General geological features of the Campagna Romana

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SUMMARY: The paleogeographic evolution of the Campagna Romana is presented as an integrated study of subsurface structural features and lithostratigraphy of superficial outcrops within the Roman suburbs. Outcropping units were developed from differentiated environmental conditions, from marine Plio-Pleistocene clayey and sandy deposits to continental Middle to Upper Pleistocene shales and conglomerates. Since the Matuyama-Brunhes magnetic reversal until Holocene, huge volumes of volcanic products were emitted by two volcanic Districts, located NW (Sabatini Mts) and SE (Alban Hills) of Roma.

1. Paleogeographic Evolution

The area of the Campagna Romana is extended along the western coast of Central Italian Peninsula, between the Apennine chain and the Tyrrhenian Sea. The Apennine is a complex structural unit mainly thrusted toward SE and recently extended in the western sector were, from Tuscan area to Neapolitan region and Southern Tyrrhenian sea, an alkaline potassic volcanic back-ark province was developed from lower Pleistocene to actual time.

The large and subplanar region of Roma, Latium, shows a landscape mainly linked to the Quaternary tectonic evolution of the Tyrrhenian Apennine boundary, with six main volcanic districts lying in a extensional plain surrounded by several Plio-Quaternary marine to continental units. A peculiar Holocene geomorphological unit of the Tevere river crosses the Latian region and characterize the coastal area with a deltaic area, which had an important role in the history of Roma.

The specific deep structure of the Campagna Romana is made by a main extensional structure, mainly founded on previous NW-SE thrust marine Meso-Cenozoic units with basin to shelf carbonate meso-cenozoic facies.

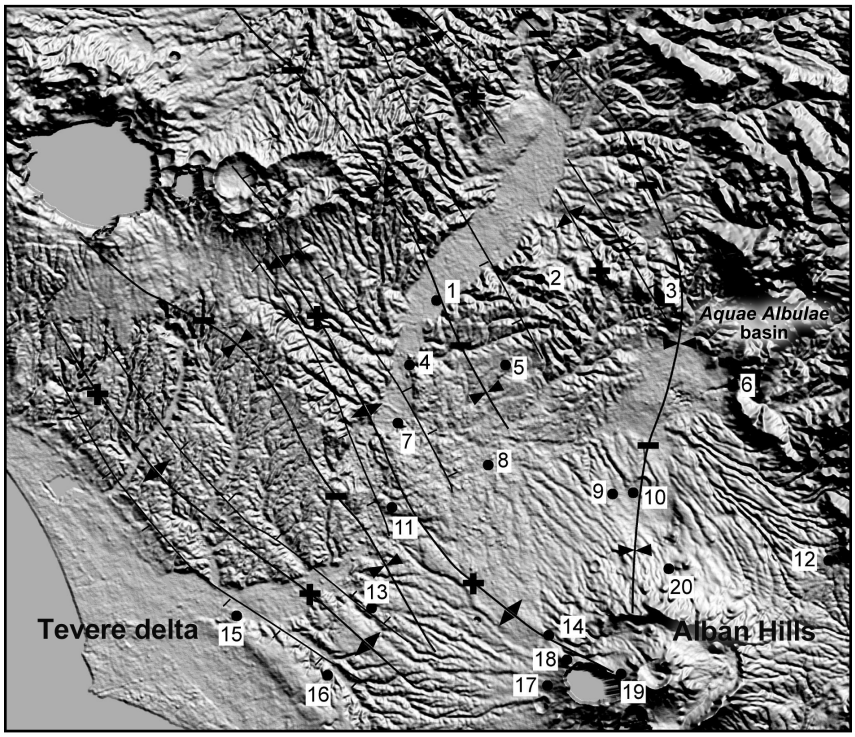
The graben-like structure is filled by Plio-Pleistocene marine deposits, continental Upper Pleistocene sediments and Sabatini Mts and Alban Hills volcanic products. The sedimentary sequence, from the bottom to the top, is composed by a thetysian "ligure" basal unit organized in a sequence of ramp and flat structure thrusted by a Tuscan basin mesocenozoic structures, uprising a maximum of few hundred of meters below the surface in correspondence with structural highs (Cristoforo Colombo, GRA) or in Cesano (1300 m below the surface) in correspondence with a ramp-like structure, filled by an irregular mantle of Plio-Pleistocene marly clays that represent a sort of impervious continuous cover.

The Plio-Pleistocene marine cover reaches the boundary of the Apennine chain and outcrops in correspondence of structural highs, previous inheritance of deep ramps still present at surface level also within the city of Roma (Monte Mario, Monte Ciocci and Monte delle Piche units). A complex pattern of regional structural units controls the different outcrops of these sediments, finally influencing the geomorphological pattern of the area. In figure 1 the interaction between the deep gravimetric structural pattern (Toro 1976) and superficial landscape is shown. Distribution and activity of volcanoes, surface and deep hydrogeology, transmission of seismic energy, landscape geomorphological evolution, features connected

with paleoenvironment evolution are mainly due to the deep structural pattern. Connections among tectonic activity, climatic and paleogeographic changes related to the glacial and interglacial periods produced a complex transgressive cycle characterized by the alternation of deposition and erosional phases.

After the Matuyama-Brunhes magnetic reversal, Sabatini Mts and Alban Hills volcanic districts were developed NE and south of Roma. Regional extensional and transtensional tectonic produced an intense activity, mainly explosive, with a volume of volcanics ranging between 500 and 1000 km^3. These events deeply modified landscapes and environment, hydrology and hydrogeology of the area of Roma.

A relevant regression of the sea level accelerated the erosional processes of the Tevere river excavating the Pliocene bedrock more than 60 meters below sea level. During the subsequent rise of the sea level, the articulated network excavate by the Tevere river and its tributaries was filled with alluvial Holocene deposits, consisting of unconsolidated clayey-sandy sediments.



Main arcaic sites of Late Bronze Age (Anzidei et al.,1985):
1) Crustumerium;2) Mentana;3) Fontana di Papa;4) Fidenae;5) Ficulea;6) Tivoli;7) Antemnae;8) La Rustica;9) Osteria dell'Osa;10) Gabii;11) Roma;12) Palestrina;13) Laurentino;14) Grottaferrata;15) Ficana;16) Castel di Decima;17) Castelgandolfo;18) Marino;19) Rocca di Papa;20) Colonna

Gravimetric structures (Toro, 1976)

Positive gravimetric axes

Negative gravimetric axes

Main tectonic discontinuities

Fig.1 - Landscape of the Campagna Romana, with the main gravimetric features and the Late Bronze Age sites.

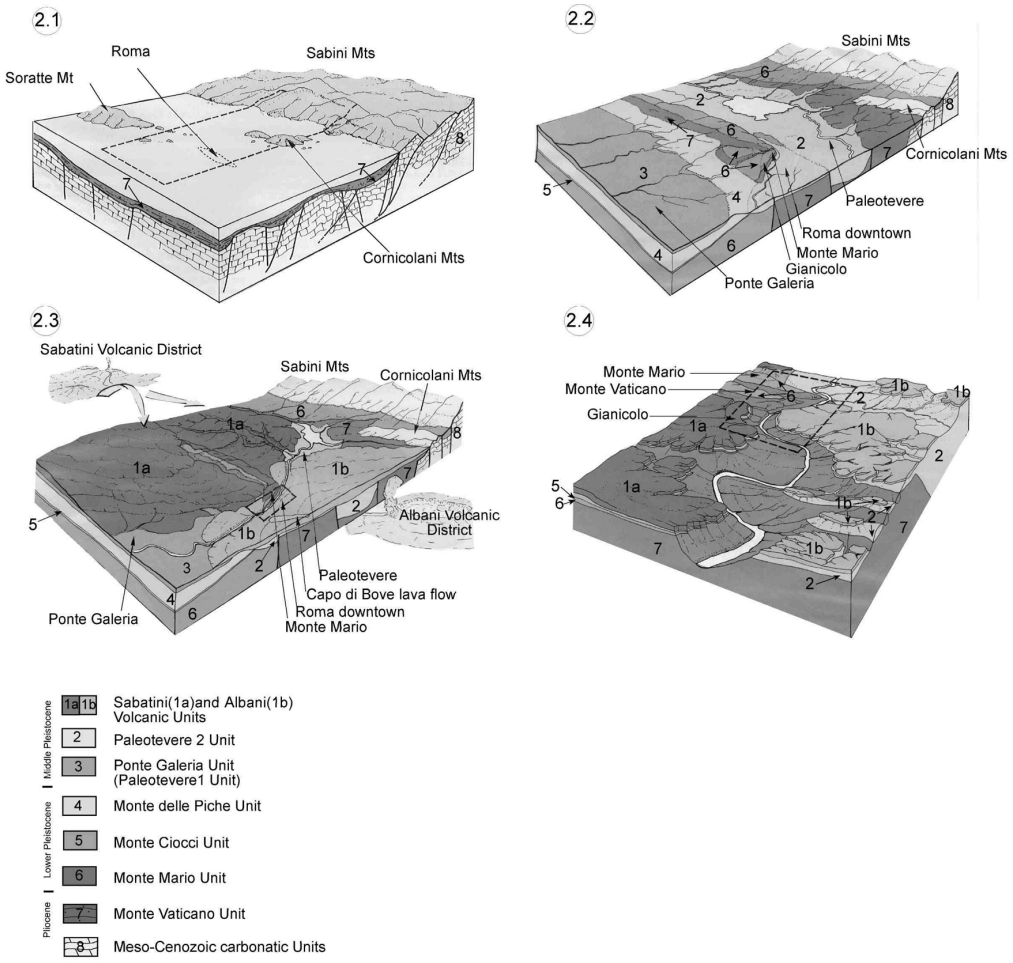


Fig.2 - Paleogeographic evolution of the Campagna Romana.

Figures 2 and 3 show to the main paleogeographic events of the Campagna Romana and landscape evolution since Upper Pliocene (the dashed squares in figures indicate the successive steps of the paleogeographic evolution).

• 2.1) The sea was reaching the border of the Apennine chain; a thick sedimentary clay to marly clay unit was deposited in a wide area corresponding to what will become the Campagna Romana. The structural relieves of Soratte Mt. and Cornicolani Mts were small islands NW-SE trending; from the future Monte Mario toward the future Roma downtown area, a shallow marine environment was developed.

• 2.2) The relief of Monte Mario came out from a wide sedimentary cover of sandy-gravelly deposits which was giving rise to the coastal belt. The ancient course of the Tevere river had its mouth to the South of the present position.

• 2.3) Extent of Alban Hills and Sabatini Mts volcanic products, mainly ignimbrites, and modification of the drainage pattern of the Tevere river.

• 2.4) Geomorphological and geological sketch of the Roma area during last low stand of sea level and deep erosion of the hydrogeological network of the Tevere river, confined in the present-day river bed. The relics of the volcanic plateau represent the present day eastern topographic relieves of Roma.

• 3) The Tevere valley was delimited at the

western margin by the Monte-Mario-Gianicolo ridge, and, in the eastern portion of the town, by the relics of the volcanic plateau, the famous Seven Hills of Roma. During the Holocene high stand of sea level, the recent alluvium filled the deep valley excavated by the Tevere river during the Wurmian glacial period. (A= recent alluvial deposits of Tevere river and its tributaries; for other symbols see Fig. 2).

2. Holocene Deposits and Final Considerations

Three peculiar geological features were developed in the Roma area until Holocene with a rapid continuous evolution: the Acque Albule hydrothermal basin, the Tevere river delta and a flat area northward of the Albano lake (Fig. 1).

These quite contemporaneous features are obviously deeply different in origin as a function of different location and influence on the surrounding environment. The landscape of these features is always flat in a sharp morphological contrast with the Pleistocene morphology of surrounding areas of the Campagna Romana.

The Acque Albule basin is a tectonic depression 30 km^2 large where thermomineral springs and travertine depositional processes are still active. Radiometric analyses (^{230}Th/^{234}U) indicate that the travertine began to deposit around 165 ka ago. The uppermost travertine deposit so called "cappellaccio" began its deposition earlier than 40 ka ago. Actually the travertine is still in active deposition by means of huge thermomineral springs upwelling with a flow of more than 4m^3/s with an average speed of 0.43 mm/a.

The Tevere delta accreted for long time. The evolutive deltaic cycle began with the last eustatic sea level rise and the river mouth position was migrated 10 km westward in the last 18 ka. Impressive geomorphological changes were penecontemporaneous to the protostoric and historic evolution of the area. Lagoonal and sandy islands environments were developed

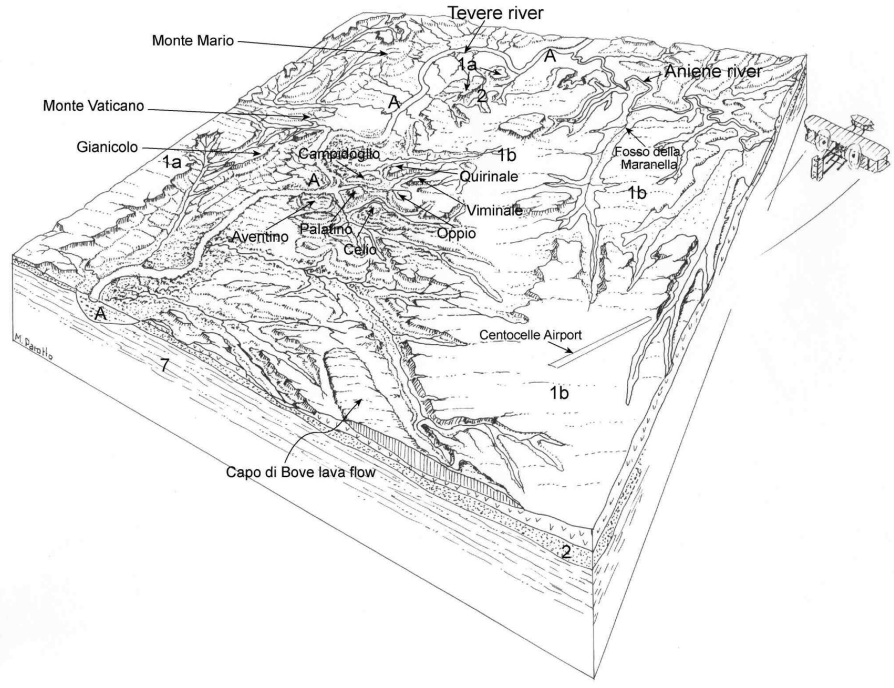


Fig.3 - Present natural landscape of the Roma area.

along the coastline 3000 years ago. Being the sea level quite stable the lagoon was filled with Tevere river deposits, consequently the lagoon-delta body rapidly prograded towards the bar. During the imperial times two main lagoons were isolated from the river. The positions of the Claudius and Trajanus harbours and their artificial canals gave rise the present mouth of Fiumicino. Anywere the Tevere river has built up its delta in the last 2000 years prograding 6 km toward the Tyrrhenian sea.

A third flat Holocene area was created northward of Albano lake within the western sector of the Alban Hills volcanic district. It was mainly connected with the limnopalustrian deposits produced by the lake positive movements and flowing. The possible connection with late endogenous activity or climatic crisis is still debated and studied. Development of the arcaic cultures until roman times seems to be influenced by this peculiar feature.

The continuous link among deep structural features, surface distribution of geological units, landscape of the Campagna Romana, distribution of sites of human settlement from Stone Age to historical times and important Quaternary fossil mammals rich outcrops seems to be clear. It seems to be mainly following the influences and restrictions of the continuos evolution of the environmental condition and also depending from some catastrophic event connected with volcanic, tectonic or hydrometeorological conditions.

3. References

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