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GEOLOGICAL MAP OF THE CENTRAL PART OF THE NARNI-AMELIA RIDGE (CENTRAL APENNINES, ITALY)

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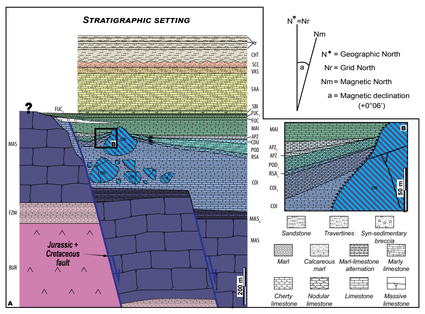
Scale 1:12,500

0 km 0.5 km 1 km

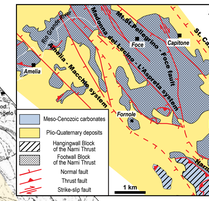
Notes

Field work was performed by the author during the period February 2015 - June 2016.
Topographic map is C.T.R. (Carta Tecnica Regionale) of Umbria at 1:10,000 scale (available on-line), Sections n°: 346010 "Amelia"; 346020 "Capitone"; 346060 "Fornole"; 346070 "Narni". Altimetric curves represent 10 m intervals.
Spatial reference of the Cartesian grid: Gauss Boaga Est Zone.
White areas on the map correspond with unmapped areas.
In the geological cross sections and the stratigraphic setting 2 units not exposed in the area are represented:
- **Anidriti di Burano** (RUR) in dark pink, underlying the Monte Cetona formation (FZM) and Late Triassic in age;
- **"calcare massiccio C litofacies"** (MAS_) (Hettangian/Sinemurian) in blu with the thick dark line label. Drowning succession of the Jurassic structural lows, the unit crops out few kms southwards the study area, in the Mt Cosce Ridge.

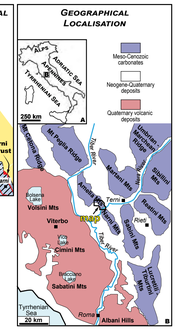
Stratigraphic setting



Structural Scheme



Geographical Localisation



Legend

POST-OROGENIC UNCONFORMITY-BOUNDED STRATIGRAPHIC UNITS

Scree (HOLOCENE)
Carbonate angular clasts up to blocks (talus deposits) with red sandy-clayey matrix.

Slope breccia (HOLOCENE-PLEISTOCENE *p.p.*)
Weakly cemented and massively-bedded, heterometric, talus deposits with red sandy-clayey matrix.

Eluvium-colluvium* and *"terre rosse" (HOLOCENE-PLEISTOCENE *p.p.*)

TIBER BASIN SUPERSYNTHEM

Nera River synthem
In-channel silty-to-coarse sands with pebble-rich lenses (tlli), terraced, fine-grained flood-plain deposits, sometimes with lenses of imbricated cobbles (tlli), heterometric, massive rudites with poorly rounded to angular clasts and red sandy-clayey matrix, cemented by freshwater carbonates. Associated are phytoherms in the Nera Gorge (tlli). (HOLOCENE-PLEISTOCENE *p.p.*)

Rio Grande river synthem
In-channel silty-to-coarse sands with pebble-rich lenses (tlli), laterally passing to lacustrine muds (tlli.); terraced, fine-grained flood-plain deposits, sometimes with lenses of imbricated cobbles (tlli.). (HOLOCENE-PLEISTOCENE *p.p.*)

Chiani-Tevere synthem
Yellow-gray, massive sandstones (tlf) unconformably resting on the Meso-Cenozoic bedrock. Oligotypic fauna characterised by *Cerastoderma* sp., *Ostrea edulis*, *Thericium* sp., *Bittium desheyesi*. *Viviparus bellucci*, *Melanopsis affinis*. Interbedded are tabular to lenticular, up to 20 m thick, travertinous levels (t). Brackish water environments are suggested by fauna and facies association. Thickness: >150 m. (EARLY PLEISTOCENE)

SYN- AND POST-RIFTING SUCCESSION

Scaglia Cinerea (AQUITANIAN *p.p.*-LATE EOCENE *p.p.*)
Gray-greenish shaly marls and marls, subordinately marly limestones. Fauna characterised by globigerinids. The unit crops out in the St Casciano sector (W of Narni). Thickness: >141 m (2A borehole data - Chiocchini et al., 1993).

Scaglia Variegata formation (LATE EOCENE *p.p.*-MIDDLE EOCENE *p.p.*)
Polychrome, thinly-bedded, marls and marly limestones rich in planktonic foraminifers ("globigerinids" and "globorotalids") and radiolarians. The unit is well exposed in the St Casciano sector (W of Narni), gradually passes to the younger SCC and the upper boundary is placed where polycrome deposits disappear. Thickness: 34 m.

Scaglia Rossa (MIDDLE EOCENE *p.p.*-EARLY TURONIAN *p.p.*)
Pink to red, well-bedded, limestones and marly limestones bearing planktonic foraminifers ("globotruncanids" and "globorotalids") and radiolarians. Pink, red and brown chert nodules and beds occur. Near Fornole, slumps occur. Thickness: >250 m.

Scaglia Bianca (EARLY TURONIAN *p.p.*-CENOMANIAN *p.p.*)
Well-bedded whitish limestones bearing dark chert nodules. The top of the unit is characterised by a 50 cm-thick level made of brown to black cherty shales, referable to the Bonarelli Level (Madonna del Lecino). Planktonic foraminifers and radiolarians dominate the faunal assemblage. Thickness: 10-30 m.

Marne a Fucoidi (LATE ALBIAN *p.p.*-EARLY APTIAN *p.p.*)
Thin-bedded, purple, grey, green and dark shaly marls, marls and marly limestones. Near the base of the unit a prominent black-shale horizon (Selli Level) occurs. Locally, Maiolica-type pebbly mudstones are embedded. Near Amelia (Podere Capalto), the unit unconformably rests on MAS. The upper boundary is placed with the occurrence of chert nodules. Thickness: 10 m.
"Rocchette" member (CENOMANIAN *p.p.*-LATE ALBIAN *p.p.*)
Cyclic alternation of gray/green marls and thinly-bedded whitish limestones. Brown to pink chert nodules occur. The faunal assemblage is characterised by planktonic foraminifers and radiolarians. Near Amelia (Podere Capalto), the unit unconformably rests on MAS. The top of the unit coincides with the disappearance of marly interbeds. Thickness: ca. 20 m.

Maiolica (EARLY APTIAN *p.p.*-LATE TITHONIAN *p.p.*)
Well-bedded white to pale yellow mudstones with radiolarians and calpionellids in the lower part of the unit. Light gray/brown chert nodules and beds occur. In the Amelia and Mt Amata sectors, the base of the unit is dolomitised, while intraformational slumps occur near the top of the formation. Neptunian dykes made of Maiolica-type facies characterise the Mt Amata - Fornole area. Near L'Aspreta, an ammonite-rich coquina associated with calpionellids and having a Maiolica-type matrix was identified. The upper boundary is sharp. Thickness ranging from 40 to 70 m.

"Calcari ad aptici e *Saccocoma*" *sensu* Galluzzo and Santantonio (2002) (LATE TITHONIAN *p.p.* - EARLY KIMMERIDGIAN *p.p.*)
Yellow to greenish, thinly bedded, marly limestones and limestones. The base of the unit is dominated by blue and green chert. Locally, reddish and irregularly nodular marly limestones associated with red chert occur (Scaglietta di Sopra, Ceccanibbio). *Saccocoma* sp. fragments are abundant and sometimes form laminated and graded calcarenitic beds (Mt Amata and Amelia). The faunal assemblage is also characterised by aptychi, radiolarians and ammonites. Shallow water-derived calcarenites occur at Podere Capalto. The upper boundary is transitional and coincides with the disappearance of *Saccocoma* fragments. Thickness: 0-35 m.
"calcari noduliari ad aptici e Saccocoma" informal member (EARLY KIMMERIDGIAN - LATE TITHONIAN/BERRIASIAN *p.p.*)
Chert-free, pale brown to orange, reddish near Amelia, massive and nodular limestones. These dolomitised fossil-rich deposits are dominated by cephalopods (ammonites, aptychi, belemnites), crinoid fragments (*Saccocoma* sp.), brachiopods. The upper boundary corresponds with the chaotic fall in macrofossils and texture change. The thickness ranges from 1 to 30 m.

"Calcari Diasprini" *sensu* Galluzzo and Santantonio (2002) (EARLY KIMMERIDGIAN *p.p.* - ?BAJOCIAN/BATHONIAN *p.p.*)
Thinly-bedded, polichrome cherts and cherty limestones with interbeds of green shales. No macrofossils occur, while the fauna is dominated by radiolarians. The passage to the overlying unit is marked by the occurence of *Saccocoma* fragments and macrofossils. Thickness: 0-55 m.

"Calcari e Marne a *Posidonia*" *sensu* Galluzzo and Santantonio (2002) (?BAJOCIAN/BATHONIAN *p.p.* - TOARCIAN *p.p.*)
Thin to well-bedded, yellow/greenish limestones and purple/red/green marls. The base of the unit is markedly nodular and ammonitiferous, while passes upward to chert-rich green limestones and interlayered green shales. Oolitic and crinoidal calcarenites occur near Force. Faunal assemblage made of "thin-shelled" posidonid bivalves (*Bositra buchi*, *Lentilla humilis*) and radiolarians. The top of the unit is marked by the disappearance of posidonids. Thickness: 0-65 m.
"calcari noduliari a Posidonia" informal member (EARLY BAJOCIAN - TOARCIAN *p.p.*)
Orange to hazelnut, well-bedded, nodular limestones. Chert-free and locally dolomitised, the unit is strongly bioclastic, bearing ammonites, po sidonid bivalves, brachiopods (*Lenticulina* sp., *Globuligerina oxfordiana*), radiolarians. The upper boundary is placed where "thin-shelled" bivalves disappear, and locally corresponds with the sharp occurrence of chert-rich facies (L'Aspreta). Near Fornole, the unit unconformably rests on MAS and on CO_1, while near Amelia also occurs in the form of neptunian dykes. Thickness: 12-20 m.

Rosso Ammonitico (TOARCIAN *p.p.*)
Chert-free, red and green nodular marls and marly limestones, strongly burrowed (*Chondrites*, *Thalassinoides*); the base is characterised by gray-greenish shales (Mt Amata). Near Amelia, calciruditic deposits bearing CO_1 and MAS clasts are embedded in the unit. Ammonites and "thin-shelled" bivalves are abundant in this formation. The boundary with the younger unit is placed above the occurrence of chert nodules. Thickness: 0-16 m.
"calcari noduliari ad ammoniti" informal member (TOARCIAN *p.p.*)

Cornicola (TOARCIAN *p.p.* - SINEMURIAN *p.p.*)
Gray to brown, well-bedded to massive, limestones. Gravity flow deposits (calcarenites and megabreccia) are dominant in the lower part of the formation, bearing also huge Calcare Massiccio clastiths (cm - e.g. Mt Amata, St Salvatore, L'Aspreta). Gray and brown chert nodules are abundant. A 5 to 8 m-thick interval made of nodular, ammonite-bearing red marly limestones with red chert occur about 30 m below the boundary with RSA (Mt Amata, L'Aspreta). Near Foce the unit is strongly dolomitised. Faunal assemblage made of siliceous sponge spicules, radiolarians, benthic foraminifers, ammonites, chaetetids, brachiopods and crinoid fragments. At Mt Amata, Mt St Pellegrino and Le Rote the unit unconformably rests on MAS, while the passage to the younger unit is sharp. Thickness: >250 m.
"calcari noduliari a spicule di spugna e crinoidi" informal member (TOARCIAN *p.p.* - EARLY PLIENSBACHIAN)
Well-bedded bioclastic packstones to mudstones, chert-free and pale brown to orange in colour. The fauna is dominated by cephalopods, echinoderm fragments, brachiopods (terebratulids and rhynchonellids), mollusk fragments, pelecypods, benthic foraminifers (*Involutina liasica*, *Spirillina* sp., *Agerina martana*, Lagenidae, Nodosariidae) and calcareous sponge (*Demospongiae*). Siliceous sponge spicules and radiolarians are also abundant. Near L'Aspreta and Fornole the unit unconformably rests on MAS, locally marked by oxydised stromatolithic envelops (*Frutexites* sp.). It also occurs in neptunian dykes (Podere Casanova, Podere Capalto). Thickness: ca. 20 m.

PRE-RIFTING SUCCESSION

Calcare Massiccio (SINEMURIAN *p.p.* - HETTANGIAN/?RHAETIAN *p.p.*)
White, gray and light brown limestones and dolostones, massive or thickly-bedded, bearing pertidal cycles. Oncoidal and peloidal packstones to grainstones, homogeneous mudstones-wackestones, fenestrae-rich levels, cryptalgal laminites, paleokarst breccias and vadose pisoids within reddish horizons are characteristic. Fauna dominated by benthic foraminifers (valvulinids, textulariids), gastropods, mollusk fragments, *Thaumatoporella parvovesiculifera*, *Cayeuxia* sp., *Paleodasycladus mediterraneus*. The top of the formation is not preserved or exposed. Thickness: >400 m.

Monte Cetona formation (RAETHIAN *p.p.*)
Alternations of brown/orange/yellow limestones and grey/brown/blackish marls; grey to black limestones and dark dolostones and dolomitic limestones. Oolitic grainstones, sometimes graded and laminated, bioclastic packstones to mudstones and bivalve floatstones are the main textures. Decametre-sized algal mounds occur. Faunal assemblage characterised by bivalves (*Rhaetavicula contorta*, *Megalodontidae*), gastropods, green algae, benthic foraminifers (*Triasina hantkeni*, *Aulotortus friedli*, *Gandinella apennnica*), *Thaumatoporella parvovesiculifera*. The base of the unit is not exposed, while the passage to the upper unit is marked by the occurrence of white oolitic and oncolitic grainstones and by a megalodontid-rich level. Thickness: >100 m.

Bed attitude
Overturned bed attitude
Vertical beds
Horizontal or sub-horizontal beds
Stratigraphic boundary, inferred
Unconformable stratigraphic boundary, inferred
Borehole
Trace of the geological cross-section
Measured stratigraphic section
Neptunian dykes
Lithophagous holes; labels indicate altitude a.s.l.
Silicification affecting the Calcare Massiccio
Normal fault, inferred
Thrust fault, inferred
Right-lateral strike-slip fault, inferred
Left-lateral strike-slip fault, inferred
Generic fault, inferred
Inferred synsedimentary normal fault
Mesoscale anticline fold
Mesoscale syncline fold
Trace of axial plane of anticline fold
Trace of axial plane of syncline fold
Alluvial and debris fan