

for



PARCO  
NAZIONALE  
TECNOLOGICO  
ARCHEOLOGICO

delle COLLINE METALLIFERE GROSSETANE

*the Tuscan Mining Geopark*



**CANDIDATE MEMBER 2009**

**European and Global Unesco Geoparks**



# APPLICATION DOSSIER

## A. DEFINITION OF THE TERRITORY

### A.1. THE TUSCAN MINING GEOPARK

The name proposed for the area applying to take part in the European and Global Unesco Network of Geoparks is Tuscan Mining Geopark. The area of the proposed Geopark includes the whole territory of the current *Parco Nazionale Archeologico e Tecnologico delle Colline Metallifere Grossetane*.

### A.2. GEOGRAPHIC AND HUMAN ELEMENTS

The Tuscan Mining Geopark (hereafter reported with the acronym TM Geopark) is located in northern sector of the Grosseto province in Tuscany, central Italy (Fig. 1). The TM Geopark coincides with the territory of the *Colline Metallifere* (Metalliferous Hills), the most important mining district in Italy together with some zones of Sardinia.

The area of the future TM Geopark extends on a whole surface of 1087 km<sup>2</sup> and includes the territories of seven municipalities: Follonica, Gavorrano, Massa Marittima, Monterotondo Marittimo, Montieri, Roccastrada and Scarlino. Other noteworthy inhabited centres are: Bagni di Gavorrano, Boccheggiano, Gerfalco, Giuncarico, Montemassi, Niccioleta, Prata, Ribolla, Roccatederighi, Sassofortino, Scarlino Scalo, Travale (Fig. 2).

The TM Geopark area has a relatively low human presence as the resident population is of 53.549 people) with a density of 49.3 people/km<sup>2</sup> against a level of 198.8 people/km<sup>2</sup> for the whole Italian territory (ISTAT data of 31 December 2007).

The most densely-populated municipality is Follonica (21761 inhabitants), while in the others population ranges from 1221 people (Montieri municipality) to 8681 people (Gavorrano municipality).



The TM Geopark is placed in strategic position respect to the main cultural and artistic cities of Tuscany (Florence, Siena, Pisa) and some important seaside tourist centres (Follonica, Monte Argentario). Moreover, it is easily reachable by car driving along the A1 and A12 highways and the SS 1 national road (Aurelia). The road network within the TM Geopark is based mainly on the following national, regional and provincial roads: SS 1 (Follonica-Gavorrano), SR 439 (Massa Marittima-Follonica), SP 162 (Massa Marittima-Montieri), SP 11 (Montieri).

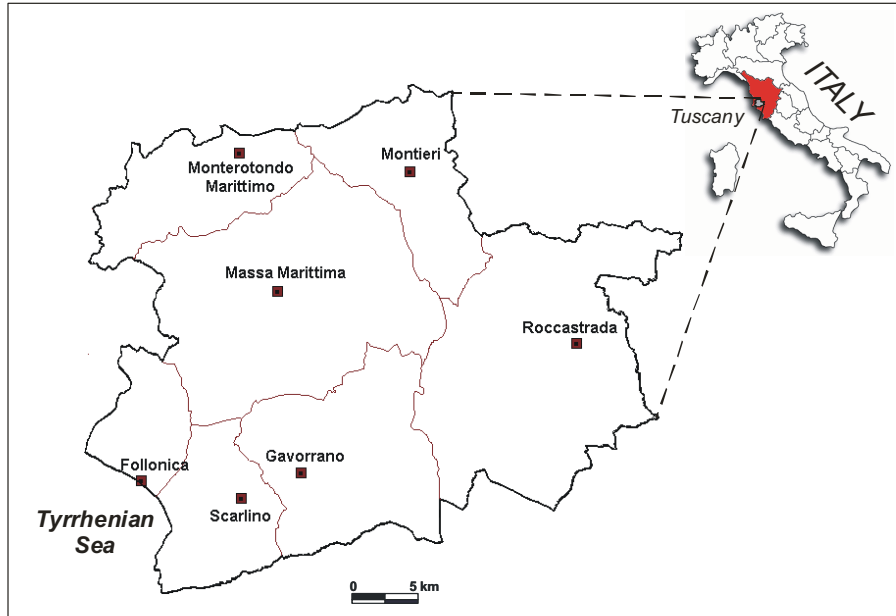


Fig. 1. Location of the Tuscan Mining Geopark area.

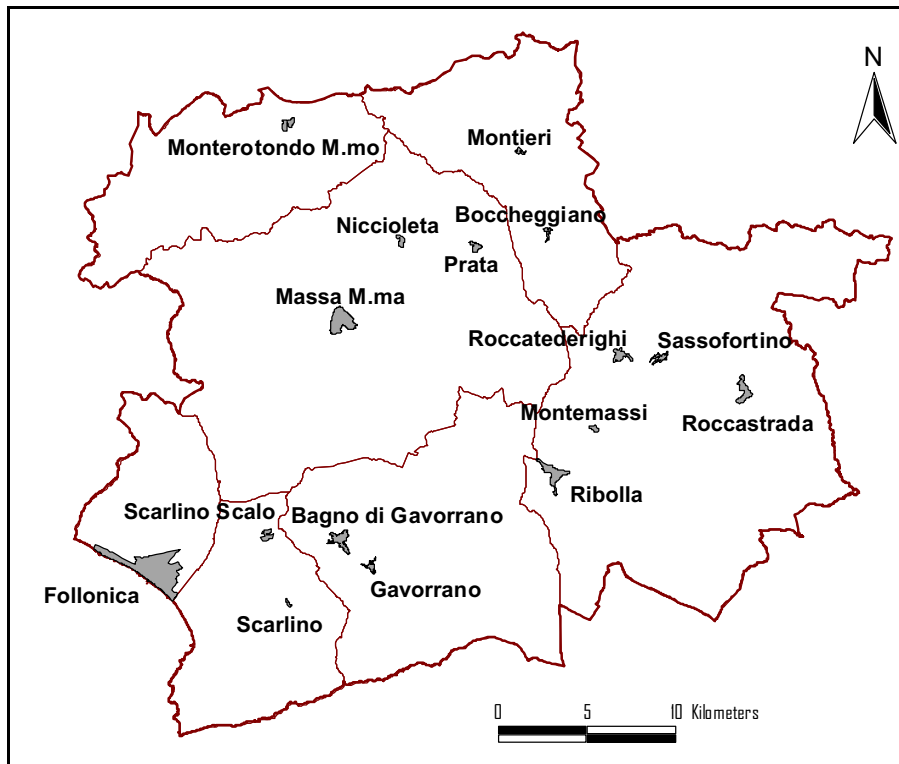


Fig. 2. The main inhabited centres in the Tuscan Mining Geopark area.

### A3. HISTORY AND CULTURE

History and culture of the TM Geopark territory are closely linked to those of the Colline Metallifere, and particularly to its mines, which have been intensely exploited since the Etruscan epoch for the production of metals such as copper, lead, zinc, silver, as well as lignite and alum. Mining and processing activities, together with the boron production in the Monterotondo Marittimo geothermal area, in time have deeply characterized the landscape and addressed the economic and social development of the territory and communities from the protohistoric age until the present day. The exploitation, working and employment of “geological resources” of the Colline Metallifere have influenced in a wide time space the urban settlements, road network, trading lines and economic and social development.

The oldest evidences concerning the ore exploitation in the Colline Metallifere district go back to Etruscan period. These evidences are represented by numerous traces of mining works such as shafts, piles of slag (“*loppe*”), lamps and a variety of tools used for the excavation and mineral extraction.

Although there are signs of mining works in Roman epoch, this period marked a decline of mining activity in the Colline Metallifere district, due to the huge expansion of Rome that took the raw materials where it was cheaper.

In the early Middle Ages, a period characterized by an economy with few exchanges, the stagnation of mine exploitation continued. Mining works ceased for some centuries for the barbarian invasions, and started again for initiative and interest of some noble families of Longobard origin exercising power over these territories. For their initiative, a number of castles (fortified villages) characterized by an economy centred on the exploitation of ore resources and processing of metals, were built up. Since 1000 D.C. the Colline Metallifere area was indeed involved in an important renewal of the mining activity, mainly related to the exploitation of polymetallic sulphide ores containing minerals of copper and silver. From 1066 until early 1200, “*Massa Metallorum*”, the present Massa Marittima, knew a significant economic and political growth, becoming the most important mining centre of the Colline Metallifere and obtaining independence from Volterra in 1225. Since the middle of the 13<sup>th</sup> century began a period of economic expansion for Massa Marittima based on the purchase of lands in which sulphide mineralization or concentrations of sulphur and alum were found. In 1317 the availability of silver became so high that Massa Marittima decided to mint an own coin, the silver “*Grosso*”.

In agreement to the economic and social importance of mining and quarrying, in 1310 in a text shown in the Statutes of the Massa Marittima municipality (“*Ordinamenta super arte fossarum ramerieae et argenteriae civitatis massae*”) principles and rules for the mining exploitation were fixed. This document represents a real mining code, the first in Europe, and constitutes a splendid example of legislation for the regulation and organization of mining activity. Among other things, in this document is explicitly asserted the innovative and revolutionary principle (opposed to what is established by Roman law) for which the underground resources do not belong to the land owner but who makes a mine productive with his work. In addition the Massa Marittima mining code is an important source for getting knowledge about the mining techniques and methods used in the Middle Ages. In fact, this document furnishes the rules for an accurate management of mining activities with regard to many aspects such as: ore explorations, exploitation techniques, methods for the construction and safeness of shafts, health of miners and marketing of the extracted materials. Furthermore the mining code established that each working and production phase was

followed by municipal authorities, in order to rationalize and optimize the procedures and to ensure a high quality of the produced metal.

Since middle of 14<sup>th</sup> century began a period of crisis of the Colline Metallifere area due to events including: transition of the Massa Marittima town under the domain of Siena, plagues and malaria which reduced population from 10.000 to 4.000 people in a few tens of years, decline of price of copper and silver because of the exploitation of German ore deposits, gradual exhaustion of mineralizations exploitable at that time.

Since the 15<sup>th</sup> century, the Colline Metallifere area was characterized by a specific extractive activity, which also involved most of the territory of Tuscany and Lazio: the exploitation of alum. After the fall of Constantinople in 1453, the trading of alum from Asia Minor to the West stopped. The latter was used for fixing dye on textiles, for the production of glass, for the tanning of hides, for the manufacture of wool and paper and, in medicine, as astringent and haemostatic.

The need to get alum urged to find alternative sources also in the Western world. This historical background gave rise to important alum mines in the Colline Metallifere area (Monte Leo, Allumiere di Montioni, Cavone) dating back to the 15<sup>th</sup> century and active until the 18<sup>th</sup> century.

In the Colline Metallifere district mining works started again in the first half of 19<sup>th</sup> century, and the most affected area was the Serabottini-Fenice Capanne one. At the end of 19<sup>th</sup> century the Montecatini S.p.A. bought the mining concessions of most mines of the Colline Metallifere territory and embarked on a new sector of exploitation centred on the production of sulphuric acid as a product of pyrite processing. In recent times, between 70s and 80s of the 20<sup>th</sup> century, the production of sulphuric acid became the mainstay of the local economy, with the exploitation of the pyrite massive mineralization at Campiano, Niccioleta and Gavorrano. Recently a worldwide severe crisis in the mining sector determined the gradual closure of all mining works in the Colline Metallifere district. The Campiano mine was the last to stop the exploitation activity in 1994.

#### **A.4. ORGANIZATION IN CHARGE OF THE GEOPARK TERRITORY**

The request for admission of the Tuscan Mining Geopark to the European and Global Geopark Unesco Network of Geoparks is submitted by the *Parco Nazionale Archeologico e Tecnologico delle Colline Metallifere Grossetane*.

The *Parco Nazionale Archeologico e Tecnologico delle Colline Metallifere Grossetane* (hereafter also named *Parco delle Colline Metallifere* or Park) is a national park established in 2002 (decree of the Italian Environment Ministry n° DEC/DCN/044, 28 February 2002) with institutional purposes focused on the recovery, maintenance and valorisation of the naturalistic, environmental, technological, scientific, cultural and historical heritage of the Colline Metallifere. This heritage is characterized primarily by signs and evidences of mining and metallurgical activities that occurred in this area of southern Tuscany for about three millennia. In view of this, the *Parco delle Colline Metallifere* is born as a mining and pre-industrial and industrial archaeological park focused on mining and metallurgical sites abandoned at the present time. In this frame, the *Parco delle Colline Metallifere* is equipped with an instrument, the Masterplan (realized by Professor Massimo Preite, *Dipartimento di Urbanistica e Pianificazione del Territorio*, University of Florence, and by Professor Riccardo Francovich, *Dipartimento di Archeologia e Storia delle Arti*, University of Siena; see Annex 2), through which it has been taken a census of the technological and archaeological heritage of the Colline Metallifere (at the present 81 sites of interest have been identified), has been documented its historical, cultural and environmental value, have been identified strategies for the recovery, preservation, management and valorisation of the archaeological and industrial goods.



The *Parco delle Colline Metallifere* is a consortium managed by a Committee in which are represented all the Public Administrations involved: *Ministero dell'Ambiente* (Ministry of Environment), *Ministero dei Beni Culturali* (Ministry of Heritage and Culture), *Regione Toscana* (Tuscan Region), *Provincia di Grosseto* (Grosseto Province), *Comunità Montana delle Colline Metallifere* and the municipalities of Follonica, Gavorrano, Massa Marittima, Monterotondo Marittimo, Montieri, Roccastrada and Scarlino. The management of sites and goods of Park and the initiatives for conservation, protection and valorisation of the territory are carried out by local government units, with their staff and under the coordination and supervision of the Park Committee.

The innovative idea of the *Parco delle Colline Metallifere* is given by the fact that it is a “living” tool; in fact, the Park is not an aseptic container of landscape beauties, but a network linking together all the social and cultural activities of the area, thus generating a chain of collaborations between local (e.g., municipalities), regional (e.g., Tuscan Region) and central (e.g., *Ministero dell'Ambiente e Ministero dei Beni Culturali*) authorities. In this frame, it is not simply a “mirror of the past”, but a window on a “possible future” represented by sustainable development, technological innovation and “restructuring” of the territory in an environmental and museum perspective.

The organizing originality is represented by the following aspect: the management of the sites and of the activities of the territory valorisation have been delegated to local governments, developing a virtuous synergy by using the professionals already working in the different municipalities. Thus, even though the *Parco delle Colline Metallifere* does not have any staff member, it can nonetheless make use of an extremely large personnel apparatus, with strongly motivated competences and experiences (e.g., Dr Paolo Stefanini, responsible of the Protected Areas and Biodiversity Provincial Office, as well as the persons in charge of the seven gateways of Park; see below). For this reason, the *Parco delle Colline Metallifere* has a light, agile, ramified structure, which allows investing almost all its available financial resources on the territory, without having to use them for management and administrative costs. Therefore, the Park is an entity which “gives” rather than “takes”, and represents an example of sustainable management of the territory and for the territory, operating in complete harmony and collaboration with local governments, as sanctioned by the “Charter of Principles” (see Annex 8).

In each municipality of the Park a “*Porta del Parco*” (gateway of Park) was established. It represents the reception and information point for visitors, where guided tours, seminars, professional training courses and didactical laboratories of environmental education are also organized. From the seven gateways of Park, coordinated by an overseer appointed by the Management Committee (*Comitato di Gestione*), start paths (5) and thematic routes (4; see Annex 2) connecting the sites of the pre-industrial and industrial mining and metallurgical heritage. At present, there are routes that allow to visitors to choose different possibilities based on specific themes of interest (for details of these routes see Annex 2).

Along the routes of the *Parco delle Colline Metallifere*, in addition to traditional educational panels there are some “*Parco-Tag*”, that is places where the visitors, by means of the “*Tag*” technology, can acquire and display on mobile phone information (informative sheets, maps, videos) concerning the site that they are visiting.

Promotional campaigns carried out in the last years have led an increase of visitors from 36.000 in 2006 to 77.000 in 2008, recorded by the seven gateway of Park.

The *Parco delle Colline Metallifere* has been conceived as a “cultural district”: a polycentric network-park where the mining sites are integrated with the natural and landscape resources, the museums and examples of the medieval architecture and art. A Park marked by its multithematic



character, able to offer its visitors a wide array of topics related to the geology, environment, landscape, archaeology, historic-architectural heritage as well as the evidences of pre-industrial and industrial mining and metallurgical activities.

The territory of *Parco delle Colline Metallifere* and the proposed Tuscan Mining Geopark can offer a variety of topics wider than that above described. Indeed, in addition to various evidences of mining and metallurgical activities and a important historical-architectonic heritage, the Park offers several geological sites of interest for their scientific significance, didactic and educational value and attractive appeal, as well as naturalistic and landscape sites.

These outlines give rise to the nomination of the *Parco delle Colline Metallifere* for admission as Tuscan Mining Geopark in the European and Global Unesco Network of Geoparks. The major intent is to restore and to valorise the geological heritage of the Colline Metallifere area, promoting a circuit for a varied and diversified tourism based on geosites integrated with the existing routes related with mining archaeology and metallurgy, and other types of sites concerning naturalistic, floristic and faunistic aspects (e.g., natural reserves and parks), archaeological features (Etruscan, Roman and medieval settlements), historical and architectonic features (historical centres, castles), which represent the typical Tuscan mining landscape.

### ***IDENTITY CARD OF THE “PARCO NAZIONALE TECNOLOGICO ARCHEOLOGICO DELLE COLLINE METALLIFERE GROSSETANE”***

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#### **A.5. ANNEX**

1. Evaluation Dossier
2. Masterplan
3. Geological maps
4. Ore mineralizations
5. The geosites: list, map and description
6. Naturalistic aspects
7. Bibliography
8. Charter of Principles
9. Divulgation
10. Supporting Letters



## B. SCIENTIFIC DESCRIPTION OF THE TERRITORY

### B.1. GEOGRAPHIC FEATURES

From the morphological point of view, the territory of TM Geopark is quite articulated embracing coastal to mountainous landscapes. The morphology is predominantly hilly, with elevation of reliefs, usually, between 200 and 600 m a.s.l. Gentle landscapes match the outcropping zones of continental to marine sediments of Mio-Pliocene age. Landforms of medium-high hill up to mountainous are peculiar of areas tectonically uplifted, where pre-Neogene geological formations crop out. The hilly to mountainous reliefs are covered mainly by woods with subordinate agricultural areas.

The westernmost sector of TM Geopark area is characterized by a coastal landscape close to the Tyrrhenian Sea. In particular this zone shows a coastal plain with a sandy coastline bordered by a pinewood. Southward the coast is rocky with inlets and small sandy beaches (the most beautiful and famous is *Cala Violina*; see geosite G38) in uncontaminated environment rich in Mediterranean vegetation. As a whole, elevation of reliefs increases from west to east, reaching in the north-east sector altitude slightly higher than 1000 m a.s.l. (e.g., Le Cornate: 1060 m, Poggio di Montieri: 1051 m; Poggio Ritrovoli: 1014 m).

A relevant morphological and structural outline of the TM Geopark area is the Monticiano-Roccastrada ridge, a portion of the Middle Tuscan ridge present in the eastern part of the territory. Along the Monticiano-Roccastrada ridge the reliefs are commonly around 500-600 m a.s.l.

The hydrographical features of TM Geopark area are mainly related to the characteristics of the basins of the following water-courses: Cornia River, Pecora River, Bruna River, Merse River and Cecina River (Fig. 3). The hydrographical basins of the Cornia R. and Pecora R. extend in the western sector of the TM Geopark, west to the Le Cornate-Poggio di Montieri-Poggio Ritrovoli morphological element, while the basin of the Merse R., whose main tributary is the Farma stream, is east of this element. The basin of Bruna R. is in the southern part of the TM Geopark. The basin of the Cecina R., with Pavone stream as its main tributary, collects the surface waters of the northern portion of the TM Geopark area.

From the hydrographical and hydrogeological point of view, are noteworthy the Farma stream for its landscape and naturalistic features (a V-shaped valley with steep sides and some vegetation and faunistic peculiarities; see geosite G1), as well as the Accessa Lake, within the Bruna R. basin (see geosite G35).

The TM Geopark area has a variable climate. From the inner mountainous zones (e.g., Le Cornate ridge) to the coast, annual average temperature increases from 11 to 15°C, while average precipitations decrease from 1200 to 600 mm/year (Barazzuoli and Salleolini, 1993). The coldest month is January (from 3 to 8°C as average temperature), the warmest one is July (from 21 to 25°C). November and July are the months with the highest e lowest precipitations, respectively.

According to the Thornthwaite classification, climate of the TM Geopark area is usually humid (B<sub>1</sub>, B<sub>2</sub> e B<sub>3</sub> types; Barazzuoli et al., 1993). Climate is subhumid in the southern sector (C<sub>2</sub> type), and subarid in the coastal area (C<sub>1</sub> type).

With regard to the land use, the territory of the TM Geopark is mainly covered by broad-leaved woods and mixed woods (about 60% of whole surface; Fig. 4). Agricultural zones mostly cultivated with cereals, olive-yards and vineyards are principally in the coastal plain and in the plain between Ribolla and Roccastrada.



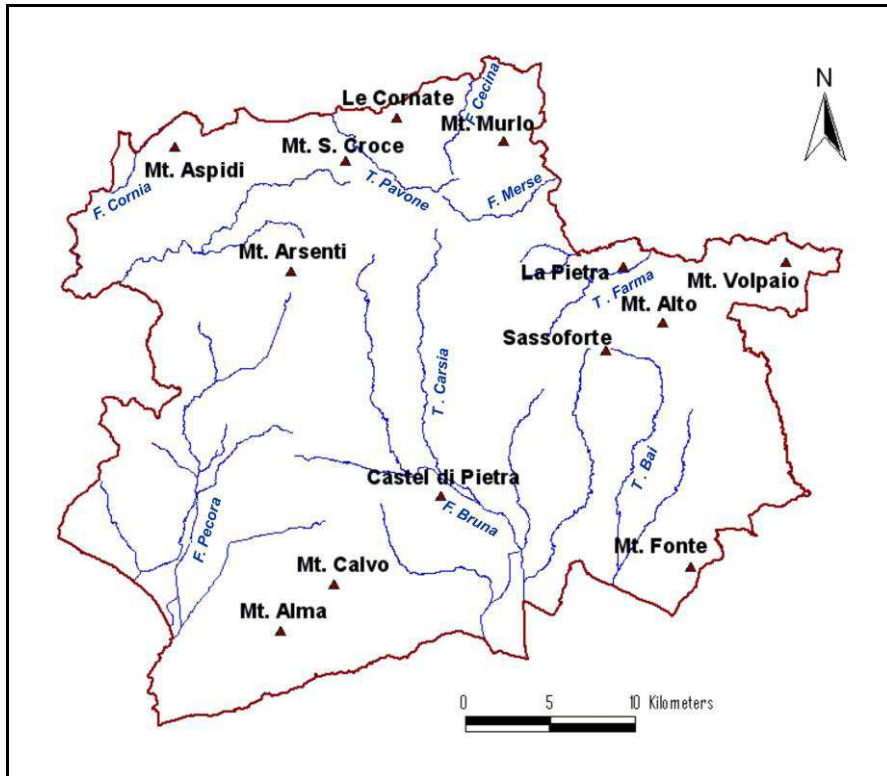


Fig. 3. The main reliefs and water courses in the Tuscan Mining Geopark area.

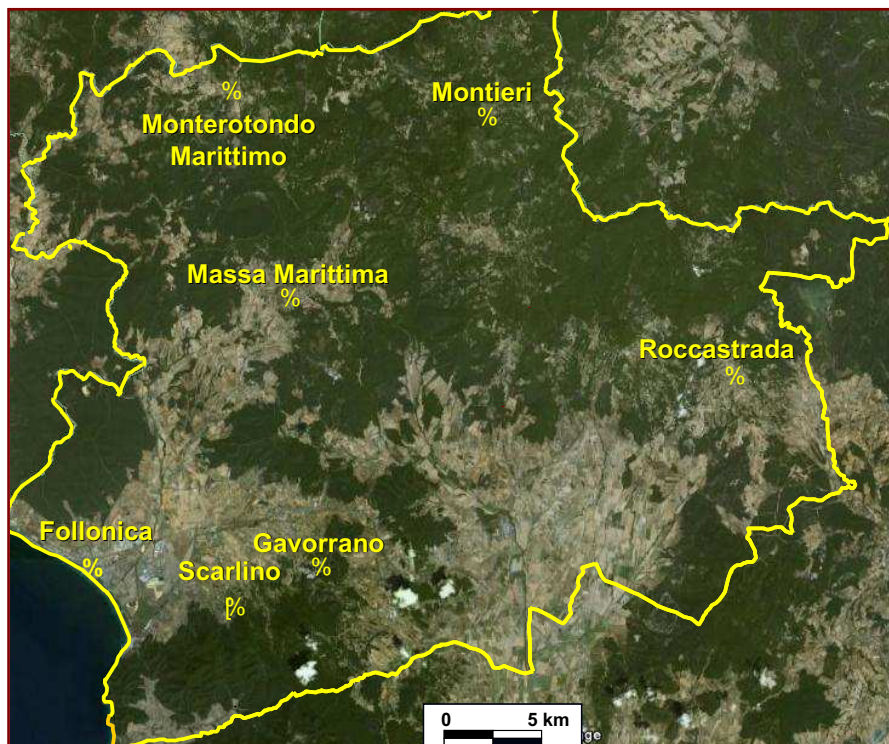


Fig. 4. Satellite view of the Tuscan Mining Geopark area.

## B.2. GEOLOGICAL DESCRIPTION

### B.2.1. HISTORY OF GEOLOGICAL STUDIES AND KNOWLEDGE

The TM Geopark area is a territory with a high geological relevance as highlighted by the several studies and researches carried out in time. A selection of the main works with their bibliographic references is reported in Annex 7.

The first geological studies in the TM Geopark area dated at the second half of 18<sup>th</sup> century and concerned aspects related to ore geology and mine exploitation as well as geothermal and hydrothermal manifestations such as gaseous emissions (“*soffioni*”) and alum deposits (e.g., Arduino, 1755; Cammelli, 1766).

Researches on these topics were performed also during the 19<sup>th</sup> century together with works focused on the minerals found in the territory and the boron-rich geothermal vents and their exploitation (e.g., Bechi, 1853, 1878; Coquand, 1848; D’Achiardi, 1898).

Between 19<sup>th</sup> and 20<sup>th</sup> the geologist Bernardino Lotti gave an important contribution toward the improvement of the geological knowledge of the *Colline Metallifere* district (e.g., Lotti, 1877, 1893, 1910a).

In the first half of the 20<sup>th</sup> century the interest was mainly addressed to the ore geology and mineralogy of the area, mostly in the Gavorrano, Fenice Capanne, Boccheggiano mining sites (e.g., Azzini, 1929; Baddi, 1931).

In the sixties and seventies of the 20<sup>th</sup> century, a relevant growth of the geological knowledge of the TM Geopark area occurred through several studies concerning biostratigraphy of the Ligurian and Subligurian Units, stratigraphy and tectonic of the Neautochthonous of southern Tuscany, mineralogy and petrography of effusive and intrusive magmatites. Within the realization of the Geological Map of Italy, Signorini (1967) and Brandi et al. (1969) provided a synthetic and modern outline of the geology of the area.

In this same period until 1990 mineralogical, geochemical and isotopic studies allowed to define the ore features and genesis of some of the most important sulphide mineralizations of the *Colline Metallifere* district (e.g., Tanelli, 1977; Gianelli e Puxeddu, 1978; Bralia et al., 1979; Cortecchi et al., 1980; Lattanzi and Tanelli, 1981; Tanelli, 1983; Innocenti et al., 1984).

In the last years the geological studies have been focused on the stratigraphic and structural features of the metamorphic basement, the Ligurian and Subligurian Units, and Neogene deposits (e.g., Costantini et al., 1988; Conti et al., 1991; Bossio et al., 1992, 1993, 1998; Lazzarotto, 1993; Lazzarotto et al., 2003; Engelbrecht, 2008).

### B.2.2. GEOLOGICAL FEATURES

The present geological features of the TM Geopark area are the result of the long and complex geological evolution of southern Tuscany mainly focused on the formation of the Apennine chain, a Cenozoic fold-thrust belt resulting from the convergence between the continental Adria microplate and the European plate (Sardinia-Corsica massif), constrained by the relative motions of the Gondwana and Europe megaplates.

The Apennine orogenesis caused in southern Tuscany the translation and overlapping, from SW to NE, of tectonic units from different sedimentation and paleogeographical areas: Ligurian domain, Subligurian domain, Tuscan domain. The Ligurian domain was an oceanic basin formed by ultrafemic and femic magmatic rocks (ophiolites) covered by a sedimentary succession deposited in



a deep marine environment. The Subligurian and Tuscany domains were epicontinental settings constituted by a metamorphic basement underlying a sedimentary coverage.

The tectonic units of these domains formed as a whole the frame of the Apennine chain tract in southern Tuscany. They superimposed from bottom to top as the following order: Tuscan Units, Subligurian Units, Ligurian Units (Signorini, 1964; Giannini et al., 1971; Decandia et al., 1980; Burgassi et al., 1983; Boccaletti and Coli, 1983; Lazzarotto, 1993; Decandia et al., 2001; Costantini et al., 2002; Brogi et al., 2005; Fig. 5).

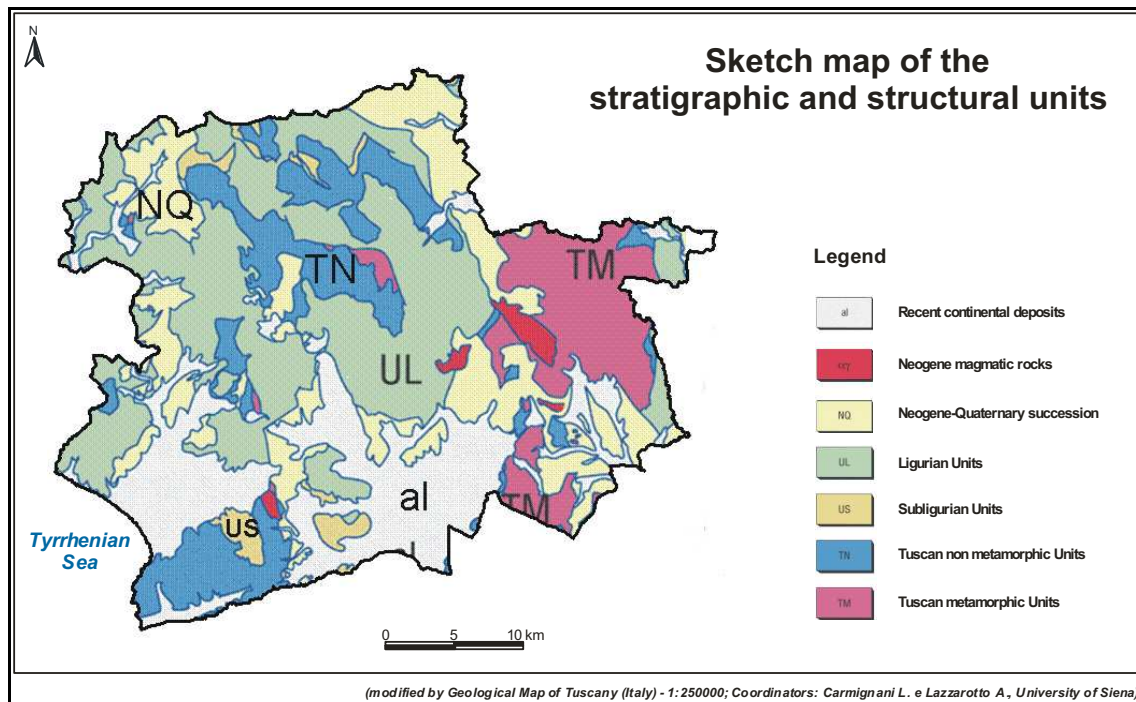


Fig. 5. Sketch map of the stratigraphic and structural units.

A late Oligocene to early Miocene compression was followed by a tectonic inversion of compressive structures and gravitational collapse of the thickened nappe-pile (Carmignani et al., 1994; Decandia et al., 2001a). Since Lower-Middle Miocene, the fold-thrust Apennine belt was affected by post-collisional extensional tectonic events with formation of a system of parallel, NW-SE oriented, graben-type depressions. The opening of these tectonic depression occurred gradually in time from west to east. Within these basins, deposition of lacustrine to marine sediments occurred forming the Neogene-Quaternary succession or Tuscan Neoautochthonous.

In southern Tuscany the post-collisional extensional tectonic was accompanied by crustal and lithospheric thicknesses (about 24 and 30 km, respectively), upwelling of asthenosphere, intrusive and effusive magmatic activity mainly related to crustal melts and characterized by a eastward space-time migration, as well as high heat flow up to 1000 Mw/m<sup>2</sup> (Monelli and Zito, 1991; Baldi et al., 1995; Gianelli et al., 1997; Manzella et al., 1998). These events produced in the region geothermal systems (at the present the Larderello and Mt. Amiata geothermal fields are active and exploited for production of geothermal energy), as well as a widespread hydrothermal circulation responsible of sulphide mineralizations (mainly in the Colline Metallifere district). Several recent and present surface evidences of the southern Tuscany thermal anomaly occur in the TM Geopark territory mainly as gaseous emissions, hydrothermal springs, hydrothermally altered rocks, travertine deposits.

The above-described geostructural complexity of the territory resulted in a large number of outcropping lithostratigraphic units as well as lithologies (see also Annex 3). These lithostratigraphic units are Paleozoic to Quaternary in age, and consist of various lithologies such as siliciclastic and carbonatic metamorphic rocks, ultrafemic to sialic intrusive and effusive magmatites, as well as carbonatic, sulphate-carbonatic and terrigenous sedimentary rocks (see also Annex 3).

In succession, are reported the geolithological features, environment formation, age and main outcropping zones of these lithostratigraphic units, grouped from bottom to top in:

- Tuscan metamorphic Units
- Tuscan non metamorphic Units
- Subligurian Units
- Ligurian Units
- Neogene-Quaternary succession
- Pliocene magmatites
- Recent continental deposits.

### ***Tuscan metamorphic Units***

The oldest terrains cropping out in the area belong to the Tuscan metamorphic Units and are grouped in the Monticiano-Roccastrada Unit. The Monticiano-Roccastrada Unit constitutes the metamorphic basement of southern Tuscany and consists of a complex pile of tectonic slices formed by epimetamorphic Paleozoic to Triassic formations (Bagnoli et al., 1978; Bagnoli et al., 1979; Burgassi et al., 1979; Costantini et al., 1988; Gattiglio et al., 1989; Conti et al., 1991; Elter and Pandeli, 1993; Rau, 1993; Lazzarotto et al., 2003; Pandeli et al., 2004; Engelbrecht, 2008). These formations underlie the lithologies of the Tuscan non metamorphic Units.

The Paleozoic formations (Silurian ? – Permian) mainly consist of metaclastites cropping out mostly in the eastern sector of the territory along the Monticiano-Roccastrada ridge (Cocozza, 1965; Cocozza et al., 1978; Franceschelli, 1980; Cocozza et al., 1987; Costantini et al., 1988; Conti et al., 1991; Pandeli et al., 1994; Engelbrecht 1999, 2002, 2008).

The oldest outcropping lithologies (Silurian ?- Devonian) are black-grey graphitic phyllites, dolomitic metalimestones and metadolostones, metasandstones, cherts, calcareous and arenaceous schists pertaining to *Risanguigno* fm. and *Fosso di Falsacqua* fm. These lithologies formed likely in a distal and relatively deep marine environment, and show evidences of both hercynian-type and alpine-type deformation and metamorphic events. Therefore, they represent tectonic unit of the Hercynian fold-thrust belt.

Late Devonian to early Carboniferous rift pulses affected the Hercynian belt, creating different basins and depositional settings where sedimentation took place during Carboniferous and Permian. At the present, these sediments occurred as tectono-lito-stratigraphic units that unconformably cover the oldest terrains. They record only alpine-type tectonic events.

In the TM Geopark area the following Carboniferous to Triassic ? tectono-lito-stratigraphic units were distinguished:

- *Poggio al Carpino* fm.: siliciclastic lithologies (metasandstones, quartzites, metaconglomerates, metasiltstones and phyllites) deposited in fluvial-deltaic to shallow marine environments. Because of the lack of fossils, the age attribution of this formation is controversial. The *Poggio al Carpino* fm. was dated to early Carboniferous by Costantini et al. (1988) and Conti et al. (1991), Permian by Cocozza et al. (1978), late Permian or early Triassic by Spina et al. (2004).
- *Carpineta* fm.: black phyllites, metasiltstones, metasandstones and metalimestones formed in a shallow marine depositional setting (Carboniferous).



- *Farma* fm.: turbiditic sequence of metasandstones, metasiltstones and metapelites with subordinate interlayers of metaconglomerates and metalimestones (Upper Carboniferous). This formation is interpreted as a siliciclastic sediment gravity flow deposit formed in proximal to distal parts of a marine basin.
- *Calcarea di Sant'Antonio* fm.: bioclastic metalimestones and metadolostones with subordinate metasiltstones and phyllites, formed in a shallow marine environment corresponding to an outer continental shelf zone. A Lower Moscovian (Upper Carboniferous) age has been suggested on the basis of the paleontological records.
- *Spirifer Schist* fm.: outer continental shelf deposits consisting of quartzitic phyllites, metasiltstones and metasandstones (Upper Carboniferous).
- *Quarziti di Poggio alle Pigne* fm.: quartzitic metasandstones interbedded with metaconglomerates and phyllites, of neritic depositional environment (Upper ? Permian).
- *Filladi e quarziti del T. Mersino* fm.: phyllites, quartzites and minor metaconglomerates (Carboniferous-Triassic ?). The *Filladi e quarziti del T. Mersino* fm. (Bertini et al., 1991; Costantini et al., 1994) is noteworthy as it is the outcropping part of the Phylladic Complex (Boccheggiano phylladic formation; Signorini, 1964), that constitutes the Paleozoic basement in the main mining zones of the Colline Metallifere district (outcroppings are in the Boccheggiano and Serrabottini zones). The Phylladic Complex is considered a tectonic slice complex made of Paleozoic to Triassic formations, and mainly consisting of phyllites with sulphate-carbonate levels that host very important pyrite mineralizations.

Despite several studies, the characterization and interpretation of the Carboniferous-Permian tectono-lito-stratigraphic units are rather uncertain owing to the scarcity of outcroppings, tectonic complications, rareness of fossils and difficulty in defining precisely the boundaries between formations consisting of very similar lithologies.

A late Permian-Mesozoic continental rifting caused the subaerial exposure of the Paleozoic units and the formation of continental redbed and shallow marine siliciclastic deposits as early depositional facies. These deposits are referred to the *Verrucano* tectofacies (Trevisan, 1966; Cassinis et al., 1980).

In the TM Geopark area *Verrucano* tectofacies occur and are represented by the metamorphic *Verrucano* Group belonging to the Monticiano-Roccastrada unit (Cocozza et al., 1975; Azzaro et al., 1976; Costantini et al. 1988; Engelbrecht et al., 1989; Costantini et al. 1991; Pandeli, 2002; Aldinucci et al., 2003; Lazzarotto et al., 2003; Aldinucci et al., 2003, 2005, 2008).

The *Verrucano* Group consists of siliciclastic deposits mainly constituted by quartzitic metaclastites such as metasandstones, metaconglomerates, metasiltstones and phyllites. These lithologies affected by tectono-metamorphic events of low-greenschist facies, crop out largely along the Monticiano-Roccastrada ridge and unconformably overlie the Upper Paleozoic units (see Annex 3). In the TM Geopark area the *Verrucano* Group comprises three formations related to different episodes of continental rifting. In upward stratigraphic order they are: *Civitella Marittima* fm. (Lower?-Middle Triassic), *Monte Quoio* fm. (Middle Triassic), *Anageniti minute* fm. (Middle Triassic). The deposition of these formations occurred in alluvial settings in a semi-arid climate (Aldinucci et al., 2008).

The siliciclastic-carbonate sediments of the *Tocchi* fm. stratigraphically overlie the *Verrucano* Group. This formation consists in the lower part of phyllites alternating with limonitic metalimestones. The upper part of formation is made up of a vacuolar carbonate breccia (*Breccia di Tocchi Aucct.*). The *Tocchi* fm. formed in Upper Triassic (Carnian) in a restricted-marine lagoon

related to the early phase of a marine transgression. It is stratigraphically overlain by the metadolostones of the *Grezzoni* fm. (Upper Triassic), deposited in a hyperaline marine platform.

### ***Tuscan non metamorphic Units***

The non metamorphic sequence of Tuscan domain corresponds to the Tuscan Nappe, a geological unit that tectonically overlays the metamorphic basement (Giannini et al., 1962; Giannini et al., 1971; Lazzarotto, 1993; Costantini et al., 2002). Sulphate-carbonate evaporitic lithologies of Upper Triassic are found at the bottom of the Tuscan Nappe, and represent the horizon where the detachment from the Monticiano-Roccastrada Unit and the thrust of the entire Tuscan Nappe occurred. The sulphate-carbonate lithologies pertain to the *Burano* fm. and *Calcare cavernoso* fm. (Passeri, 1975; Ciarapica and Passeri 1976; Martini et al., 1989; Gianelli, 1994). The *Burano* fm. is a sequence of alternating layers of dark-grey dolomite and white anidrite. The sedimentological and micropaleontological features suggest a sabkha depositional environment and an Upper Triassic age (Carnian-Upper Norian). The *Burano* fm. is found in very few and small outcroppings mainly in the eastern sector of the TM Geopark territory (Roccastrada zone). On the other hand, on the surface environment this formation rarely shows its original mineralogical and sedimentological characteristics. In fact rather complex diagenetic processes, mainly focused on anidrite hydration, gypsum dissolution, dolomite transformation and calcite precipitation, have usually changed the original evaporitic sequence. The final product of the epigenetic transformation of the *Burano* dolomite-anidrite formation is a grey vacuolar limestone called *calcare cavernoso* (cavernous limestone). This limestone is a tectonic and autoclastic breccia consisting of limestone and dolomitic limestone elements cemented by calcite. The main outcroppings of the *Calcare cavernoso* fm. are in the northern sector of the TM Geopark in vast area between Monterotondo Marittimo and Boccheggiano (see Annex 3).

The sulphate-carbonate lithologies of the *Burano* fm. and *Calcare cavernoso* fm. underlie a sequence of calcareous terrains, sometimes siliceous (Group of the calcareous-siliceous fms.) and clayey-calcareous-arenaceous formations (Fazzini et al., 1968; Fazzuoli, 1980; Fazzuoli et al., 1988, 1994; Cornamusini et al., 1999; Costantini et al., 2002). The Group of the calcareous-siliceous formations mainly crops out in the northern part of the TM Geopark territory showing the main outcroppings along the Cornate di Gerfalco ridge, close to the Monterotondo Marittimo and Travale villages as well as in the zone comprised between Niccioleta and Prata (see Annex 3). This Group crops out also along the Gavorrano ridge in the southern sector of the TM Geopark. The main outcroppings of the clayey-calcareous-arenaceous formations are usually in the same zones where the Group of the calcareous-siliceous formations occur. A large outcropping of the *Macigno* fm. extends along an E-W oriented ridge from Gavorrano to the coast line (see Annex 3).

By considering in detail the stratigraphy of the Tuscan Nappe, we observe that the sulphate-carbonate horizon is in stratigraphic contact with the overlying *Calcari e marne a Rhaetavicula contorta* fm., made up of stratified limestones, dolomitic limestones and marly limestones. These lithotypes are usually crosscut by a dense network of veins filled by spatic calcite, giving to the rock an appearance like breccia. The fossiliferous content supports a lagoon to coastal wetland depositional settings, and dates the formation to Upper Triassic (Rhetian).

The stratigraphic sequence of Tuscan Nappe continues upward with the *Calcare massiccio* fm., composed of massive, fine-grained limestones and dolomitic limestones. This lithostratigraphic unit formed in a lagoon zone (supratidal to intertidal settings) where the deposition of carbonate muds took place. The paleontological association dates the *Calcare massiccio* fm. to Lower Jurassic (Lower Lias).

The *Calcare massiccio* fm. gradually passes upward to the overlying *Calcare rosso ammonitico* fm. Main lithotypes are roughly or well bedded, light grey, pink or dark red limestones and marly limestones. The nodular structure and the relevant presence of fossils (mainly ammonites and crinoids) are typical features of this formation. As regards depositional environment and age, a deposition in a shallow marine setting during Lower Jurassic (Middle Lias) is suggested. This unit is in stratigraphic contact with both the *Calcare selcifero* fm. and the *Marne a Posidonomya* fm., also through heteropic relationships.

The *Calcare selcifero* fm. consists of well stratified, fine-grained grey limestones with interlayers of thin marly levels. Light grey to brown cherts occur as lenses and nodules within the limestone layers. This lithostratigraphic unit formed in a marine pelagic environment during the Lower Jurassic (Middle-Upper Lias).

The *Marne a Posidonomya* fm. is made up of marly, clayey marls and marly limestones. Deposition occurred in a marine pelagic setting during the Middle Jurassic (Dogger).

The *Diaspri* fm. overlies with a stratigraphic contact the *Marne a Posidonomya* fm. It consists of thin beds of radiolarian cherts with minor pelitic interlayers. The depositional environment was a deep marine setting below the CDD (Carbonate Compensation Depth). The *Diaspri* fm. is Upper Jurassic (Malm) in age.

The above-mentioned calcareous-siliceous formations rest below the clayey-calcareous-arenaceous lithostratigraphic units of the Tuscan Nappe. In the TM Geopark area the latter are represented by the *Brolio* fm. of the *Scaglia toscana* Group and the *Macigno* fm.

The *Brolio* fm. is constituted by fissile shales with subordinate interlayers of siltstones and siliceous limestones. These lithotypes formed in a deep marine environment where turbiditic channel sedimentation occurred. The age of *Brolio* fm. is Upper Cretaceous-Upper Oligocene.

The *Macigno* fm. closes the stratigraphic succession of the Tuscan Nappe. It consists of a siliciclastic turbiditic sequence of sandstones and siltstones with subordinate pelitic levels. The typical facies of the *Macigno* fm. is given by quartz-feldspatic-micaceous sandstones as layers up to 4 m thick. This lithostratigraphic unit formed in a submarine fan system between Upper Oligocene and Lower Miocene.

In the succession of Tuscan Nappe there are lateral-vertical facies changes and sedimentary unconformities mainly in Middle-Upper Jurassic. Furthermore, the Tuscan Nappe is often tectonically laminated or locally lacks (“*Serie Toscana Ridotta*”) by low-angle extensional faulting.

### ***Subligurian units***

In the TM Geopark area the Subligurian domain is represented by the *Argille e calcari di Canetolo* fm. and *Poggio Pallone* fm. pertaining to the *Argille e calcari* Unit. These formations crop out mainly in the Gavorrano zone (see Annex 3).

The *Argille e calcari di Canetolo* fm. is composed of shales and siltstones with intercalated calcareous sandstones, calcarenites and calcilitites. The deposition of these sediments occurred in Paleocene-Eocene in a deep marine environment.

The *Poggio Pallone* fm. (Lower-Middle Eocene) consists of carbonatic turbidites made up of marly limestones, limestones and marly. The bottom of formation shows a pelitic-arenaceous facies.

### ***Ligurian units***

In the territory of TM Geopark the Ligurian domain is represented by tectonic units tectonically overlapped on the formations of the Tuscan and Subligurian domains (Manganelli, 1982; Lazzarotto, 1993; Costantini et al., 2002). From bottom to top these units are:

- *Santa Fiora* Unit



- *Monteverdi Marittimo-Lanciaia Ophiolitic Unit*
- *Argille a palombini Ophiolitic Unit.*

The *Santa Fiora Unit* consists of two formations: *Santa Fiora fm.* and *Monte Morello fm.* The *Santa Fiora fm.* is formed by shales and siltstones, with subordinate calcarenites, fine-grained limestones, marls and marly limestones. They are turbiditic deposits formed in Upper Cretaceous-Lower Paleocene in a deep marine environment. The *Monte Morello fm.* is constituted by a turbiditic sequence where the main lithotypes are marls and calcareous marls with minor sandstones, calcarenites, limestones and calcareous breccias. Sedimentation occurred in a submarine plain during Middle Paleocene-Middle Eocene.

The *Monteverdi Marittimo-Lanciaia Ophiolitic Unit* is represented by the *Poggio Rocchino fm.* and *Monteverdi Marittimo fm.* The *Poggio Rocchino fm.* (Middle Cretaceous) is the base of this unit, and is mainly constituted by shales and siltstones with minor limestones, formed in a submarine plain periodically affected by turbiditic input. The *Monteverdi Marittimo fm.* (Middle-Upper Cretaceous) is a turbiditic flysch made up of marly limestones, marls, calcareous arenites, fine-grained limestones and siltstones. Deposition occurred in a deep marine environment.

The *Argille a palombini Ophiolitic Unit* is a portion of oceanic crust consisting of ultrafemic and femic magmatites such as serpentized peridotites and serpentinites, gabbros and basalts, called as whole ophiolites (green rocks). These magmatic rocks, sometimes occurring as breccias with carbonatic cement, are covered by a sedimentary succession consisting upward of the *Diaspri fm.*, *Calcari a Calpionelle fm.* and *Argille a palombini fm.*

The *Diaspri fm.* (Upper Jurassic) is constituted by thin layers of red and green radiolarites formed in a deep marine environment. The *Calcari a Calpionelle fm.* (Lower Cretaceous) consists of fine-grained limestones and marly limestones deposited in a deep marine environment above the CCD. The *Argille a palombini fm.* (Lower Cretaceous) is mainly represented by shales, siltstones and siliceous fine-grained limestones (also called “*palombini*”). At the bottom and top of the formation a calcareous member (limestones and shales) and a pelitic-arenaceous member (shales, siltstones and sandstones) occur respectively.

The *Argille a palombini* formation extensively crops out in the TM Geopark territory representing the most widespread lithostratigraphic unit (see Annex 3). The other Ligurian units form smaller outcroppings mainly in the northern sector of the TM Geopark.

### ***Neogene-Quaternary succession (Tuscan Neoautochthonous)***

The Neogene-Quaternary succession or Tuscan Neoautochthonous encompasses the whole sediments deposited on the allochthonous units during the extensional tectonic events that affected since Lower-Middle Miocene the fold-thrust Apennine belt (Ambrosetti et al., 1978; Bartolini et al., 1982; Pasquare et al., 1983; Bossio et al., 1992, 1993, 1998). Sedimentation took place between the Upper Miocene (Messinian) and Upper Pleistocene mainly in NW-SE oriented, graben-type basins. Deposition was mainly influenced by the vertical movements of crust caused by the post-collisional extensional tectonic and eustatism, with consequent variations of sea level.

Within the Neogene-Quaternary succession the late Miocene formations are constituted by a great variety of sediments such as: clays, silty clays, sands, conglomerates, sandstones, siltites, marly clays, marls, sandy marls, calcareous arenites, calcarenites, calcirudites, gypsum as well as breccias and conglomerates with elements of calcareous limestone. These deposits formed in continental (fluvial, lacustrine and fluvial-lacustrine), lagoonal and shallow marine settings.

The clayey and sandy-clayey sediments of lacustrine and wetland environment placed at the base of the Neogene-Quaternary succession (“*Serie lignitifera*”) are noteworthy. They accumulated locally relevant amounts of organic matter whose transformation has led to the formation of lignite deposits

such as those of economic interest at Ribolla and Montebamboli-Rio Piastrello in the TM Geopark territory (see also geosites G32 and G33). The basal lacustrine sediments are overlain by lagoonal to marine deposits, sometimes characterized by heteropic relationships and gypsum levels (“*Successione gessifera*”). The late Miocene formations crop out mainly in the western sector of the TM Geopark, in the Niccioleta zone, in the area between Roccastrada and Ribolla as well as close to the Gavorrano ridge (see Annex 3).

The Pliocene sedimentary cycle starts with a vast marine transgression. Deposition of clays, silty clays, clayey sands, sands and conglomerates mainly occurred during Lower-Middle Pliocene in a shallow to neritic marine environments, with limited lacustrine episodes. The main outcroppings of the Pliocene sediments are in the Monterotondo Marittimo, Roccastrada and Gavorrano areas.

At the end of Middle Pliocene a marine regression occurs related to the uplift of a large area embracing southern Tuscany and northern Latium. In the time span between Upper Pliocene and Upper Pleistocene clayey to sandy sediments, conglomerates and limestones such as travertines mainly deposited in continental settings.

### ***Pliocene magmatites***

The geological framework of the TM Geopark territory is completed by magmatic rocks of the Tuscan Magmatic Province cropping out along the Gavorrano ridge and in the Roccastrada area (Marinelli, 1961, 1983; Barberi et al., 1971; Poli et al., 1989, 2002; Innocenti et al., 1992; Serri et al., 1992; see Annex 3). The emplacement of these magmatites occurred during Pliocene connected to the post-collisional extensional tectonic. A hypoabissal monzogranitic body associated with leucogranitic differentiates and dated at  $4.4\pm 0.6$  Ma, crops out at Gavorrano (Boccaletti and Conticini, 1985; Rossetti et al., 2001; Mazzarini et al., 2004; Musumeci et al., 2005, 2008; see also geosite G4). In the Roccastrada area, subcaline rhyolitic volcanites are present ( $2.3\pm 0.2$  Ma) as fissure effusions, intrusive domes and ignimbritic flows (Mazzuoli, 1967; Balducci and Leoni, 1981; Pinarelli et al., 1987; Marianelli and Carletti, 1999; see also geosites G10 and G11). Both the above-mentioned magmatic rocks were originated by crustal anatexis processes.

### ***Recent continental deposits***

The recent continental deposits are mainly alluvial and eluvio-colluvial deposits, forming the Scarlino plain and Ribolla plain in the southern sector of the TM Geopark, as well as minor travertines.

## **B.2.3. ORE GEOLOGY**

As often above indicated, the TM Geopark territory embraces the area of the Colline Metallifere (Metalliferous Hills), one of most important ore districts of Italy. In this area, there are several sulphide orebodies that for their grade and size were intensely exploited from remote to modern age for production of lead, zinc, copper, silver, iron (AA.VV., 1971; Tanelli, 1983; Riccobono, 1993). The list and location of these mineralizations in the TM Geopark territory are reported in Annex 4.

In the Colline Metallifere district the sulphide mineralizations pertain to two main ore types: pyrite massive ores and base metal vein-type ores (AA.VV., 1971; Arisi Rota and Vighi, 1971b; Vighi, 1971; Tanelli, 1977; Gianelli e Puxeddu, 1978; Dallegno et al., 1979; Tanelli, 1983; Tanelli and Lattanzi, 1983; Innocenti et al., 1984; Lattanzi and Tanelli, 1985; Corsini et al., 1991; Riccobono, 1993).

The pyrite ores (e.g., Niccioleta, Gavorrano and Campiano mines) are hosted both in sulphate-carbonate lenses within the Paleozoic Phylladic Complex of the Tuscan basement and in the

*Calcare cavernoso* fm., which tectonically lies on the lithologies of the basement. Pyrite ores are massive bodies mainly consisting of pyrite with subordinate other sulphides such as: sphalerite, galena, chalcopyrite and pyrrhotite, as well as iron oxides (e.g., magnetite).

The base metal ores are polymetallic (Cu-Pb-Zn) sulphide vein-type occurrences usually related to Apennine fault systems that involved the Paleozoic formations of the basement, the Tuscan and Ligurian Units as well as the Neogene succession. Sphalerite, galena, chalcopyrite and pyrite form the predominant ore paragenesis. This type of mineralizations is mainly found in the zones of Massa Marittima and Montieri (e.g., Boccheggiano, Niccioleta, Fenice Capanne, Serrabottini, Poggio Mutti, Montieri mining sites).

A two-stage genetic model has been proposed for the pyrite massive ores and the base metal vein-type ores (Bralia et al., 1979; Cortecchi et al., 1980; Lattanzi and Tanelli, 1981, 1985; Lattanzi et al., 1987). An exhalative-sedimentary episode likely created the pyrite massive ores within the Paleozoic Phylladic Complex. A late-Apennine hydrothermal event caused partial to total mobilization of the pyrite massive ores with deposition of sulphides in structurally controlled sites. Silicization and metasomatization phenomena were associated to the mineralization process. This event ensued in a number of hydrothermal epigenetic ore deposits mainly hosted by the *Calcare cavernoso* formation.

In the territory of TM Geopark copper mineralizations are also found (AA.VV., 1971; Klemm and Wagner, 1982). The copper occurrences are closely related to the ultrafemic and femic rocks belonging to the Ophiolitic Units of the Ligurian domain. Mineralizations occur at the boundary between different ophiolitic rocks (serpentinites, gabbros and basalts), along fractures crossing these rocks, as well as at the contact between the ophiolitic bodies and the sedimentary coverage. The ore paragenesis mainly consists of copper sulphides (chalcopyrite with bornite, calcosine, cuprite, covellite) together with pyrite and minor zinc and lead sulphides and iron oxides. The mineralized zones frequently show diffuse and intense hydrothermal alteration of host rocks with formation of steatite, magnesite, chlorites, clay minerals and minor quantities of quartz, calcite, dolomite, feldspars and barite. The copper mineralizations are usually small and have had no particular economic interest, although some of them (e.g., at Roccatederighi) were exploited during the medieval age and at the beginning of 19<sup>th</sup> century.

The genesis of copper mineralizations is linked to the process that determined the formation and evolution in time of the ophiolitic rocks of the Ligurian domain. For these occurrences it is likely a primary exhalative-sedimentary origin in oceanic ridge zone during Jurassic, followed by a secondary minerogenetic event related to the alteration processes triggered by the circulation of hydrothermal fluids during the Mio-Pliocene extensional tectonic phase of the Apennine chain.

The TM Geopark area is also characterized by the presence of lignite deposits (mainly at Ribolla and Montebamboli-Rio Piastrello; geosites G32 and G33) and alum masses (mainly at Monte Leo, Cavone, Montioni; geosites G18, G19 and G20).

The lignite deposits are within Miocene clayey and sandy-clayey sediments of lacustrine to wetland facies. In this environment important amounts of organic matter were locally accumulated and preserved forming lignite deposits of economic interest.

The alum deposits resulted as consequence of the circulation of sulphur-rich hydrothermal fluids with alteration of the affected rocks (mainly kaolinitization) and deposition of hydrous sulphates (Landi, 1978; Lombardi, 1977).

More details about the main sulphide mineralizations and the lignite and alum deposits in the TM Geopark territory are reported in the descriptive section of geosites in Annex 5.

### B.3. LISTING AND DESCRIPTION OF THE GEOLOGICAL SITES PRESENT ON THE TUSCAN MINING GEOPARK

In the TM Geopark area several geosites (38 in total) of scientific relevance, didactic and educational value, and attractive appeal have been singled out. These geosites cover a wide spectrum of geological topics such as: sedimentology, stratigraphy, tectonic, mineralogy, petrography, palaeontology, magmatism, ore geology, geothermics, hydrothermalism and geomorphology. This geodiversity is noteworthy and results from the long and complex geological history of the area. Within this geodiversity there are some geological peculiarities represented by surface geothermal manifestations (e.g., gas vent, vapour jets, thermal pool) and diffuse and sometimes relevant sulphide mineralizations, which have influenced the history, economy and culture of the territory of the future Geopark.

It is to be pointed out that despite the geodiversity most of the geological outlines characterizing the geosites are related to a single event represented by the evolution of the Apennine chain. This event has led to the formation of the fold-thrust belt, the intrusive and effusive emplacement of crustal anatectic magmas, the genesis of geothermal systems, the widespread circulation of fluid hydrothermal that originated polymetallic sulphide vein-type ores and produced alteration phenomena.

The geosites singled out in the TM Geopark area are listed, mapped and described in the Annex 5. On the basis of the prevalent geological interest and significance, the geosites have been grouped in:

- sites of sedimentological, stratigraphic, geostructural, magmatic and minero-petrographic interest
- geothermal and hydrothermal sites
- mining sites
- geomorphological sites.

In the Annex 5 for each geosite there is a brief report including the localization in the territory, the description of the main geological features, the aspects of interest and relevance as well as some explicative photos.

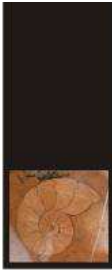






**B.4. DETAILS ON THE INTEREST OF THESE SITES**

**B.4.1. Sites of sedimentological, stratigraphic, geostructural, magmatic and minero-petrographic interest**











**TAB. 1**

SITES OF SEDIMENTOLOGICAL, STRATIGRAPHIC, GEOSTRUCTURAL, MAGMATIC AND MINERO-PETROGRAPHIC INTEREST		GEOMORPHOLOGICAL	GEOSTRUCTURAL	SEDIMENTOLOGICAL	PALEONTOLOGICAL	MINERALOGICAL	MAGMATIC	GEO-HYDROTHERMAL	MINING	NATURALISTIC	ARCHAEOLOGICAL	HISTORICAL	SCIENTIFIC	EDUCATIONAL
	THE TUSCAN METAMORPHIC BASEMENT													
	G1. Farma Valley	●	●	●	●					●			●	●
	G2. Merse Valley	●	●	●	●					●			●	●
	THE TUSCAN NAPPE: THE TRIASSIC EVAPORITIC HORIZON													
	G3. Bai Valley		●	●		●			●				●	●
	THE TUSCAN NAPPE: THE GROUP OF THE CALCAREOUS-SILICEOUS FORMATIONS													
	G4. Gavorrano ridge	●	●	●	●	●			●					●
	G5. Cornate di Gerfalco ridge	●	●	●	●				●	●		●	●	●
	THE ALLOCHTHONOUS UNITS OF THE LIGURIA DOMAIN: THE OPHIOLITES													
	G6. Roccatederighi	●	●			●	●	●	●			●		●
	G7. Montemassi	●	●		●	●				●	●	●		●
	G8. Bartolina		●			●	●		●					●
	THE ALLOCHTHONOUS UNITS OF THE LIGURIAN DOMAIN: THE RADIOLARITES													
	G9. La Pietra		●	●		●			●	●			●	●
	THE PLOCENE VOLCANISM: THE RHYOLITES													
	G10. Roccastrada	●	●			●	●		●	●	●			●
	G11. Sassoforte-Roccatederighi	●	●			●	●		●	●	●			●
	THE RECENT AND PRESENT CONTINENTAL DEPOSITS: THE TRAVERTINES													
	G12. Massa Marittima	●		●	●			●	●	●	●	●		●
	G13. Poggio al Montone	●		●	●			●	●	●	●	●		●
	G14. Pianizzoli	●		●	●			●	●	●	●	●		●







**B.4.2. Geothermal and hydrothermal sites  
TAB. 2**

 <p>GEOTHERMAL AND HYDROTHERMAL SITES</p>		GEOMORPHOLOGICAL	GEOSTRUCTURAL	SEDIMENTOLOGICAL	PALEONTOLOGICAL	MINERALOGICAL	MAGMATIC	GEO-HYDROTHERMAL	MINING	NATURALISTIC	ARCHAEOLOGICAL	HISTORICAL	SCIENTIFIC	EDUCATIONAL
	G15. The Biancane geothermal vents					●		●		●			●	●
	G16. The geothermal vapor jets of San Federigo					●		●		●			●	●
	G17. The kaolin deposit of Torniella					●	●	●	●					●
THE DEPOSITS OF ALUM														
	G18. Monte Leo					●		●	●			●		●
	G19. Cavone					●		●	●			●		●
	G20. Allumiere di Montioni					●		●	●			●		●

**B.4.3. Mining sites**  
**TAB. 3**

		GEOMORPHOLOGICAL	GEOSTRUCTURAL	SEDIMENTOLOGICAL	PALEONTOLOGICAL	MINERALOGICAL	MAGMATIC	GEO-HYDROTHERMAL	MINING	NATURALISTIC	ARCHAEOLOGICAL	HISTORICAL	SCIENTIFIC	EDUCATIONAL
	<b>MINING SITES</b>													
	<b>G21. Sant'Antonio mineralization</b>		●	●	●	●			●	●		●	●	●
	<b>G22. Gavorrano</b> <i>Gavorrano, Rigoloccio, Ravi Marchi Ravi Montecatini, Valmaggiore mines</i>		●			●		●	●			●	●	●
	<b>G23. Niccioleta</b> <i>Niccioleta e Valdaspra mines</i>		●			●		●	●			●	●	●
	<b>G24. Boccheggiano</b> <i>Merse, Campiano, Bagnolo, Valle Buia Rigagnolo, Mollignoni, Botroni, Baciolo and Ballarino mines</i>		●			●		●	●	●		●	●	●
	<b>G25. Fenice Capanne</b>		●			●		●	●	●		●	●	●
	<b>G26. Serrabottini</b>					●		●	●		●		●	●
	<b>G27. Monte Gai – Val Canile</b>					●		●	●		●		●	●
	<b>G28. Poggio Mutti</b>	●	●			●		●	●	●	●		●	●
	<b>G29. Montieri</b>					●		●	●		●	●	●	●
	<b>G30. Rocchette-Cugnano</b>					●		●	●	●			●	●
	<b>G31. Castel di Pietra</b>		●			●		●	●	●	●		●	●
	<b>G32. Ribolla</b>			●		●		●			●		●	●
	<b>G33. Montebamboli – Rio Piastrello</b>			●	●	●		●			●		●	●

**B.4.4. Geomorphological sites**  
**TAB. 4**

 GEOMORPHOLOGICAL SITES		GEOMORPHOLOGICAL	GEOSTRUCTURAL	SEDIMENTOLOGICAL	PALEONTOLOGICAL	MINERALOGICAL	MAGMATIC	GEO-HYDROTHERMAL	MINING	NATURALISTIC	ARCHAEOLOGICAL	HISTORICAL	SCIENTIFIC	EDUCATIONAL
 G34. Waterfall of Pecora River	●		●										●	
 G35. Accessa Lake	●									●		●	●	
 G36. Buca dei Forni dell'Accesa	●				●								●	
 G37. Buca della Serra (or del Paladino)	●				●								●	
 G38. Cala Violina	●								●				●	

## **B.5. CURRENT OR POTENTIAL PRESSURE ON THE TERRITORY AND THESE SITES**

The territory in question is characterized by hilly slopes with frequent outcrops of limestone, and red clayey soils deriving from the action of external agents on the limestone. Of particular note is the presence of various phenomena such as: Karst formations (G35-Lago dell'Accesa, Karst dolina, G36 Buca dei Forni dell'Accesa, G37 Buca della Serra); geothermal phenomena (G 15 Biancane, G16 Lago San Federigo with the boraciferous soffioni at Monterotondo); thermal springs; and, finally, the large-scale mining and ore-processing areas (G22 Gavorrano, G29 Montieri, G24 Boccheggiano, G25 Fenice Capanne, G23 Niccioleta, G32 Ribolla).

Down in the plain, one finds the remains of a marshland ecosystem represented by the Padule di Scarlino, with the presence of migratory wildfowl. The agricultural landscape near the coast is dominated by arable farming, and has a series of drainage ditches from the major land reclamation projects in the 19th century and the first half of the 20th century. The hills are dominated by extensive woodland. Upper valley vegetation has residual ancient holm-oak groves (G5 Cornate di Gerfalco), a beech plantation at Montieri (G29), and copses of Turkey-oak, downy oak, and chestnut, in which one can clearly see an invasive presence of black pine and Maritime Pine on abandoned farmland and pasture-land. Most of the woodland cover is found in nature reserves, which are open to hikers, thanks to an efficient network of paths, providing access to most of the geosites. Worthy of mention is the fact that part of the system of woodlands served the mining industry.

On the lower slopes, with a more gentle morphology, there is a greater presence of agriculture. This is of patchwork variety (mixed land use), consisting predominantly of specialized vineyards (this zone makes Montereio DOC wine), olive groves, and arable land. This area was once marked by large estates, which were then split up during the second half of the 20th century.

Nevertheless, the forest landscape dominates over the agricultural landscape. The population dynamics in the medieval period can still be seen in the presence of old towns still functioning in the lower hills (G5 Gerfalco, G29 Montieri, G6 Roccatederighi, G7 Montemassi, G10 Roccastrada, G4 Gavorrano, Ravi, Scarlino...), and the remains of castles that were mostly abandoned in the 14th century (G30 Rocchette Pannocchieschi, G30 Rocchette di Cugnano, G31 Castel di Pietra, G11 Sassoforte) and the remains of mine-workings. The hilltop settlement system is dominated by Massa Marittima, a medieval walled city of very great historical and artistic value.

The areas with the steepest hills, and the more hilly upland country in and around Massa Marittima, Monterotondo Marittimo and Montieri, are rich in mineral, geothermal and thermal resources, the exploitation of which has left a great deal of evidence relating to the various historical periods. This evidence has created a unique and unrepeatably landscape, a distinctive feature of which are the pipelines for steam generated by geothermal activity, and the natural, endogenous manifestations of naturalistic and geological value (G15 Biancane, and G18 Lago San Federigo), together with the ancient alum quarries (G18 Monteleo).

Large-scale morphological and ecological alterations of the landscape (stone quarries) are also a product of the demand for material for use as filler in the mines (Gavorrano), and for stones for ornamental use (G5 Romano–Gerfalco quarries, and G4 Portasanta quarries at Caldana-Gavorrano), and for gypsum (G3 Valle del Bai-Roccastrada). However, these are now a characteristic feature of the mining and industrial landscape of the Colline Metallifere, also marked by examples of cultural development (the Teatro delle Rocce theatre, built inside an abandoned quarry connected with the Gavorrano Mine)



The plain is traversed lengthwise by a band of infrastructure comprising the railway and the highway. Worthy of note here is Follonica, the centre of which is marked by the presence of a former iron- and steelworks, Ilva, with 19th century buildings (but with surviving remains from the 16th, 17th, and 18th centuries) and characteristic cast-iron urban fittings. In the 20th century, owing to the development of activities linked to mining, other towns grew up such as Ribolla (G32), Niccioleta (G23), and Bagno di Gavorrano, as residential agglomerations serving the mines, which, in some cases, at the end of mining activity, became magnets for settlement in the valley floor (Bagno di Gavorrano, Ribolla). Ribolla (G23), sited at a three-way crossroads between the main local arteries (Siena-Grosseto-Follonica), still has its original nucleus as a mining centre, although this is now overshadowed by more recent expansion.

The largest modern and contemporary towns can be seen in the urban expansion of Follonica, and the industrial zone of Casone di Scarlino, with its jetty, and the new tourist port of Portiglioni.

Anthropic pressure is particularly significant in the summer months along the entire coast, especially at Follonica, at Puntone di Scarlino, with an increase in the demand on road infrastructure, also affecting the geomorphological geosite of Cala Viola (G38).

In general, the Colline Metallifere landscape has a number of valuable aspects relating to the environmental quality of sites, and infrastructure of great worth. Rural upland roads follow routes strictly dictated by the morphology and contour lines, thereby reducing to the barest minimum the need for engineering works, risks of instability, and maintenance requirements. Owing to its artistic heritage, and its key position between the coast and the hinterland, the Colline Metallifere foothills have a high development potential for many tertiary sector businesses (marketing agricultural products, expositions and museum display, and alternative tourism or tourism that complements coastal tourism) and for manufacturing (hand-made goods, and quality foods).

## B.6. CURRENT STATUS IN TERMS OF PROTECTION OF THESE SITES

Ministerial Decree 044 dated 28 February 2002, issued by the Minister for the Environment and the Protection of Land and Seas, in agreement with the Minister for Cultural Assets and Activities, instituting the National Technological and Archeological Park of the Colline Metallifere Grossetane, lists those sites which are part of the “Park Assets”. Under Art. 2 of the Founding Decree (“Aims and Activities of the Park”), it is specified that: “The aims which, with the creation of the Park, it is intended to pursue involve the salvaging, conservation and development of the environmental, historical-cultural and technical-scientific heritage of the sites identified in this decree”. And under paragraph 2 it is specified that: “To this end, the Park Consortium will handle and coordinate, by agreement with the superintendencies with responsibility for each subject and geographical area, and with the relevant local authorities, the following activities: a) protecting, conserving and enhancing the sites and resources connected to mining activity, for environmental, cultural, scientific, educational and tourism purposes; b) conserving and developing, in museum and archive facilities, the legacy of the industrial archaeological heritage and documentary, library and photographic resources of educational interest for the history and culture of mining; c) safeguarding and protecting the habitats, the cultural landscape, and the social values connected to mining; d) promoting and supporting educational and research activities in the sectors of history, archeology, science, and technology; e) promoting and supporting educational and artistic-cultural activities compatible with the values which are to be protected; f) promoting tourism related to the environment and culture.

With the Territorial Coordination Plan, adopted on 20 April 2009, the Province of Grosseto – and, with it, the Park – was subsequently supplied with the main instrument for implementing protection measures for the environmental resources for the whole area. This document, under paragraph 7 of



Article 10, states that: “The geological and speleological features of special environmental and landscape status are regarded as having the value of a resource defining the identity of the provincial area, at the same time recognizing their strategic value for the purposes of collective use”. This important administrative measure goes on to decree that geological sites will be “safeguarded for the purposes of conservation and recovery, with specific reference to the natural and environmental context” (see also, under point D, the paragraph “PROTECTION STATUS OF THE LOCAL AREA”). That is why the candidacy, and possible listing with the European and Global Unesco Geoparks Network represents a major opportunity for promoting, safeguarding, and developing the geological and environmental sites of the Colline Metallifere.

## **B.7. DATA ON THE MANAGEMENT OF THESE SITES**

The authority responsible for the administration of the Park of the Colline Metallifere is the Park Consortium, members of which are the Ministry of the Environment, the Ministry of Cultural Assets, Tuscany Region, the Province of Grosseto, the Colline Metallifere Upland Community authority, and the municipalities of Follonica, Gavorrano, Massa Marittima, Monterotondo Marittimo, Montieri, Roccastrada and Scarlino. Management is placed in the hands of the Management Committee, members of which are: the Chairman, appointed by the Environment Minister; the Vice-Chairman, representing the Consortium municipalities; one representative each from the Ministry of Cultural Assets, Tuscany Region, the Province of Grosseto and the Colline Metallifere Upland Community. The Committee appoints a “technical coordinator” with managerial and supervisory functions, who is also the coordinator of the “Park Gateways”, each with its own person in charge appointed by the respective municipality. This streamlined structure, which enables the use of professional skills present in the bodies belonging to the Consortium, allows a responsive and flexible managerial activity capable of giving quick and immediate answers to the needs of the territory, in close liaison with the local administrations which remain responsible for the preservation of the Park’s geosites, in accordance with the terms of the Territorial Provincial Coordination Plan, and as endorsed by the Park’s “Charter of Principles”.

## **B.8. LISTING AND DESCRIPTION OF NON-GEOLOGICAL SITES PRESENT IN THE TERRITORY THAT MAY BE LINKED TO THE SITES OF GEOLOGICAL INTEREST**

### **B.8.1. NATURAL SITES WITH FLORA AND FAUNA OF SPECIAL INTEREST**

A major feature of the environment of the TM Geopark is the amount of woodland (covering around 60% of the total surface area), dominated by Mediterranean scrub and sclerophyllous vegetation on low-lying hills, and woods of broad-leaved trees at higher altitudes. This characteristic denotes a largely uncontaminated environment, with a low level of human intervention, which finds its best expression in the numerous areas subject to special protection. However, the rest of the local area also has characteristics which offer the ideal habitat for numerous varieties of plants and wildlife.

Accordingly, the territory of the TM Geopark is marked by the presence of numerous forms of flora and fauna, which underline the great ecological and environmental heterogeneity of the area. This biodiversity is found above all in the highly natural state of the landscape, marked by the presence of numerous Protected Natural Areas, the protection of which may be an incentive for the conservation and enhancement of the natural features, as well as for eco-compatible economic activities and sustainable development. The Protected Natural Areas inside the TM Geopark are: 2 State Reserves, 3 Regional Reserves, 1 Interprovincial Park, 1 Forestry Park, 1 Oasis (currently being set up) and 5 proposed Sites of EU Importance (SIC).



**Marsiliana State Reserve.** The Marsiliana State Nature Reserve for Animal Repopulation, created in 1980, is a pilot company aimed at the conservation and development of horse and cattle species native to the Maremma. In addition, the firm's aim is the protection of plant associations and natural habitats, maintaining biodiversity, and safeguarding wildlife. The reserve covers an area of 443 hectares, and falls almost entirely within the Montioni Interprovincial Park. This area of the lower Apennines, with average altitudes of 120-180 metres a.s.l., is constituted by Mediterranean scrub, copses of evergreen sclerophyllous, and farmland

**Belagaio Animal Repopulation State Nature Reserve.** The Belagaio Animal Repopulation State Nature Reserve, set up in 1980, covers an area of 157 ha and is run by the State Forestry Guard. The reserve is marked by the presence of Mediterranean scrub vegetation, sclerophyllous evergreen woodland, and fodder cultivation. Belagaio is a zone of animal repopulation; specifically, it is an experimental pilot company for the safeguarding and reintroduction of the Maremman horse, the tawny owl, and the little owl.

**Torrente Farma Regional Nature Reserve.** The protected area covers around 1500 hectares, between the river Merse and the Farma torrente (seasonal stream), on the border between the provinces of Siena and Grosseto. This Reserve, set up in 1996, comprises valleys and hills rich in woodland, interspersed with small cultivated areas and isolated pasture. In the middle of the area stands the Belagaio State Nature Reserve for Animal Repopulation.

The particular orientation of the valley has allowed the development of different forms of vegetation on the two sides: the side towards Siena is dominated by sclerophyllous scrub and mixed oaks, while on the side toward Grosseto one still finds vegetation composed of plant forms typical of cold, wet climates. Indeed, the mixture of Mediterranean scrub environments (comprising ilex, arbutus, cork-oak, mastic tree, heathers and cistus) and chestnut woods and hornbeam, with undergrowth rich in holly, ferns and mosses, and between riparian vegetation (composed of poplars, willows, alder, linden trees and hazel-nut), makes the nature reserve the most important environmental feature in the whole area.

The reserve also features botanical rarities, such as the beech, at unusually low altitudes, and the birch. Yew trees, the osmunda fern, and numerous kinds of plants have also been found in the area, represented by endemic species such as foxglove and cotton lavender. Among rare species, or species which are found here on the limit of their area of distribution, one finds box and heather. Finally, worthy of note is the presence of lupins, a species which has only recently appeared in Italy's range of flora.

The Farma valley also has numerous examples of interesting fauna, represented by the otter, the Alpine newt and the spectacled salamander. Also present are species of great importance for conservation, such as the marten, the skunk and the wild cat. Finally, the rich community of birds in the Reserve comprises, for example: the hobby, the honey buzzard, goshawk, the long-eared owl, the kingfisher, and the dipper.

**Cornate and Fosini Regional Nature Reserve.** The Cornate and Fosini Regional Nature Reserve, situated in the eastern zone of the Colline Metallifere and covering an area of 879 ha, is one of the few upland areas in southern Tuscany. This mountainous massif, which rises to heights of well over 1,000 metres, consists of a complex of limestone cliffs, partially covered by spontaneous tree vegetation and some areas of replanted conifers. The hillsides are marked by woods dominated by the *ostrya carpinifolia*, while the remaining heights are covered by mixed woodland with turkey-



oak, downy oak and ilex. On the peaks of the massif, there are dry meadows and garrigues of great interest from the point of view of conservation, having wild orchids and plant life (eg the Etruscan violet, snake's-head, and orophytes).

The nature reserve boasts a highly varied range of mammal life, represented by the wild cat, the wolf, albeit present only sporadically, the roe-deer, the fallow deer, the porcupine and the beech-marten. Birdlife is marked above all by the presence of the short-toed eagle and the sparrow-hawk.

**La Pietra Regional Nature Reserve.** This 530-ha protected area, which is named after a rocky outcrop called La Pietra (442 m a.s.l.), is marked by the presence of heliophilous deciduous woods, and riparian formations. One after the other, one comes across the following: groves of mesophyll Turkey oak with hornbeam, ilex, field maple, cornel and beech, groves of acidophilic Turkey-oak with durmast, broom, and guilder rose, and groves of hornbeam with downy oak, Montpellier maple and manna-ash.

Wildlife is similar to fauna found in the nearby Farma reserve.

**Montioni Interprovincial Park.** The Montioni Interprovincial Park, covering around 6,400 ha, and situated between the valleys of the Cornia and Pecora rivers, comprises an extensive woodland area long used for logging, for the production of charcoal, and for the extraction of Alum. Also, within the perimeter of Montioni stands the State Nature Reserve of Poggio Tre Cancelli. The protected area is dominated by Mediterranean sclerophyllous woodland and turkey-oak, although near gullies there are patches of riparian woodland. Also present are areas under olive, cereal and allotment cultivation, as well as areas reforested with non-local species.

Flora in the Park number 495 types of plant, including 5 very rare species (box, goat's beard, marsh bluegrass, *ophrys vernixia* and *euphorbia solcata*).

The Park's fauna mainly comprises roe-deer, fallow-deer, wild boar and porcupine. Also present are badger, beech-marten, weasel, hare and squirrel. Birdlife is typical of the sclerophyllous woodland and mixed oak-woods of Tuscany's Maremma area (short-toed eagle, buzzard, sparrow-hawk, hen harrier and common harrier). Nocturnal birds of prey are represented by the tawny owl, barn owl and horned owl.

**Monte Leoni Wildlife Oasis.** This oasis, which is still in the process of being set up, is found within the municipalities of Roccastrada, Grosseto and Campagnatico. The particular pattern of use of the woods has favoured the presence of groves of cork oak, chestnut trees and dense undergrowth rich in ivy, cytinus hypocistis, butcher's broom and broom.

There is an abundant and varied range of fauna.

**Sites of EU Importance.** The particular environmental conditions in the territory of the Colline Metallifere have allowed 5 Sites of EU Importance to be designated (Lago dell'Accesa, Val di Farma, Monte Leone, Cornate and Fosini, Poggi di Prata). For details relating to the habitats and species of flora and fauna of the above-mentioned Protected Natural Areas, see Appendix 6.

## B.8.2. SITES OF DEMOGRAPHIC, ETHNOGRAPHIC AND ANTROPOLOGICAL INTEREST

### B.8.2.1. Archeological, archeo-mining and archeo-metallurgical sites

#### Municipality of Follonica



Customs, former Pumping Station, Foundry 1, Foundry 2, Etruscan furnaces at Rondelli, Ringrane furnaces, San Ferdinando Furnace, Cancellone Magonale, Museum of Metal and Cast Iron, Doctor's building, Director's building, Palazzo Granduca, water tower, clock-tower.

#### Municipality of **Gavorrano**

Bagno di Gavorrano, Caldana, potash workings, Casteani. Lignite mine, Castellaccia, Caldana marble quarries, Gavorrano furnaces, Gavorrano, Giuncarico, Ravi Marchi Mine, Ravi Val Maggiore Mine, Pozzo Impero, Pozzo Roma, Ravi, Ribolla, Rigoloccio.

#### Municipality of **Massa Marittima**

Castellaccia, Rocchette Pannocchieschi castle, Fenice Capanne, La Fenice Ironworks, Lower Ironworks, Middle Ironworks, Montebamboli coal railway, Bufalona well, Fonte and Palazzo dell'Abbondanza, Lake Accesa furnaces, Marsiliana furnaces, Marsiliana medieval furnaces, Railway water channel, Le Mura, Niccioleta Mine, Molinpresso, Montebamboli, Montebamboli lignite mine, Botrona mill, Niccioleta, Palazzo della Dirigenza, Poggio Castiglione, La Pesta shaft, Prata, Riella, Serabottini, Sorgente Aronne, Ghirlanda railway station, Tatti, Valle dello Stregajo, Valpiana.

#### Municipality of **Monterotondo Marittimo**

Monteleo alum-works, Antico Bagno Regio ("Il Bagnaccio"), Frassine, Palazzo Comunale, Palazzo delle Logge.

#### Municipality of **Montieri**

Boccheggiano, Mulignoni mine, Campiano, Gerfalco, foundries of Montieri, Le Roste, Poggio Mutti, Pozzo Beato Giacomo, Travale.

#### Municipality of **Roccastrada**

Lattaia castle, Montemassi castle, Sticciano castle, Giugnano ironworks, Farma ironworks, Sassoforte castle, dam over river Bruna, Acqua Nera mine, Ribolla mine, Roccatederighi mine, Poggio Mozzeto, Roccatederighi, Sassofortino, Sticciano, Torniella.

#### Municipality of **Scarlino**

Poggio Tondo necropolis (Pian D'Alma), Palazzo Comunale, Portiglioni, Puntone, Scarlino Scalo, Cable-ways: pyrites sorting.

(See Appendix 2 - Masterplan)

### **B.8.2.2. Sites of architectural and historic interest**

#### Municipality of **Follonica**

Church of S. Leopoldo; Modigliani Art Gallery; Villa Benedetti; Villa Jole; Villa S. Anna.

#### Municipality of **Gavorrano**

Caldana castle; Gavorrano castle; Castel di Pietra; Church of S. Giuliano, Giuncarico; S. Germano necropolis; Le Rocce Theatre, Gavorrano.

#### Municipality of **Massa Marittima**

Lago dell'Accesa archeological area; birthplace of S. Bernardino; Malavolti castle; Castello dell'Accesa (or "Bishops's Castle"); Marsiliana castle; Montebamboli castle; Montereale castle; Perolla castle; Tatti castle; Cathedral of S. Cerbone; Church of S. Barbara, Niccioleta; Fortezza Arco Senese and Torre del Candelieri; Cloisters of S. Bernardino; Montepozzali castle; Palazzo Comunale; Palazzo della Zecca; Palazzo dell'Abbondanza.

#### Municipality of **Monterotondo Marittimo**

Cugnano castle; Sanctuary of Madonna of Frassine.

#### Municipality of **Montieri**

Fosini castle; Il Cassero; Palazzo Comunale; Porta Senese di Gerfalco.



Municipality of **Roccastrada**: Abbey of Giugnano; Crypt of Giugnano; Montemassi olive-press; Concordi Theatre; clock-tower.

Municipality of **Scarlinto**

Scarlinto castle; Roman villa and Portus Scabris.

(See Appendix 2 - Masterplan)

### **B.8.2.3. Museums**

Municipality of **Massa Marittima**

Archeological Museum, Lago dell'Accesa Archeological Park; Mines Museum; Museum of Mining Art and History; old olive-press; old carpenter's shop; Museum of Sacred Art and Collection of Contemporary Art; Torre del Candeliere and Cassero Senese; Porta Parco degli Etruschi.

Municipality of **Gavorrano**

Le Rocce Mining and Nature Park; Castel di Pietra Documentation Centre; "+240" Exhibition Centre

Municipality of **Follonica**

Amedeo Modigliani Civic Art Gallery; Museum of Metal and Cast Iron

Municipality of **Scarlinto**

MAPS-Portus Scabris Archeological Museum; Local History Documentation Centre

The range of museums in and around the Colline Metallifere is particularly rich, and reflects the importance which mining resources had in every historical period in this area. The subject of the mining and processing of metals is the unifying element of the history of this part of the Province of Grosseto, as well as the most evident and recognizable mark on its landscape and in its environment.

Massa Marittima, with its Municipal Museums' System, has gathered together most of the museums in the area; visitors find a conceptual sequence of museums, ranging from archeology to art history, without neglecting aspects involving an educational reconstruction of the life and work of mines.

In Gavorrano the issue of mining is proposed in a framework involving industrial archeology and social history in the recently-opened Mining Park, while the Documentation Centre at Castel di Pietra illustrates a medieval mining settlement.

At Follonica, alongside the Art Gallery, which is being turned into a dynamic centre for the staging of exhibitions and cultural events, there is the Museum of Metal and Cast Iron, located inside the former ILVA plant, where the aspect of the processing of metals is developed in more detail.

Finally, in Scarlinto, the Documentation Centre provides a panoramic view of an area where archeological research has been particularly dense and fortunate in recent years, while the "Portus Scabris" Archeological Museum, at the Il Puntone Mining Interport, has been inaugurated recently.

(See Annex 2 – Masterplan)



## C. ARGUMENTS FOR NOMINATING THE TERRITORY AS A EUROPEAN GEOPARK

### C.1. COMPREHENSIVE ANALYSIS OF THE TERRITORY FOR THE DEVELOPMENT OF GEOTOURISM

#### Geodiversity

As mentioned above, the geological features of the TM Geopark territory are the result of the long and complex geological history of the *Colline Metallifere* area, mainly focused on the evolution of the Apennine chain. This geological history can be seen, accessed, and made use of at numerous geosites (see paragraph B.4 and Appendix 5), being nothing short of natural monuments of priceless scientific, didactic and educational value, representing the most significant record of the geological events which have taken place over time in this part of southern Tuscany. These geosites cover a wide spectrum of geological topics (eg sedimentology, tectonics, petrography, palaeontology, ore geology, hydrothermal phenomena); hence the TM Geopark territory is marked by significant geodiversity, with some geological peculiarities such as surface geothermal manifestations and sulphide mineralizations, which have influenced the history, economy and culture of the territory of the future Geopark.

Under the Masterplan (Appendix 2), accessing the current sites in the *National Archeological and Technological Park of the Colline Metallifere Grossetane* is effected by means of seven Gateways (museums, documentation centres, info points in every municipality in the Park), five walking routes (copper and silver; iron; alum and geothermal sites; lignite; pyrites) and four theme-based tours (medieval castles, mines, metallurgy and geothermal sites). By means of this system of visiting, special importance is given to mining history, with particular reference to the forms of extraction and exploitation of metals and other resources (lignite, alum, and boric acid) which have been seen down the centuries in the Colline Metallifere district.

The development project implemented with the TM Geopark hinges upon the central issue of understanding the geological features of the entire local area, of which sulphide mineralizations, and their associated mining activity, are just one of the salient aspects. The geosites of the TM Geopark thus represent the most significant and valuable features of the environmental heritage which it is possible to develop further, by means of the creation of geotourism visitors' routes.

In order to facilitate an understanding of the geology of the local territory of the TM Geopark, a visitors' tour has been devised which traverses the whole area in question, a route which sometimes joins up with, or intersects, the other visitor routes. This is a tour which, as regards content, represents the initial route, hence its name, **Itinerary Zero**, linking sites which illustrate and describe the various phases and features of the geological history of the Colline Metallifere area.

By means of didactic supports (guide to the geosites, topographical maps), the installation of suitable multilingual panels at geosites, the possibility of following the itinerary from start to finish, or only a part of it, with professionally qualified guides, visitors will be able to understand the geological evolution of the local area, as testimony to a long and complicated evolution over millions of years.

The itinerary must guarantee safe access for visitors. It is necessary that visitors are not exposed to dangers, and that the geosites are not exposed to the risk of damage. Since we are dealing with environmental assets, it is necessary to set up a control network, and to prepare paths with differing degrees of accessibility, following careful evaluation of the risks.

Itinerary Zero is subdivided into three sub-itineraries, distinguished on the basis of the characteristics of the geosites involved (see also paragraph B4):



**Itinerary A:** Geosites of sedimentological, stratigraphic, geostructural, and mineral-petrographic interest

*The Tuscan metamorphic basement*

G1. Farma Valley

G2. Merse Valley

*The Tuscan nappe: the Triassic evaporitic horizon*

G3. Bai Valley

*The Tuscan nappe: calcareous-siliceous formations*

G4. Gavorrano ridge

G5. Cornate di Gerfalco ridge

*Allochthonous units of the Ligurian domain: ophiolites*

G6. Roccatederighi

G7. Montemassi

G8. Bartolina

*Allochthonous units of the Ligurian domain: radiolarites*

G9. La Pietra

*Pliocene vulcanism: rhyolites*

G10. Roccastrada

G11. Sassoforte-Roccatederighi

*Recent and current continental deposits: travertines*

G12. Massa Marittima

G13. Poggio al Montone

G14. Pianizzoli

**Itinerary B:** geothermal geosites

G15. Biancane geothermal vents

G16. San Federico geothermal vapour jets

G17. Torniella kaolin deposit

*Alum deposits*

G18. Monte Leo

G19. Cavone

G20. Montioni alum-works

**Itinerary C:** mining geosites

G21. Sant'Antonio mineralization

G22. Gavorrano (Gavorrano, Rigoloccio, Ravi Marchi, Ravi Montecatini, Valmaggiore mines)

G23. Niccioleta (Niccioleta and Valdaspra mines)

G24. Boccheggiano (Merse, Campiano, Bagnolo, Valle Buia, Rigagnolo, Molignoni, Botroni, Baciolo and Ballarino mines)

G25. Fenice Capanne

G26. Serrabottini

G27. Monte Gai – Val Canile

G28. Poggio Mutti

G29. Montieri

G30. Rocchette-Cugnano

G31. Castel di Pietra

G32. Ribolla

G33. Montebamboli – Rio Piastrello

## Basic tools for activating Itinerary Zero

### 1) System of panels at Park Gateways

At every Park Gateway there is a 4 x 3 panel of the territory of the Park, showing Itinerary Zero and all the geosites of the TM Geopark.

### 2) Info Points at Park Gateways

Via the Park Gateways, it is possible to find out about Itinerary Zero or the various geosites which comprise it, through the organization of the Park (front-office), promotional material, and the system of panels

### 3) Production of basic information material

Leaflets, small maps

### 4) Information panels and display boards

Each geosite included on Itinerary Zero is to have a system of one, two, or three multilingual panels (Italian-English-German), made of forex with metal supports, showing its location, geological context, description, interpretation, and possible reference to other geosites.

### 5) Map of Itinerary Zero



The map is printed on both sides. On the front is a geological illustration of the area, the key, and a few example views; on the back are shown the itineraries, with a number of points of geological and landscape interest.

#### **6) Guide to Park geosites**

A printed information aid with geological details of the area, itineraries, a list of geosites, location, description and interpretation, and bibliography. Selection of photos and tables illustrating geological phenomena, coordinated with the system of panels.

#### **7) Ongoing training of environmental guides**

40-hour training course for the Park's Environmental Excursion Guides, run by the Department of Environmental Sciences at Siena University.

#### **8) Control network**

Periodic site visits covering all the Itinerary Zero geosites, to check on the condition of the geosites and information apparatuses, reporting any maintenance problems to the local authorities (Colline Metallifere Upland Community, Park municipal authorities).

### **Geotourism and the economy**

The geotourism visitor routes, as well as targeting a particular kind of tourist (people especially sensitive to environmental issues, from personal interest or owing to their profession), can also offer an opportunity for cultural growth to visitors without this motivation, who have an opportunity of finding new channels for understanding the local area.

The area involved in the TM Geopark takes in zones marked by differing economic vocations, including tourism, especially seaside tourism, which in summer is concentrated along the coast. Cultural tourism involving cities of art-historical interest (Massa Marittima) is also present, and "agriturismi" have an important status in the hotel sector, being widespread throughout the hilly hinterland, and being of a high standard.

The local area also has economic activity linked to wine-growing, olive cultivation, farming and animal raising, marked by the production of typical foodstuffs which are often of gourmet standard ("cinta Senese" pork meats, honey, oil, quality wines). The influx of tourists reaches a peak in the summer months especially, thanks to the presence of well-known and much-frequented seaside resorts (Follonica, Scarlino). But as of the 1990s there has been a desire to diversify the range of what is on offer, gearing it toward sustainable tourism, in which the environmental component has become the significant, special element. Thus, from this period on, after mining activities were closed down, the first projects to redevelop the Park's heritage came into being: the creation of the Environmental Education Laboratory at Gavorrano, and the formation of a network of trekking paths covering almost all of the area of the TM Geopark.

These hubs have offered local communities an opportunity for cultural growth, and to gain an awareness of, and to recoup, the local history which was being lost after mining was abandoned. At the same time, they set in motion a process whereby tourism was spread over more than one season, with the possibility of visiting these places at times of the year other than the summer period. This phenomenon has allowed those zones which were least developed from the point of view of tourism to be promoted, too, via attractions involving green tourism, sustainable tourism, and niche tourism. This is the case with the Le Biancane Park, a splendid geosite with geothermal manifestations of international importance, which, thanks to a specially laid-out visitors' route, is frequented by thousands of interested visitors all year round.

Also of particular importance is tourism involving school trips (from the local area and also from further afield, from primary schools and secondary schools in Tuscany and central and northern Italy), concentrated especially in March, April, and May, and for which the Park offers educational walking routes, guided tours, and workshops. In particular these workshops, proposed together with

visits to museums themselves (eg the Mining Museum, and the Museum and History of Mining Art in Massa Marittima; the Museum of Metal and Cast Iron at Follonica; the Mining Tunnel Museum in Gavorrano etc etc), and with the many museum visitors' routes (eg Marchi di Ravi Mine in Gavorrano, Le Biancane Park); and with trekking routes (eg the Old Mineshaft Visitors' Route at Massa Marittima) are activities which, under the careful guidance of expert naturalists, offer further information on specific issues relating to natural science and geology, as well as to archeology, environmental education, anthropology etc. In particular, the "La Finoria" Information Centre of the Environmental Education Workshop offers the chance of taking part in theme-based activities relating to geology, mineralogy and petrography, by means of handling and observing finds directly, the use of audio-visual aids and laboratory equipment (see Proposal "Be a geologist for a day").

## ***C.2. OVERVIEW OF EXISTING GEO-INSTITUTION AND GEO-ACTIVITIES IN THE GEOPARK***

For many years now, the territory of the TM Geopark has been the subject of scientific research by research bodies such as the University of Florence and the University of Siena. Some of this research, which is still under way, involves studies aimed at acquiring knowledge for the conservation of the environmental heritage (geosites) and of the mining landscape (clearance of abandoned mine spoil heaps).

**The project called "Preservation and development of cultural assets of a geological nature in the Province of Grosseto".** In 2000, the Province of Grosseto appointed the Department of Earth Sciences at Siena University (head of research: Prof. Armando Costantini) to carry out a study to identify geosites in the province of Grosseto. The project has led to the identification of more than 150 geosites, on the basis of the following assessment criteria:

- rarity and condition, referring both to the formation process and to the scientific significance at the regional level
- diversity
- characteristics and representativeness
- historical value and "key position" for scientific value
- ease of access, for educational value
- vulnerability
- scenic value, to which value has been attributed as a "natural beauty owing to its evocative status within the context of the landscape".

Subsequently, databases were created with various levels of information, to allow the communication of information, and the spread of knowledge for social, cultural and educational purposes.

In relation to this Application Dossier, the Park has appointed the "G. Sarfatti" Department of Environmental Sciences at the University of Siena (head of research: Prof. Francesco Riccobono) to develop further research on the Colline Metallifere geosites. The head of the Geosites Project is Dr. Riccardo Cinelli (geologist), an official from the Province of Grosseto.

As well as the presence of research bodies in the Park, a number of cultural institutes are present, where geo-activities are carried out on a daily basis.

**The Park Gateways** as museum facilities, and documentation centres relating to mining activities, are centres where guided tours and numerous educational and cultural activities are carried out, with information material being handed out.

**The La Finoria Environmental Education Workshop at Gavorrano** (the LEA) organizes Environmental Education projects which take the form of educational courses featuring meetings



and practical/manual activities in the workshop spaces and field excursions, complementary to the work carried out at the centre, at sites of particular natural and historical-archeological value.

The educational experiences can be summed up according to two major types:

I) residential courses designed for school groups staying at the LEA for several days, during which they take an intensive course with excursions, workshop experiences and some leisure time;

II) non-residential courses generally intended for local schools, including classroom lessons, excursions and workshops scheduled together with the teachers, conducted in the schools (the LEA teachers travel to the schools involved), at the LEA and in the surrounding area.

The educational courses are organized according to formulas proposed by the LEA, to which teachers can, by agreement with the LEA staff, make all the changes they feel necessary to make the course more suited to the specific needs of the class.

**The Bernardino Lotti Higher Institute of Education** is based in Massa Marittima (GR) and offers a training course for Geo-Mining Technicians. The School was set up by Royal Decree on 14 September 1919, and was turned into a Technical Institute of Mining in 1933. This school was a true reference point in the past in training most of the mining technicians at mines in the Colline Metallifere. Still today the training course for Geo-Mining Technicians includes the study of mineralogy, geology, and technical equipment.

### ***C.3. POLICIES FOR PROTECTION, ENHANCEMENT AND ECONOMIC DEVELOPMENT OF LOCAL GEOLOGICAL ASSETS***

In Italy, cultural tourism dedicated to natural resources can also satisfy a range of requirements, from leisure to social and educational usefulness which derives from raising awareness regarding environmental issues.

A widespread culture which helps to live happily with the local area improves knowledge of and respect for that area. Developing existing and potential relations between the geological heritage, the landscape, natural and cultural assets, and quality wine and food is, thus, one of the most interesting aspects of development in the TM Geopark. In the last few decades cultural and natural resources have been at the centre of a debate in which they are a factor of economic and territorial development. The need to rethink the nature of interventions to promote the cultural and natural heritage, redefining them in the context of a strategy which is more integrated at the local level, has paved the way for a policy of synergies in the various different fields of local development.

The relaunch of the territorial system makes use of the skills and development of theoretical fields such as territorial marketing, which, despite being very closely based on company management, can provide useful analytical tools to develop the implementation of medium- and long-term policies, in the framework of territorial promotion and development, and to make it possible to introduce a systematic form to relations between the countless bodies which have legitimate interests in the local area: the stakeholders.

The concept of the territorial district is a model in which the correlation between culture, nature and the local area is the prime mover behind the creation of an integrated system of players which, via the environment, draw elements to activate productive processes with high added intangible value.

What the Park has to offer in terms of culture is so varied (access to the geological, archeological, natural, anthropological heritage, reuse of mining areas for shows, conferences, art exhibitions), as to prove an interesting point of reference for sustainable economic development for the various holders of interests in the local area.

This development comes about by means of territorial policies agreed upon with local authorities and aimed at the development of their heritage in the form of protection and conservation policies, as well as improvement by means of actions aimed at promoting “sustainable tourism” with projects



focused on making people aware of the problematics linked to the protection of nature, environmental education, and a thorough knowledge of our territory, where geotourism is one of the most important triggers for development.

As an important reference point, and as the body which promotes this integrated system of players, the National Park is the body via which it is possible to activate policies to develop its assets in the most diversified way: from protection to knowledge, and the creation of forms of educational information and opening up sites for access. The Park is the only body capable of being a guarantor of coordination of the various actions, in line with the overall guidelines of the project.

#### ***C.4. INTEREST OF LOCAL AREA IN JOINING EUROPEAN GEOPARK NETWORK***

In the Park's Charter of Principles, signed at Gavorrano on 14 December 2007, the signatories undertook to protect and safeguard the cultural assets present in the local area, and to embark upon joint initiatives in the sectors of training and research, compatible with the values to be preserved, to promote the widest possible knowledge of the Park among all sectors of the public, and to add to the range of attractions on offer for cultural tourism.

It is in this document that the bodies belonging to the Park undertake to promote and support the candidacy of the TM Geopark in the Global Network of Geoparks.

The complexity of the Colline Metallifere territory, the geodiversity resulting from multiple geological events, the formation of a mining landscape which is the fruit of millennia of mining activities (Nature, Man, and then Nature again, reconquering the spaces which were once occupied by mining machinery, creating impossible forms of architecture, eg Le Roste) constitute a genuine open-air laboratory.

For this reason, the need was felt to complete the system of museums with the creation at Gavorrano, at the Park Gateway, of plans for a **Museum of the Mining Landscape**. The idea for this Museum, the execution of which is currently being planned, arose in order to reflect on the dynamic aspect of the landscape. Indeed, the Museum's mission is to provide information for an understanding of the transformation of the landscape by reading the signs left in it by Nature, and by the work of Man.

Plans for the creation of the Museum envision a display section with geological and archeological material (archeological material from research conducted in the municipal area of Gavorrano). The display is devised as a true itinerary, setting out from the geodiversity of the Colline Metallifere and arriving at the problematics of clearance of abandoned mining areas. By means of reconstructions, videos, the use of multimedia files and projections, a (multilingual) educational tool is offered which can be adapted to the age and level of visitors, with specially-designed files. The Museum will also be totally accessible to those with impaired vision, with the reconstruction of noises, oral accounts and explanations, and software for reading.

The TM Geopark is marked by the presence of a geological heritage of extraordinary interest. Facilities are already present in the area whose main mission is education, linked to environmental education. The possibility of increasing an awareness and knowledge of one's local area thanks to the widespread presence of cultural outlets coordinated by the Park (Park Gateways, Environmental Education Workshop), and of encouraging the authorities to implement geotourism policies, would be further expanded by the presence of the Park within the Global Geoparks Network.

The presence of the TM Geopark within the Global Network, a presence that is desirable, is certainly an opportunity for growth and exchange for cultural operators and scientific researchers in our local area with individuals with different experiences. Via the Network, dialogue, and the sharing of issues and problematics, would be possible, which otherwise would risk being resolved or handled in a self-referential way.



By the same token, the possibility of making available our experience in managing a complex mining landscape, with difficult interpretations to be given, and difficult educational “renditions” to be carried out, may also be an interesting contribution for the other Geoparks in the Network, which we wish may become part of the common heritage.

## D. GENERAL INFORMATION ON THE LOCAL AREA

### ***D.1. ECONOMIC ACTIVITIES, DESCRIPTION OF PRIMARY STRUCTURES RESPONSIBLE FOR SUSTAINABLE DEVELOPMENT OF LOCAL AREA***

Under Decree 4515 from the Regional Council of Tuscany, dated 31 October 2006, the territory of Grosseto Province was officially declared to be a “Rural District”. The “mission” of this important recognition is to foster sustainable economic and social development in the agricultural sector, and to help in defining a quality territorial system: this is the aim of the Maremma rural district, which was created experimentally in 2002, and which has made Grosseto Province the leading province in Italy in the creation of units of this kind.

The rural district represents a territorial economic system distinguished by quality farming, in keeping with the natural vocations of the local area, and which is significant for the local economy, a homogenous historical identity, consolidated integration between rural activities and other local activities, and the production of goods or services of particular specificity, in line with the area’s natural traditions and vocations, including, and especially, in the service of a “responsible” form of tourism.

The following are the private bodies which signed the accord for the recognition of the Maremma rural district: Grosseto Chamber of Commerce; Consorzio dell'Acquedotto del Fiora; Consorzio di Bonifica Grossetana; Consorzio di Bonifica Osa Albegna; Lega Regionale Coop Comitato di Grosseto; Confederazione Cooperative Unione Provinciale; Italian Farmers’ Confederation; Unione Provinciale Agricoltori; Federazione Provinciale Coltivatori Diretti; Consorzio Agrario Provinciale; National Confederation of Small Businesses and Artisans; Confesercenti; Confcommercio; Associazione Industriali; Associazione Albergatori; FAR Maremma.

In this connection, FAR Maremma (Fabbrica Ambiente Rurale Maremma, a limited liability consortium created in 2002 as a development partnership between public and private bodies, with the main aim of activating the P.I.C. Leader Plus) represents the main tool for the sustainable development of the Maremma area, which, in terms of its size and the diversity of its situations, is very varied and displays environmental aspects of exceptional interest as regards nature and archeology. In this, Grosseto Province fully reflects the defining features of the “Tuscan model”, in which the productive system and landscape resources are integrated, setting out the following points of strength and weakness:

- the quality and typical nature of the products of farming and the food industry;
- the presence of a collection of top-quality firms;
- landscape as the result of a particular agricultural productive organization;
- systemic integration between the community and the productive activities;
- great sensitivity and fragility, at times, of environmental resources, including as a result of the connections with the landscape and activities linked to the attractions of local areas, as well as the quality of life of local people;
- structural lightness of the fabric of the business world;
- human resources displaying a high level of aging, and with professional shortcomings;
- infrastructure and services for agriculture, and the rural world in general, and for environment-based tourism.

### **The PAL – Local Action Plan**



The Local Action Plan is the GAL's planning tool and working instrument, and provides the guidelines for bringing together locally-based development projects.

The **Plan** sets itself objectives of excellence, achievable by means of implementing innovative interventions, acting as repeatable and demonstrable examples at various different sites which make simple, explicit and immediate an understanding of the **Leader** method, and which bear witness to the achievement of results which are of high quality, but also within the reach of all local players.

The central aim of this Leader proposal is **giving a fresh boost to the development of the local area, by breathing new life into the economic, social and cultural fabric, within a framework of sustainability.**

These are intermediate goals and essential elements, since they help in the achievement of the main objective:

- the activation of innovative integrated strategies, and strategies for sustainable quality development;
- support for the local fabric of business, owing to interventions directly and indirectly aimed at promoting local products, with knock-on effects for jobs;

### **Local projects**

The priority of the GAL is to carry out actions and activities relating to the EU's "**LEADER PLUS**" initiative, and activities in support of local economic development.

LEADER plus promotes the implementation of development strategies built around one or more priority themes capable of making rural areas more dynamic, of creating new opportunities for employment, and of having lasting effects.

The goal is to help generate, in each rural area, indigenous and lasting development dynamics, built on history, the environment, and competitive factors specific to each area.

Thus, the Initiative sets out to:

- favour the implementation of original, high-quality development strategies, built around one or more priority themes;
- back the realization of actions which supplement and/or complement the developmental objectives of the structural programs;
- provide incentives for rural areas to be opened up to other European and non-European countries;
- foster the transmission of experiences, skills and knowhow;
- test solutions for development problems in rural areas which can constitute an example for the future policies of the European Union.

Support activities relate to the following spheres:

- enhancing the environmental resources of the local area, identifying development interventions compatible with the environment, including renewable forms of energy;
- developing and promoting local production, with special attention to quality products and organic products, also by means of support for local associations and firms;
- creating and promoting services, including in the advanced tertiary sector, area marketing, advertising, information, communications, promotion and creating computer-based and online links within the area of intervention and with the outside world;
- planning and setting up services in the field of training and vocational courses;
- enhancing, promoting and supporting local tourism services, with special reference to developing coordination between the different sectors of intervention (environment, local production, other services ...), and the knock-on effects for tourism and the image of the local area, hinging upon the "green economy". In this respect, the Colline Metallifere area, also thanks to the Upland Community Authority which, together with the municipal authorities of Massa Marittima, Monterotondo Marittimo, Montieri and Roccastrada, is developing the Local Agenda 21 process with the Meta 21 project, has taken a lead role, and the Park has put itself forward as a centre of excellence for



technological development, in the service of protecting and developing the environment, renewable and alternative energy sources, and research. The “Cicalino” solar energy park (EMAS certification) in the municipality of Roccastrada is the most significant example of this, as well as the Biancane geothermal park at Monterotondo Marittimo, together with efforts in support of the “Strada del Vino del Monteregio” for quality organic and biodynamic farming in the sector of wines and typical products, eg the “cinta Senese” of Monterotondo Marittimo

## ***D.2. PROVISIONS FOR LOCAL TERRITORIAL PROTECTION***

Under Council Ruling n. 112 dated 19 May 2009, Grosseto Province signed up to the UNI EN ISO 14001 protocol for environmental certification, with the prime aim of helping to continually improve the quality of the environment in the provincial area, including within the bounds of the Colline Metallifere Park. Specifically, the spheres of action of the environmental policy include: providing incentives for, and promoting, renewable energy sources; providing incentives for sustainable tourism and geotourism; enhancing the environmental quality of local rural areas, and local agricultural products and fine wines and food, by means of the “short production chain” and the “Strade del Vino”; conserving the landscape, protected areas and biodiversity, via proper planning; striving for the environmental and social sustainability of urban, productive and infrastructure systems.

These goals are in line with the aims of the Territorial Provincial Coordination Plan and with the Park’s “Charter of Principles” signed by the Province and by local authorities on 14 December 2007.

## ***D.3. PROTECTION STATUS OF THE LOCAL AREA***

With the Territorial Coordination Plan (PTC), adopted on 20 April 2009, Grosseto Province – and with it the Park – provided itself with the main instrument for implementing preservation of the environmental resources of the whole area. With this document, it states, under paragraph 7 of Article 10, that: “The geological and speleological features of special environmental and landscape status are regarded as having the value of a resource defining the identity of the provincial area, at the same time recognizing their strategic value for the purposes of collective use”. This important administrative measure goes on to decree that geological sites will be “safeguarded for the purposes of conservation and recovery, with specific reference to the natural and environmental context. At all events, the necessary accessibility will be censure for the development of the sites for the purposes of education and research, as well as geotourism,” obviously excepting “interventions for the purposes of protecting and conserving the sites in question”.

With the coming into force of the PTC, together with the pre-existing activities of the parks and nature reserves, the territory of the Colline Metallifere Park takes on, to all effects, the status of a “protected area” where the interest in conservation of the geological heritage is to be placed within the framework of the necessary enhancement of the cultural and environmental assets, also with a view to passing on the most significant elements of our landscape to future generations. The geological heritage thus needs to be seen not just as a rich legacy of science and culture, but also as a source of didactic and educational interest, and interest for tourism, with repercussions for jobs and the economy, such as geotourism.

## ***D.4. EXISTING FACILITIES***



The main strategy of the Colline Metallifere Park, implemented since 2005, has been twofold: on the one hand, a territorial policy agreed upon with the local authorities, aimed at developing natural resources and geosites, at the same time as socio-economic development to the benefit of the local communities; on the other hand, active conservation activities with regard to this heritage for the promotion of “responsible tourism”, with projects centred on increasing awareness, educating people about the environment, and creating a cultural system and a “network” of museum spaces in various places throughout the area.

Among the various initiatives which have been got under way in the direction of an increasingly skilled development of the Park’s sites, stress is laid on the creation of 5 “mineral routes” (alum, iron, lignite, pyrites, silver) and 4 “themed routes” (medieval castles, mines, metallurgy, geothermal power). These are about to be joined by “Itinerary Zero”, the geosites route (currently being set up and completed, and which will be up and running this summer), which is aimed at encapsulating and summing up the time-ancient geological history of this particular area. Access to these visitor routes is via the 7 “Park Gateways”, set up one in each municipality, which branch out along the Colline Metallifere, and which have a liaison point in the Management Centre at the “National Park Gateway” situated at the “Ex-Bagnetti” site in Gavorrano, which is also the location of the “Museum of Memory”, the Documentation Centre, and the Park’s Media Archive, as well as of the Municipal Wine Shop, which displays and sells the main wines produced in the local area. Linked to these routes, and in support of them, there is the “Museums Network”, found across the local area, which offers a multiple range of guided tours and educational trips (available both for free, and on payment of a fee), and which covers the whole historical range, from the Etruscans to the 20<sup>th</sup> century. To accompany all this, the Park makes use of the Finoria Environmental Education Workshop (LEA), the activities of which are centred especially upon courses and educational activities dedicated to schools of all levels, as well as to geo-excursions and trekking. It is worth underlining that the “Park Gateways” are themselves centres of culture and teaching, in the form of seminars, training courses and theatrical performances, as well as of advertising and promotion of typical local wines and foods, culminating in the “Calici Sotto le Stelle” summer event which is held at the same time at the main archeological sites in the Park, on an evening in mid-July, and which attracts a considerable number of visitors and tourists

#### ***D.5. FACILITIES PLANNED IN THE FUTURE***

The Park’s basic mission is to convert into development opportunities for the community, and for the local area, the remains of an impressive legacy of industrial archeology which local councils and local communities have undertaken to conserve and develop, seeing in them a valuable foundation of their local identity, and an expression of a culture of work which for many long years has acted as a binding force for local society.

The Masterplan of the National Technological and Archeological Park of the Colline Metallifere was drawn up to this end. Its strategy is founded on a number of vital points: the integrated development of the cultural resources present in the local area (natural, archeological, historical and industrial resources), the protection of the heritage extended to its tangible and intangible components, the participation of local communities, and a form of management of archeological and industrial assets which is capable of wedding conservation and new end uses.

The main strategic planks listed above delineate a program of work in which everybody is involved: the community as heirs to a legacy whose values preserve effectiveness, also with a view to renewal; the institutions and local authorities which have to demonstrate that they are able to govern a delicate process of conservation and transformation; and the Park, which will have the task of interpreting and promoting the overall development scheme.



The Masterplan was drawn up to provide the tools needed for this task. Another important element relates to the accessible heritage of the “Park of the Present”. This is the term used in the Masterplan for the sites in the Park which are already open to the public (or which are about to be opened); since 2006, the size of the “Present” fraction has undoubtedly increased, the number of accessible sites has risen, and the visible heritage is certainly greater than that recorded in the Masterplan three years ago. This is why it was thought necessary to develop *ex-novo* an exhaustive inventory of projects which have been completed, which documents the efforts made by the Park and by local authorities to salvage and develop the elements of the heritage which may benefit from active management (for the purposes of museum display, and for cultural and/or service purposes). But the drafting of the Masterplan is in no way intended to be an epilogue, a “mirror of the past”. In this, the Park’s Charter of Principles, signed up to on 14 December 2007, is the expression of a genuine desire to get things done, and a determination to build things, according to a shared vision of sustainable development of the Colline Metallifere, geared toward the conservation of that manifold heritage (natural, archeological, technological etc) which is the real resource which the local area must exploit, but at the same time without failing to cultivate an innovative idea of the future, which is not a simple extrapolation of the past, but the active and convinced creation of a new horizon.

On this basis, we can state, with sincere conviction, that the development of the archeological and technological heritage of the Colline Metallifere is to be seen as the production chain on which to build, in the park’s seven municipalities, a full-scale cultural district, and in which the assets of cooperation, flexibility and business creativity are placed at the service of a bold project designed to wed local history, geotourism, and sustainable development: the “possible future” of the local territory.

There remains one last aspect to be considered: training. This is a far from subordinate pillar in the future of the Park. The program accords which have just been signed (March 2009) for the clearance of mining sites represent a major opportunity in this connection. The subject of clearing large mining areas, and making them safe, is at the centre of reflections on the subject of environmental redevelopment in Europe. The implementation of the accords in the Colline Metallifere will mark the start of a cycle of experiences which, owing to the innovative forms of intervention, will be raised to the status of a paradigm, and an unrivalled model. The Colline Metallifere Park can take on the role of promoting and organizing training and research activities with a high scientific profile, involving universities and centres of excellence in Italy and abroad. In view of the content of the March accord, which allows one to glimpse the very real possibility of a systematic intervention on as many as 35 mining sites to be cleared, the Colline Metallifere has all the requisites for taking a place at the top of research in Europe in the sectors of environmental reclamation and the industrial heritage.

For this reason, and owing to all the other reasons outlined above, the National Technological and Archeological Park of the Colline Metallifere Grossetane hereby puts forward its candidacy as the “Tuscan Mining Geopark” for listing in the European and Global Geoparks Network: in order to link the protection and development of the geosites to the work carried out to date for the protection and conservation of sites connected to mining, for the purposes of the environment, culture, research, training and tourism, fostering educational and artistic-cultural initiatives which are compatible with the values to be safeguarded, so as to support tourism, and environmental and cultural geotourism, within the context of the sustainable development of the local area.



