16th of July 2010

Report
on the geoarchaeological investigations
in the greater area around the
excavations of Case Nuove, San Martino and Pievina
(Cinigiano, GR, Italy)
2010

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1) Geological framework of the area
2) Land Units map
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4) The origin of the building stones (draft version)
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The geoarchaeological consultancy of 2010 was a follow up of the work done in 2009 (see report of the 7th of August 2009).

In cooperation with the archaeologists responsible for the project, it was decided to extend the working area as far as to encompass the site catchment of Pievina as proposed in 2009, as well as a reasonably large area around the sites of San Martino and Case Nuove (figure 1).
The geoarchaeological investigation has aimed at the identification of the major geo-resources of the areas around Pievina, Case Nuove and San Martino.

A Land Units map in scale 1:25,000 of the land surrounding the sites was prepared, covering a total surface of about 14,500 hectares, i.e. measuring ca. 12 x 12 km. This area includes the map prepared in 2009 covering a surface of ca. 4,600 hectares. Thus ca. 10,000 hectares had to be surveyed *ex novo*. To that aim, in the first half of June 2010 a stereoscopic aerial photograph\(^1\) interpretation was executed.

Field work was done in the week between the 21\(^{st}\) and 25\(^{th}\) of June 2010. In that period the limits and the contents of the Land Units map were checked. Other topics dealt with have been: the possible sources of the stone types found as building material at the excavations, the practical role of rivers and valleys as obstacles when moving within the landscape, the presence and distribution of springs near the sites, and the geological setup of the hilltop of Case Nuove.

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1) Geological framework of the area

From the geological viewpoint, a large part of southern Tuscany can be considered as a tectonic mosaic, made up of older, rather high, steep, intensively folded and partly metamorphosized geological units (uplifted blocks, “horsts”), alternating with younger ones, generally lower and with a softer morphology, and with layers only slightly to not tilted (subsided blocks, “graben”).

This fragmentation was due to a process of “stretching” of the earth crust, related to the orogenesis of the Apennine chain. It started during the upper Miocene and continued unto the Quaternary. Volcanism and metal ore enrichment were due to the same process.

Figure 2 is a partial copy of the geological map in scale 1:100,000, sheets 128 and 129. Figure 3 gives the schematized distribution of the older and younger geological formations around the mapped area, derived from the generalized geological map of southern Tuscany, of Lazzarotto 1993.

The maps show that the three archaeological sites considered are located in an area corresponding to younger geological units, wedged in between two older blocks, located to the east and the west.

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2 The geological chronologies mentioned on these pages are: the later Tertiary period divided in: Miocene from 23 to 5.3 millions of years ago and Pliocene from 5.3 a 1.8 millions of years ago, and the Quaternary period divided in: Pleistocene from 1.8 to 11,000 years ago and Holocene from 11,000 years ago to present.

3 Not only these sites, but almost all the sites identified by Mariaelena Ghisleni.
Fig. 3 - part of the geological map of Southern Tuscany, modified from Lazzarotto 1993. In the legend, to the left the younger formations, to the right the ones of the older uplifted blocks. The square delimits the area mapped in 2010.
These older blocks are mainly made up of formations belonging to the “Serie Toscana” (Tuscan Nappe or Domain), ranging from the Secondary to the Middle Tertiary, and the “Flysch” facies (Early and Middle Tertiary)\(^4\).

The following geological formations belonging to the “Eastern” uplifted block crop out within or adjacent to the mapped area\(^5\); they belong mainly to the Flysch facies:

- widely distributed is the “argilloscisti” formation (“galestri e palombini”), alternating thin bedded fine grained layers and coarse banks of limestones and marls (“asc” on sheet 128, “ac” on sheet 129; “cm”/”ac” on the map of Lazzarotti, figure 3).
- the “argilloscisti varicolori” (“sv” on sheet 129; “ce” on the map of Lazzarotti), with intercalations of red jasper (“sv2”); outcropping in the SE corner of the mapped area and near Stribugliano (just outside the mapped area);
- predominantly quartz-calcareous sandstones of the “pietraforte” type, locally with lenses of very small pebbles (pt\(^1\) on sheet 129; “sf” on the map of Lazzarotti); outcropping between Monticello e Arcidosso (outside the mapped area).

![Fig. 4 - outcrop of the “macigno” sandstone near Monte Cucco; the subangular form and the yellowish colour on the broken surfaces are characteristic.](image)

Within or near the mapped area, the “Western” older block, is mainly made up of:

- quartz-feldspatic sandstones and sand-schists (“macigno”), grey to yellow, belonging to the “Serie Toscana” (“mg” on sheet 128; “O” on the map of Lazzarotti, figure 3; see figure 4);

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\(^5\) Codes with reference to the geological maps in scale 1:100.000 as well as to the geological map of Lazzarotto 1993. Also available were the new CARG project geological maps in scale 1:10.000 of the Regione Toscana, see: [http://159.213.57.101/geologia/map_10k.phtml?winsize=large&language=it&config=geo10k rt](http://159.213.57.101/geologia/map_10k.phtml?winsize=large&language=it&config=geo10k rt), which have been used only for the considerations on the single sites (chapter 3).
- formations of the Flysch facies: light coloured, more or less compact marly limestones (“alberese”), marly shales, and more rarely “argilloscisti”, the latter indistinguishable from the formation indicated as “ase” on the geological map in scale 1:100.000 (“ca” on sheet 128; “ac” on the map of Lazzarotti, figure 2; see figure 5). Note: in the mapped area, this formation is mainly of the “argilloscisti” type.

![Image of outcrop](image)

**Fig. 5** - Outcrop of the “argilloscisti” near Sasso D’Ombrone: the alternation between (dominantly) friable shales and more resistant marly limestone is evident, as well as the strong tilting and tectonic stress undergone by the formation.

In the central part of the investigated area the younger formations predominate, dated from the Upper Miocene to the Holocene. On the geological map of Lazzarotti 1993 (figure 3) they are indicated with the codes “MI”, “P”, “PQ”, and “ρ”.

These formations were partly described in the report of 2009, and in chapter 3 will be treated in detail for the single sites of San Martino and Case Nuove.

For the geological context of the Pievina site, see the 2009 report.

According to the geological map in scale 1:100,000, sheet 128, the Upper Miocene formations (in figure 3 indicated as “MI”) consist of the unit “M₃”, described as well-stratified sands and sandstones, generally not very compact, covering the marly-clayey formation “M₃”, described as marine-lacustrine marls and clays. In the area of Cinigiano the arenaceous beds are reported to be widely extended and regular.

The Upper Miocene layers are locally overlain by the Pliocene “Peg” formation, described as polygenic conglomerates with various limestone types derived from the older Flysch formations.

A large part of the area investigated in 2010 is made up of Pliocene formations (code “P” in figure 3). These are mainly clays (“Pm” on sheet 128, “Pa” on 129) and conglomerates
("Pcg"), the same that cover the Upper Miocene formations, with subordinately sands ("Ps").

According to the notes to the geological sheet 128 (Motta 1969), there is no systematic stratigraphic relationship between the three Pliocene formations.

The tilt angles of these formations range from 20° to 35° 6 (see figure 6).

For more photo’s of the “older” and of the Upper Miocene and Pliocene formations we refer to the 2009 report.

Fluvial terraces of the Ombrone, Orcia and other rivers ("q"/"f3" on sheets 128/129; included in “PQ” in figure 3) are widely present in the northern part of the investigated area, but not only. Aerial photo interpretation revealed the presence of at least 3 terrace levels, elevated with respect to the valley floors (see chapter 2, Land Units map). Generally they are composed of a loamy fine sandy surface layers, lying upon gravelly layers, which crop out along the eroded terrace margins.

The most extended of the fluvial terraces is the intermediate level located south of the Orcia; the area is called “Piani Rossi”, and now we know why: the soils are definitely reddish (see figure 7).

The valley floors of the Orcia and Ombrone are the most extended among the river valleys. They are indicated as “a” on the geological sheets 128/129 and enclosed in the unit “PQ” in figure 3.

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6 Data from the geological map in scale 1:10.000 from the Regione Toscana, sheet 320090.
The Orcia, left-side tributary of the Ombrone, has a decidedly braiding hydraulic regime, whereas the Ombrone exhibits characteristics transitional between meandering and braiding, which becomes more meandering towards the entrance of the gorge of Sasso D’Ombrone (see figure 8).

**Fig. 7** - view to the north over the “middle” terrace of the Orcia; the red colour of the soils of the so-called “Piani Rossi” (subunit T2a) is well visible in the olive yard behind the truck. In the foreground the gently sloping clayey Pliocene reliefs.

**Fig. 8** - view to the west over the Ombrone valley from Sasso d’Ombrone, just before the river (running from right to left) enters the gorge. To the right in the foreground a slope of the landscape unit C (see chapter 2).
For the morphological and hydrographical framework we refer to the 2009 report, and to chapters 2 and 5.

2) Land Units map

A Land Units map in scale 1:25.000 of the land surrounding the sites was prepared, covering a total surface of about 14,500 hectares, i.e. measuring ca. 12 x 12 km. This area includes the map prepared in 2009 covering a surface of ca. 4,600 hectares.

As stated in the 2009 report, this thematic map pictures the spatial distribution of the Land Units, intended as portions of the territory with homogeneous characteristics as far as soil, substrate, geomorphology and hydrology are concerned.

Figure 9 gives the location of the registered field observation points of 2010, in and outside the newly mapped area.

Figure 9: in yellow dots the field observation points registered for the Land Units map 2010; the archaeological sites within the yellow ellipses; roads in red, rivers in blue.

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7 For the methodology of compiling the map see Arnoldus-Huyzendveld & Pozzuto 2008, Arnoldus-Huyzendveld 2009.
Figure 10: Land Units map of the greater area around Pievina, San Martino and Case Nuove, scale 1:25,000⁸; the dotted line delimits the area mapped in 2009.

Abbreviated legend (full legend in Annex 2):
M: schist-carbonatic reliefs (“galestieri e palombini”, pre-Miocene); M, moderately steep; M, undulating; Mv, very deep valleys;
C: moderately steep reliefs in marly shales (“argilloscisti”, “alberese”, pre-Miocene);
N: very steep reliefs in clay-schists and sandstone, pre-Miocene;
L: sandstone reliefs (“macigno”, Lower Miocene); Lo, undulating broad hilltops; Lv, steep to very steep slopes;
K: marly-conglomeratic landscape (Upper Miocene); Kc, hilly in clay; Ks, hilly in fine sands; Kv, deep valleys;
P: clayey-sandy-conglomeratic landscape (Pliocene); Pa: rolling in clays, locally covered by travertine (Pat); P, depressions in Pa; Pr, fluvial system dissecting Pa down to the level of the intermediate terrace; Pg, hilly in conglomerates;
T: fluvial terraces (Pleistocene); T1, lower level; T2a, intermediate level with red non-calcareous soils; T2b, with grey calcareous soils; Tv, terrace borders; T3, highest level;
A: alluvial deposits (Holocene); A1, valley floor of secondary rivers; A2, valley floor of the Ombrone-Orcia river system; A3, active river bed of the Ombrone-Orcia in 1954.

⁸ The various classes are given in the Annex (3). They follow mainly the classes proposed in USDA 1993.
The legend units added to the “greater” landscape map of *Pievina, Case Nuove & San Martino* with respect to the 2009 map are given in the Annex (1). The Land Systems are now 8 (in 2009 there were 6) and the Land Units/Subunits 22 (in 2009: 11).

The map is given in figure 10, with an abbreviated legend. The full legend is given in the Annex (2). For each legend unit are defined: the physiography or lithology, soil depth, soil stoniness, drainage class (only for level to nearly level slopes), morphology of the landscape (slopes), dominant land use, dominant soil type (FAO 1998).

Figures 11 - 20 offer an overview of the landscape and soils of the various new map units, and some “old” ones. For pictures of the existing map units we refer to the 2009 report.

![Image of landscape](image_url)

**Fig. 11** - view towards SW from the *Casale Nuove* site over the “macigno” sandstone landscape, with the neat division in two morphological units: **Lv** - steep slopes (suitability class **N**), **Lo** - undulating broad tops (suitability class **S2**). The valley of the Fosso Cortilla, running from right to left, separates this landscape from the Pliocene clay-conglomerate reliefs in the foreground.

Figure 11 is a good example of the meaning of the Land Units concept: this whole ridge is mapped as a single unit on the geological map (see figure 2, unit “mg”), whereas, from the viewpoint of potential land use (in all senses: agriculture, forestry, human mobility), there are two evidently distinguished land forms.
Fig. 12 - landscape of the undulating top unit Lo of the “macigno” sandstone S of Poggio del Sasso, suitability class S2.

Fig. 13 - soil exposure in the undulating top unit Lo of the “macigno” sandstone S of Poggio del Sasso: loamy fine sand, slightly to non-stony, non-calcareous, suitability class S2.
Fig. 14 - soil surface in the unit C of the “argilloscisti” (shales) SE of Sasso d’Ombrone: clay, slightly stony, calcareous, suitability class S3.

Fig. 15 - the steeply dissected landscape of the Pliocene conglomerates, land unit Pg, ca. 3 km SW of Cinigiano. The soils are reddish, calcareous, moderately stony (pebbles, size 5-10 cm), suitability class S3. The valley itself is too narrow to be mapped in a 1:25.000 scale.
Fig. 16 - soil profile in the “Piani Rossi” to the W of Borgo S. Rita, land unit T2a of the intermediate river terrace: reddish clay loam, non calcareous (suitability class S1), at greater depth presence of pebble layers (size 3-5 cm), which crop out along the margins of the terrace (unit Tv).

Fig. 17 - soil surface of the “Piani Rossi” to the W of Borgo S. Rita, land unit T2a of the intermediate river terrace: the clayey loamy texture prevents cracking when drying out, but leads to “sealing” of the surface (suitability class S1).
Fig. 18 - landscape 2.5 km SE of Borgo S. Rita, unit T2b of the intermediate river terrace, view towards S; soils grey, calcareous, silty clay; in the background the low hills of the Pliocene clay unit Pa; both suitability class S1.

Fig. 19 - landscape 4 km SE of Borgo S. Rita, view towards W, the intermediate river terrace T2b, surrounded by (and resting upon) the Pliocene clay hills Pa; both suitability class S1; the river separating the two terrace remains is the Torrente Ribusieri, running towards the right, bordered by its lower terrace T1.
The Land Suitability for crops and tree crops was established for each Land Unit. In terms of a low-technology agriculture, we considered clayey soils more suitable than fine sandy soils, since they have a higher natural fertility and water availability, although they are harder to plough. The map is given in figure 21.

Land Suitability for crops for each legend unit:

<table>
<thead>
<tr>
<th>ID</th>
<th>Land Unit</th>
<th>Class (crops)</th>
<th>ID</th>
<th>Land Unit</th>
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</tr>
</thead>
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<td>Pv</td>
<td>S1</td>
</tr>
<tr>
<td>2</td>
<td>Mo</td>
<td>S3</td>
<td>13</td>
<td>Pr</td>
<td>S1</td>
</tr>
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</tr>
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<td>17</td>
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<td>S1</td>
</tr>
<tr>
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<td>N</td>
<td>18</td>
<td>Tv</td>
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</tr>
<tr>
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<td>S1</td>
<td>19</td>
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<tr>
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<td>20</td>
<td>A1</td>
<td>S3</td>
</tr>
<tr>
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<td>21</td>
<td>A2</td>
<td>S2</td>
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<tr>
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<td>S1</td>
<td>22</td>
<td>A3</td>
<td>N</td>
</tr>
</tbody>
</table>
Figure 21: Suitability for crops and tree crops, considering low level agricultural technology. Legend: S1, highly suitable; S2, moderately suitable; S3, marginally suitable; N, not suitable.

Rough statistics for the various suitability classes are:

<table>
<thead>
<tr>
<th>class</th>
<th>surface in ha</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
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<td>6450</td>
<td>44</td>
</tr>
<tr>
<td>S2</td>
<td>2450</td>
<td>17</td>
</tr>
<tr>
<td>S3</td>
<td>2600</td>
<td>18</td>
</tr>
<tr>
<td>N</td>
<td>3050</td>
<td>21</td>
</tr>
</tbody>
</table>

This evaluation implies that the mapped territory has a potential area for crop and tree crop production (classes S1, S2) of about 8900 hectares.

We can use the same evaluation to obtain maps for the probable distribution of forests, assuming first that all units evaluated “N” were under forests (in brown, map_1, figure 22), then that all units “N” + “S3” were under forests (in brown, map_2), and finally idem all units “N” + “S3”” + “S2” (map_3). The active river bed has not been considered (blue). These derived maps are confronted with the present real distribution of forests (map_4, figure 22).
The maps 1-3 are extrapolations of a model derived from the evaluation of the Land Units for crops (inverted), with the main and only advantage that it is based upon an independent “historical” source, e.g. the physical landscape characteristics (presuming that the present landscape in this area is quite similar to the historical landscape).
3) Geo-context of the single archaeological sites

Case Nuove

This site is located upon a hilltop in the rolling/hilly reliefs of the Pliocene conglomerates (Pg of the Land Units map), at a height of about 300 m a.s.l. (figure 23).

![Fig. 23 - view towards SE over the initial tract of the Fosso Cortilla valley (the river runs from left to right); the Case Nuove excavation is just visible upon the right hilltop; to the left the slopes of the Santa Marta area.](image)

The other archaeological sites nearby (among which the Villa Santa Marta) are located along a slope in the same geological formation, extending south-westwards and downwards from the hilltop locality Santa Marta (at ca. 290 m s.l.m.) towards the valley of the Fosso Cortilla, a minor tributary of the Ombrone river, running southwards (figure 24). The lower parts of the slope are made up of Pliocene clays and fine sands, which form a kind of shallow depression that that accommodates the initial tract of the Fosso Cortilla. South of the sites, the valley begins to be steeply incised with a narrow valley floor.

Several small springs are present in this area. These are:

- the Fonte Santa Marta (indicated as 1 on figure 24), still active;
- the Fonte del Prete (2a), which recently has been moved to a lower position (2b) before the planting of a vineyard (see figure 25); I estimated the present flow at about 0.02 liters/second;
- several springs (3) were said to be present just below the road leading to Volpaia;

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9 The springs were indicated to us by Giuliano Guerrini, agronomist and manager of the Colle Masari farm.
- considering the alignments of abundant vegetation, more springs could be present in the tract between Case Nuove and the Villa S. Marta.

Fig. 24 - physiographical/morphological position of the Case Nuove site. Contour lines equidistance 10 meters. In red the modern roads, in blue the rivers and springs. In black are indicated the water sheds, showing clearly the site’s position upon the water parting between the basins of the Torrente Trisolla (to the north) and the Fosso Cortilla.

Fig. 25 - the Fonte del Prete spring in it’s present position (the original position is visible on page 1, ca. 10 m within the vine yards).
The area around *Case Nuove* is located near the transition between the Pliocene hills to the east and the much steeper and older “macigno” reliefs to the west. The morphological transition is well visible in figure 26, with to the left (W) the steep “macigno” reliefs and to the right (E) the rolling/hilly Pliocene reliefs.

![Fig. 26 - view to the north, along the Fosso Cortilla valley, 2 km south of the Case Nuove site, with the transition between the steep “macigno” reliefs to the left and the rolling/hilly Pliocene reliefs to the right.](image)

This transition is also visible in figure 27, which is based upon the geological maps of the Regione Toscana in scale 1:10,000, sheets 320050 and 32009010.

From the strike and dip directions indicated on figure 27, it becomes clear that in this area the Pliocene layers are intensely folded.

To these data we can add the observed dip angle of 25°/30° S of the sandy-conglomeratic layers exposed to the south of the site (indicated as “GPS35” in figure 27; figure 28).

It also becomes clear from figure 27 that the position of the springs close to the archaeological site must be related to the transition between the Lower Miocene “macigno” sandstone and the clayey and fine sandy layers of the Pliocene formations. We may presume that, in this case, the rather permeable sandstones contain the groundwater (aquifer), which is forced to the surface by the clayey and fine sandy layers.

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10 I have transformed these maps into a lithological map, by unifying several “Synthems”, which are the original map units (a “Synthem” is a chronostratigraphic unit that defines an unconformity-bounded regional body of sediments and represents a cycle of sedimentation in response to changes in relative sea level or tectonics).
Fig. 27 - geological map of the area around Case Nuove, based upon the 1:10.000 map of the Regione Toscana, sheets 320050 and 320090. In red the modern roads, in blue the rivers and springs. In black are indicated the water partings. The symbols indicate the strike and dip (in degrees) of the layers directly around the site, as indicated on the geological sheet 320090.

Fig. 28 - outcrop of the clayey-sandy-conglomeratic layers to the south of the site (“GPS35” on figure 27), north to the left. Dip direction is towards south (SW, SE). The reddish clay-loam layer to the right is similar to layer “R” of the Case Nuove hilltop (see figure 29).
A detailed map in scale 1:200 of the geological layers exposed at the surface of the excavation has been drawn (figure 29). In the northern part of the exposed surface the layers have a strike ca. NW-SE and a dip of 20° to the W, whereas in the central part the strike changes abruptly to SSW-NNE, with a dip probably towards E (the latter not observed).

A dip towards W is also visible in the natural layers of the western and eastern walls of the square pit (“p” on figure 29).

These local measurements are coherent with the values indicated on the geological map of figure 26 directly to the north of the site (dip 35° to WSW, strike NNW-SSE) and to the south-west (dip 25° to SSE, strike WSW-ENE).

The layers distinguished on the surface of the excavation area are (figure 29):

- “Northern” structural domain (all layers calcareous), figure 30:
  - C1: conglomerate, medium sized pebbles (5-8 cm), with a reddish weathering (also exposed in the walls of the square pit!)
  - W1/W2: whitish clay loam, highly calcareous
  - R: orange-reddish clay loam
  - G: light-grey loamy fine sand, with some fine-sandy loamy layers
  - DR: brick-red clay loam
  - GS: light-grey fine-sandy loam
  - GC: grey clay loam with very fine sand, locally with small calcareous nodules (also exposed in the walls of the square pit!)

- “Central” structural domain (all layers but S1 calcareous), figure 31:
  - C2: sandy pebble layer, small sized pebbles
  - S1: fine reddish sand, slightly loamy (non to slightly calcareous)
  - S2: fine yellow sand, slightly loamy
  - S3: greyish loamy very fine sand, with red mottles
  - B1 / B2: silty clay with cm-size white calcareous nodules.

In some areas the geological layers were not visible because of the presence of excavation dump and other disturbances (D), or elsewhere beneath the pebbly soil layers (N).

The transition between the two “domains” seems to be rather abrupt, or anyway within a few meters (blue dashed line in figure 29).

The presumed well (“w”) is located in the central-western area of the excavation. It is possible that its position so close to the transition between the two structural “domains” is not casual, although it is difficult to be more specific on the topic.
Fig. 29 - geological map of the area surface of the Case Nuove excavation, original scale 1:200, in yellow the areas were the layers were visible, in red the archaeological features. Legend see text. Red double arrows indicate the strike direction of layers, green arrows the dip direction; the blue dashed line indicates the limit between the two structural “domains”; w = ”well”, p = square pit.
Fig. 30 - view to north west, along the strike direction of the layers of the northern structural “domain”, from left to right are visible: the conglomerate C1, the whitish clay loam W, the reddish clay loam R, and the light grey loamy fine sand G. Dip direction is 20° towards the left (SW).

Fig. 31 - view to north east, along the strike direction of the outcropping layers of the central structural “domain”; from left to right are visible: the silty clay with white calcareous nodules B1, the fine reddish sand S1, and (partly) the sandy pebbly layer C2.
San Martino

The San Martino site (altitude about 125 m a.s.l.) is located upon a gentle slope within a particular landscape (Pr of the Land Units map, figure 32), composed of a fluvial system dissecting shallowly the rolling landscape of the Pliocene clays (unit Pa) down to the level of the intermediate terrace (T2) of the Orcia-Ombrone river system. The site is close to the Fosso Vallanzo, a minor tributary of the Orcia river, running northwards.

This particular position in the landscape can clearly be read from the contour lines traced in figure 33 and from the figure 34, the latter showing the Fosso Vallanzo valley as visible from the Orcia fluvial terraces.

The map of figure 35 is based upon the geological maps of the Regione Toscana in scale 1:10.000, sheets 320010 and 32005011. The Lower Pleistocene travertine / limestone is not indicated on these maps, but derived from the geological map in scale 1:100.000, sheet 128 (the two outcrops to the east; see also figure 36) and to field observation (the outcrop to the left). This geological formation is important, as it is supposed to be the source of the building material found at San Martino (see chapter 4).

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11 See note 10.
Fig. 33 - physiographical/morphological position of the San Martino site. Contour lines equidistance 10 meters. In red the modern roads, in blue the rivers and spring. In light blue the three known local outcrops of Lower Pleistocene travertine / limestone (see text).

Fig. 34 - view to the SSE from the “intermediate” fluvial terrace of the Orcia river into the valley of the Fosso Vallanzo (marked by the tree alignment), here running from right to left. The San Martino site is hidden behind the rolling Pliocene clay hills in the foreground.
Fig. 35: geological map of the area around San Martino, based upon the 1:10.000 maps of the Regione Toscana, sheets 320010 and 320050. The Lower Pleistocene travertine / limestone is not indicated on these maps, but derived from the geological map in scale 1:100.000, sheet 128 (two outcrops to the east) and from field observation (the outcrop to the left). In red the modern roads, in blue the rivers and spring.

Fig. 36: part of the geological map in scale 1:100.000, sheets 128 - 129, with the known outcrops of the Lower Pleistocene travertine / limestone (see text).
This Lower Pleistocene travertine / limestone formation is a story in itself. In 2009, following the indications of Marielena Ghisleni, we went looking for the outcrops indicated by the numbers 4 and 5 in figure 36. The rock outcrops could not be reached, but we found small travertine stones distributed in the fields and a few large blocks standing along the entrance roads to the country houses. This year we encountered casually a small outcrop not indicated on the geological sheet 128 (3), made up of a massive whitish travertine, sometimes layered but not always, and locally characterized by cm-sized round holes on the surface, and, moreover, we went to observe the blocks from the quarry near Plátina (1a), though not the quarry itself. In the latter location, the blocks were light grey travertines, without pebbles, layered but not always (see figure 37), and rarely with cm-sized round holes. The quarry itself has not been visited yet.

On the geological sheet 128 in scale 1:100.000 the formation is indicated with the code “T”. Important to mark that on figure 36 are copied all the known outcrops of sheet 12812, and that a similar formation is not indicated on any of the geological maps surrounding sheet 128 (sheets 120, 127, 129, 13513). The legend and the explanatory notes to sheet 128 offer the following description:

- **T** - Travertineous limestones14, conglomerates with calcareous cement, conglomerates (pudding stones) with small snails, in small outcrops on the crest of the underlying Pliocene or Miopliocene formations, rarely upon the Flysch formations.

---

12 Other small ones are mentioned to the north of Sticciano - Fattoria Venturi and a small one near Roselle.
13 There may be a reason for that: they may be indicated as belonging to the Miocene formations, like it was the case, according to explanatory notes, on the preceding edition of the sheet 128.
14 None of the outcrops is indicated on the geological maps in scale 1:10.000 of the Regione Toscana.
The explanatory notes continue:

Two types of travertine are unified under this heading.

The first type crops out near M. Antico (1a, 1b, 1c, 1d on figure 36), and covers Miopliocene and Flysch formations. Several small outcrops are located upon the crests, with a maximum extension of some hundreds m² up to a few hectares. These are dark grey travertines, often fetid on percussion, rich in inner models (my comment: imprints?, the holes?) of sweet water gastropods. The average thickness is about ten meters.

The outcrops around the locality Falsettaio (3, 4, 5 in figure 36) cover the Pliocene formations (my comment: they are not explicitly described, but the text suggests that they belong to the first type).

The second type of travertine consists of conglomerates where the travertine forms a hard cement between the pebbles. Large bivalve shells are often present. The most typical of these outcrops is to the west of Poggi e Volpaia, on the left side of the Ombrone river, where they cover the Flysch formation (“ca”, “asc”; 2 on figure 36).

At the moment, no other references to this particular formation are available.

The outcrop near Poggi e Volpaia has yet to be observed.

**Pievina**

On the geological map in scale 1:10,000 sheet 320090 of the Regione Toscana a landslide is indicated just to the south of the excavated area (see figure 37).

If this feature is mapped correctly, this could be a good explanation for the subsidence undergone by the “traverse” wall.

![Fig. 37 - (modified from the 2009 report) - map of the soil surface texture of the area around the excavation, indicating sand (fine loamy sand locally with pebbles) and clay (silty clay). With a grey dashed line is given the landslide indicated on the geological map of the Regione Toscana sheet 320090.](image-url)
4) The origin of the building stones (draft version\textsuperscript{15})


\textit{Case Nuove}

The building stones encountered at this site are mainly rounded and subrounded pebbles and boulders, average size 8-10 cm, up to 30-35 cm (see figure 38, infill of the square pit), and, subordinately, subangular marly limestones, size up to 50 cm (see figure 39, from the “well”, location see figure 29).

Fig. 38 - \textit{Case Nuove} excavation, rounded and sub-rounded pebbles and boulders of the infill of the square pit.  

Fig. 39 - \textit{Case Nuove} excavation, subangular blocks of marly limestone, and pebbles, along the rim of the “well”.

The pebbles could well originate from the Pliocene conglomerates (“Pg” of the Land Units map), a formation that in particular in the south-western part of the mapped area contains rounded pebbles and boulders of that size.

The closest outcrops of marly limestones belong to the Flysch formation indicated on the geological map as “ca” (figure 2) and on the Land Units map as “C” (figure 10).

A good places to collect both pebbles and stones\textsuperscript{16} could have been the large natural outcrop of the Flysch formation along the Ombrone near Sasso (see figure 40), and the pebbles and stones accumulated down there in the river bed (figure 41).

The “road” distance from this place to the site is ca. 6.5 km.

\textsuperscript{15} Some field notes are not available at the moment, awaiting to be scanned.

\textsuperscript{16} The same limestone is used in the older houses of the village of Sasso d’Ombrone. Presumably those derive as well from this outcrop, since, according to our information, no other quarries of such a stone are known in the area.
Fig. 40 - natural outcrop of the Flysch formation “ca” close to the bridge over the Ombrone near Sasso.

Fig. 41 - pebbles accumulated in the river bed of the Ombrone below the Flysch outcrop of figure 40.

San Martino

The stones mainly used for building the structure of San Martino are hard travertine limestones, tendentially layered, and locally with cm sized holes (figures 42, 43).
Subordinately we find medium sized pebbles, and rather large, reddish hard conglomerates made up of cm-sized pebbles (figure 44). A few other stone types are present, among which non-calcareous marls.

As stated in chapter 3, the travertine limestones and conglomerates derive probably from a single formation, the lower Pleistocene travertines, specifically the travertineous limestones from the outcrops near Falsettaio indicated as 3, 4, 5 on figure 36, and the conglomerates probably from the outcrop to the west of Poggi e Volpaia (2 on figure 36).
**Pievina**

It has still to be demonstrated, but a good candidate for the fine grained, hard, light coloured, tending to layered, locally dark reddish conglomerate (see 2009 report), is the travertine formation reported to the west of Poggi e Volpaia (2 on figure 36).

It is described as a conglomerate, where the travertine forms a hard cement between the pebbles, with presence of large bivalve shells.

This location (figure 45, 2) can reached well from *Pievina* and *Case Nuove*, though not so easily from *San Martino*.

![Fig. 45 - the sites positioned with respect to the rivers (blue) and watersheds (water partings) in yellow. In red the modern roads. Location 2 between Poggio del Sasso e Campagnatico is a possible candidate for the hard reddish conglomerates found at the excavations of *Pievina* and *San Martino*. This outcrop has yet to be verified.](image)

5) On rivers, valleys and crests

The hydrographical and morphological framework of the area was partly treated in the 2009 report. The steep parts of the valleys of the T. Ribusieri and T. Melacce were considered serious obstacles for human mobility across the territory, whereas the final parts of the T. Ribusieri, T. Trisolla and T. Melacce were proposed as preferential pathways lengthwise.

To my opinion, the proposed classification of the valleys of the major rivers in three degrees of difficulty for crossing remains valid, but the work of this year has partly mitigated the idea of an easy mobility along the valley floors, and reinforced the idea of a preferential human movement in this area along the crests.
The motives are:

1) valley floors are crossed by numerous small tributaries, which are rather easy to cross afoot or on horseback, but not so easy with a cart; moreover, valley floor walking or riding is in practice limited to the dry season;
2) the present road system follows mainly the crests;
3) the *Pievina* and *Case Nuove* sites are positioned upon the same major water parting (between the Trisolla/Ribusieri and Melacce/Cortilla basins), that forms a continuous E-W crest connecting the Amiata reliefs to the east with the Ombrone valley to the west, specifically to the location of present *Paganico*: a kind of regional “high way” (see figure 45, see also the black line in figure 46).

Remain to express some considerations on the difficulty of crossing the streams, not so much the valleys.

The distribution of the major and minor rivers is given in figure 46. The blue dots indicate the points where the possibility of crossing the stream has been explicitly checked (July 2009 / June 2010).

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17 The Leopoldino cadastre should be checked from that viewpoint.
The same points are put on the map of the major valleys presented in 2009 (figure 47).

First the Ombrone and Orcia river.

In points 4, 9 and 10, during the summer of 2010, the Ombrone river was impossible to cross afoot or by chart. Interesting is the report that a few years ago a chart has crossed the Ombrone in point 9. Figure 48 gives the situation in June 2010.

A possible better crossing point could be point 10, that was observed from the height of Sasso d’Ombrone (see figure 8) (to be checked more close by).

In the same period (summer 2010), the Orcia was also impossible to cross, although the many stones in the riverbed near point 5 (see figure 49, close to the modern bridge), might have allowed in the past crossing afoot.
Fig. 48 - the Ombrone river before receiving the waters of the Orcia, summer 2010 (point 4 in figure 46). Here during a dry summer of some years ago, a ford has allowed the crossing of the river by chart. In 2010 the stream was particular strong in the area indicated by the arrow; stream direction from right to left.

Fig. 49 - the Orcia river to the W of the only modern bridge that crosses the river, summer 2010 (point 5 in figure 46). Crossing afoot, using stepping stones, could be possible during the dry season.

The Ribusieri, Trisolla and Melacce rivers were checked in points 1, 2, 3, 8 and 11. At least during the summer, the river itself should not be the problem for crossing afoot, the rivers are narrow, and with few water or none (see figures 50, point 3, and 51, point 1). If
ever there is a problem (for both walking and by cart), it is the form of the valley (as sustained in the 2009 report).

Obviously, the rivers gain water discharge downstream (cfr. figures 52, point 2, and 53, point 8).

In point 11 the Torrente Melacce has a very deeply dissected valley, almost impossible to cross. In point 12 the deep incision of the Ribusieri valley was observed, but not the river itself.

Finally some considerations on the minor streams, of which the territory is very rich. We checked specifically the Fosso Vallanzo, running close to the San Martino site, and it’s tributaries. It turned out that where we checked it (points 6 and 7) the stream could be crossed afoot, using some stepping stones (as we did ourselves 400 m N of Borgo S. Rita, to reach the Orcia), though is difficult by cart (figures 54, point 6, and 54, point 7). The val-
ley form, only slightly incised, never poses a problem. In practice during fieldwork the rich vegetation flanking the stream turned out to be an obstacle for reaching the stream.

Fig. 54 - the Fosso Vallanzo (the stream running close to the *San Martino* site) near Borgo S. Rita, summer 2010, downstream tract. Crossing of the river and the valley seems possible afoot, but poses difficulties by cart (point 6).

Fig. 55 - tributary of the Fosso Vallanzo just upstream from the *San Martino* site, summer 2010; upstream tract. Crossing of the river and the valley is possible afoot, but poses some difficulties by cart (point 7).

The eventual mapping and application of these data would be a welcome discussion topic with the archaeologist of the project.
Annex:

1) The legend units added in 2010 to the “greater” landscape map of Pievina, Case Nuove & San Martino with respect to the 2009 map:

- the sandstone (“macigno) reliefs in the west with 2 units (Lv, steep to very steep borders; Lo, undulating broad hilltops);
- the marly limestone (“argillo-scisti”) reliefs near Sasso D’Ombrone, unit C, moderately steep;
- two new units of the clayey-sandy-conglomeratic reliefs: Pv, depressions, and Pr, a valley system dissecting the hilly clay landscape Pa down to the level of the intermediate fluvial terrace T2 of the Orcia-Ombrone river system;
- to the unit Pa is added the diction: “locally travertine” (indicated as Pat)
- the fluvial terraces of the major rivers, articulated on three distinct levels:
  - T1 (former T): low terrace, slightly elevated valley floors
  - T2: intermediate terrace, large unified extensions (limited to the Orcia-Ombrone river system); divided in 2 subunits on the base of the soil characteristics: T2a, red soils of the “Piani Rossi”, T2b, grey soils
  - Tv: steep borders or incisions of the intermediate terrace T2 of the Orcia-Ombrone river system
  - T3: high terrace, isolated rests overlying the hilly clay landscape Pa (limited to the Orcia-Ombrone river system);
- the alluvial deposits of the river system, with the following units:
  - A1 (former A): alluvial deposits of the secondary rivers
  - A2: valley floor of the Orcia-Ombrone river system
  - A3: active river bed of the Orcia-Ombrone river system.

2) Complete legend of the Land Units Map of the greater area around Pievina, San Martino and Case Nuove, scale 1:25.000, classification according to the World Reference Base for Soil Resources, FAO 1998.

<table>
<thead>
<tr>
<th>ID</th>
<th>System</th>
<th>Land Unit</th>
<th>Description</th>
<th>Class (crops)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Mc</td>
<td>M) schist-carbonatic reliefs (“galestri e palombini”) (pre-Miocene)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Mo</td>
<td>Mo</td>
<td>moderately steep reliefs, locally rocky, with shallow, stony, non calcareous soils, slightly acid, fine textured; dominant use woods; dominant soils Eutric Regosols</td>
<td>N</td>
</tr>
<tr>
<td>2</td>
<td>Mv</td>
<td>Mv</td>
<td>undulating reliefs, with moderately deep, moderately stony, non calcareous soils, slightly acid, fine textured; dominant use woods, olives; dominant soils Eutric Cambisols</td>
<td>S3</td>
</tr>
<tr>
<td>3</td>
<td>Mv</td>
<td>Mv</td>
<td>very deeply incised valleys, rocky, with very shallow, stony, non calcareous soils; dominant use woods; dominant soils Eutric Leptosols</td>
<td>N</td>
</tr>
<tr>
<td>ID</td>
<td>System</td>
<td>Land Unit</td>
<td>Description</td>
<td>Class (crops)</td>
</tr>
<tr>
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<td>-----------</td>
<td>-------------</td>
<td>---------------</td>
</tr>
<tr>
<td>C)</td>
<td>marly shales (“argilloscisti”, “alberese”) (pre-Miocene)</td>
<td></td>
<td>C</td>
<td>moderately steep reliefs, locally rocky, with moderately deep, non to slightly stony, calcareous soils, fine textured (clay); dominant use woods, shrubs, subordinately olives; dominant soil <em>Calcaric Regosols</em></td>
</tr>
<tr>
<td>N)</td>
<td>clay-schist and sandstones (pre-Miocene)</td>
<td></td>
<td>N</td>
<td>very steep reliefs, locally rocky, with very shallow, moderately stony, slightly calcareous soils; dominant use woods; dominant soils <em>Eutric Leptosols</em></td>
</tr>
<tr>
<td>L)</td>
<td>sandstone reliefs (“macigno”) (Lower Miocene)</td>
<td></td>
<td>Lo</td>
<td>undulating broad hilltops, with moderately deep, non calcareous soils, slightly acid, locally slightly stony, medium-coarse textured (loamy fine sand); dominant use crops, vine yard, olives; dominant soils <em>Dystric Cambisols</em></td>
</tr>
<tr>
<td>K)</td>
<td>marly-conglomeratic reliefs (Upper Miocene)</td>
<td></td>
<td>Ke</td>
<td>hilly landscape, partly rolling, in clay, with moderately deep, calcareous non-stony soils, fine textured (clay and silty clay), with vertic properties (cracks); dominant use crops, olives, vine yards; dominant soils <em>Calcari-Vertic Cambisols</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ks</td>
<td>hilly landscape, partly rolling, in fine sands, locally with pebbles in the higher parts of the reliefs, with moderately deep, calcareous soils, medium textured (silt loam); dominant use crops, olives, vine yards; dominant soils <em>Calcaric Cambisols</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Kv</td>
<td>deeply incised valleys, with shallow, slightly stony, calcareous soils, medium textured (silt loam); dominant use woods; dominant soils <em>Calcaric Regosols</em></td>
</tr>
<tr>
<td>P)</td>
<td>clayey-sandy-conglomeratic reliefs (Pliocene)</td>
<td></td>
<td>Pa</td>
<td>rolling landscape, partly hilly, in clays, locally in fine or very fine sands* with deep, non-stony, calcareous soils, fine textured (silty clay); dominant use crops, olives, vine yards; dominant soils <em>Calcaric Cambisols</em>; locally with hard travertine upon the crests (Pat)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pv</td>
<td>depressions with an undulating to rolling morphology, with calcareous soils, fine textured (silty clay and clay) with vertic properties (cracks); dominant use crops; dominant soils <em>Calcari-Vertic Cambisols</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pr</td>
<td>fluvial system dissecting the unit Pa, down to the level of the intermediate terrace (T2) of the Orcia-Ombrone river system; undulating to nearly level landscape, with calcareous soils, fine textured (silty clay and clay) with vertic properties (cracks); dominant use crops; dominant soils <em>Calcari-Vertic Cambisols</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pg</td>
<td>hilly landscape, partly rolling, in conglomerates, often with moderately steep borders, with moderately deep soils, locally reddish in the higher parts of the reliefs, calcareous, moderately stony (pebbles); dominant use woods, shrubs, olives; dominant soils <em>Calcaric Cambisols</em></td>
</tr>
<tr>
<td>T)</td>
<td>fluvial terraces (Pleistocene)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID</td>
<td>System</td>
<td>Land Unit</td>
<td>Description</td>
<td>Class (crops)</td>
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<td>--------</td>
<td>-----------</td>
<td>-------------</td>
<td>--------------</td>
</tr>
<tr>
<td>15</td>
<td>T1</td>
<td>(in 2009 “T”) fluvial terraces and slightly elevated valley floors, nearly level, with moderately deep, moderately stony, calcareous to non-calcareous soils, medium-fine to fine textured (loam to clay loam), moderately well drained; dominant use crops; dominant soils Hapli-Cutanic Luvisols; mostly other rivers, but locally also the Orcia-Ombrone river system</td>
<td>S2</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>T2</td>
<td>surface of the intermediate terraces of the Orcia-Ombrone river system, level to nearly level, moderately well drained</td>
<td>S3</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>T2a</td>
<td>subunit T2a: the “Piani Rossi”, with reddish brown, moderately deep, non calcareous soils, slightly acid, medium-fine textured (clay loam), not stony, but stony in depth, well drained; dominant use crops, subordinately vine yards; dominant soils Hapli-Cutanic Luvisols</td>
<td>S1</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>T2b</td>
<td>subunit T2b: terrace surface with grey, moderately deep to deep, calcareous soils, medium to fine textured (clay loam / silty clay), not stony, but locally stony in depth, well drained; dominant use crops, subordinately vine yards; dominant soils Calcaric Cambisols</td>
<td>S1</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Tv</td>
<td>moderately steep borders or incisions of the intermediate terrace of the Orcia-Ombrone river system, with shallow non calcareous soils, slightly acid, medium-fine textured (clay loam), stony (pebbles, 3-5 cm); dominant use bushes, crops; dominant soils Eutric Regosols</td>
<td>S3</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>T3</td>
<td>remains of the high terrace of the Orcia-Ombrone river system, nearly level, with moderately deep to deep, slightly calcareous to calcareous soils, medium textured (clay loam), not stony, well drained; dominant use crops, subordinately vine yards, olives; dominant soils Calcaric Cambisols</td>
<td>S1</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>A1</td>
<td>(in 2009 “A”) alluvial deposits of the secondary rivers, with moderately deep soils, calcareous to non calcareous, medium-fine textured (clay loam), moderately well drained; dominant use crops; dominant soils Haplic Fluvisols</td>
<td>S3</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>A2</td>
<td>valley floor of the Orcia-Ombrone river system, not active**, with deep calcareous soils, medium-fine textured (clay loam); moderately well drained; dominant use crops; dominant soils Haplic Calcaric Fluvisols</td>
<td>S2</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>A3</td>
<td>active river bed of the Orcia-Ombrone river system**, mostly with a braiding hydrological regime, with deep, calcareous soils, coarse textured (sand), locally stony to extremely stony (pebbles); imperfectly to poorly drained; dominant use bare land; dominant soils Calcaric-Arenic Fluvisols</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>

*) close to the Case Nuove site; unit not mapped separately.

**) 1954, year of the aerial photographs.
3) Tables of the classes used in the legend of the Land Units map

Texture

<table>
<thead>
<tr>
<th>Texture in 5 classes</th>
<th>Textural class U.S.D.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse</td>
<td>sand, loamy sand</td>
</tr>
<tr>
<td>Medium-coarse</td>
<td>sandy loam (with coarse or fine sand); loamy sand (with fine sand)</td>
</tr>
<tr>
<td>Medium</td>
<td>sandy loam (with very fine sand); loam, silt loam, silt</td>
</tr>
<tr>
<td>Medium-fine</td>
<td>sandy clay loam, clay loam, silty clay loam</td>
</tr>
<tr>
<td>Fine</td>
<td>clay, sandy clay, silty clay</td>
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Soil depth

<table>
<thead>
<tr>
<th>Depth (+ modal value)</th>
<th>Class description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25 cm (15 cm)</td>
<td>very shallow soils</td>
</tr>
<tr>
<td>25 - 50 cm (40 cm)</td>
<td>shallow soils</td>
</tr>
<tr>
<td>50 - 100 cm (70 cm)</td>
<td>moderately deep soils</td>
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<tr>
<td>&gt;100 cm</td>
<td>deep soils</td>
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Stoniness

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<th>Stoniness (+ modal value)</th>
<th>Class description</th>
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<tr>
<td>5-20 % (10%)</td>
<td>slightly stony</td>
</tr>
<tr>
<td>20-40% (30%)</td>
<td>moderately stony</td>
</tr>
<tr>
<td>40-90% (60%)</td>
<td>stony</td>
</tr>
<tr>
<td>&gt;90% (90%)</td>
<td>extremely stony</td>
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Slope/inclination:

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<th>Inclination in % (+ modal value)</th>
<th>Single slope</th>
<th>Landscape</th>
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</thead>
<tbody>
<tr>
<td>0 – 1 % (0 %)</td>
<td>level</td>
<td>level</td>
</tr>
<tr>
<td>0 – 3 % (2 %)</td>
<td>nearly level</td>
<td>nearly level</td>
</tr>
<tr>
<td>1 – 8 % (4 %)</td>
<td>gently sloping</td>
<td>undulating</td>
</tr>
<tr>
<td>4-16 % (10 %)</td>
<td>sloping</td>
<td>rolling</td>
</tr>
<tr>
<td>10-30 % (20 %)</td>
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<td>hilly</td>
</tr>
<tr>
<td>25-60 % (35 %)</td>
<td>steep</td>
<td>steep</td>
</tr>
<tr>
<td>&gt;45 % (60 %)</td>
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<td>very steep</td>
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</table>

Soil drainage

<table>
<thead>
<tr>
<th>Class description</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>very poorly drained</td>
<td>water is removed from the soil so slowly that free water remains at or very near the ground surface during much of the growing season</td>
</tr>
<tr>
<td>poorly drained</td>
<td>water is removed so slowly that the soil is wet at shallow depths periodically during the growing season or remains wet for long periods</td>
</tr>
<tr>
<td>imperfectly drained</td>
<td>water is removed slowly so that the soil is wet at a shallow depth for significant periods during the growing season</td>
</tr>
<tr>
<td>moderately well drained</td>
<td>water is removed from the soil somewhat slowly during some periods of the year</td>
</tr>
<tr>
<td>well drained</td>
<td>water is removed from the soil readily but not rapidly</td>
</tr>
<tr>
<td>somewhat excessively drained</td>
<td>water is removed from the soil rapidly</td>
</tr>
<tr>
<td>excessively drained</td>
<td>water is removed very rapidly</td>
</tr>
</tbody>
</table>
References


Servizio Geologico d’Italia - Carta Geologica d’Italia alla scala 1:100.000, foglio 128, Grosseto, foglio 129, S. Fiora
