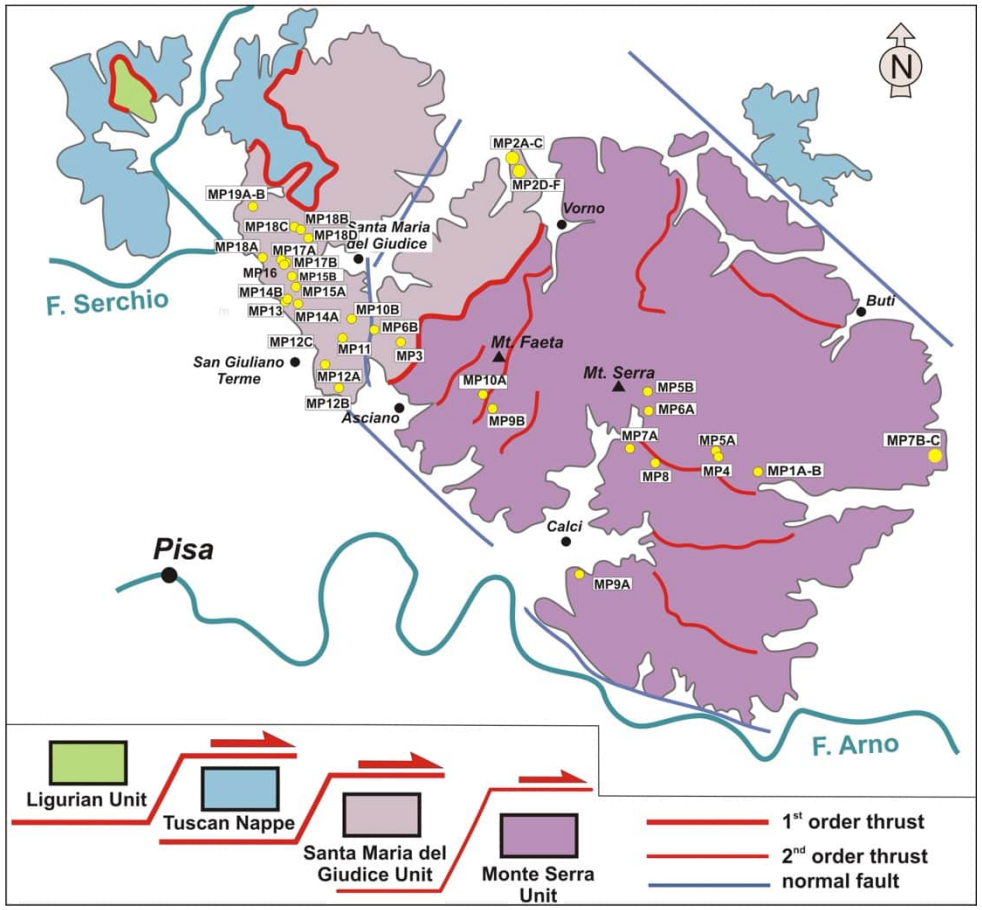
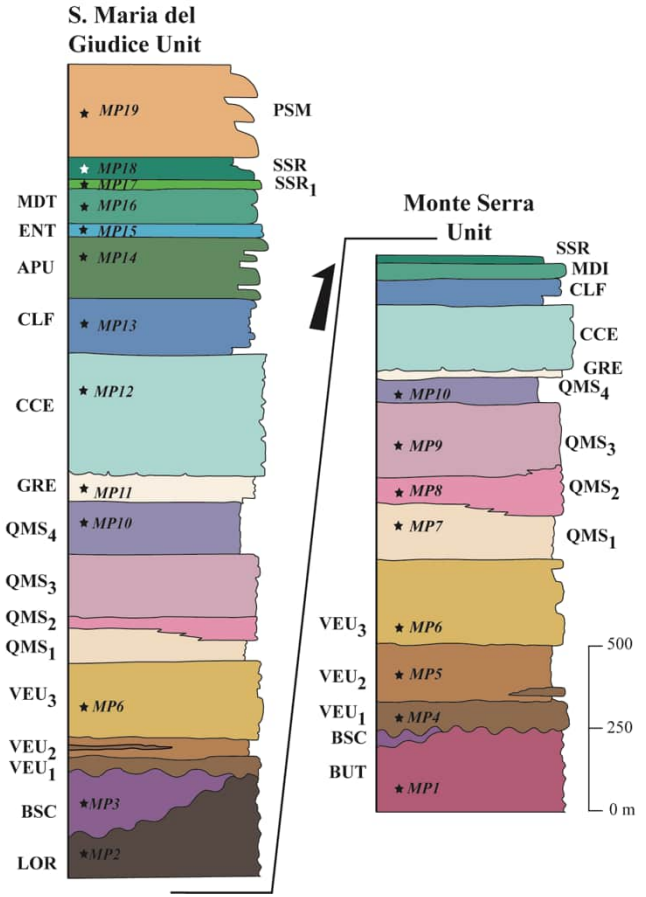
## Supplementary S1: Paleozoic - Triassic sequence




**a**: tectonic sketch map of Monti Pisani with sample location




**b**: lithostratigraphic column with sample location

**“Variscan Basement”**

**<u>Filladi e Quarziti di Buti</u> (BUT)**

*Cambrian?- Ordovician?*

*Grey-greenish medium to fine grained and hematite-rich metasandstone, phyllite and metasiltite with locally chloritic-sericitic schist.*

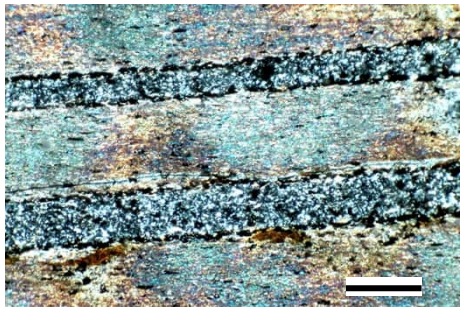
Outcrop located along the SP56 road at the hairpin bend below the climbing wall (Monte Pisano Hiking trails map 1: 25.000).

Decimetre alternation of finely laminated light grey quartzite levels and light brown phyllite. Foliation of direction NW-SE plunging to NE. In the overlying slope it is exposed the discordant contact with the overlying Anageniti grossolane member (Verruca Formation).

**MP1A**

43°44'04.41"N, 10°34'06.70"E


Phyllitic quartzite made up of millimetre thick dark grey and shiny grey quartzite levels alternate with thin discontinuous phyllosilicate layers. Glossy grey foliation surfaces rich in phyllosilicate with a phyllitic appearance.



White mica-rich lepidoblastic layers with weak undulose extinction and thin (< 0.5 mm) very fine-grained quartz layers.

scale bar: 0.5 mm

**“Variscan Basement”**

**<u>Filladi e Quarziti di Buti</u> (BUT)**

Outcrop located along the SP56 road at the hairpin bend below the climbing wall (Monte Pisano Hiking trails map).

Decimetre alternation of finely laminated light grey quartzite levels and light brown phyllite. Foliation of direction NW-SE plunging to NE. In the overlying slope it is exposed the discordant contact with the overlying Anageniti grossolane member (Verruca Formation).

**MP1B**

43°44'04.41"N, 10°34'06,.70E


Grey phyllite with a shiny and greasy appearance to the touch, consisting of prevailing very thin levels (<1 mm) of phyllosilicate and quartz-micaceous levels. Crenulation lineations are clearly visible on the foliation surface. Alteration patches of yellowish colour associated with oxidation processes of ferrous minerals.

**“Santa Maria del Giudice” Tectonic Unit**

**<u>Scisti di San Lorenzo</u> (LOR)**

*Late Carboniferous - Early Permian*

*Rhythmic sequences of metre thickness made up from bottom to top by thin graphitic levels, black graphitic phyllite with plant remains and thick layers of medium-fine quartz-micaceous metasandstone and fine-grained quartzitic metaconglomerate characterized by a weak crossed stratification and from rare faunas to lamellibranchs. Sedimentary facies: marine coastal followed by continental deposit.*

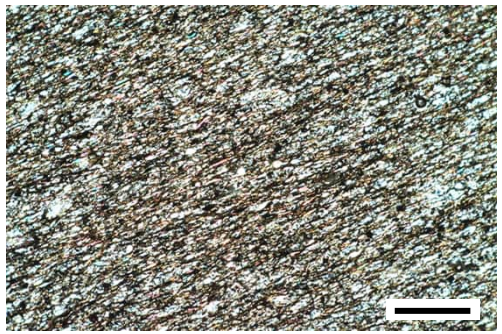
San Lorenzo a Vaccoli, road to Monte Vignale (Via del Vescovo), outcrop located at the bottom of the valley.

Light brown-grey slate with yellowish patinas, finely laminated in decimetre thick levels, alternating with centimetre and discontinuous levels of fine-grained metasandstone and metaconglomerate.

**MP2A**

43°47'44.39” N, 10°29'33.33''E


Finely laminated light brown grey phyllite consisting of phyllosilicate layers. Alteration yellowish surfaces along the foliation planes.



Finely foliated phyllosilicate rich layers containing very fine grained (0.02 mm) quartz grains, parallel to foliation.
scale bar: 0.5 mm

## “Santa Maria del Giudice” Tectonic Unit

## <u>Scisti di San Lorenzo</u> (LOR)

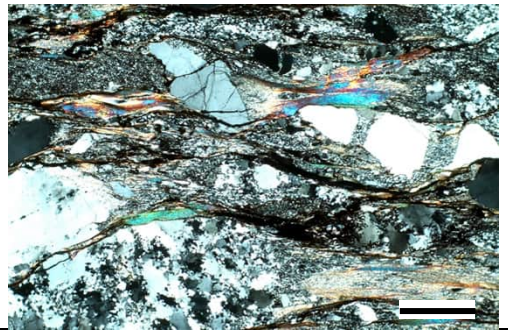
San Lorenzo a Vaccoli, road to Monte Vignale (Via del Vescovo), outcrop located at the bottom of the valley.

Fine-grained metaconglomerate (microconglomerate) of reddish colour in discontinuous levels and/or pockets of centimetre thickness (max 10 cm). The light brown-grey schist shows discontinuous pink levels when in contact with metaconglomerate.

**MP2B**

43°47'44.39” N, 10°29'33.33''E


Microconglomerate with 1-5 mm clasts of quartz/feldspar composition, in a foliated matrix of reddish colour consisting of prevailing quartz levels. The clasts have elongated shapes parallel to the foliation. The red colour is due to oxidation processes in the continental environment.



Coarse to fine grained mono and polycrystalline quartz clasts in quartz and phyllosilicate rich foliation. Coarse-grained detrital muscovite.

scale bar: 0.8 mm

## “Santa Maria del Giudice” Tectonic Unit

## Scisti di San Lorenzo (LOR)

San Lorenzo a Vaccoli, road to Monte Vignale (Via del Vescovo), outcrop located at the bottom of the valley.

Fine-grained metaconglomerate (microconglomerate) of reddish colour in discontinuous levels and/or pockets of centimetre thickness (max 10 cm). In contact with metaconglomerate, the light brown phyllite have discontinuous levels of pink colour.

**MP2C**

43°47'44.39” N, 10°29'33.33''E


Finely laminated red to pinkish grey phyllite greasy to the touch. On the foliation plane detrital muscovite grains are visible with the magnifying glass (10 x). Presence of crenulation and mineralogical elongation lineations marked by black granules with elongated shape.

## “Santa Maria del Giudice” Tectonic Unit

## Scisti di San Lorenzo (LOR)

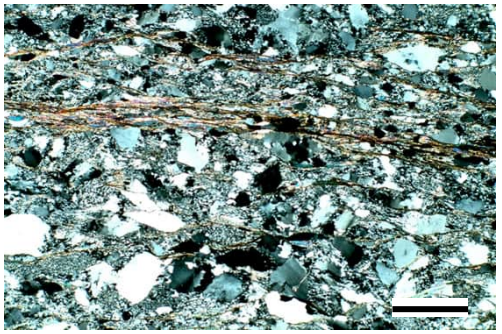
San Lorenzo a Vaccoli, road to Monte Vignale, outcrop located along Via di Villa Altieri.

Vertical section about 2 metre thick. Upper level (about 50 cm thick; yellow circle) made up of metasandstone alternating with centimetre-thick levels of light grey to dove grey microconglomerate .

**MP2D**

43°47'32.68’’N, 10°29’32.98’’E


Fine-grained grey metasandstone (1-2 mm) with "rough" appearance, due to abundant quartz granules. Phyllosilicate grains are visible on the foliation plane. In the section orthogonal to the foliation, quartz levels alternating with very thin and discontinuous phyllosilicate levels are clearly visible.



Fine-grained (< 0.5 mm) quartz and feldspar clasts. Foliation consists of very fine-grained quartz and thin biotite and white mica layers.
scale bar: 1 mm

## “Santa Maria del Giudice” Tectonic Unit

## Scisti di San Lorenzo (LOR)

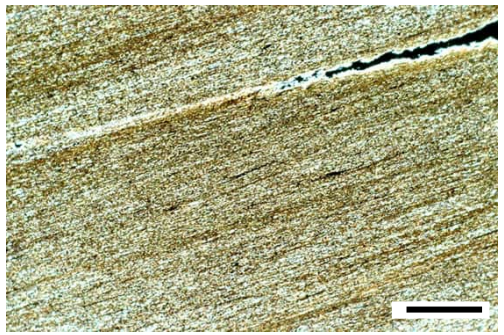
San Lorenzo a Vaccoli, road to Monte Vignale, outcrop located along Via di Villa Altieri.

Vertical section about 2 metre thick. Intermediate level (thickness about 50 cm; yellow circle) consisting of finely laminated light grey metasiltite and thin pelitic levels. The transition to the overlying metasandstone is marked by a discontinuous carbonaceous level of centimetre thickness (1-3 cm).

**MP2E**

43°47'32.68’’N, 10°29’32.98’’E


Metasiltite with laminated structure, layers of millimetre thickness (1-2 mm) separated by discontinuous fracture surfaces. The foliation is characterized by phyllosilicate with abundant detrital quartz and muscovite.



Well foliated texture consisting of very fine-grained quartz and phyllosilicate grain.

scale bar: 0.7 mm.

## “Santa Maria del Giudice” Tectonic Unit

## Scisti di San Lorenzo (LOR)

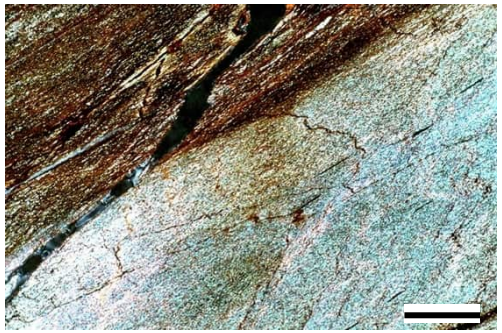
San Lorenzo a Vaccoli, road to Monte Vignale, outcrop located along Via di Villa Altieri.

Vertical section about 2 metre thick. Lower level (yellow circle) consisting of shiny grey clayey schist sometimes of a purplish colour with centimetre levels (2 - 4 cm) metasiltite and/or reddish metasandstone.

**MP2F**

43°47'32.68’’N, 10°29’32.98’’E


Finely foliated phyllite; foliation planes consist of metamorphic phyllosilicate with abundant detrital white mica. Crenulation lineations are visible on the foliation plane.



Very fine-grained white mica-rich foliation with thin and discontinuous quartz layers. Diffuse alteration in Fe-hydroxides.

scale bar: 0.7 mm

## “Santa Maria del Giudice” Tectonic Unit

## <u>Brecce di Asciano</u> (BSC)

*Permian*

*Poorly sorted debris deposits with angular to sub-rounded quartz, phyllite, and albite-bearing quartzite pebbles in a sericitic-chlorite matrix with hematite. The brecce mainly derive from the Filladi and Buti quartzite, and discordantly lies on the underlying San Lorenzo schist. Sedimentary facies: continental deposit.*

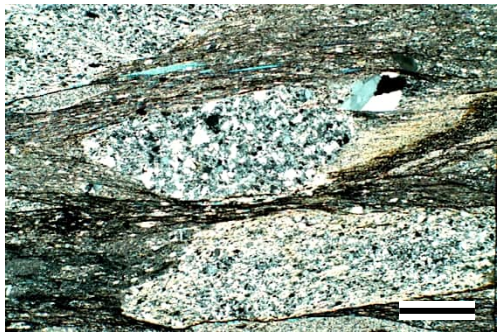
Outcrop along path 117 near “Le Fontanelle” locality (Monte Pisano Hiking trails map).

Grey polygenic breccia with clasts ranging in size from centimetre (1 - 2 cm) to decimetre (10 - 12 cm). Prevalent quartz-feldspar clasts with subordinate phyllitic clasts.

**MP3**

43°45’43.13”N, 10°28’10.76”E


Polygenic breccia with heterogeneous distribution of clasts ranging from 0.5 to 9 cm in size in a foliated matrix of a red wine colour. The clasts consist of light grey sandstone (red arrow) and light green phyllite (yellow arrow).



Coarse-grained (3 - 15 mm) rounded to subrounded polycristalline quartzitic and pelitic clasts, parallel to very fine-grained phyllosilicate rich foliation.

scale bar: 1.0 mm

**“Monte Serra” Tectonic Unit**

**Formazione della Verruca - <u>Membro delle Anageniti Grossolane (VEU1)</u>**

*Ladinian*

*Poorly sorted polygenic metaconglomerate and coarse-grained metasandstone. Sedimentary facies: braided fluvial environment.*

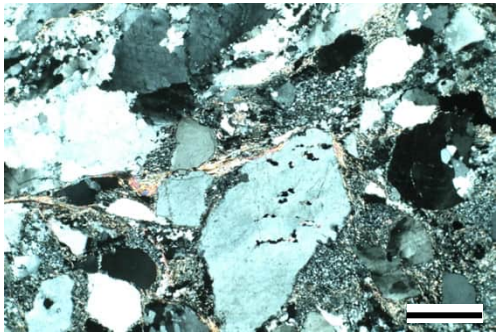
Outcrop of Anageniti Grossolane (VEU1) located along the SP56 road at the top of the climbing wall (Monte Pisano Hiking trails map).

In the background metre thick polygenic coarsely layered metaconglomerate. In the foreground purple schist alternating with levels of quartzite and quartzite phyllite belonging to the Scisti Violetti member.

**MP4**

43°44'05.40"N, 10°33'36.03"E


Metaconglomerate with centimetre to millimetre (2 - 0.5 cm). quartz and feldspar clasts in poorly foliated matrix. Clasts show sub-rounded to rounded and rare angular shapes.



Angular to subrounded coarse-grained (0.5 - 2 mm) polycrystalline quarzitic grains with undulose extinction. Fine-grained quartz and phyllosilicate recrystallized matrix.

scale bar: 0.5 mm

**“Monte Serra” Tectonic Unit**

**Formazione della Verruca - <u>Membro degli</u> <u>Scisti Violetti</u> (VEU2)**

*Ladinian*

*Violet quartzite phyllite with intercalations of purple, white or, more rarely, grey or light green quartzite, and purple-coloured phyllitic quartzite that become predominant towards the top. Sedimentary facies: alluvional plain.*

Outcrop of Scisti Violetti (VEU1) located along the SP56 road at the top of the climbing wall (Monte Pisano Hiking trails map).

In the foreground Scisti Violetti member (VEU2) that consist of alternate levels of quartzite and quartzitic phyllite.

**MP5A**

43°44'05.40"N, 10°33'36.03"E

4 cm

Schist of purplish colour clearly visible on the foliation plane. Continuous cleavage consisting of thin alternations of phyllosilicate levels and quartz-rich levels**.**

## “Monte Serra” Tectonic Unit
## Formazione della Verruca - <u>Membro degli Scisti Violetti</u> (VEU2)

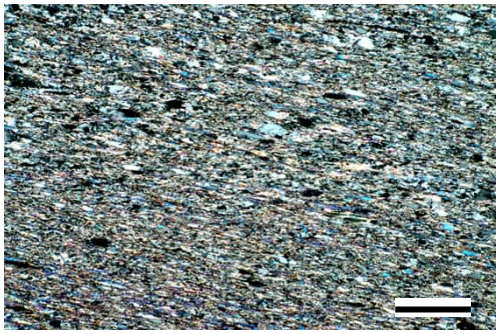
Outcrop of Scisti Violetti (VEU2) located along the SP56 road near the summit of Monte Serra.

Grey pink metasandstone and phyllitic metasandstone in levels of decimetre to metre thickness alternating with finely foliated purplish shale.

**MP5B**

43°45'03.32"N, 10°33'02.31"E


Purple phyllite with well-developed cleavage made up of thin levels of phyllosilicate alternating with millimetre thick (2 mm) levels of quartz. Glossy foliation surface due to the presence of phyllosilicate.



Very fine-grained phyllosilicate rich foliation with elongated clastic quartz and clastic white mica parallel to the foliation.

scale bar: 0.3 mm

**“Monte Serra” Tectonic Unit**

**Formazione della Verruca - <u>Membro delle Anageniti Minute</u> (VEU3)**

*early Carnian p.p.*

*Positive megasequences with weakly erosive bases consisting of lenticular bodies of light quartzite, whitish quartzite meta conglomerate phyllite and light or dark purple phyllitic quartzite. Sedimentary facies: alluvional plain and fluvial channel.*

Outcrop of Anageniti Minute (VEU3) located along the SP56 road in “Prato della Taneta” locality (Monte Pisano Hiking trails map).

Poorly foliated light grey metasandstone and quartzite in centimetre to decimetre-thick levels, alternating with metaconglomerate. Presence of levels with cross layering.

**MP6A**

43°44'48.9"N, 10°33'02.1"E


Poorly foliated quartzite with local prefered orientation of elongated quartz grains. Presence of detrital muscovite visible on the foliation plane (cleavage).

**“Monte Serra” Tectonic Unit**

**Formazione della Verruca - <u>Membro delle Anageniti Minute</u> (VEU3)**

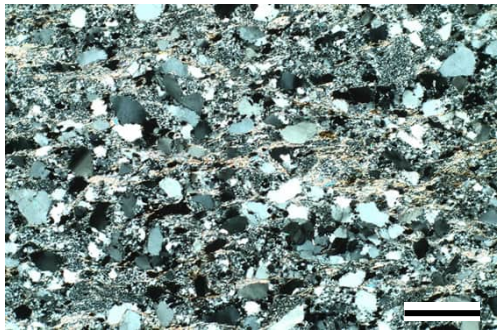
Outcrop along path 117, locality "Le Pianacce"
(Monte Pisano Hiking trails map)

Positive sequence formed by a decimetre level of coarse metaconglomerate upward followed by a monotonous sequence of centimetre-thick light quartzite layers.

**MP6B**

43°45'49.80"N, 10°27'50.78"E


Foliated quartzite with cleavage defined by millimetre-thick quartz-rich levels (2 - 4 mm) alternating with very thin (<1 mm) discontinuous dark levels of phyllosilicate. In the quartz layers, clastic grains are enveloped by fine-grained recrystallized quartz-phyllosilicate matrix.



Angular fine grained (0.1 - 0.5 mm) quartz grains in very fine grained quartz rich foliated matrix with thin and discontinuous phyllosilicate layers.

scale bar: 1.0 mm

**“Monte Serra” Tectonic Unit**

**Formazione delle Quarziti del Monte Serra - <u>Membro degli Scisti Verdi</u> (QMS1)**

*early Carnian*

*Light grey quartz-micaceous metasandstone and green quartzitic phyllite. Sedimentary facies: tidal plain.*

Outcrop located along the SP56 road, locality “Le Squille” (Monte Pisano Hiking trails map).

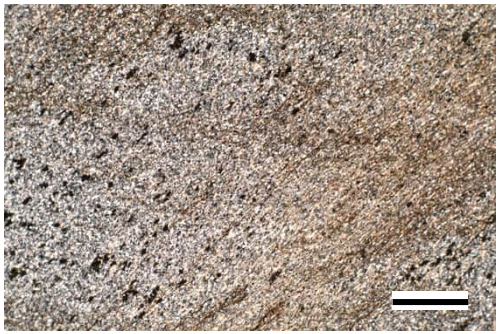
Sequence of greyish green phyllite characterized by boudinated quartzite levels).

Detail of above image showing the alternance of green phyllite and stretched pinkish quartzite levels.

**MP7A**

43°44'15.80"N, 10°32'01.94"E


Quartzitic phyllite with cleavage defined by alternating quartz-rich and phyllosilicate-rich levels. Clastic grains of white mica, fine-grained recrystallized phyllosilicate new grains and crenulation lineations are visible on foliation plane.



Very fine-grained quartz rich foliation with thin phyllosilicate (white mica and biotite) layers and chloritized clastic biotite. Rare grains of tourmaline.

scale bar: 0.65 mm

## “Monte Serra” Tectonic Unit

## Formazione delle Quarziti del Monte Serra - Membro degli Scisti Verdi (QMS1)

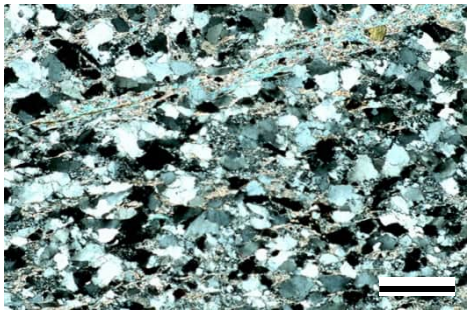
Outcrop located in the locality of “Molino del Rotore - Caccialupi” along the SS 439 (Monte Pisano Hiking trails map).

The outcrop, located in an abandoned quarry, consists of a sequence of green phyllite and light micaceous metasandstone.

**MP7B**

43°44’53.60”N, 10°36’59.80”E


Metasandstone with alternating levels of predominantly quartz composition and discontinuous levels of phyllosilicate. Foliation plane marked by diffuse occurrence of phyllosilicate (white mica) and crenulation lineations.



Angular to subrounded fine grained poly and mono crystalline quartz grains with intergranular white mica layers.

scale bar: 0.5 mm

## “Monte Serra” Tectonic Unit
## Formazione delle Quarziti del Monte Serra - Membro degli Scisti Verdi (QMS1)

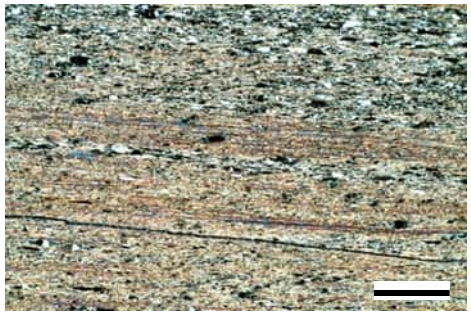
Outcrop located in the locality of “Molino del Rotore - Caccialupi” along the SS 439 (Monte Pisano Hiking trails map).

The outcrop located in an abandoned quarry consists of a sequence of green phyllite and light micaceous metasandstone.

**MP7C**

43°44’53.60” N, 10°36’59.80” E


Phyllite with well-developed finely spaced cleavage of glossy appearance. Foliation consists of prevailing phyllosilicate-rich levels alternating with thin and discontinuous arenaceous levels.



Phyllosilicate layers made up of very fine-grained (0.05 mm) white mica and chlorite. Occurrence of detrital quartz and chloritized biotite grains (0.25 - 0.1 mm).
scale bar: 0.4 mm

**“Monte Serra” Tectonic Unit**

**Formazione delle Quarziti del Monte Serra - <u>Membro delle Quarziti Verdi</u> (QMS2)**

*Carnian*

Fining-upward sequences consisting of grey, greenish-grey quartz metasandstone organized in medium to thick layers with wedge-shaped cross-layering and cross-layered green phyllite laminae. *Sedimentary facies: beach environment.*

Outcrop located along the SP56 road in the locality “Le Porte” (Monte Pisano Hiking trails map).

Monotonous sequence of grey-green quartzite with locally purplish levels. Centimetre to decimetre thick (2 - 15 cm) coarse-grained layers, roughly foliated with locally preserved cross-stratification (circled area).

**MP8**

43°44'10.11"N, 10°32'16.90"E


Roughly foliated fine-grained quartzite with mostly equigranular rounded quartz grains. Detrital muscovite grains are visible on the foliation plane. The textural and compositional features of the sedimentary protolith are well preserved.

**“Monte Serra” Tectonic Unit**

**Formazione delle Quarziti del Monte Serra - <u>Membro delle Quarziti Bianco-Rosa</u> (QMS3)**

*Carnian*

*Fining-upward sequences consisting of grey-pink quartz metasandstone with massive and planar stratification (1 - 10 cm) and levels of grey-green phyllite (max 3 cm) with ripples that become dominant in the upper part of the member. Local occurrence of microconglomerate layers and lenses. Sedimentary facies: shallow water.*

Outcrop located in the locality "Magona", north of Caprona (Monte Pisano Hiking trails map).

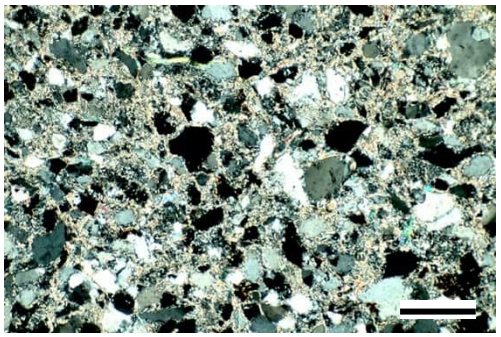
Wide outcrop on the Magona hill south of S. Agostino convent of Nicosia (Calci). Quartzite is characterized by decimetre thick strata with well-developed foliation.

Detail of previous photo showing the occurrence of ripple marks that characterize the upper portion of member

**MP9A**

43°42’45,8’’N, 10°31’01.4’’E


Non-foliated, equigranular, fine-grained pink quartzite



Poorly foliated quartzite made up of very fine-grained (0.25 - 0.05 mm) mono and polycristalline quartz grains in phyllosicate (white mica) matrix.
Rare occurrence of detrital white mica and tormaline.
scale bar: 0.45 mm

**“Monte Serra” Tectonic Unit**

**Formazione delle Quarziti del Monte Serra - <u>Membro delle Quarziti Bianco-Rosa</u> (QMS3)**

Upper portion of Quarziti bianco-rosa member. Outcrop of the Agnano quarry on the right side of the “Valle della Polla”.

Monotonous succession of coarsely layered dark grey quartzite in centimetre-thick levels. Diffuse occurrence of ripple marks, load casts, mud cracks and less frequent fossil traces consisting of saurian footprints.

**MP9B**

43°44'34.48’’N, 10°29'27.19''E


Non-foliated fine-grained equigranular quartzite. On the layer surface fossil traces such as: mud cracks (red arrow) and probable saurian footprints (white arrow) are visible.

**“Santa Maria del Giudice” Tectonic Unit**

**Formazione delle Quarziti del Monte Serra - <u>Membro delle Quarziti Viola Zonate</u> (QMS4)**

*late Carnic*

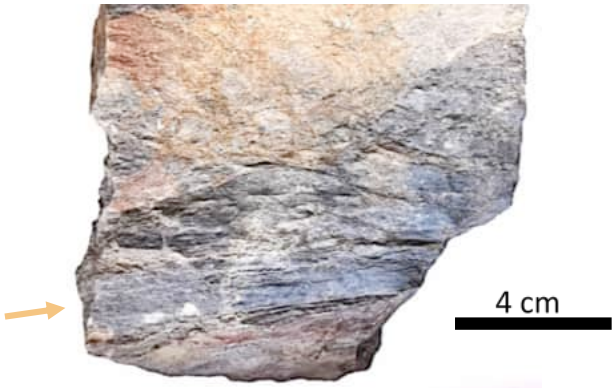
Very fine-grained quartzite and hematite-rich phyllite. *Sedimentary facies: deltaic plain environment.*

Outcrop located along path 123 (Monte Pisano Hiking trails map), towards “Cima della Sugheretta” above the Agnano village.

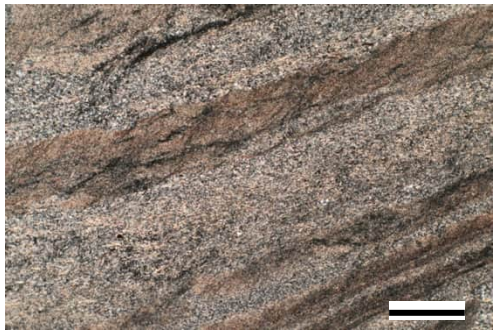
Violet quartzite member. Monotonous sequence of fine-grained quartzite in centimetre-thick layers.

**MP10A**

43°44’43.72”N, 10°29’26.12”E




Very fine-grained and slightly foliated quartzite with alternating grey-purple levels and thin light grey levels (ocher arrow).



Very fine-grained (<0.05 mm) foliation with phyllosilicate (white mica) layers alternate with quartz, phyllosilicate and Fe-oxides rich layers.

scale bar: 1.44 mm

**“Santa Maria del Giudice” Tectonic Unit**

**Formazione delle Quarziti del Monte Serra - <u>Membro delle Quarziti Viola Zonate</u> (QMS4)**

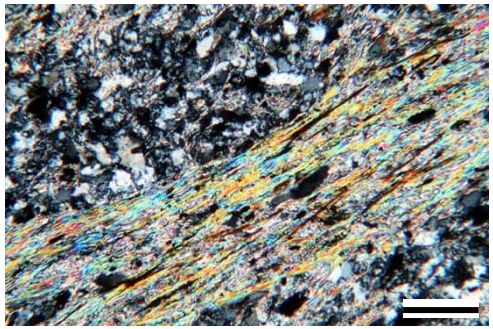
Outcrop along western side of path 117 (Monte Pisano Hiking trails map), locality “Il Sugherone”, at the head of the valley.

Upper portion of violet quartzite member. Well foliated purple grey phyllite levels ranging from millimetre to centimetre in thickness alternating with thin arenaceous levels.

**MP10B**

43°45’56.04”N, 10°27’28.39”E

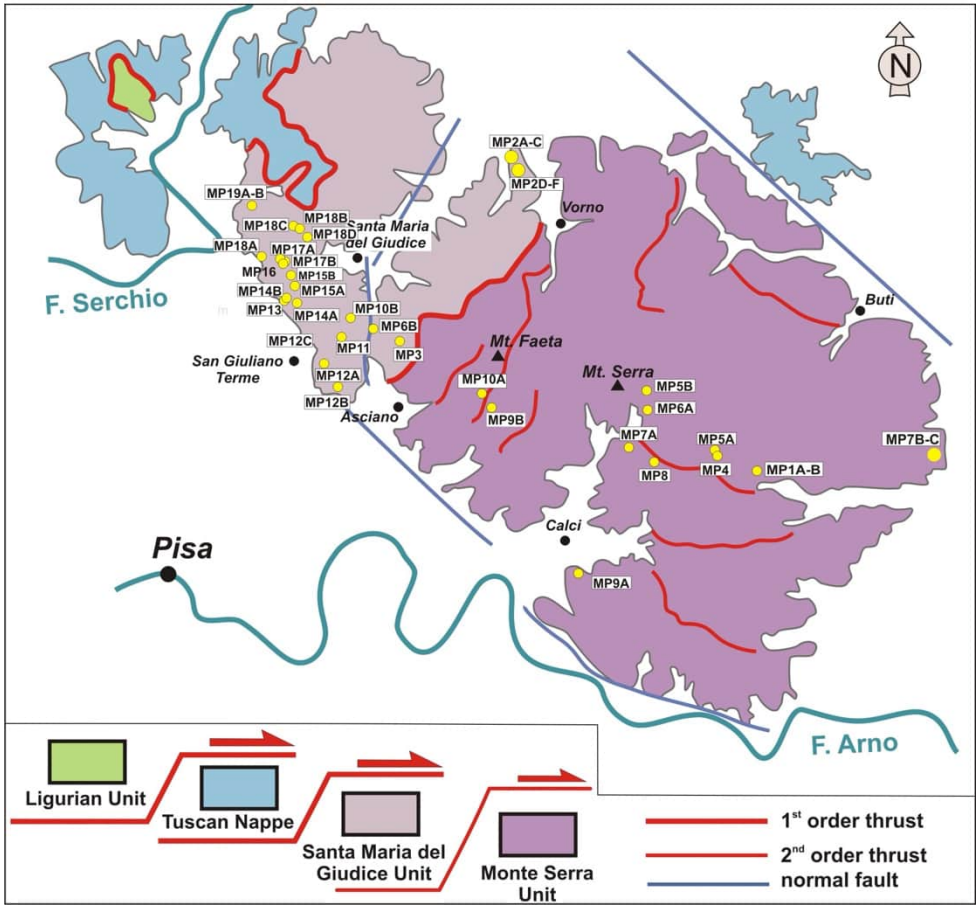

Purplish grey phyllite with arenaceous siltite levels showing yellowish alteration patinas. Finely spaced cleavage with millimetre-sized detrital muscovite grains, still recognizable on the foliation plane



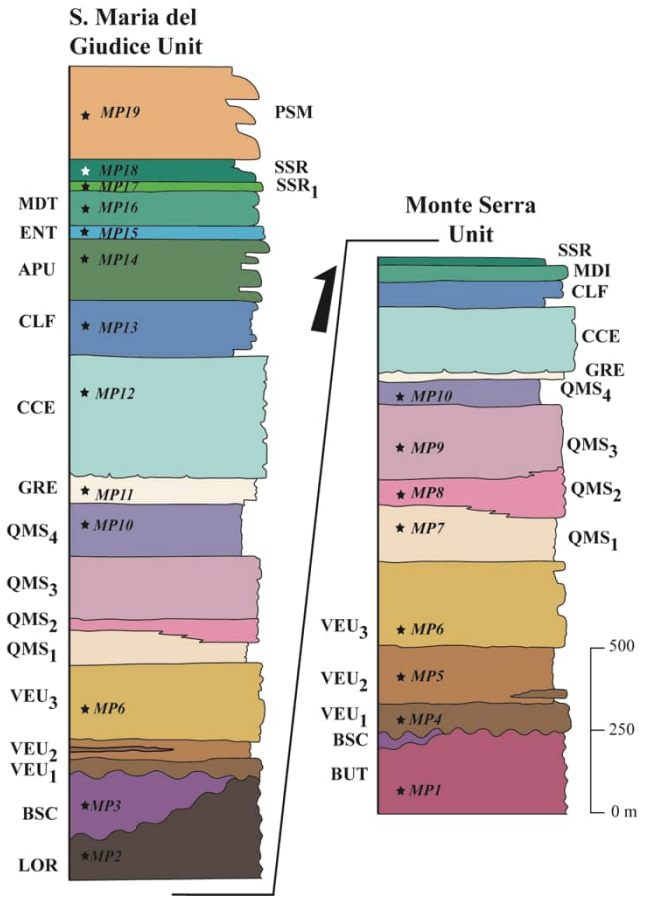
Very-fine grained foliation (< 80 μm) with alternance of micaceous-rich and quartz-rich layers with clastic grains.

scale bar: 0.08 mm

# Supplementary S1 –Triassic - Oligocene sequence




**a**: tectonic sketch map of Monti Pisani with sample location




**b**: lithostratigraphic column with sample location

**“Santa Maria del Giudice” Tectonic Unit**

**<u>Grezzoni</u> (GRE)**

*Norian-Rhaetian*

*Grey recrystallized dolomite, more rarely pink, organized in thick layers separated by wavy dissolution surfaces. Frequent occurrence of metalimestone with light grey oolytic levels. Sedimentary facies: carbonate platform.*

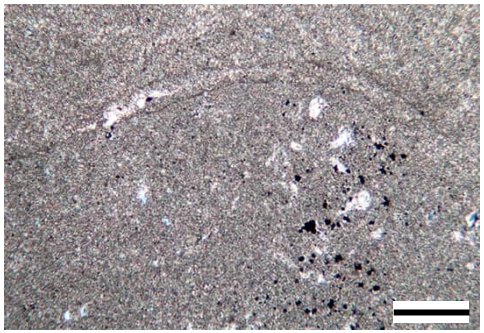
Outcrop along the western side of 117 path, locality “Il Sugherone”, at the head of the valley.

Pinkish grey dolomite, roughly stratified with reddish altered surfaces.

**MP11**

43°45'44.50"N, 10°27'16.90"E


Fine-grained grey dolomite without stratification.



Very fine-grained dolomite (average grain size 30 μm), with fossiliferous content. A fragment of bivalve shell (lamellibranchs) in the upper half of photo

scale bar: 0.2 mm

**“Santa Maria del Giudice” Tectonic Unit**

**<u>Marmi dei Monti Pisani</u> (CCE)**

*Hettangian – Lower Pliensbachian*

*White, grey-yellowish or pink marble, irregularly stratified and locally characterized by lamination.*
*In the lower and upper portion occurrence of thin and discontinuos detritic layers.*
*Sedimentary facies: carbonate platform.*

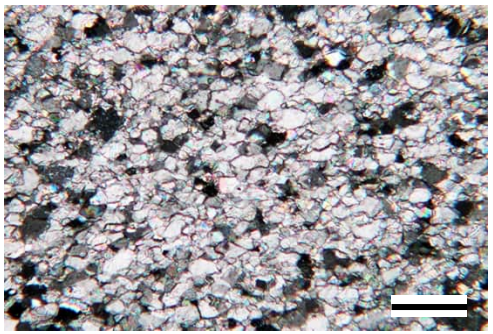
Outcrop of marble along path 115 in the direction of Villa Bosniaski, near the San Giuliano Terme town.

White-grey layered marble with layers ranging from decimetre to metre thickness.

**MP12A**

43°45’30.19’’N, 10°26’41.33’’E


Fine-grained white - grey massive marble.



Granoblastic texture with fine-grained (80 - 100 μm) calcite grains marked by elongate shape and preferred orientation.

scale bar: 0.16 mm

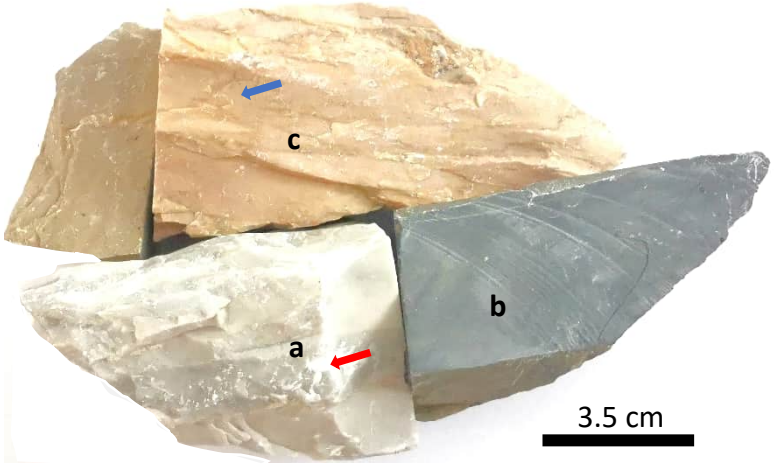
## “Santa Maria del Giudice” Tectonic Unit
## Marmi dei Monti Pisani (CCE)

Outcrop of the marble located in the large quarry along the “SP Lungomonte” near the San Giuliano Terme town.

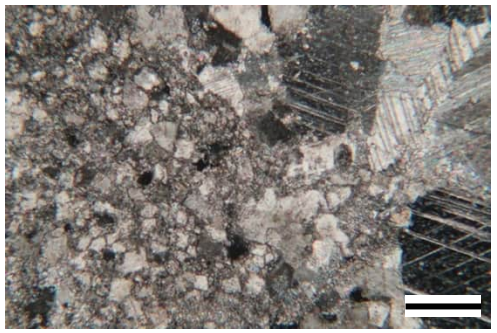
Stratified white to yellowish grey and light brown marble, steeply dipping layers of decimetre to metre thicknesses (yellow arrow) crossed by fracture surfaces (white arrow).

**MP12B**

43°45’15.76N, 10°26’47.87”E




Very fine-grained marble varying in colour from white to dark grey and pink. Presence of calcite veins (red arrow) in the white sample (**a**) and dissolution-recrystallization surfaces (blue arrow) in the pink sample (**c**)



Marble with very fine grained (<0.05 mm) recrystallized calcite with euhedral shape. Coarse grained calcitic veins.

scale bar: 0.2 mm

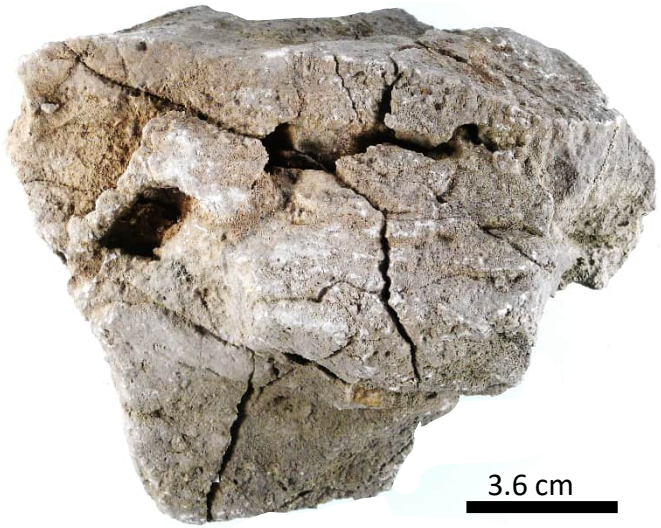
## “Santa Maria del Giudice” Tectonic Unit
## <u>Marmi dei Monti Pisani</u> (CCE)

Marble outcrop along path 117 near the Monte Castellare Visitor Center (La Valle locality).

Poorly stratified light grey marble with layers in metre thickness. Diffuse occurrence of dissolution structures and altered fracture joints.

**MP12C**

43°45’45.11”N, 10°27’02.54”E




Grey marble with fractures and dissolution cavities. Rough appearance due to the presence of rounded shape and millimetre size calcite crystals (allochemical), in finer-grained calcitic matrix.

**“Santa Maria del Giudice” Tectonic Unit**

**<u>Metacalcari con selce</u> (CLF)**

*Pliensbachian p.p.-Toarcian p.p*

*Light brown-grey metacalcilutite in cm thick layers (20 – 40) and light brown or greenish metapelitic intercalations. Chert lists and nodules and local levels or lenses of metacalcarenite. Sedimentary facies: pelagic*.

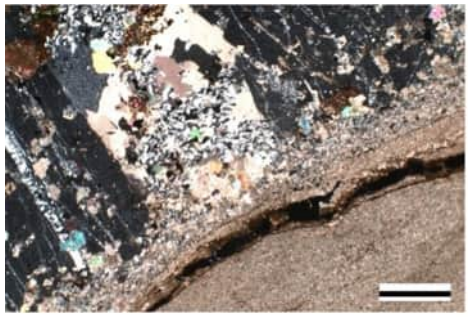
Outcrop located on the western slope of Monte San Giuliano along the local road from “Case Baroni” to “Le Capanne”.

Decimetre-thick layers of grey metalimestone with centimetre to decimetre thick chert lists and/or nodules. Metalimestone show thin laminations mor developed close and around the chert nodules or lists.

**MP13**

43°46’19.57’’N, 10°26’18.47’’E


Very fine-grained metalimestone (calcilutite) with centimetre-thick chert lists. Presence of numerous dark calcite veins.



Foliation consists of very fine - grained recrystallized euhedral calcite with sparse quartz grains. Chert layers with fractures filled by quartz, calcite, and epidote.
scale bar: 2.2 mm

**“Santa Maria del Giudice” Tectonic Unit**

**<u>Calcescisti</u> (APU)**

*Toarcian p.p. - Bathonian p.p.*

*Centimetre-thick alternated layers of tobacco-coloured metapelite and grey-havana metacalcarenite.*
*A Level of intraformational calcareous metabreccia about 15 cm thick at the top of the sequence. Sedimentary facies: pelagic.*

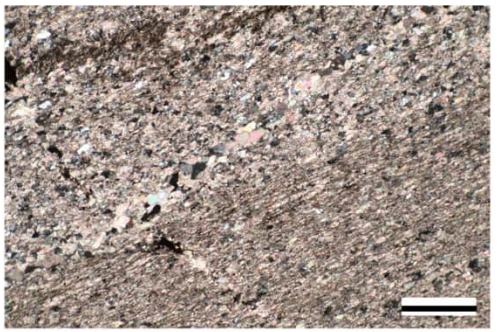
Outcrop located on the western slope of Monte San Giuliano along the local road from “Case Baroni” to “Le Capanne”.

Metalimestone layers of centimetre thickness alternating with thin phyllitic levels.

**MP14A**

43°46'18.00"N, 10°26'22.52"E


Fine-grained (calcilutite) yellowish grey metalimestone with millimetre to centimetre thick foliation and coarse grained calcite veins.



Well developed foliation marked by euhedral fine grained calcite grains and veins (see microphoto). Some calcite veins cross-cut the foliation.

scale bar: 0.5 mm

## “Santa Maria del Giudice” Tectonic Unit
## <u>Calcescisti</u> (APU)

Outcrop located on the western slope of Monte San Giuliano along the local road from “Case Baroni” to “Le Capanne”.

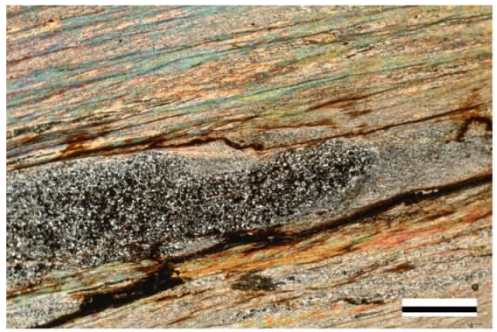
Centimetre-thick alternations of metalimestone and metapelite with steeply dipping foliation.

**MP14B**

43°46'18.89"N, 10°26'21.58"E

3 cm

Yellowish grey phyllite with finely spaced cleavage. Shiny foliation planes marked by phyllosilicate growth. Presence of lineations of crenulation lineations on the cleavage planes.



Foliation consists of tight alternance of phyllosilicate (white mica and biotite) and very fine grained (< 0.04 mm) quartz layers.

scale bar: 1.44 mm

**“Santa Maria del Giudice” Tectonic Unit**

**<u>Metacalcari ad Entrochi</u> (ENT)**

*Bathonian p.p-Tithonian p.p.*

*Coarsely layered grey marble and metacalcarenite, characterized by abundant articles of crinoids. Rare nodules and lenses of dark cherts and of polygenic metacalcirudite. Sedimentary facies: pelagic continental slope.*

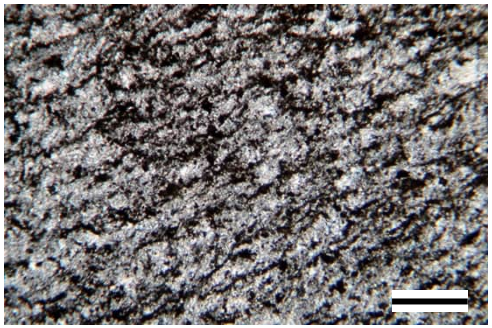
Outcrop located on the western slope of Monte San Giuliano along the local road from “Case Baroni” to “Le Capanne”.

The lower (basal) part of the formation in contact with the calcschist consists of metalimestone in centimetre strata alternating with centimetre to decimetre levels of finely foliated metamarl.

**MP15A**

43°46’31.12” N, 10°26’19.36” E


Finely foliated yellowish grey phyllitic marl, with tight alternations of thin (<1 mm) phyllosilicate-rich and millimetre-thick (1-2 mm) calcite-rich levels.



Calcite layers alternate with thin and discontinuous Fe-oxides and phyllosilicate-rich films

scale bar: 0.2 mm

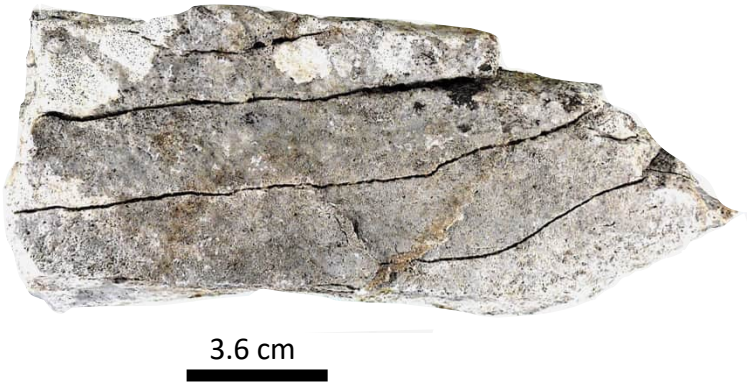
## “Santa Maria del Giudice” Tectonic Unit
## Metacalcari ad Entrochi (ENT)

Outcrop located on the western slope of Monte San Giuliano along the local road from“Case Baroni” to “Le Capanne”.

The top of formation consists of decimetre thick and roughly stratified grey metalimestone, characterized by abundant fossiliferous content mainly represented by crinoid articles (entrochi) showing rounded shape (red circle in the detail photo).

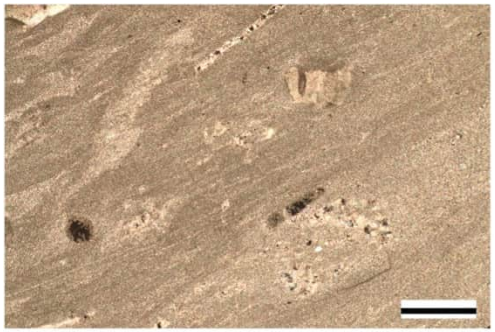
**MP15B**

43°46’38.07” N, 10°26’17.42” E




Massive fossiliferous metalimestone with centimetre-spaced fracture surfaces. Fossil content consisting mainly of articles of crinoids, clearly visible on the lower part of the sample. The protolith corresponds to biomicritic packstone.

Fine grained recrystallized calcite matrix with coarse grained (0.3 – 0.5 mm) calcite and dolomite clastic grains. Crinoid articles show rounded shapes with very fine-grained core and coarser rim.



scale bar: 1.2 mm

**“Santa Maria del Giudice” Tectonic Unit**

**<u>Metaradiolariti</u> (MDT)**

*Bathonian p.p .- Upper Tithonian p.p.*

*Red, green or white metaradiolarite in layers of centimetre and decimetre thickness thin metapelitic intercalations.*

*Sedimentary Facies: abissal plain.*

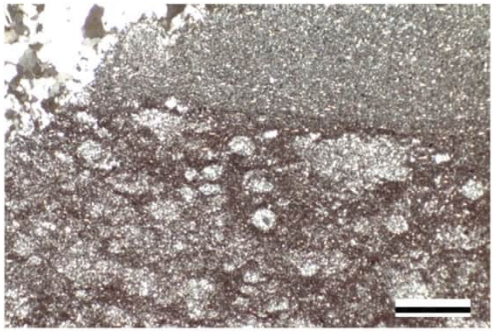
Outcrop located on the western slope of Monte San Giuliano along the local road from “Case Baroni” to “Le Capanne”.

Centimetre to decimetre roughly foliated red to dark red metaradiolarite with thin grey layers. (3 – 10 cm).

**MP16**

43°46’43.97’’N, 10°26’15.81’’E


Dark red metaradiolarite with massive structure and weak lamination evidenced by levels at different grain size. Presence of quartz-filled veins.



Fine grained siliceous reddish matrix with rounded to elongated radiolarian fossils, ranging in size from 0.03 – 0.08 mm, and sponge spicules. Quartz and feldspar-filled veins.

scale bar: 0.4 mm

**“Santa Maria del Giudice” Tectonic Unit**

**<u>Cipollini</u> (SSR1)**

*Turonian – Maastrichtian*

*Greenish or red-violet calcschist (SSR1; Turonian - Maastricthian) Sedimentary facies: pelagic abissal plain.*

Outcrop located on the western side of Monte San Giuliano along the local road from “Case Baroni” to “Le Capanne” resort.

Basal portion of calcschist (SSR1) close to the contact with underlying metaradiolarite. Centimetre -thick (3 – 8 cm) reddish to greenish carbonate layers with thin intercalations of foliated marly levels.

**MP17A**

**43°46’44.33’’N, 10°26’15.27’’E**


Roughly stratified red calcschist with alternance of millimetre to centimetre thick calcite-rich and very thin red marly layers.

Very fine grained (<0.05 mm) calcite, oxides and graphite -rich layers, deformed by isoclinal folds. Fossil rests are represented by elongated calcite aggregates.

scale bar: 1.1 mm

## “Santa Maria del Giudice” Tectonic Unit
## <u>Cipollini</u> (SSR1)

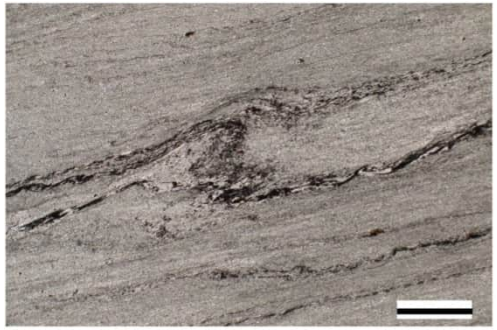
Outcrop located on the western side of Monte San Giuliano along the local road from “Case Baroni” to “Le Capanne”.

Grey calcschist (SSR1) made up of massive to finely laminated centimetre to decimetre thick (5 – 20 cm) calcite-rich layers alternating with finely laminated grey marly levels.

**MP17B**

43°46’44.90”N, 10°26’14.92”E


Light grey finely foliated calcschist with tight alternations of calcite layers (3 - 5 mm) and phyllosilicate levels (<1 mm). Crenulation lineations and manganese dendrites (red arrow) are visible on the foliation.



Very fine grained (< 0.05 mm) calcite and oxides-rich layers with rare calcite and quartz veins.

scale bar: 2.2 mm

## “Santa Maria del Giudice” Tectonic Unit

## <u>Scisti Sericitici</u> (SSR)

*Greenish, red, purplish or grey muscovite-rich phyllite with calcareous base (Scisti Seritici SSR - ?Aptian p.p. - ?Albian p.p.)*
*Sedimentary facies: pelagic abissal plain.*

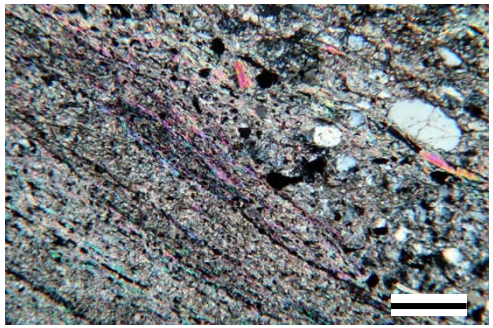
Outcrop located on the western side of Monte Cupola, along the road for the “Langdut Belvedere”.

Small outcrop of grey purplish phyllite with diffuse occurrence of calcite veins.

**MP18A**

43°46’56.04 N, 10°25’46.22 E


Finely laminated grey phyllite, consisting of tight alternation of millimetre thick phyllosilicate and 0.5 -1.0 mm thick calcite layers.



Fine-grained micaceous layers alternate with coarser level with abundant content of clastic mica and quartz grains.

scale bar: 0.08 mm

## “Santa Maria del Giudice” Tectonic Unit
## <u>Scisti Sericitici</u> (SSR)

Outcrop located on the pathway 00 between Monte Cupola e “Le Cimette” (Monte Pisano Hiking trails map).

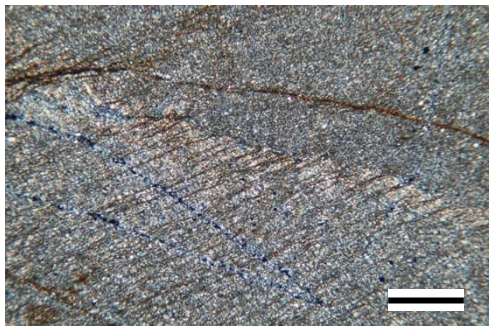
Outcrop of phyllite and calcareous phyllite exposed along the pathway 00 in direction of “*Quattro Venti*” locality, two hundred metres before the “Le Cimette”.
Alternance of grey and green purplish phyllite and calcariferous phyllite. Centimetre thick grey metalimestone layers are locally intercalated.

**MP18B**

43°47’15.70’’ N, 10°26’18.16’’E

3.4 cm

Finely laminated greenish phyllite consisting of millimetre thick phyllosilicate layers with calcite veins and/or nodules parallel to the foliation.



Very fine grained foliation marked by phyllosilicate layers cross cut by spaced crenulation cleavage, well developed in the phyllosilicate.

scale bar: 0.08 mm

## “Santa Maria del Giudice” Tectonic Unit
## <u>Scisti Sericitici</u> (SSR)

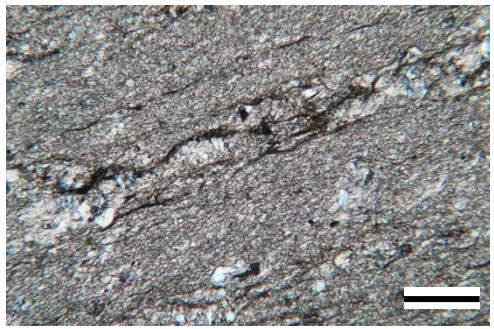
Outcrop located on the pathway 00 between Monte Cupola e “Le Cimette” (Monte Pisano Hiking trails map).

Grey brownish metalimestone defined by alternance of grey and dark grey discontinuous levels. The outcrop is in an esplanade, partly covered by vegetation in the spring season.

**MP18C**

43°47’10.95’N’, 10°26’22.78’’E


Brownish fine-grained metalimestone with intercalated millimetre thick (1 – 2mm) very fine-grained phyllosilicate levels.



Foliation marked by very fine grained recrystallized calcite with occurrence of coarser grained calcite veins parallel to the foliation.

scale bar: 0.08 mm

## “Santa Maria del Giudice” Tectonic Unit

## <u>Scisti Sericitici</u> (SSR)

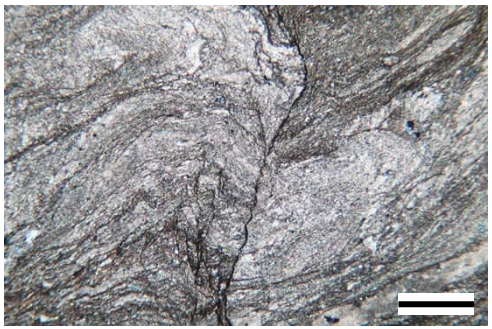
Outcrop located on the pathway 00 between Monte Cupola e “Le Cimette” (Monte Pisano Hiking trails map).

Grey purple well foliated and folded phyllite cropping out along the trail. Open to tight folds with spaced axial plane cleavage are well recognizable on the outcrop, that is partly covered by vegetation.

**MP18D**

43°47’14,21’’ N, 10°26’19.98’’E


Very-fine grained grey well foliated phyllite.



Folded foliation with axial plane crenulation cleavage. Alternace of very fine grained phyllosilicate and coarser calcite layers.

scale bar: 0.2 mm

**“Santa Maria del Giudice” Tectonic Unit**

**<u>Pseudomacigno</u> (PSM)**

*Chattian p.p - Aquitanian p.p.*

*Medium-coarse metasandstone in thick layers with direct gradation and weakly erosive bases.*
*Thin layers of quartzite at the top of each sequence*

Sedimentary facies: abissal plain, foredeep turbidite.

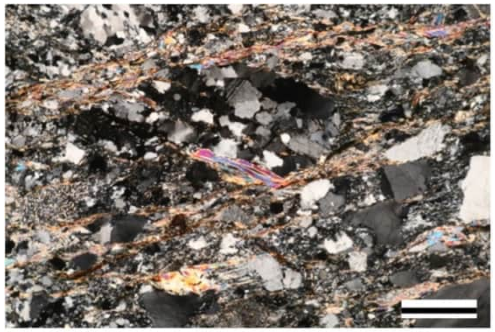
Outcrop located on the SP 61 from Molina di Quosa towards “Quattro Venti”.

Metre thick grey light metasandstone level of with crossed stratification. At the top of the level centimetre thick dark grey metapelite layer.

**MP19A**

43°47’36.7”N, 10°25’41.1”E


Medium-grained metasandstone with millimetre-spaced foliation containing fine-grained quartz clasts (1 mm) and detrital muscovite. On the foliation plane, thin layers of metamorphic mica.



Angular mono and polycrystalline quartz grains (2 – 0.2 mm) wrapped by fine grained quartz and phyllosilicate (white mica and biotite) - rich matrix. scale bar: 1.1 mm

## “Santa Maria del Giudice” Tectonic Unit
## <u>Pseudomacigno</u> (PSM)

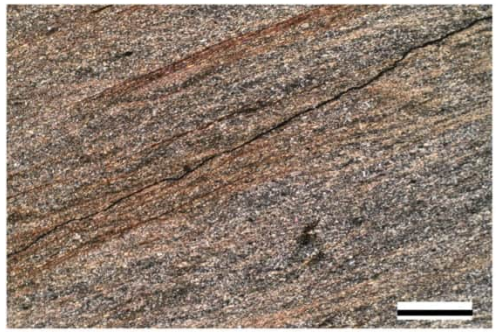
Outcrop located on the SP 61 from Molina di Quosa towards “Quattro Venti”.

Centimetre thick finely laminated dark grey metapelite and metasandstone (yellow arrow) at the top of the metasandstone.

**MP19B**

43°47’36.7”N, 10°25’41.1”E


Dark grey phyllitic metasandstone made up of millimetre thick (3 - 5 mm) fine-grained quartz-rich levels alternating with very thin phyllosilicate-rich levels.



Alternances of phyllosilicate and quartz- rich layers with abundant occurrence of quartz, mica and zircon clastic grains.

scale bar: 1.4 mm