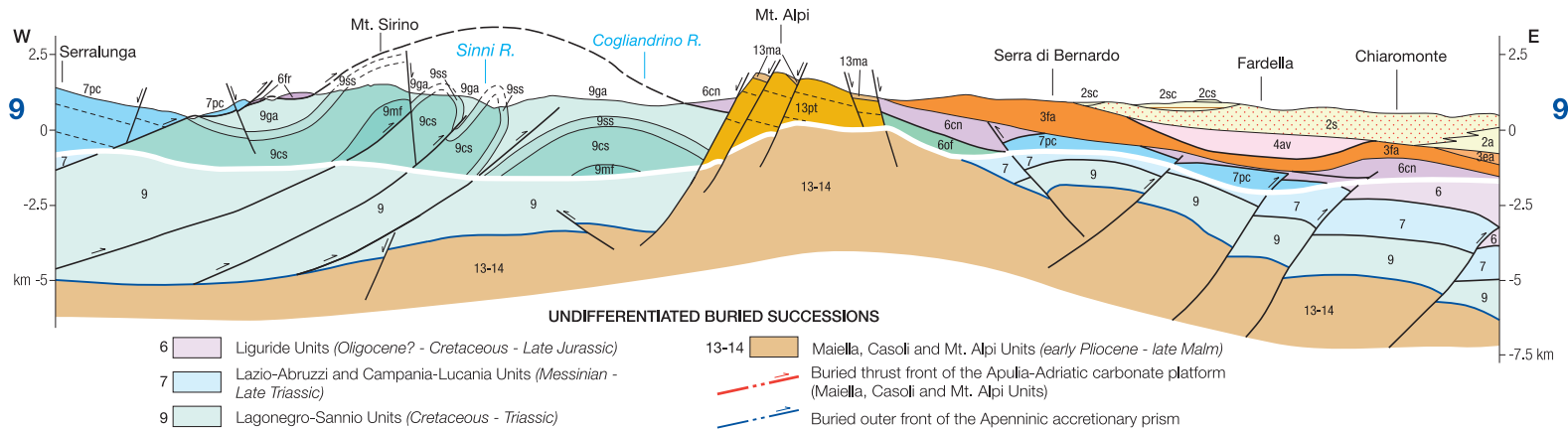
Section 9, *Geological-Structural Map of the Central-Southern Apennines (Italy)*

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Top of buried Maiella, Casoli and Mt. Alpi Units after Vezzani, Ghisetti and Festa (2004) for section n. 3 and after Nicolai and Gambini (2007) for all other sections.

