

THE GEOARCHAEO-TOURIST MAP OF THE TERRITORY OF OTRICOLI (UMBRIA REGION, CENTRAL ITALY): PRELIMINARY NOTES

Milena BERTACCHINI^{*1}, Alfonso BENITO CALVO², Dorianò CASTALDINI¹

Abstract: *The GeoArchaeo-Tourist map of the territory of Otricoli (Umbria Region, Central Italy): preliminary notes.* This article illustrates the preliminary notes on the criteria and methods applied for implementing a GeoArchaeo-Tourist map of the territory of Otricoli.

Otricoli is a village located in the south of the Umbria Region (Central Italy), on the eastern margin of the Apennine chain and the west bank of the River Tiber. Marine sediments (Late Pliocene-Early Pleistocene) and fluvial sediments (Early-Middle Pleistocene) covered by tuff rocks (Middle-Late Pleistocene) crop out in the area and control the physical forms of the landscape. By means of ArcGIS computer programme, a set of maps and three-dimensional visualizations have provided to represent the Otricoli natural landscape. The GeoArchaeo-Tourist map has been elaborating, integrating geological, geomorphological and archaeological aspects with the tourist infrastructure in order to obtain a document readable, simple, clear but scientifically accurate also for non-expert users. This map is an original cartographic elaboration in the field of geo-tourist thematic mapping. The main purpose of the GeoArchaeo-Tourist map is to favour the tourist to discover the Otricoli landscape and to promote its sustainable development.

Key-words: Geology, Geomorphology, Archaeology, GeoArchaeo-Tourist map, Umbria Region, Central Italy

Introduction

In the recent time several studies have been carried out for the conservation of Geologic Heritage (Wimbledon *et alii*, 1995 and 1998; Eberhard, 1997; Barrettino *et alii*, 1999; Panizza, 2001; Piacente & Poli, 2003; Reynard *et alii*, 2003; Castaldini *et alii*, 2005a, 2005b; Gutierrez *et al.*, 2005) with the aim to preserve and popularize “areas of special geological interest” also known as, according to the various authors, “Earth science sites”, “Geologic Assets”, “Geotopes”, “Geosites” or “Geomorphosites” (Reynard, 2004). A general discussion on this topic is treated in Panizza & Piacente (2003, 2005).

The territory of Otricoli is situated in the Umbria Region in Central Italy (Fig. 1) and offers examples of wonderful geodiversity and stunning variability in landforms together with the possibilities to link them with art, history, archaeological and historical architecture.

The GeoArchaeo-Tourist mapping project of the Otricoli area comes from a cross cooperation that have been developing for many years between the Earth Sciences Department of the University of Modena and Reggio Emilia and the Archaeological

* Corresponding author: milena.bertacchini@unimore.it

¹ Dipartimento di Scienze della Terra, Università degli Studi di Modena e Reggio Emilia, Largo S. Eufemia 19, 41100 Modena, Italy

² Departamento de Geodinámica, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, Ciudad Universitaria s/n, 28040, Madrid, Spain

Heritage Survey of the Umbria Region. This joint collaboration developed from the need of a holistic approach to favour the fruition of this Umbrian area for scientific, cultural, educational and amusement purposes.

A geological-geomorphological map of the territory of Otricoli was one of the first products of some geoarchaeological studies (Bertacchini, 2006; Bertacchini & Cencioli, 2004, 2006) that have underlined the influence of the Otricoli natural environment on the development and distribution of human settlements, which started during about the VII-VI century B.C.

The GeoArchaeo-Tourist map represents an original elaboration in the field of geo-tourist cartographic production and an important document, which could be used to give information for safeguarding and preserving the Otricoli site and for promote its sustainable development.

Geological, geomorphological and archaeological setting

The study area is located on the eastern margin of the Apennine chain and the west bank of the River Tiber (fig. 1).

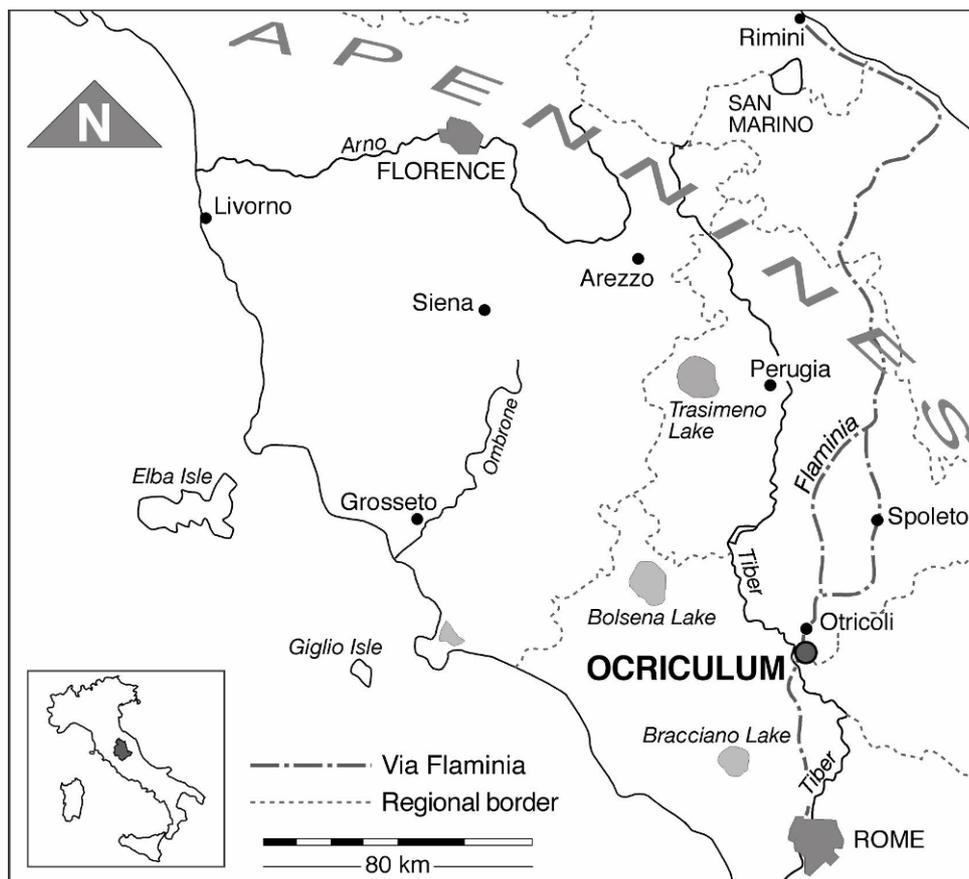


Fig. 1. Location of the modern town of Otricoli and the Roman town of *Otriculum* in the south of Umbria Region (Central Italy).

The ancient settlement of *Otriculum* is one of the most important archaeological sites in modern Umbria; it was first settled in pre-Roman times at the top of a hill, where the modern village of Otricoli stands then, during the Roman Republican Age (1st Century B.C.), it was moved to the plain below near a wide meander of the River Tiber (Fig. 2).

The evolution of the Roman village of *Otriculum* can be traced through its monuments. Most of them were built between the 1st Century B.C. and the 2nd Century A.D. Only a few of the main buildings of the ancient village can still be seen: the amphitheatre, the theatre, the baths and the large substructures

In 2000 the Archaeological Park of *Otriculum* was established by the Archaeological Heritage Survey of the Umbria Region and in 2005 the Museum and a visitor centre were created by encouraging the visit of this important cultural site.

The largest group of monumental ruins is situated near the San Vittore torrent, which is a tributary of the River Tiber. The Tiber and San Vittore watercourses are the morphological elements that mainly influenced the development of *Otriculum* (Bertacchini, 2006).

A marine sequence of the Late Pliocene-Early Pleistocene crops out in the area covered by a conglomerate fluvial deposit of the Early-Middle Pleistocene. Tuff rocks of the Middle-Late Pleistocene are at the top of the sequence. The marine sedimentary sequence is composed of muddy and sandy deposits and conglomerates at the top. The latter “conglomerate unit” is about 20 m thick and forms steep cliffs that break up the gentle morphology of the landscape linked to muddy and sandy ground. The modern village of Otricoli stands on a plateau formed from this unit. Pleistocene pyroclastic rocks cover part of the sedimentary sequence; they were originated from the eruptive phases of the Vico volcano, which is situated at about a hundred kilometres on the west side of Otricoli in the Latium volcanic area (Bertacchini, 2006; Bertacchini & Cencioli, 2004, 2006).

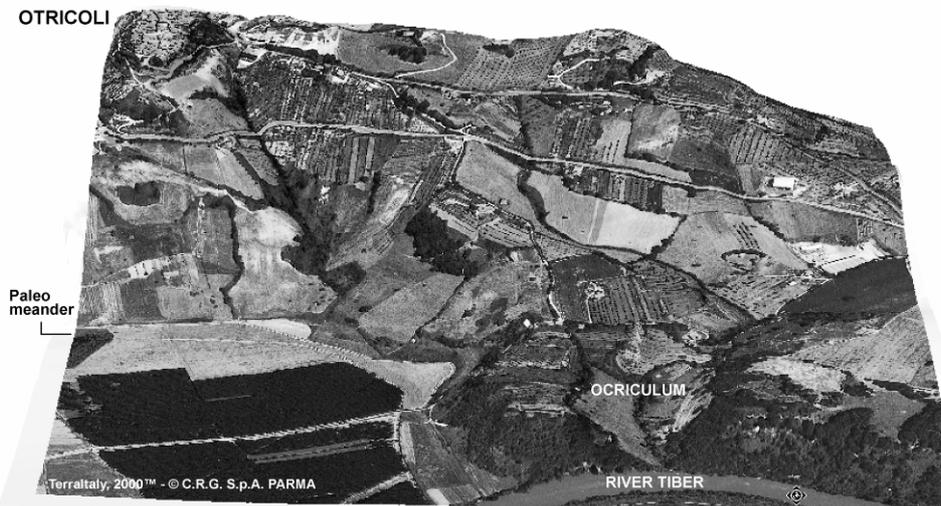


Fig. 2. Three-dimensional visualization of rural landscape mosaic of Otricoli area, using the aerial orthophotograph and the DEM

GeoArchaeo-Tourist map

A GeoArchaeo-Tourist map is a thematic map where geological-

geomorphological and archaeological aspects are integrated with the tourist infrastructure (information point, access, accommodations, excursion trails, etc). The level of information has to be readable, simple, clear and scientifically accurate also for not specialist users.

According to these premises and previous works (Castaldini *et alii*, 2005a, 200b), the GeoArchaeo-Tourist map of Otricoli has been carried out from an appropriate simplification of the original geological-geomorphological map of the area (Bertacchini & Cencioli, 2004), which was resulted from the subsequent integrations of bibliographic data with analysis of aerial photographs, field surveys and data from archaeological excavations. The implementation of these data with the ArcGIS computer techniques (Fig. 3) have facilitated, on the one hand, the reading of several detailed information about the physical landscape of the study area, on the other hand, their simplification, especially for the elements of difficult identification or understanding. On the contrary, the ArcGIS computer programme has emphasized the basic aspects of landscape perception.

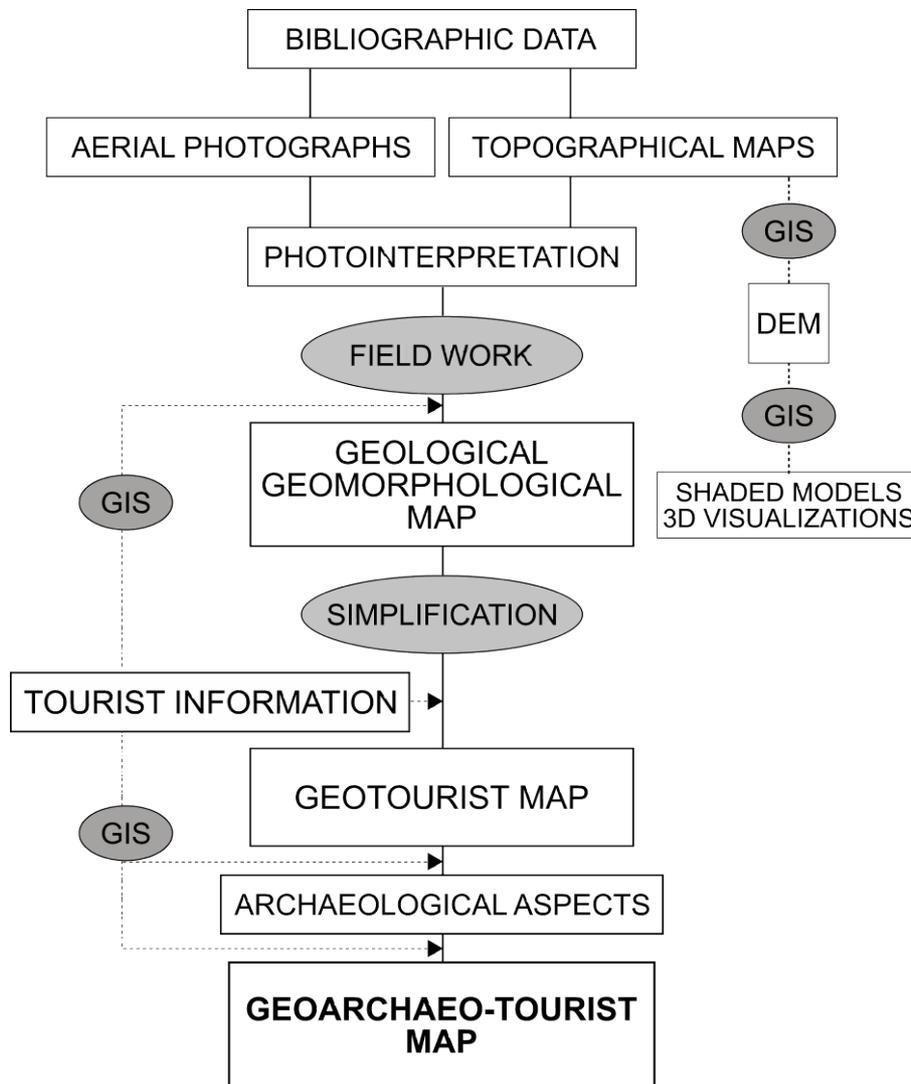


Fig. 3. Scheme of elaboration of the GeoArchaeo-Tourist mapping project

To make easier the reading of the map, a clear, essential and easily distinguishable symbology has been used, which was initially produced in colour, although here is presented in black and white. In particular, the legend was subdivided into three distinct sectors (Fig. 4): in the first one the symbols representing geological-geomorphological aspects are illustrated, whereas the second one is dedicated to archaeological and historical aspects and the third one shows tourist information.

Some kinds of Geosites that a tourist can observe and identify, such as geological outcrops or landforms created by running water and gravity, have been mapped, avoiding specialist terminology. The cartographic representation of these Geosites favours their valorisation from the viewpoint of their significance for scientific research, education and tourism; how actually claimed by Panizza (2005), Earth Heritage and Geodiversity are tools to create opportunities for education, recreation and tourism and, consequently, to increase

the quality of life in rural areas and cities.

From the practical viewpoint, using the geological-geomorphological map as a starting point, the following criteria of elaboration have been applied: a) the main types of rocks outcropping have been differentiated using symbols that the tourist can immediately recognize; b) the distinction of activity for landforms and deposits has been eliminated; c) also faults/fractures have been cancelled from the geological-geomorphological map since they are not identifiable in the field; d) the various types of deposits have been simplified (e.g., a single grouping for deposits due to running waters).

Archaeological elements constitute the main attraction of the zone and, consequently, they have been shown with evident symbols, in order to be immediately recognized by the visitors. The GeoArchaeo-Tourist map (fig. 5) pinpoints all the most important archaeological remains of Archaic and Roman age, such as tombs carved in the tuff rocks localized at the margin of the plateau, buildings made of tuff stones: monuments, funeral monuments, town walls; tracks of the Flaminia road and the well known Roman "Harbour of Oil" (for the olive oil trade) situated along the paleomeander of the River Tiber (fig. 2, 5). The archaeological symbols also include: a) the Museum *Antiquarium*; b) historical architectures (chapels); c) anthropogenic examples of landforms (abandoned quarries in tuff rocks), infrastructures (a disused farming area) and recent constructions (River Tiber berths).

Tourist information have been indicated with the conventional symbols (both in colour and shape) used generally in the tourist maps. Like that, the tourist can obtain the basic information having a quick look at the map. The used symbols include general information (e.g., San Fulgenzio visitor centre, excursion trails, panoramic points along the excursion trails, picnic areas) and logistic information (main access roads, parking places, refreshment and overnight-stay sites consisting of restaurants, bar and hotels).

The GeoArchaeo-Tourist map has been implemented in a Geographical Information System (GIS), specifically in ArcGIS Desktop 9.0. This has been fundamental to up to date the spatial database with the news data discovered in the archaeological excavations and to combine with other cartographic information (DTM, aerial orthophotos). The latter has provided an interesting set of maps for the geological-geomorphological and archaeological representation of the landscape. The aerial photographs (TerraItaly 2000™ - © C.R.G. S.p.A. Parma) were used to carry out maps and 3D visualisations (in combination with the DEM, Fig. 3), where is showed the GeoArchaeo-Tourist aspects in the current landscape mosaic (vegetation, land use and landforms) of the study area. The Digital Elevation Model (DEM) were carried out from the contour lines of topographical data using a raster linear interpolator, since it has provided a better representation of the landscape forms than TIN models. From the DEM, several models were generated according their didactic values in the understanding of the terrain morphologies.

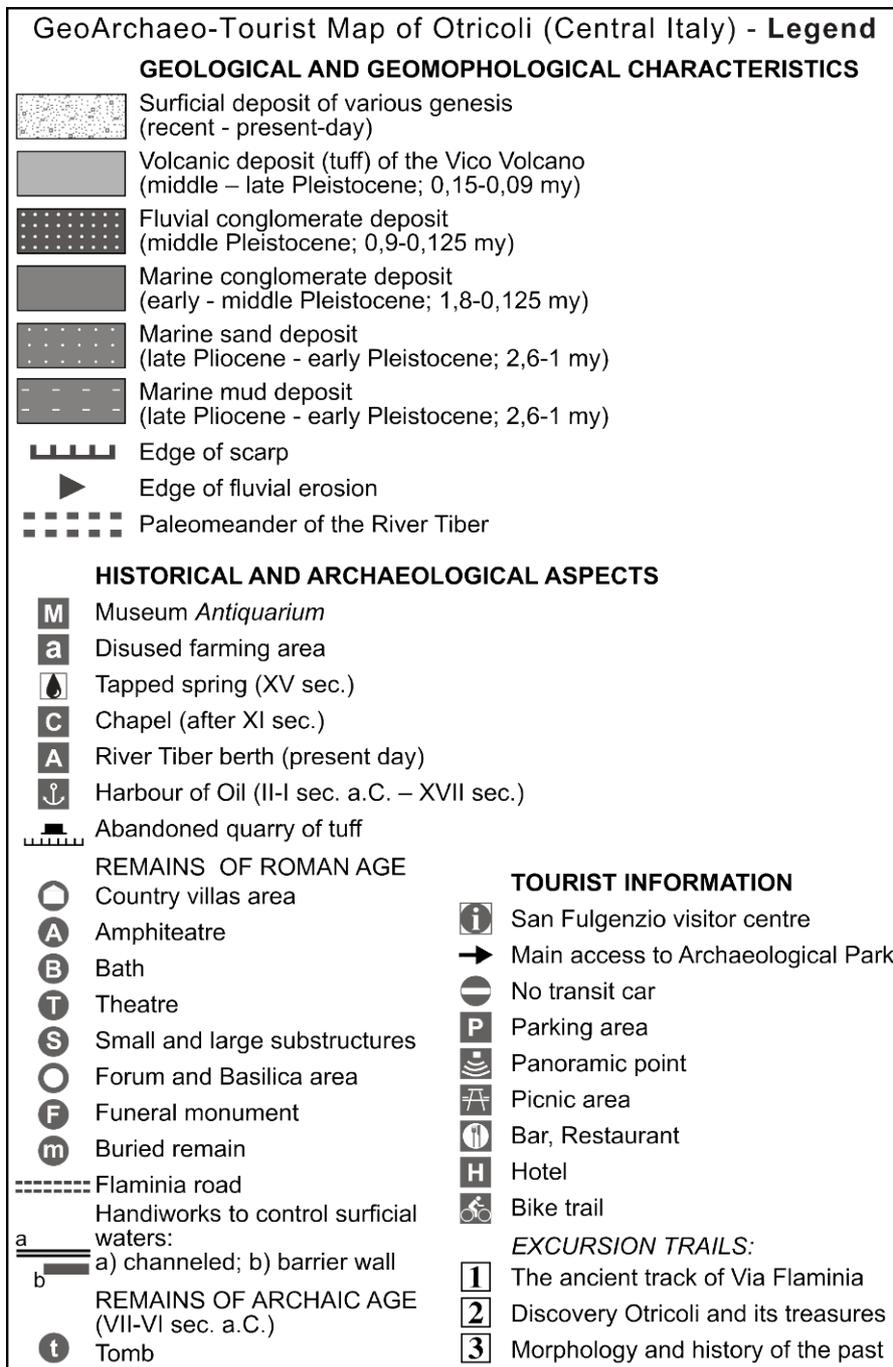


Fig. 4. Legend of the GeoArchaeo-Tourist map of the Otricoli area

In this way, shaded relieves and models for the three-dimensional visualizations (anaglyphs and perspectives) were generated (Reichenbach *et alii*, 1993; Giusti, 2001; Benito Calvo, 2004). On these models, the principal morphological aspects have been emphasized and were superposed on the tourist information and the archaeological elements in order to obtain the GeoArchaeo-Tourist map. These computer graphic elaborations provide attractive maps both in colour and black and white, useful to capture the attention of tourists who can so better understand the key correlation between the natural landscape and the archaeological aspects. From the DEM, topographic profiles have been obtained as well, being very useful to show the difficulties in relief of the excursions trails.

In order to facilitate the visit of the Otricoli area, some excursion trails have been proposed. Different symbology indicates their way of access, such as car access or cycleway. The trails proposed are as follow: 1. *The ancient track of Via Flaminia*: it follows this important Roman road through the tuff plateaux and bordered by the main Roman monument remains. 2. *Discovery Otricoli and its treasures*: it follows the main tracks of the Park up to the village of Otricoli to appreciate the integration between natural landscape and historical and archaeological remains. 3. *Morphology and history of the past*. it invites to walk around the territory of Otricoli to discover its landforms and the natural elements that controlled its evolution.

Conclusions

The study developed in this paper was finalized to the production of a GeoArchaeo-Tourist map through the implementation of a geological-geomorphological map and a DEM using GIS.

The GeoArchaeo-Tourist map combines the most evident geological-geomorphological and archaeological features with fundamental tourist information. It wants to be a document clear, readable, simple but scientifically accurate in order to be understood by not specialized users (visitors) and able to invite them to discover the surrounding landscape.

The clarity of a map essentially depends on the simplicity of its selected symbols; on the base of that, the legend was subdivided into three different sectors: the first for geological-geomorphological aspects, the second one for archaeological and historical aspects and the last for tourist information.

More detailed project of accessibility of the Archaeological Park of Otricoli area, i.e., projects of tourist infrastructure and concepts of presentation of geological and historical heritage from the education viewpoint, should be a subject of the further works that could be planned to expand the action power of the project with a direct involving of local Administration, eventually suggesting establishments with tour operators.

Acknowledgements

The financial support of this study was provided by PRIN 2004 Research Project *Il Patrimonio geomorfologico come risorsa per un turismo sostenibile* (co-ordinator Mario Panizza, Dipartimento di Scienze della Terra dell'Università di Modena e Reggio Emilia).

The participants in the research and their contributions were as follows: Milena Bertacchini, is author of the plan and the field surveys; Alfonso Benito Calvo, is technical editing and digitalisation of geological layers in the ArcGIS programme; Doriano Castaldini, contributed to the elaboration of the GeoArchaeo-Tourist map.

REFERENCES

- Barrettino D., Vallejo M. & Gallego E. (Eds.) (1999), *Towards the balanced management and of the Geological Heritage in the New Millenium*. Sociedad Geologica de España, Madrid, 146 pp.
- Benito Calvo A. (2004), *Análisis geomorfológico y reconstrucción de los paleopaisajes neógenos y cuaternario en la Sierra de Atapuerca y el valle medio del río Arlanzón*. PhD Thesis, Universidad Complutense, Madrid, Spain, 381 pp.
- Bertacchini M. (2006), *Geologia tra passato e presente nel territorio di Otricoli*. In: Soprintendenza per i Beni Archeologici dell'Umbria "Un museo per Otricoli. L'Antiquarium di Casale San Fulgenzio". EFFE Fabrizio Fabbri Editore srl, Perugia, 11-17.
- Bertacchini M. & Cencioli L. (2004), *Uno sguardo sulla città romana di Oriculum (Umbria)*, Il Quaternario, 16 (2), 207-216.
- Bertacchini M. & Cencioli L. (2006), *The past and the present of the roman town of Oriculum (Umbria)*. In: F. Coarelli & H. Patterson (eds.) "Mercator Placidissimus. The Tiber Valley in Antiquity. New research in the upper and middle river valley". British School at Rome, Proceedings of the Conference 27-28 Feb. 2004, Ed. QVASAR, Rome, in press.
- Castaldini D., Valdati J. & Ilies D.C. (2005a), *The contribution of the geomorphologic mapping to the environmental tourism in protected areas: examples from the Apennines of Modena (Northern Italy)*. Revista de Geomorfologie. Vol. 7, 91-106.
- Castaldini D., Valdati J., Ilies D.C. & Chiriac C. (2005b), *Geo-tourist map of the Natural Reserve of Salse di Nirano (Modena Apennines, Northern Italy)*. Il Quaternario, Italian Journal of Quaternary Sciences, 18 (1), Vol. spec., 245-255.
- Eberhard R. (ed.) (1997), *Pattern and Process: Towards a Regional Approach to National Estate Assessment of Geodiversity*. Techn. Series n. 2, Australian Heritage Commission & Environment Forest Taskforce, Environment Australia, Canberra, 102 pp.
- Giusti C. (2001), *Il Modello Digitale del Terreno (DTM) come supporto alla cartografia geomorfologica: l'esempio della pianura modenese (Pianura Padana, Italia Settentrionale)*, Atti del Convegno Nazionale: "Cultura cartografica e culture del territorio", Sassari, 12-13 dicembre 2000, Bollettino della Associazione Italiana di Cartografia, AIC, 111, 112, 113, Genova, 409-417.
- Gutierrez F., Gutierrez M., Desir G., Guerrero J., Lucha P., Marin C., & Garcia-Ruiz J.M. (eds.) (2005), *Sixth International Conference on Geomorphology*. Abstracts Volume. Zaragoza (Spain), 7-11/9/2005.
- Johansson C.E. & Zarlenga F. (1999), *Protection of Geosites in Europe. State and Trends*. Mem. Descr. Carta Geol. d'It. 54, 13-22.
- Panizza M. (2001), *Geomorphosites: Concepts, methods and examples of geomorphological survey*. Chinese Science Bulletin, 46, 4-6.
- Panizza M. (2005), *Foreword*, Il Quaternario, Italian Journal of Quaternary Sciences 18 (1) – Vol. Spec., p. I.
- Panizza M. & Piacente S. (2003), *Geomorfologia culturale*. Pitagora Ed., Bologna, 350 pp.
- Panizza M. & Piacente S. (2005), *Geomorphosites: a bridge between scientific research, cultural integration and artistic suggestion*. Il Quaternario, Italian Journal of Quaternary Sciences, 18 (1), Vol. spec., 3-10.
- Piacente S. & Poli G. (a cura di) (2003a) - *La memoria della Terra, la terra della memoria*. Università di Modena e Reggio Emilia - Regione Emilia-Romagna, Edizioni L'inchiostruolu, Bologna, 159 pp.
- Poli G. (a cura di) (1999), *Geositi. Testimoni del tempo*. Regione Emilia-Romagna, Edizioni Pendragon, 259 pp.
- Reichenbach P., Pike R.J., Acevedo W. & Mark R.K. (1993), *A new landform map of Italy in computer-shaded relief*, in «Bollettino di Geodesia e scienze affini», 1, 21-44.
- Reynard E. (2004), *Geosite*. In Goudie A.S. (ed.): *Encyclopedia of Geomorphology*. Vol. 1, p 440, Routledge, London and New York.

- Reynard E., Holzmann C., Guex D. & Summermatter N. (eds.) (2003), *Géomorphologie et Tourisme*. Act. Réunion annuelle Soc. Suisse de Géomorphologie, 21-23/9/2003, Finhaut (Suisse), 216 pp.
- Wimbledon W.A.P., Benton M.J., Bevins R.E., Black G.P., Cleal C.J., Cooper R.G. & May V.J. (1995), *The development of a British methodology for selection of geological sites for conservation*. Part 1, "Modern Geology", 20, 159-210.
- Wimbledon W., Ishchenko A., Gerasimenko N., Alexandrowicz Z., Vinokurov V., Liscak P., Vozar J., Vozarova A., Bezak W., Kohut M., Polak M., Mello J., Potfaj M., Gross P., Elecko M., Nagy A., Barath I., Lapo A., Vdovets M., Klincharov S., Marjanac L., Mijovic D., Dimitrijevic M., Gavrilovic D., Theodossiou-Drandaki I., Serjani A., Todorov T., Nakov R., Zagorchev I., Perez-Gonzalez A., Benvenuti M., Boni M., Brancucci G., Bortolami G., Burlando M., Costantini E., D'Andrea M., Gisotti G., Guado G., Marchetti M., Massoli-Novelli R., Panizza M., Pavia G., Poli G., Zarlenga F., Satkunas J., Mikulenas V., Suominen V., Kananaja T., Lethinen M., Gonggrijp G., Look E., Grube A., Johannson C., Karis L., Parkes M., Raudsep R., Andersen S., Cleal C. & Bevins R. (1998), *A first attempt at a Geosites framework for Europe - an IUGS initiative to support recognition of world heritage and European geodiversity*. *Geologica Balcanica*, 28 (3-4), 5-32.