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THE CONTRIBUTION OF "SIBILLA APPENNINICA" LEGEND TO KARST KNOWLEDGE IN THE SIBILLINI MOUNTAINS (CENTRAL APENNINES, ITALY)

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Abstract

Geological studies of the Sibillini Mountains carried out mainly during last century, evidenced an hypogeous karst characterised by small number of caves of limited extent. The only one frequently mentioned is the "*Grotta della Sibilla*", especially for its legendary references. This cave hides one of the most fascinating secrets of the Apennines, having been a place of mountain cult as far back as historical time and for having been the home of the magician "Sibilla". Historical sources tell of presence at the location from the time of the Romans but amongst the historical descriptions, notable is the testimony of Antoine De La Sale who visited the site in 1420 and described the cave as a good-sized cavity within the bowels of the mountain. Nothing about this setting is mentioned in the geological bibliography or in topographic descriptions made for the first time at the beginnings of '40s when a regular but small shape was evidenced. Today fall deposits completely obstruct the entrance.

Basing on mentioned legendary references, geomorphological and geophysical studies started aiding to define real cave extent. The planimetric trend of electromagnetic anomalies surveyed allow us to make hypotheses about the presence of a wide hypogeous system.

The myth of the "Sibilla Appenninica"

The term "symbol", which derives from the Greek "*sum-baÿllw"*, for "put together", "gather", "rejoin" and alludes to the act of fitting two fragments of a broken object together to recompose the original and in so doing sees that the holders of the two parts are able to recognise themselves in the re-arranged item. They are familiar, in fact, only with the part they themselves own but, ignoring that that they do not have, they look for it with trust, strong in the faith that what they possess acts as a substitute of the whole and as a mediator for the understanding of the meaning which they seek. Born in a time in which man had realised he had lost his wisdom, this

metaphor evokes the recognising experience, though only ? in the intense short instant that the image lasts, what had been mislaid. For this, man tries to crystallise the manifestation of the divine in symbolic signs but, when he gives them a name, what happened to Oedipus, who loosened with a word what the sphinx had tied, happens to him.. So the vision disappears, what was knotted becomes untied and there is nothing else but "mystery", or the entrustment of himself to the mute language of "symbolism".

Different values and meanings have been given in time to myth, starting from the transformation of the tribal society of nomadic collectors and hunters, to that of rural and permanent ones (end of the Upper Stone Age, c.a. 11.000 years ago in the area of the *Mezzaluna fertile* (*Fertile Crescent*). It is understood as being a «subordinate or deformed product of intellectual activity» in the history of western thought, it is opposed to *logos* according to Aristotle, while Plato, considering it a defective and different way of approaching the *world of ideas*, gives it a certain moral and religious validity.

The sacred threads, woven throughout the centuries are nostalgically present in the unconscious, in dreams, in the universe of the imagination of modern man that, while refusing them, is not able to eradicate them from himself and, therefore, whatever project that goes through the fundamental examination inevitably connected to his natural habitat and to the geology of the planet, cannot ignore mythical narration, together with the historical narration, of its own origins.

Myth implicates co-operation with historical investigation of a people, systematic and scientific studies of its mythical-narrative sources with the contribution of the earth sciences, of the human sciences and of the social sciences, that in "transversal and integrative" synergy are able to promote a new scientific language. Due to their own narrative continuity, their mediation between man, nature and the cosmos, for their content of tradition, knowledge ,

values and wisdom, they are therefore to be considered inter-cultural elements.

The territory of the *Sibillini* Mountains, where origin was given to the myth, and the cave of the Sibilla is located, is to be found in the Piceno area of the mountainous ridge bearing this name and constitutes a natural watershed between Umbria and Marche (Fig. 1). The landscape characterising this mountainous group is spotted with places of notable natural suggestion that have influenced popular .imagination for an unbelievably long time. . Place names such as *Peak of the Devil, Top of the Redeemer, Cave of the Fairies, Gorge of Hell, Rock of the miracle,* to name only some , testify to the coexistence of a tenacious pagan substrate on these mountains which alternated with the practise of Christian exorcism carried out by the Pontifical State in all of the *Ancona Marca* under its jurisdiction, up to the time of the unification of Italy.

In the particular morphology of this Apennine area the root and the persistence of myths and legends are to be found. If in the past, in fact, the magic frame of this spellbound landscape was a decisive attraction for human settlement, recently it has became the trace of the boundaries of a national park, not only to protect the ecosystem of an area still miraculously intact, but also to save a cultural heritage made of compact and persistent traditions, of monumental and documentary reports, of inestimable knowledge handed down orally by way of myths and popular legends, or picked up in this place and set into the medieval literature, the Renaissance intellectual's travel log and the tales of riders who came from all over, and in the studies of contemporary academicians and researchers of the unusual.

The *Piceno* area of the Park of the Sibillini is, in particular, a very rugged and wild area. It is called the S*lope of the magic*, and confers enchantment to the park that strengthens its attraction, differentiating it from other solely naturalistic parks and rendering it worthy of the

attribute “legendary” (the *Legendary Park of Europe).*

The mountain and the cave of the Sibilla that are located in the Umbro-marchean Apennines, archaic symbols of mysteries never disclosed both physical and metaphysical, local and universal, sacred and profane, so beloved and so ignored, constitute the mythical *omphalos* of this central–italian area, the meeting place for contact with and the access to the celestial universe and to the chthonian world. In the Myth, the Sibilla, a metamorphic icon and survivor of a *totipotens (all powerful)* and fatal female archetype - not only because of the classical prophetic role of the woman of the time, that represents present, future and past in a single design, but also for that of the fairy (from the Latin *for-faris*, to speak, to narrate) and therefore as narrator of mystery, of values, of wisdom and knowledge - is in close interaction with the geophysical and geographical reality of the mountain and the foothills in which she exists.

The existence, now verified through geological investigation of an archaic hypogeal site about 600 m long, placed at a height of nearly 2000 m a.s.l. under the rugged "crown" of the Sibilla Mountain and about 15 meters underground, made of labyrinthine burrows and great unexplored hollows, attests the places and the scenery dear to the myth, further enriched from a narrative point of view, by a series of other archetypes that corroborate the characteristic "consecrated" space *ante litteram,* within which the narration has to move and confirm, backdating to a primordial epoch, timeless boundaries. The universal archetype of the labyrinth, that of the mountain, of the cave, of the lake (the near *Lacum Sibillae*, later called Lake of Pilate, for the interjection of a post-Christian legend), here dominate the scene with their symbolic and mysterious references to the collective unconscious and their pressing calls back to initiatory pilgrimage.

In accordance with the authoritative opinion of the anthropologist Tullio Seppilli (Piscitelli 2001), this "myth" is the result of the memory of cave divination cult and therefore of the

participation of people that came on purpose to pursue a cultural space certainly more substantial than today's collapsed vestibule, not immediately near to a housing settlement and in a context in which these zones were much more central with respect to the ways of communication (Ristori & Carobbi 1999). The memory of this well developed and articulated hypogeal system, otherwise would not have been preserved for so long nor would the popular legend which arrived to us have taken form so strongly.. Therefore, cave, femininity and divination, are the three key-points of the sibylline myth and it is assumable that the persistence of such a vivid memory, in the Umbro-marchean Apennines, is to be accredited to the presence of a Sibilla, a priestess, that in a cave operated divinations and prophecies, the memory of which remains only thanks to narration. It cannot be excluded that this type of cave cult was used to communicate with the other world, with the divine or with hell, behaviour that has been historically attributed to the Greek oracles (Rossi 1999). In fact, it is very probable that these priestesses or sibyls, in a state of trance, lived a kind of contact with the underground world, and they were questioned not only as foreseers, but also to provide for the needs of the community. All this has remained in the memory of the people, reinforced by the stories and by the romanticised literature that pictures the Sibilla involved in erotic, metamorphic and magical activities, as if she were a *Circe* of the *Sibillini*. A figure who, however, was in contact with the divine and to which the collective asked for ways to solve the different problems of life.

Among the essential elements of the sibylline myth emerge, as well, the mysterious wisdom of the archaic magism of the Neolithic cave cults, which survived at least up till the Renaissance (Lucentini 2001). These mysteries, that influenced the European collective imagination, promoting an inter-cultural anticipation of more current aspirations or experiences, constitute the main pillar of the popular and oral narration of the myth and of its transcription in medieval, Renaissance and modern literature, up to our day. .

The intrinsic mystery of the initiatory cults practised in caves, and in particular in the high hypogeal site of the Sibilla mountain (known in Europe back in the ancient times as the centre of the Apennine oracle), as well as having been transmitted from the Middle Age onward through "cult" narration, continued, and still continues, to be virtually alive for a large number of the pilgrims that have passed by here in time, and to be narrated orally both by the local people, as a heritage of their own anthropological and cultural roots, and by those visitors that have come to the land of the Sibilla for very different reasons and that there have taken it in, to subsequently meditate on it and re-elaborate it each according to his own experience.

Snatch from the heavens a spark of light, go down into the abysses of ancestral memory (*regressus ad uterum*) then to be born again built according to your own "sacred" humanity, constitutes the *leit-motiv* of a large part of classical and non-classical mythology, of the cosmogonies and of the revelations, of the Homeric poems, of the *Comedia* of Dante, of the medieval saga of Tannhauser that inspired Wagner and of the epic and fantastic literature of all times. In sibylline territory, the mostly oral popular narration of the myth of the "Sibilla Appenninica", cannot nor could ever be separated from the environmental context (mountain, cave, lake, nature, mountainous and agricultural-pastoral civilisation) where it was born and from where it was handed down. Here the respect for nature, the cohabitation with its indomitable forces (earthquakes, avalanches, bad weather, cold winters, and so on…) and with its seasonal rhythm that regulates the tasks and the daily flow of time, are still a reality today.

The fame of the cave spread all over Europe in the medieval ages, transmitted by the chivalrous literature concerning it, by the novel written by Andrea da Barberino, by the manuscript of the travel log of the rider of "Provence" Antoine de La Sale (Fig. 2), by transcriptions that followed, up to novels interspersed with autobiographic "license" by more recent authors. The many faceted character of the Apennine Sibilla, the immortal lady of the

myth, and the prophetic cave that, with its arcane mysteries constitutes the "symbol", represent tangible proof of the persistence, of the epochal actualisation, of the lay rendering of a very ancient myth, in a new narrative style to fulfil, for the man of yesterday and the man of today, not only his profound need to live the "sacred" and the magic of nature in "possible worlds", but also the more rational and consonant need of today's society to discover new types of knowledge and more and more fitting ways of narrating experience. And it is with respect for this aspiration of man, perhaps little demonstrated or often badly expressed, that a pluralistic collaboration should be formed among european institutions and between multidisciplinary human sciences and "normal science", to initiate a synergistic project of education in the mystery of origins, and in the "vital" (earth-nature) and "lived" environment (society), so as not to risk losing the global identity of a territory, buried in the same way that the archaic, historical, anthropological and mythical origins of the sibylline culture were buried under the landslide that obstructs the hypogeal site of the Sibilla Mountain.

Chronology of main historical events of the visitation of the cave of the Sibilla:

69 B.C. - Svetonio reports that Vitellio "celebrated a sacred vigil on the yokes of the Apennines".

270 A.C. - Trebellio Pollione in “Scriptores Historiae Augustae” writes that Claude II the Gothic consulted the Apennines oracle in that year.

820 A.C. - Date to which the examination of the cave by an anonymous rider dates back to, the same one described in the first years of ‘400 by Andrea da Barberino in his novel *Guerin Meschino.*

1320-1340 - Probable closing of the cave due to natural causes (the terrible earthquake of 1328), due to political-religious causes underlined by the historian Falzetti (struggles between guelph and ghibellines of Umbria and Marche, between heretics and Dominicans; an ordinance of the

church to oppose the heresies of *Templars, Alchemists, Spirituals, Cathars, Patareni* etc… whose survivors had found shelter in the land of the Sibilla). The visit of the German rider Her Hans Van Bamborg, subsequently named by Antoine de La Sale in his travel diary, would date back to 1338.

1420-1450 - Antoine De La Sale examines the sibylline cave twice leaving in his diary manuscript, dedicated to Agnese de Bourbon-Bourgogne his agent, a description and detailed and realistic drawing of the natural morphology of the place and of the sibylline antrum.

1452 - In parchment n.40 in the historical archives of the town of Montemonaco, the visitation of the land, of the lake and of the cave of the Sibilla by riders that came from all over Europe to practise the alchemy and consecrate magic books is documented.

1578 – a date sculpted on a rock overlooking the actual collapsed vestibule and also today clearly visible. This date, that oddly is connected to the legend of the birth of Christian Rosenkreuz, would be symptomatic as well of the presence of Rose+Cross in the land of the Sibilla.

1610-1612 - Date in which Martino Bonfini frescoed in the ancient sanctuary of the Lady of the Ambro, at the foot of the Sibilla mountain, a cycle of twelve Sibyls among which one that was a chemist or alchemist..

1870 – Attempted speleological exploration, without any particular result, by the Caponecchi brothers, called the Vezzanesi.

1885 - G.B. Miliani, forerunner of modern speleologists, climbedto the cave in the hope of finding the continuation of the burrow after vestibule.

1897 - The intellectuals Pio Rajna and Gaston Paris , after an excursion to the cave, opened the cultural debate on the Sibilla that, in the midst of publications and conferences and increasingly rich scientific data, extends to the present day.

1889 - A committee of alpinists climbed to the cave limiting themselves to arranging the entry.

1920 – An expedition led by Falzetti, went into the vestibule, seems to have individualised a probable continuation of the cave by way of a descending burrow. An attempt of excavation by unknown persons followed between the years 1921 and 1925 , when Falzetti returned to the cave discoveringthe modifications effected by the awkward explorers and the disappearance, under fall-deposits, of the supposed descending burrow.

1926 – The superintendent of archaeological findings, Dr.Moretti, obtained the first technical-scientific data on the state of the hollow of the time: "*The hollow, that across an unusual open fissure along the oblique seam of rock is not more of eight meters long, four in width and three in height, does not have other accesses to climbs or to rooms in the inside abysses. The only vacuum that is left is the vestibule from which a hole lets us suppose that there once existed or still exists, not only the rooms that the legend lent in the heaven of the Sibills, but at least some other hollows of which the present one is the vestibule".*

1929-1930 - Examination by the belgian philologist Fernand Desonay and other excursions by Falzetti without result..

1946 – the Marchean poet T. Colsalvatico did an excavation on his own which was interrupted by the superintendence on the basis of an unfounded suspect of the use of explosives to widen the hollow. He was followed by the professor geologist Lippi Boncampi that, in a report dedicated to karstification in the Sibillini Mountains, furnishes a first official document on the hypogeal development of the cave of the Sibilla, illustrated by topographical surveys, sections, planimetries and other technical data.

1952 - General Emidio Santanché, dowser and president of the bureau of tourism of Ascoli Piceno, effected a reconnaissance, that did not yield results, together with exponents of the Forestry Corps probably aimed at a reopening of the hollow for purposes of tourism.

1953 Annibali, the superintendent of archaeological findings gives the starting signal for an

excavation that was more binding than any tried before. But the inadequacy of techniques worsen the obstruction of the hollow adding deposits to deposits.

1953-1965 - In this period the definitive collapse of the cave's vestibule occurred and the probable theft of certain meaningful remains, among which an incised stone in illegible characters was to be found.

1968 - The geologist Odescalchi from Pesaro, on behalf of the bureau of tourism of Ascoli Piceno, with the aid of geoelectrical instrumentation, succeeded in surveying anomalies probably evidence of the existence of a burrow.

1983-1984 - The Speleological Group of the Marche from Ancona, on behalf of the Marche Region and led by the speleologist Giuseppe Antonini, made repeated attempts to individuate the descending burrow indicated by Odescalchi, through systemic prospecting especially on the "crown" of the Sibilla mountain and aimed digging-. But the precarious working conditions forced the speleologists to abandon the enterprise, probably close to the discovery of the burrow's access.

1997-2001 - The scientific debate on the Apennine Sibilla and her cave was reopened encouraged by the scientific committee of the cultural project "Elissa" of Montemonaco, presided by professor Paolo Aldo Rossi of the University of Genoa. Three main conferences were organized in the researchers of national and international fame came to the Piceno region.Besides establishing the historical, literary and anthropological data of the myth, they solicited studies and geological and geophysical investigations that aimed at denying or confirming the hypothesis formulated.. As a result, in the autumn of the year 2000 the "Cave of the Apennine Sibilla" promoting committee with the patronage of the archaeological superintendence of the Marche, sustained by the presence on the field of Dr. Nora Lucentini, with the active participation of the Department of Earth Sciences of The University of Camerino

represented by Prof. Gilberto Pambianchi and assisted by Dr. Angelo Beano, with the financing of their partners and of The Savings Bank of Ascoli Piceno, promoted the geologic and geophysical investigation on the site of the "Cave of the Sibilla", published in the Proceedings of the Conference “Sibyl, Shaman of the mountain and the Apennine Cave”. The following investigative phase, that was intended to schedule the non-invasive boring at the more meaningful points on the field overlooking the collapsed vestibule, has been unexplainably prohibited by a veto of the Sibillini Mountain National Park Office and of other local institutions.

Geological and geomorphological features

The Umbro-marchean Apennine is made up of a sedimentary stratigraphic sequence (having a thickness up to 2500 m) primarily calcareous at the bottom and with limestone alternations, marly-limestone and marl, in the upper remaining portion. In the first phases of Jurassic age, in the great gulf of the Tetide sea, that divided the African continent from the Eurasian one, the *Calcare massiccio* formation, with a thickness up to 1000 m, the most ancient one known in the Umbro-marchean area, was deposited, in a shallow sea and in a carbonatic platform environment. Toward the end of the Lias, the carbonatic platform began a slow and gradual sinking, tied to the extensional tectonics that distanced Africa from Europe and produced in the gulf of Tetide numerous and deep sedimentary basins, including the Umbro-marchean one. Afterwards, from Middle Jurassic up to Middle Eocene period, during a relative tectonic calm, primarily calcareous rocks, flinty calcareous, marly calcareous and marly, having a general thickness of about 2000 meters, were deposited. In the present case, between the Middle Cretaceous and the Middle Eocene periods, in the Umbro-marchean sedimentary basins, the marly calcareous formation of *Scaglia rosata* was deposited. This formation constitutes the upper skeleton of the Sibilla

Mountain that has a sub-horizontal bedding where the layers are locally interested by intense folds, connected to inter-formational slumpings, and to calcarenitic benches with thicknesses of tens of meters, the thickest of the area (Chiocchini et al. 1976). The big calcarenitic pack forms the characteristic and fascinating "crown" of the Sibilla Mountain (Fig. 3). The inter-formational slumpings were formed in a sea bottom which was not uniform and unstable; while the calcarenitic benches were tied to turbiditic flows that from the carbonatic platform in the Abruzzi introduced themselves northwards towards the Umbro-marchean sedimentary basin.

From the upper Eocene period, after the deposition of the *Scaglia rosata*, the collision between the African and European-Asian plates provoked a great extension of the emerged areas. In the Umbro-marchean sedimentary basin , narrowed by the surrounding continental areas, a primarily clayey sedimentation began that persisted during the entire Pliocene. In this latter period of time, the intense wrinkling that led to the entire structuring of the Umbro-marchean Appenines chain, characterized by thrusts and folds, took place, producing two big ridges: the Marchean and the Umbro-marchean ones (Fig. 4). In the emerged areas of central Italy between the Upper Pliocene and Lower Pleistocene, in a continental environment, a continental landscape with gentle forms and quotas close to sea level was modelled. The traces of this ancient landscape are represented by wide flat spaces (erosion surfaces) modelled in an arid environment and can be found on the Apennines and Pre-Apennines relieves. In the final phase of the lower Pleistocene an intense and general tectonic uplifting, connected again to the collision of Africa and Europe, produced the dismemberment of the primordial landscape that raised rapidly (Gentili & Pambianchi 1999).

The rocky formations most intensely karstified are those at the base of the statigraphic sequence and are made up overall of pure limestone of the carbonatic platform (*Calcare massiccio,* Hettangian-Sinemurian). Minor karst phenomena interest the following calcareous and

marly-calcareous formations of the *Maiolica* (Upper Titonic-Lower Aptian) and of the *Scaglia rosata* (Caenomanian p.p.-Middle Eocene p.p.) cropping out in the Mount Sibilla.

In the Umbro-marchean Apennines the outcropping of the calcareous formations are particularly extensive and the karst phenomena result rather frequent , of a different type, and interest the two apenninic ridges: the Umbro-marchean Ridge and the Marchean ridge, located slightly further eastward (Fig. 4).

The speleogenesis that may interest the calcareous formations in the central Apennines can be explained by the interaction of different factors: a) the erosive action of the infiltration of waters, the action of CO_2 of superficial derivation; b) hyperkarstic processes connected to the mixing of different waters and to the oxidation of H_2S both in the phreatic environment and in the atmosphere, caused by the action of sulphureous steam; c)the interaction of H_2SO_4, produced by the metabolism of certain bacteria on the calcareous surfaces of the hollows (Galdenzi & Sarbu 2000).

The northern portion of the apenninic ridges do not have relevant karst phenomena, with the exception of the mountain group of Mount Nerone (1525 m a.s.l.; Fig. 4), where along the steep walls, carved in the *Calcare massiccio*, cavities and natural arcs are to be found. Here the *Grotta delle Tassare* is found, the cavity of the Marche most developed in depth; while one of the deepest caves in Italy lies a short distance southward, in Umbrian territory, in the Cucco Mountain (1566 m a.s.l.) again part of the same formation (Dramis & Bisci 1991).

In the middle portion of the Marchean Ridge, the best known and developed hypogeal karst system of the region, is located: that of the Frasassi Caves (Figs. 4 and 5), set in an anticlinal core constituted by the formation of the *Calcare massiccio* cropping out on the inside of a narrow and deep valley. In this area characterised by a sub-continental mountain climate, with an average T of about 13°C and precipitation of about 1000mm/year, the surface karst forms are

little diffused, while numerous caves with a general development of over 25 kilometres open at heights of between 200 m (the level of the Sentino river) and 500 m a.s.l. The development is branched having galleries and caves at times large in dimension: the first ones are primarily horizontal, with a diameter of up to 10 metres, developed at least in 4 levels and mainly set on the fractures and strata joints; the second ones, pseudo-conical shaped, can reach heights of up to 200 metres, as in the cave named *Grotta Grande del Vento*. In this karst system generally phreatic morphologies prevail, where the vertical variations of the water table have played a determinate role. When the water level remains stable, the hyperkastic action in an underwater environment produces a hypogeal sub-horizontal environment; when a rapid drop of the water level occurs, instead, the karstic system tends to conform and develops vertical drains (Bocchini & Coltorti 1990). Large and deep pits connect rooms with hundreds or thousands of cubic metres of volume at different levels, showing a clear hypogenic origin (Galdenzi & Menichetti 1995).

In the central area of the Umbro-marchean Apennines, relatively important Karst phenomena characterise the inter-mountain tectonic basins as well (Castelluccio, Norcia, Colfiorito. Montelago, etc…), where there are numerous sinkholes that drain the water in depth (Scarsella 1947; Dramis & Bisci 1991; Gentili 2002).

The Sibillini Mountains constitute the southern joining area of the two mountainous ridges and at the same time, in this area, the highest reliefs are located (Vettore Mountain, 2476 m a.s.l.). Here the superficial karstification, however limited, reaches its maximum regional diffusion with *karrenkampfs*, streamsinks, and dolines (Dramis & Bisci, 1991; Gentili 2002).

In the Sibillini Mts. area, instead, the hypogeal karst phenomena is much rarer and is mainly associated with the Calcare massiccio formation, where the karst system made of generally small caves, channels and sinks, with horizontal, vertical and oblique development are found. The horizontal cavities are located in the lower slope portion of deep valley incisions, the vertical

ones are less developed and located in the upper portion of the relief where calcareous formations (aquiferous) with impermeable marly units at the bottom are to be found (Gentili 2002). Caves, wells and natural tunnels of greater interest are to be found along the Rio Garrafo (labyrinth system) on nearby Mount Bove (the “Cave of Sin” or the “Cave of the Devil”) and Mount Patino (the”Cave of Patino”). The highest known cave of all in the Sibillini Mountains, famous for its legends which have given origin to the vast historical, romantic and poetic literature regarding it, is the Cave of the Sibilla located almost at the top of the mountain bearing this name.

The Sibilla Mountain with its height of 2173 m. a.s.l. is one of the most important mountain reliefs in the group of the Sibillini Mountains; the summit is characterised by an evident rocky crest, developed in a roughly E-W direction, that gives origin to very steep slopes that degrade northwards into the Tenna River Valley and southwards into that of the Aso River (Fig. 3).

The main lithotypes that crop out from the valley floor up, are made up of the micritic limestone of the *Maiolica* formation (Upper Titonic – Lower Aptian.) and by the marly calcareous formation of the *Marne a Fucoidi* (Aptiano p.p.–Caenomanian p.p) and, nearly the top, of the *Scaglia rosata* (Caenomanian p.p. – Middle Eocene p.p) that are essentially in a sub-horizontal bedding or locally characterised by minor folds (slumping).

These last also interest the less thick calcarenitic layer like those observed at the entrance of the cave. Here, the fallings have underlined a structure of recumbent folds, where the major fold probably constituted the roof of the cavity and corresponds to the vestibule described by Lippi Boncambi in 1948 (Fig. 6). The fallings of the vestibule are surely attributable to tampering by man, as well as to the strong earthquakes that characterise this area.

Detailed geological surveys , at the cave’s entrance, have evidenced faults and fractures oriented at about a N 30°E direction where probable phenomena of left-strike slip have produced widening of the plicate structure. The system of faults and fractures continues in the direction of

the “Fosso delle Vene” with a development of about 1 Km. Tectonic action on the bedrock favoured the infiltration of meteoric waters and karstification has found preferential development in the calcarenitic layers. The widening of underground hollows has been aided also by gravitational phenomena that concern the summit portion of the relief. Translational slide phenomena, valleyward of the cave entrance, concern the *Scaglia rosata* layers, not connected to the system of faults and fractures, that have as their shear-plane the decimetric marly-calcareous level that gravitational movement causes to become particularly fractured, up to the point of deleting the bedding (crush breccia levels). On the Sibilla’s relief and on surrounding slopes gravitational phenomena are particularly developed. Deep-seated gravitational slope deformations (which evident double crest represent a basic diagnostic element) and big landslides have been favoured by the lithostratigraphic setting, identified by the overlaying of lithotypes with rigid deformation (limestones) on ductile deformation levels (marls); by the fast quaternary tectonic uplifting and consequent deepening of hydrographic system, that produced high relief values; by glacial-decompression phenomena, related to the melting of pleistocenic glaciers; by the numerous and strong earthquakes (Aringoli et al 1996; Dramis et al 2002).

Geophysical Investigation

The purpose of the geophysical investigation (Beano 2001) was to confirm the first geologic hypothesis regarding the localisation of hypogeal structures in the area surrounding the vestibule of the Sibilla cave and along the line (in N 30° E direction) that connects the entry of the cave to the “ Fosso delle Vene” spring (Fig. 8).

The zone is not very large, it is encircled by precipices, and it lies on a very steep slope, which is difficult to reach; the use therefore of the seismic method, and partially of the geoelectrical method was excluded from the start.

The Georadar analysis was considered to be the most appropriate method to use for this kind of survey, to maintain data quality, completeness of information and easy transportation of equipment to the site. Whereas “geoelectrics” allows a generic individuation of a situation, georadar instead is able to reconstruct with greater precision obtaining, in this particular lithostratigraphic setting, much greater depth. To estimate the reflected radar signal attenuation and therefore the radar penetration depth, two geoelectrical tomography surveys were carried out to check on the radar effective prospecting. The maximum depth that could be achieved was about 40 metres below the surface level. The georadar data were also calibrated at a depth of 10 metres, said depth was found during excavations in the 80’s.

The present field program consisted in a series of measurements along longitudinal and transversal lines to the slope and, where possible , in a grid of lines spaced 2.5 m. from one another for a total length of 8975 metres.

The electro-stratigraphic sequence evidenced by the geological profiles confirms the presence of a maximum in the superficial area, while in the second half, a fold of material of medium resistivity (marls or calcareous marls) overlaying a core of medium-high resistivity core (marly limestone) can be imagined. Geoelectrical tomography was carried out to evaluate the attenuation of electromagnetic signals irradiated by the Georadar techniques, in a preliminary phase it was possible to attest that an adequate surveying depth of about –25 m could be reached, therefore it was decided to proceed with the survey using Georadar.

The doubts regarding the use of Georadar concerned the real penetration capability of the e.m. waves (with a good quality of recorded data) and the possibility of individuating possible hypogeal structures, having a limited “horizontal” extension in depth of between 10 and 20 metres. A set of profiles that consented to settle all the uncertainties was therefore obtained in the vicinity of the antrum (collapsed) . It was then possible to proceed to the systematic

acquisition of data.

During the phase of data elaboration, after a long normalisation process, filtration and amplification of recorded signals, three typologies of e.m anomalies, “A”, “B”, and “C” were scanned and identified.

The type “A” anomalies (Fig. 9) are characterised by strong signal reflection due to the transit between two media having a very different dielectric constant (high reflection coefficient) as, in the case under examination, would happen on occasion of contact between rock and air (hypogeal structures), while, the two observed “tails” are produced by the particular form (arch) of the side walls and of the roof. The type “B” anomalies are similar to the previous mentioned ones but they result less evident, because of different factors: a low reflection coefficient, reverberation of the signals on the side walls (sub-vertical) and /or the presence of chaotic and/or fractured material. The “C” type anomalies are easily recognisable on the net radargramms because of two or more parallel and inclined bands: they have been correlated to fractures and/or open surface discontinuity (in accordance with geological -tectonical information of the area).

It is interesting to note that a lot of type “A” and “B” anomalies are located near to or on the projection of the type “C” anomalies (fractures). All the sets of “A” and “B” anomalies, placed preferentially along tectonic alignments surveyed on the surface (N30°E, the prevailing direction) have been contoured to better evidence the distribution of underground voids.

In brief, the anomalies examined clearly individuate a fracture in the underground, stretching roughly in a direction E-W and emerging southwards; also the surface geological surveys confirm the presence of a similar preferential orientation (E-W and NE-SW) of the different tectonic structures. As far as the dimensions of the evidenced cavities are concerned, its possible to affirm that there are horizontal and vertical hollows, with an average width of about 2 metres

(going up to a width of 8 m), located at varying depths of between those of 10 and 14 metres.

The compiling of an elaborate three dimensional graph viewed from south-east (Fig. 10) allows a spatial image of all the sets of anomalies that, it must be remembered, is in relation with the "roof" of the objects that produce it.

Conclusions

The myth of the Sibilla, well rooted before the birth of Christ and that has always attracted people to this area from all over Europe, has aroused a strong interest even among researchers of different disciplines and has in particular furnished interesting food for thought to the researchers of the earth sciences, that have aimed at verifying the setting of the physical environment, directly or indirectly made known in scripts of history or legend or by way of oral news handed down throughout the ages.

Recent geological-geomorphological and geophysical studies seems to confirm this general setting. In fact, they have underlined a high elevation karst system (roughly up to 2000 m) which is well developed in horizontal levels at different altitudes, joined together by vertical and inclined hollows. In accordance with the geophysical records, that confirms the geological data of the surface, the system develops in all for about 600 m across a preferential N 30° E direction, from the entrance of the cave to the "Fosso delle Vene" spring. The karstified levels with horizontal development reach a maximum size of about 300 m, with galleries a few meters in diameter, located at different depths from 10 to 14 m underground. These karst forms, with prevailing horizontal development, represent a rare episode, if not the only one, in the more elevated areas for the Umbro-marchean Apennines, generally countersigned by karstification in vertical development.

This particular karst episode, that pertains to the classical typology of the calcareous rocks of

the Umbro-marchean sequence, can be explained by different geologic features. Above all, by the presence, in the *Scaglia rosata* formation, of very thick (30-40 m) calcarenitic benches in a sub-hoizontal bedding, which alternate with calcareous-marly and marly levels that allow the establishment of a suspended aquiferous, that can persist in the time entrapped in the numerous folds of the slumpings. The calcarenitic material present in the pelagic formations of the Umbro-marchean sedimentary basin (in this particular case in the *Scaglia rosata*), characterize exclusively the area of the "Sibillini" that, in the Mesozoic, bordered the carbonatic platform of "Lazio-Abruzzo" to the north. More northward, the Umbro-marchean sedimentary basin was exclusively an open sea and thus without detritic turbiditic material. The thickness of the calcarenites in this area results to be the highest of all, since the palaeo-geographic data reveal this area as a depositional depo-central zone.

The karst phenomenon is imposed on the calcarenitic levels, encouraged also by the presence of a stagnant aquiferous and led by a fault with a N 30° E direction. This final tectonic element together with other more or less orthogonal ones, have disjoined the formation of the *Scaglia rosata* creating plates with different widths, subsequently deformed in general by translational mass movements. Such gravitational phenomena have acted enwidening the fractures, very much increasing the velocity of the phenomenon.

It is not easy to locate the karst phenomena in time, yet the above exposed considerations allow us to formulate the hypothesis that during the late-glacial phase of the Upper Pleistocene, the relatively cold climatic conditions facilitated a greater solubility of CO_2 in the waters and gravitational phenomena, connected to the melting of the glaciers, surely facilitated the establishment of the phenomenon, that then went on in time.

References

Aringoli D., Gentili B. & Pambianchi G. 1996. The role of recent tectonics in controllino the deep-seated gravitational deformation of Mount Frascare (central Apennines). Geografia Fisica e Dinamica Quaternaria, **19**, 281-286.

Beano A. G. 2001. Indagine geofisica. In: AA.VV. Sibilla sciamana della montagna e la grotta appenninica. Editrice Miriamica - Progetto Elissa, Montemonaco, 193-201.

Bisci C. & Dramis F. 1991. La Geomorfologia delle Marche. In: AA.VV. L'Ambiente Fisico delle Marche. S.E.L.C.A., Firenze, 83-113.

Bocchini A. & Coltorti M. 1990. Il complesso carsico Grotta del Fiume-Grotta Grande del Vento e l'evoluzione geomorfologica della Gola di Frasassi. Memoria Istituto Italiano di Speleologia, s.II, **4**, 155-180.

Chiocchini M., Deiana G., Micarelli A., Moretti A. & Pieruccini U. 1976. Geologia dei Monti Sibillini nord-orientali. Studi Geologici Camerti, **2**, 7-44.

Dramis F., Gentili B., Pambianchi G. & Aringoli D. 2002. Gravitational morphogenesis in the adriatica side of the Marche region. Studi Geologici Camerti, Nuova Serie Edimont, **1**, 103-125.

Galdenzi S. & Menichetti M. 1995. Occurrence of hypogenic caves in a karst region: examples from central Italy. Environmental Geology, **26**, 39-47.

Galdenzi S. & Sarbu S.M. 2000. Chemiosintesi e speleogenesi in un ecosistema ipogeo: I rami sulfurei delle Grotte di Frasassi (Italia centrale). Le grotte d'Italia, **1**, 3-18.

Gentili B. & Pambianchi G. 1999. Contributo alla ricostruzione dell'evoluzione geomorfologica del versante adriatico dell'Appennino umbro-marchigiano (Italia centrale). In: Orombelli G. Studi geografici e geologici in onore di Severino Belloni, Glauco Briganti Genova, 391-403.

Gentili B. 2002. Note di Geomorfologia del Parco Nazionale dei Monti Sibillini, Quaderni Scientifico Divulgativi n.**6.** Aniballi Grafiche, Ancona.

Lippi-Boncambi C. 1948 I Monti Sibillini, Tip. Mareggiani, Bologna.

Lucentini N. 2001 Le grotte in preistoria. Prospettive per la Grotta della Sibilla? In: AA.VV. Sibilla sciamana della montagna e la grotta appenninica. Progetto Elissa, Montemonaco, 79-87.

Pambianchi G. 2001. Caratteristiche geologiche e geomorfologiche di M.Sibilla. In: AA.VV. Sibilla sciamana della montagna e la grotta appenninica. Editrice Miriamica - Progetto Elissa, Montemonaco, 185-191.

Piscitelli A.M. 2001 L'antro della sciamana appenninica, arcaico simbolo di un mito immortale. In: AA.VV. Sibilla sciamana della montagna e la grotta appenninica. Progetto Elissa, Montemonaco, 89-97.

Ristori M. & Carobbi M. 1999. I sentieri delle stelle. Emergenze architettoniche nel versante piceno dei Monti Sibillini, in AA.VV. Le terre della Sibilla appenninica, antico crocevia d'idee scienze e cultura. Editrice Miriamica - Progetto Elissa, Montemonaco, 69-103.

Rossi P.A. 1999. Itinerari reali e immaginari sulle tracce della Sibilla, in AA. VV. Le terre della Sibilla Appenninica. Editrice Miriamica - Progetto Elissa, Montemonaco, 1-9.

Scarsella F. 1947. Sulla geomorfologia dei piani di Castelluccio e sul carsismo nei Monti Sibillini. Bollettino Ufficio Geologico d'Italia.

Figure captions

Fig. 1- The Sibillini Mountains and the valley of Pilato Lake.

Fig. 2- Sketch of Mount Sibilla by Antoine De La Sale in 1420 (after a gothic edition in 1521, Paris National Library).

Fig. 3- The Sibilla Mountain and its characteristic “crown”.

Fig. 4 – Geological sketch of central Apennines: 1-limestones; 2-marls and terrigenous sediments; 3-main thrusts.

Fig. 5 – The Frasassi Caves.

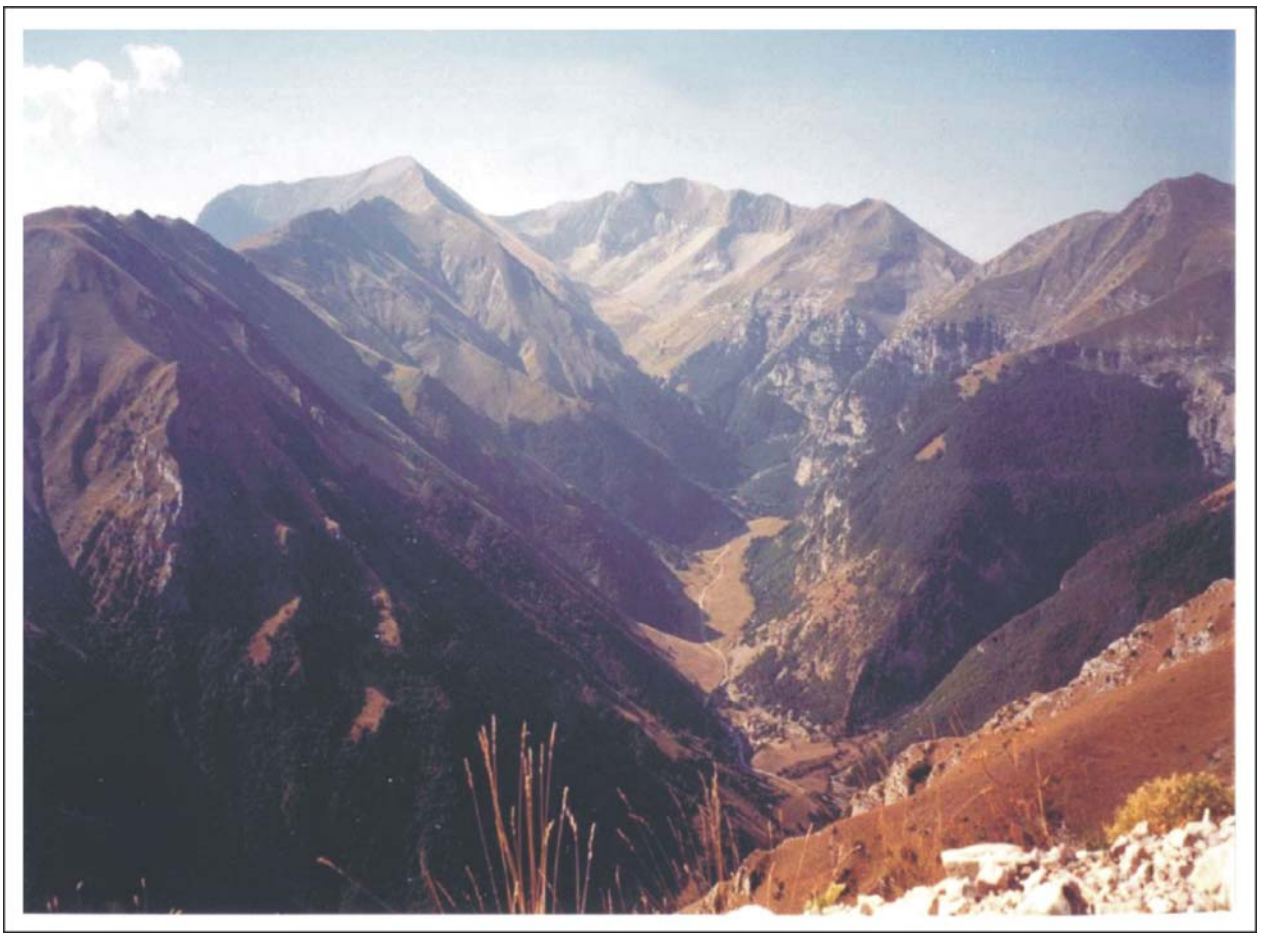
Fig. 6 - Slumping fold near the cave entrance: may be reconstructed the location of the vestibule’s roof (A-A), today collapsed (A'-A').

Fig. 7- Sketch of summit portion of the Sibilla Mountain: main joints in dashed red line and relaxing direction of calcareous plates with arrows.

Fig. 8 - Planimetry of the investigated area by geophysical prospectings.

Fig. 9 - "A" anomaly radargram; the white dashed line shows the roof of an hallow.

Fig. 10 - Three-dimensional view of the investigated area: in black the anomalies contour.



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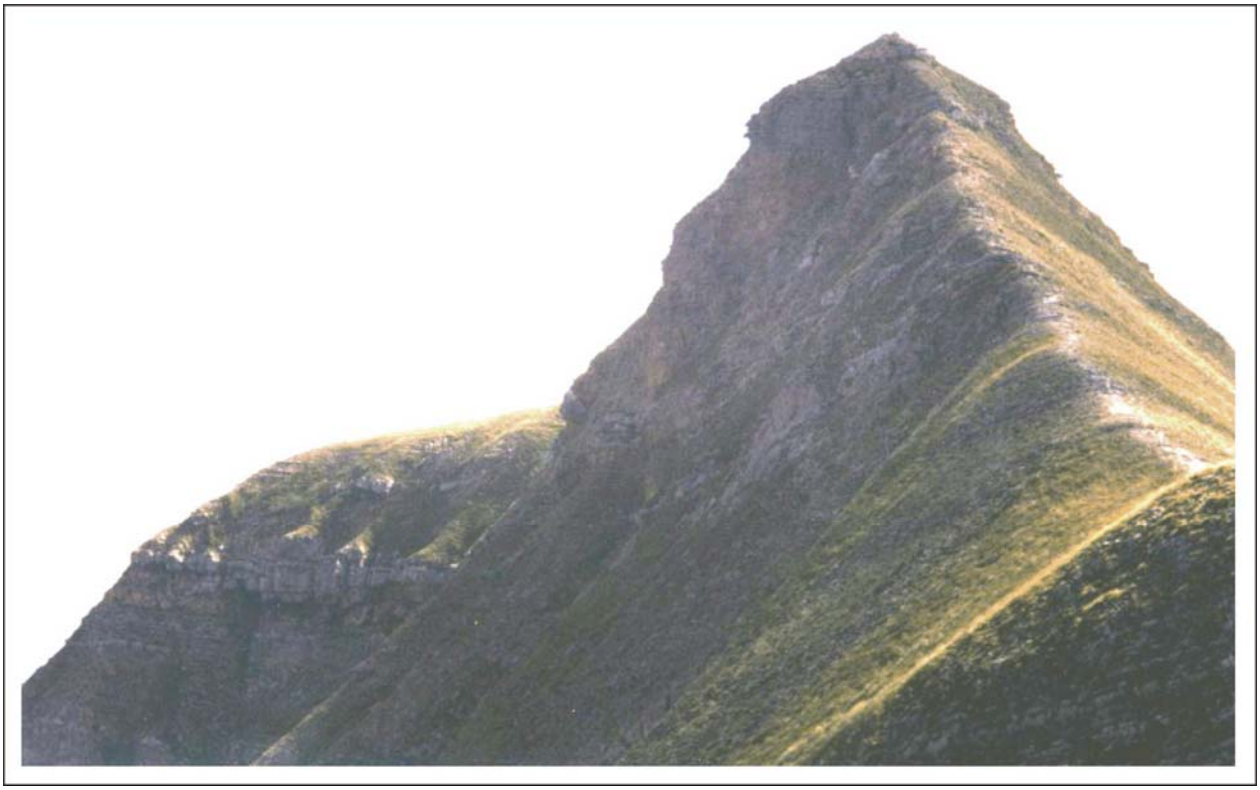

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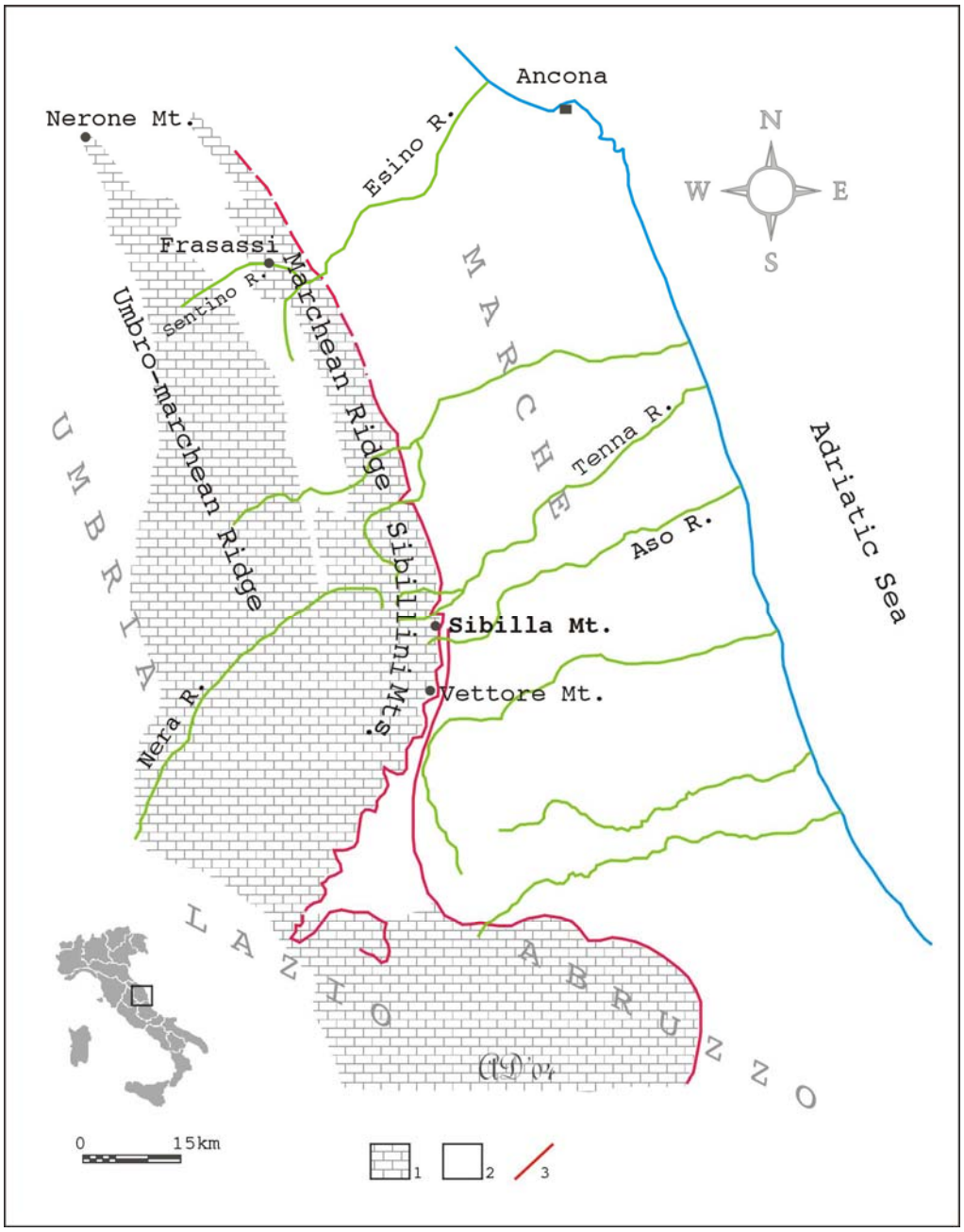

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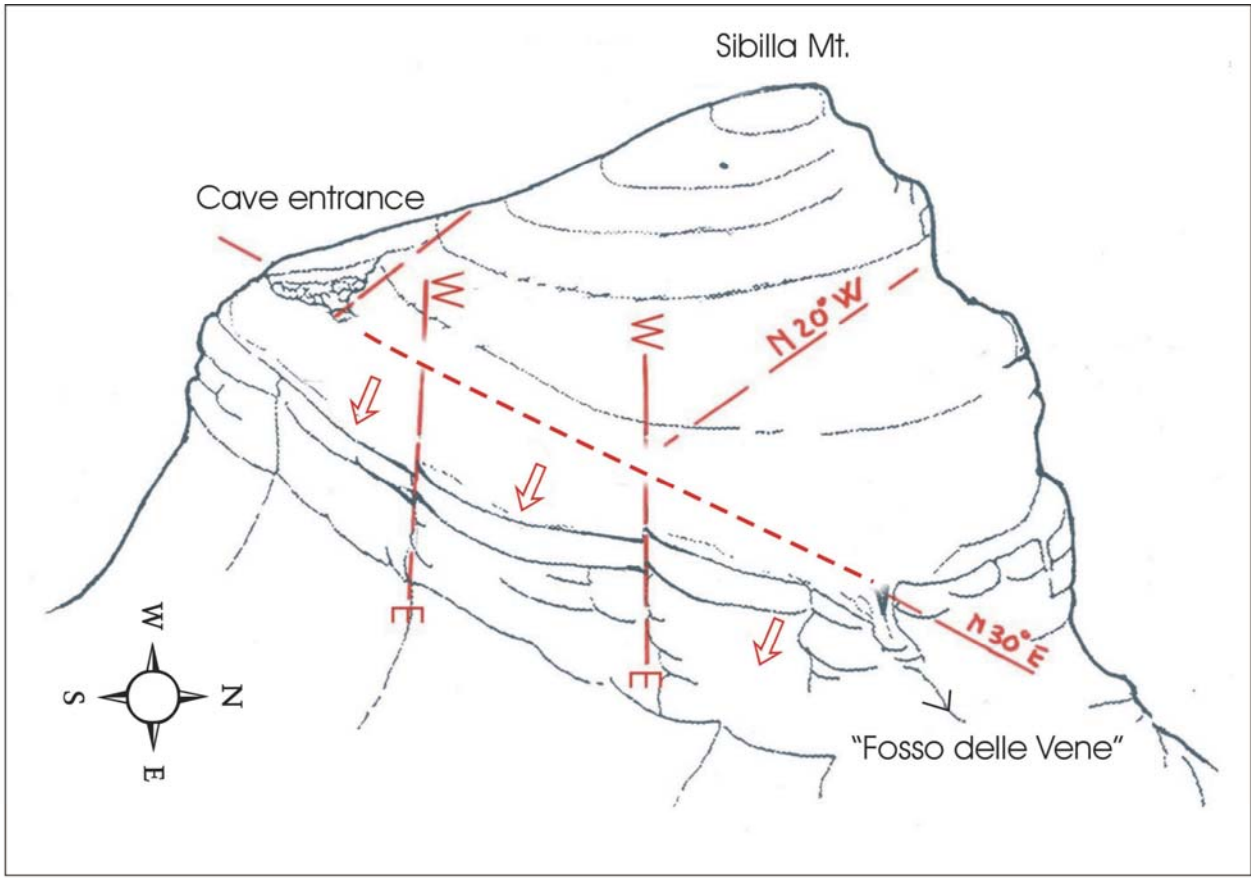

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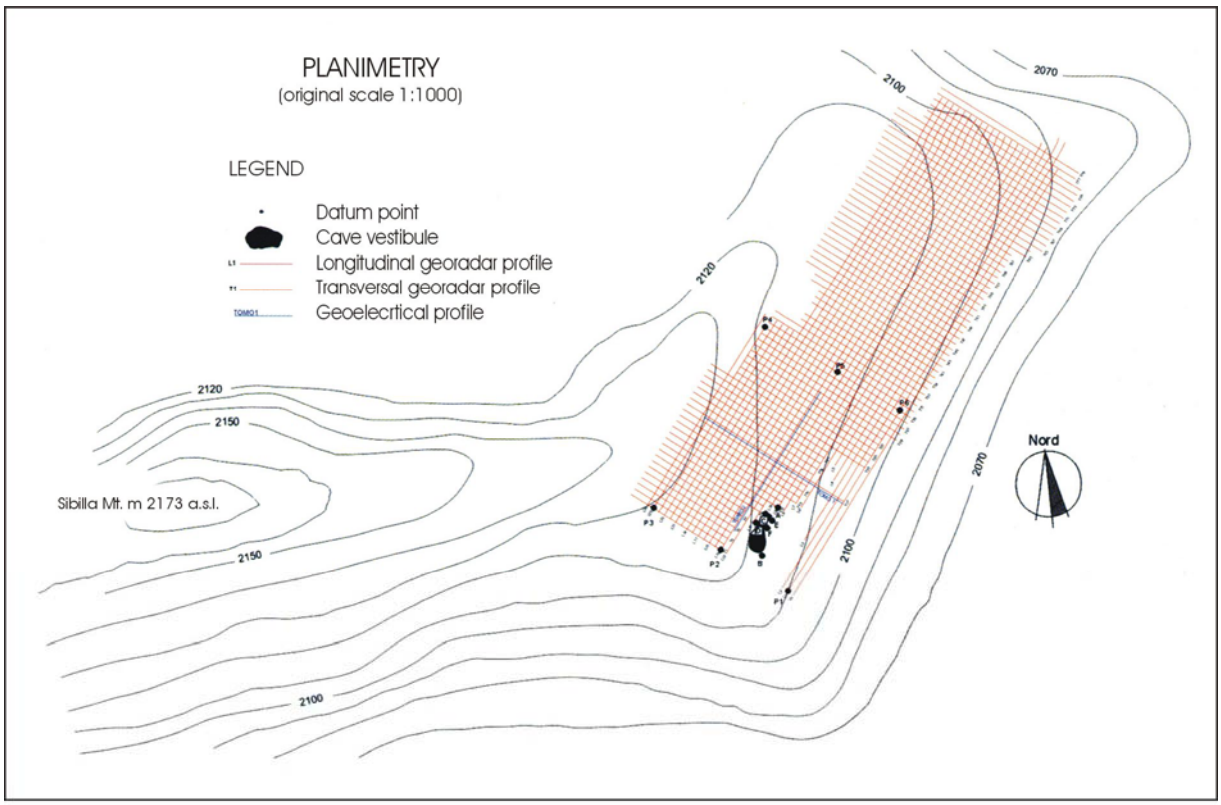

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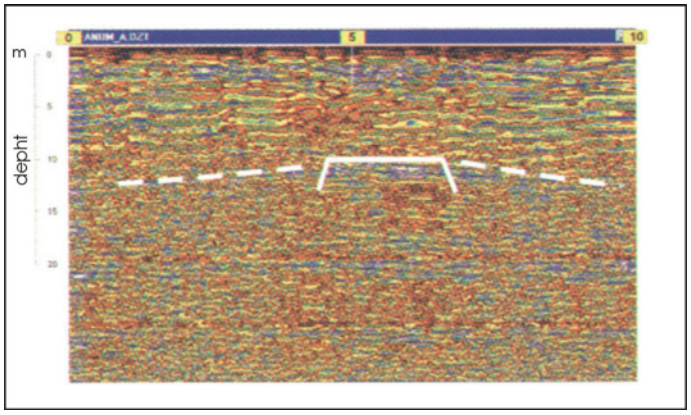

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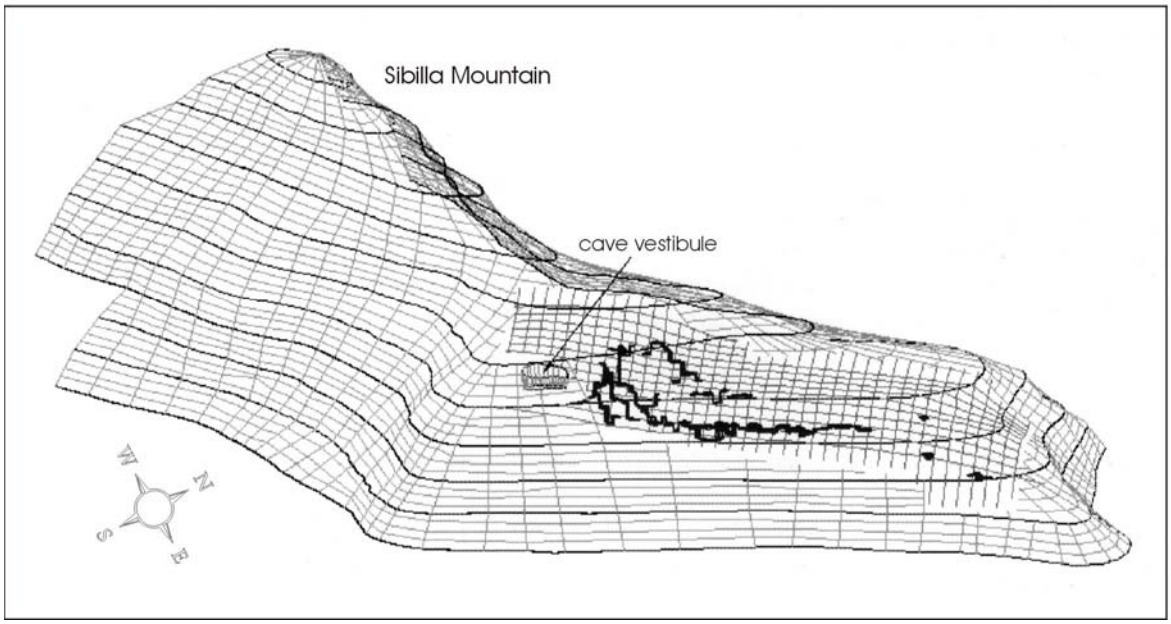

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