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Description and nomenclature of the tafoni features (cavernous rock forms). Research approaches in granite terrains

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Abstract

Scientific terms have a descriptive, conceptual and categorical meaning. In the geomorphic research the applied terms can describe the landform features on the Earth's surface; also, they can reflect the different development conditions and stage of the studied landform; moreover, they are always related to the key concepts about the landform explanation. So, whole terminology has a very important role in the geomorphic research because supports the landform nomenclature. However, a suitable nomenclature according this finality must be unequivocal. But in the study of the cavernous features on granite rocks there is often a co-existence of many terms applied to the same form-types. Also, there is a literal or modified translation of local terms from regional studies. And the terms acceptance and their spreading by the researchers are very diverse along time. The situation can generate a conceptual and a categorical uncertainty in the knowledge of the cavernous granite forms. This work deals with several questions about this terms meaning on the light to the research approaches in the granite terrains. The earliest scenery where the landforms were recognised and termed dates from the last years of the XIX century. Starting from this time, two general terms are usually applied to report the basal or lateral cavities developed in granite rocks. The single word "tafone" (plural "tafoni") and the compound name of "cavernous weathering form".

Key words: tafoni, cavernous landforms, terminology, typology, nomenclature, granite, geomorphology

INTRODUCTION

The earliest news on basal or lateral hollows developed inside granite rock masses dates back a long time. The first description was collected by PRADO (1864) from Sierra de Guadarrama, in central Spain. A little later they were described from Corsica by REUSCH (1882): this author designed them with the local term of *tafoni* (singular *tafone*) related to the verb "tafonare" (to make a hole or to open a window). They were reported newly from Galicia, north-western Spain, by Ragnar Hult (FRAGA et al. 1994) in 1898. Since then, these rock features are often designated with the Corsican term. But they equally are named with others local or particular names in the scientific papers. The different morphological properties or the different development stages from specific observations over time are reflected in new terms. This terminology not only has a descriptive or categorical sense but also involves a conceptual framework selection in the study of granite landforms.

In most cases the collective term has the meaning of an empty space in a rock volume, developed starting from a basal or a lateral discontinuity plane. The problem appears when it is necessary to summarize the knowledge available in the light of a new research project that needs the complete account of this landform nomenclature. According to NORWICK & DEXTER (2002:11) "Long before there was a science of geomorphology people notice the pitted weathering of some rocks... The nomenclature for pitted and cavernous weathering was not harmonized through most of the twenty century but the word tafoni has now become standard for all such pits, large and small." It is noted the lack of agree with regard to the typical features that could define this form. GOUDIE (2004) points out them as several cubic metres in volume, the arch-shaped entrances, the concave inner walls, the overhanging margins (visors) and the smooth gently sloping debris-covered floors. But others think that "the literature survey reveals that there has been a great deal of liberty in deciding which features can be described using this term" (MIGON, 2006: 139).

The studies of granite terrains, where these landforms are well-developed and very common, had provided a differentiation in their spatial, morphological and evolutionary patterns (TWIDALE and VIDAL ROMANÍ, 2005). Their names usually start from their general location in the granite landscape or from their local position in the host rock. They are also derived from their external visual appearance and from their inside features. In addition, they are related to the various origins that have been proposed since they were recognized in the granite terrains. All these names have been understood as the expression of different landforms although this typology can really reflect the different stages in the development and in the progressive degradation of an initial cavity (VIDAL ROMANI et al., 2006). Moreover, this terminology has been applied in many senses because they have been an unequal impact in the scientific community. So, the progress towards a comprehensive nomenclature system needs a research about their elaboration along the time. This work is about this process to the forms developed on granite terrains. The use of the "cavity" and "hollow" words are applied to an undetermined typological sense in this text.

FIRST DIFFERENTIATION OF THE ORIGINAL TERMS

Tafoni, caverns, niches and cavernous rock surfaces

The *tafoni* name was used or ignored in the papers which made a field hollows description until the twenty century three first set of ten. CHOFFAT (1895) applied it to mention the cases from the granite lands in the northern of Portugal (Fig. 1a); this author wrote about them as a curious phenomenon of similar design with

the forms named as tafoni by REUSCH (1882 o.c.); also considered that these hollows were equal to the first termed *horados* by PRADO (1864 o.c.) and identified as tafoni in non-granite terrains by PENCK (1894).

> "La colline de Faro d´Anha présente un outre fait beaucoup plus curieux… cavitès irrégulières, ayant à l´intérieur des bandes proèminentes, à arêtes vives, se trouvant aussi bien au toit que sur les côtés et paraissant être les restes de parois ayant séparé des cavités distinctes. Ces ouvertures sont plus généralement sur le côté que dans les dessus et se trouvent tantôt dans la roche en place, tantôt dans des blocs isolés." (CHOFFAT, 1895 o.c.: 19)

All these cavities (tafoni or horados) were explained as the result of an exogenous process according to the granular disintegration or flaking observed from their inner walls. Already there was a genetic concept in these terms. And this meaning became a favourable context to the following use of two associated words in their future designation: erosion and weathering. Soon after, CAYEUX (1911) described many cases developed in the gneiss and the granite masses of Delos Island; their conceptual boundary related to the possible morphological types was lighted with their words:

> "Entre le domaine continental, soumis a l´influence exclusive de l´atmosphere, et l´étroite zone littorale façonnée par l´érosion marine seule s´étend parfois una aire placée dans des conditions mixtes, où les phénomenes d´érosion preséntent un intérêt de tout premier ordre...La nature y a façonné les roches avec un art, une délicatesse et une fantaisie uniques à ma conaissance...L´érosion qui résulte de l´action combinée de la mer et de l´atmosphere est essentiellement une *érosion alvéolaire*, et parfois *caverneuse*..." (CAYEUX, 1911 o.c.: 162)

The forms size was the key to provide a classification (Table 1), excluding here the use of the previous terms. But the explanations picked up in this work clearly retain a sub-aerial origin. However, the author stated that the two different types of cavities could be the result of two different evolutionary trends. The smallest hollows with orderly patterns named *alvéoles* were ruled over the gneiss surfaces near the sea: their fast growth may merge them in a cavern. The largest isolated hollows named *cavernes* are usually developed on the inside of the inland granite blocks (Fig. 1b): their growth starts from a single cavity little by little differentiated (along tens of thousands of years). In spite of this, old morphological and evolutionary concept, later in most papers about these granite forms only appears a definition based on the size.

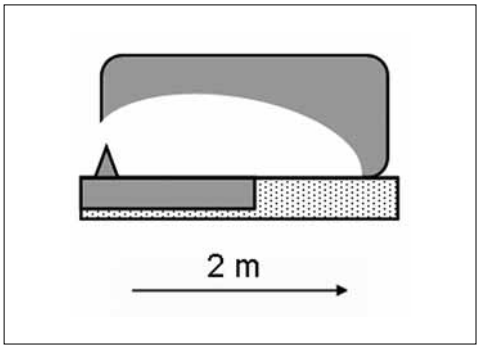

Fig. 1a Tafone cross-section from Choffat (1895).

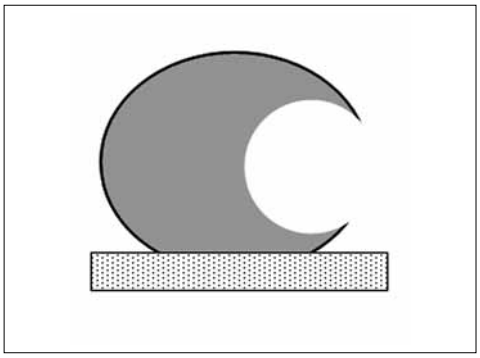

Fig. 1b Cavern cross-section from Cayeux (1911).

Similar hollows founded in the semiarid and arid lands of the United States were related to weathering processes too. In this way, new terms were used to report the different cavities. For instance, the shelters from Arizona and Nuevo México sandstone terrains were named *solution niches* (BRYAN, 1928). In this context perhaps the most interesting contribution to the following research in granite terrains was the work of BLACKWELDER (1929); he used to describe the very frequent hollowing-out rocks from California desert the general term of *pockets*, which has a meaning with regard not only to their visual features but also to their development processes:

> "Although commonly bowl-shaped or purse-shaped, they display great variety of form. One generally finds that the outside of the partly decayed rock is more coherent than the inner part...Excavation proceeds largely beneath such external crust. The pockets are enlarged until they coalesce and thus leave isolated plates of the crust standing out in relief...The cavities, which have been called "niches" by Bryan…are familiar features of most igneous rocks, sandstones, sandy shale and conglomerates." (BLACKWELDER, 1929 o.c.: 393)

The pockets classification is equally based on their size range (Table 1). But this author suggested that Bryan's terminology only could be really used for the cavities developed by a single solution process. Against in a granite cavity "the inner surface of the recess is generally covered with crumbling scales…identical with the usual products of exfoliation… this condition favours the inward and upward growth of the cavity." (Blackwelder 1929 o.c.: 395-396). This was the conceptual sense that reveals the term *cavernous rock surfaces* as a result of the *cavernous weathering* which has prevailed in USA research until today.

AUTHOR	Centimetre range		Metre range
Cayeux (1911)	Cellules "cellules d´abeilles"	Alvéoles "éponge de pierre"	Cavernes
Blackwelder (1929)	Pitted rock surfaces	Honeycombed rock surfaces	Cavernous rock surfaces
Bourcart (1930)	Alvéoles en "dentelle", "treillage", "ruche" et "éponge" dans les parois rocheuses		Taffoni Grottes

Table 1. Main hollowing-out rock nomenclature at the beginning of XX century

Literal transcription and reinforced concepts

The term of tafoni was newly used in the description of granite cavities from Corsica. But BOURCART (1930) wrote the name as *taffoni* (singular *taffone*), so retained long time in the French research; just as this author explain in the first page of their paper, the word was transcribed literally from a publication about the Corsican landscape (Deprat,

1908). The features observed here were related in detail by the author:

> "Les *taffoni* sont des cavités grossièrement hémispheriques sculptées dans la paroi verticale des rochers de granite. Plus exactement, elles comportent une paroi supérieure, en voûte souvant très régulière, et un plancher quelquefois presque plan, mais toujours en pente vers léxterieur. Ce plancher peut être concave et la cavité prend alors une forme en demi-ellipsoide ou même en demi-sphere...Il arrive souvent que deux de ces grottes ont empiété l´une sur l´autre. Au lieu d´être séparées par un pilier, comme c´est la cas quand elles sont simplement juxtaposées, elles le sont alors par un rebord tranchant. Deux taffoni peuvent également êtres surperposés et le plancher qui les sépare peut s´effondrer; la courbure des parois de la nouvelle grotte qui en résulte indique alors son mode de formation." (BOURCART, 1930 o.c.: 5-6)

Again the classification was size-based (Table 1). The smallest cavities were identified as similar forms to the previous named alveoli. The largest were recognised as niches. In fact, this work stated the same origin to these types because both together were located on the same side wall rock surface. Since this reasoning the author noticed that an accurate genetic explanation of these forms is doubtful: any initial condition could be erased along the evolutionary time, particularly in the biggest cavities. So, the final statements of this study retain that these forms have an exogenous origin but they show a lack of consistency with the former research about the role of the rock structural properties in the genetic and the evolutionary process. Even this time all studies underlined the significance of the joint system in the granite on the hollows shape whereas this author reveals that the control could be only possible in some specific observations.

The following research was centred on the landform classification related to their causal mechanisms. Some prior concepts and their associated terms were ignored. Another concepts and names were reinforced. The different impact of these works on scientific community gave rise to paradoxical interpretations. For example, the hollows found in the granite blocks from Monte Alvarado in Portugal north (clearly tafoni from several photographs) were named *blocos cavados* because "os tafoni sao tipicamente litorais" (COTELO, 1940: 3) and the location of these forms was far away the sea.

TERMS DIVERSIFICATION RELATED TO MORPHOLOGICAL TYPES

The basal, the sheet and the side-wall forms

At the same time that this landform occurrence began to be considered as a common success in the granite landscapes, the specific terminology applied to a suitable definition of their typology increased. In a general sense, all the new terms contained the concept of a process-response system with a dynamical behaviour under open air conditions. They have an obvious descriptive role related to the cavity location in the unities of a granite morphological system (boulder, block, sheet, walls...). Also, they have a categoric role seeing that indicate their size variations and their growth stage. The research carried out in the granite terrains of Corsica where "les taffoni s´alignent systématiquement sur les principales directions des diaclases" (LIGUS, 1952: 185) and "every boulder of stone and also the outcropping rock is perforated with cavities" (WILHELMY, 1958: 155). These features were object of a comparative analysis with the honeycomb forms founded on any crystalline rocks from France (CAILLEUX, 1953) and from the northeast of Spain where "le niveau de base des taffoni est une surface de discontinuité, plus ou moins horizontale" (DENAEYER, 1953: 205). But also they were studied in other locations as Brazil where they were related to the structural properties of the bornhardts (Fig. 2a): here "les taffoni anciens qui s´étaint normalement dèveloppés à la base

sont maintenant renversés...ayant son ventre en l´air" (BIROT, 1958: 32). The hollows are often "roches évidées de façcon à offrir au regard une face intacte et une face creusée d´une grotte don't l´intérieur est plus haut que l´orifice d´entrée, de sorte qu´elle est protégée par une sorte d´auvent rocheux" (RONDEAU, 1958: 453) (Fig. 2b).

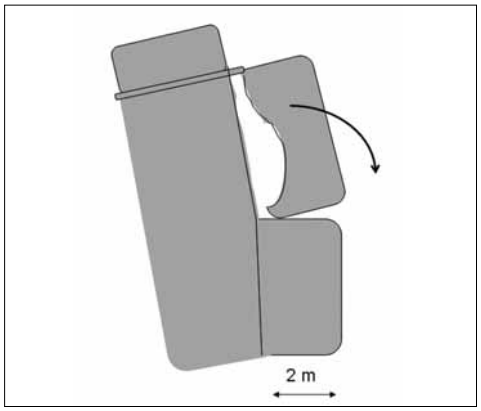

Fig. 2a Cavity cross-section from Birot (1958).

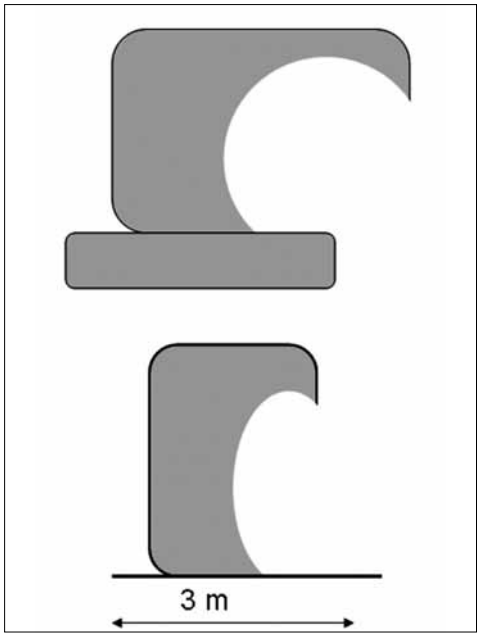

Fig. 2b Cavity cross-section from Rondeau (1958).

The most successful nomenclature, still managed today, was provided by several regional studies: the hollows types were designated according to the position of an initial discontinuity plane of growth in their host unity (PANZER, 1954; KLAER, 1956; WILHELMY, 1958 o.c.; RONDEAU, 1961). The impressive use of this proposal is derived from their apparent simplicity to the field work. The basic terms that differentiated the hollows types were the *basal*, the *side-wall* and the *sheet* forms (Table 2) but could be more detailed. In order to define the shape sub-types, it was measured the hollows opening diameters and their perpendicular axis (Fig. 3). All these properties represent an observational tool about the general "forms of cavernous weathering, chiefly found in medium and coarse grained, acid to intermediate crystalline rocks" (JENNINGS, 1968: 1103).

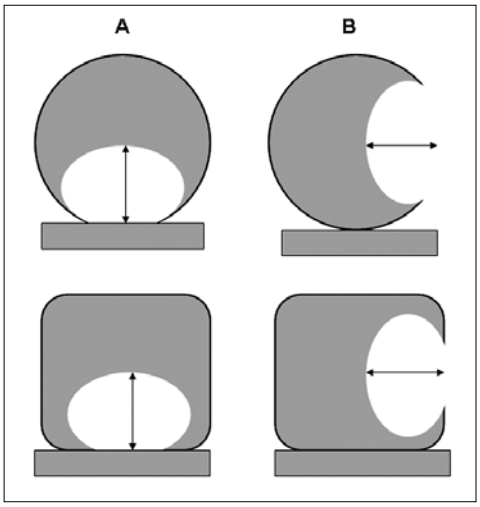

Fig. 3 Depth measures in basal (A) and side-wall (B) forms.

In other granite regional studies the nomenclature was also based on the traditional size rule. The cavities from the desert lands in Chile were classified by SEGERSTROM & HENRÍQUEZ (1964) in two main groups: the

small centimetre forms or *pits* with a waffle-like patterns and the large metrics forms or *caves* with diverse morphological features; these latter were usually perforated with owl's eyes forms. DEMEK (1964) distinguished in the Bohemian massif between the largest side-wall forms as the *rock niches* (wider than deep) or the *rock hollows* (deeper than wide) and the smallest side-wall/basal forms as the *dew-holes*. Also, this author observed in their fieldwork some small pits patterns naming them with the old term of honeycombs.

LOCATION	LANGUAGE	TERMINOLOGY (SINGLE FORMS)
Beneath boulders or blocks	German French English	Basistafone (Hohlkehlen) Taffone de boule Basal tafone, Basal niche, Basal cavern
Between sheet or bed planes	French English	Taffone de diaclase (horizontal) Sheet tafoni, Basal cavern
Inside sloped rock walls (largest forms)	German French English	Seitentafone Taffone de parois, Taffone de diaclase Side tafone, Sidewall tafone Rock niche, Rock hollow
On whatever sloping bedrock (smallest forms)	German French English	Nebentafone Alvéole, Nid d´Abeille Honeycombed forms

*from Panzer (1953); Klaer (1956); Wilhelmy (1958); Rondeau (1961)

Table 2. Main cavities types according to the development plane into host rock*

Later research from granite rocks in the Chile desert (Fig. 4) equally retained a size distinction from the honeycombs to the tafoni although "on ne peut douter qu´il s´agisse de la meme forme plus ou moins évoluées" (GRENIER, 1968: 195). The prevailing concept was always an exogenous origin: the basal type beneath sheets, along joints planes where moisture is retained, or to the side-wall type on vertical rock faces associated with the ground level weathering, provided the same explanation to the cavities found in the granite of Australia (DRAGOVICH, 1969), both clearly different of the small hollows groups named alveoli.

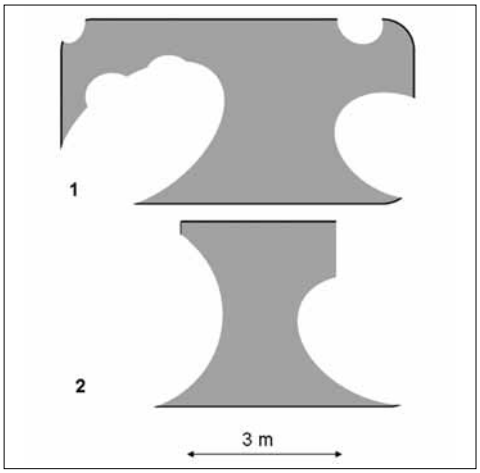

Fig. 4 Cross-section of cavities in oldest development stages from Grenier (1968).

At the beginning of 1970, really the available observations and the data of these landforms in the granite terrains were very numerous. They were noticed from all geographical environments (i.e. CALKING & CAILLEUX, 1962; WILHELMY, 1964; TSCHANG, 1966; PREBBLE, 1967). So, there was a need of limit and define the research landform and their operational nomenclature.

Looking at a new suitable typology

The landform terminology now has a strict sense as a specific weathering landform in the granite landscape. This meaning closes the research to many causal processes. On the one hand, this concept involves the two main classes of hollows typology derived by the size and the patterns which were used until this time. A differentiation of prior named alveoli or honeycombed surfaces (Photo 1) was made with more or less detail, not only about the general terms but also on the particular origins, for instance:

> "Cavernous weathering may be used as a general term for the many landforms made by weathering on steep slopes...occurs in many kinds of rock, in many climates an on many scales. Some cavernous weathering pits are know as ´tafoni´...The smallest kinds of cavernous weathering need a different term, and ´honeycomb weathering´ seems popular...Honeycomb weathering develops rapidly, perhaps in just a few years." (OLLIER, 1969: 236-237)

> "The nomenclature has not been standardised and authors have variously described this type of erosion as ´alveolar weathering´, ´stone laticce´ and ´stone lace´ Alveolar weathering has been preferred among French geomorphologist while publications in English often describe these features as honeycomb weathering or fretting. Commonly weathering features of this type are described as miniature tafoni although this usage is unfortunate since it implies that honeycomb is genetically related to large scale cavernous features (tafoni). Although tafoni and honeycomb weathering frequently occur together numerous locations exist where each occur independently suggesting possible differences in their mode of origin" (MUSTOE, 1982: 108)

On the other hand, many evidences on the complex features and the frequent compound hollows provided other morphological terms. The cavities were recognised not only under the side of boulders or into the walls bedrock but also into the curvilinear and laminar structures, being very frequent on the steepened slopes or flares where they were regarded as stages in a sequence of development from the weathering front evolution (TWIDALE, 1971). The frequent occurrence of ruined or inverted forms endorsed that a hollowing out rock is a natural irreversible process. In this way, the previous nomenclature position-based was multiplied according to the types enclosed by the field measures. Incidentally, this shape was explained outside the conceptual model of an origin only by weathering. For instance, the review of TSCHANG (1974: 43) pointed to the relationships between the inter-feet distance and the curvature of the basal forms (Fig. 5): the shorter distance is related to the higher curvature.

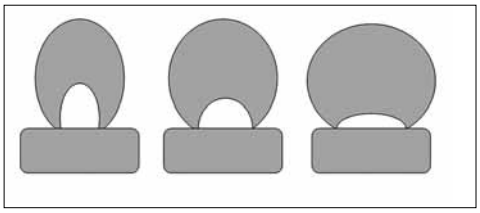

Fig. 5 Support distance and cavity curvature in Hong-Kong from Tschang (1974).

At this scenery the book about the granite landforms wrote by GODARD (1977) summarizes the morphology of these forms with the following words:

> "Creusés dans les parois rocheuses ou évidés aux dépends des flancs des grandes boules, les taffonis sont des cavités

arrondies dont la taille peut aller de celle d´un oeuf à celle d´une grande chambre. On en connaît des géants qui mesurent près de 10 m de hauteur et occupent un volume de plusiers dizaines de mètres cubes...mais les dimensions les plus fréquentes sont d´ordre métrique." (GODARD, 1977 o.c.: 112)

Considering the size range of landforms in the granite landscapes, this author identified the cavities with the minor rank level: the size is a criterion both to discriminate and to explain the landforms. These minor forms or *micromodelés* from a granite outcrop allows understanding the geomorphologic evolution because many generative events could be differed between them. Afterwards, when this line of argument was retained there ran into the question of the landform convergence whenever an explanation of genetic processes came next to an exogenous natural system.

The following monograph work about the granite landforms (TWIDALE, 1982) recognised the previous hollows dimensional range or types and also reflected the theoretical and practical unambiguously of their nomenclature. And many studies began to planning a different perspective in the conceptual and methodological sense of the accurate terms. The research in the granite lands from Galicia (northwest of Iberian massif, Spain) made at this time an interesting contribution set (VIDAL ROMANÍ et al., 1979; VIDAL ROMANÍ, 1983; VIDAL ROMANÍ, 1989). The hollow forms were named with the Galician term of *cacholas* or *cacheiras*. In these works the applied terminology attended to the main conditions that could affect the shape and the size, the growth trends or the eventual destruction of whatever rock cavity (Table 3). First, the main control variable on the dimensional and morphological features is related to the available rock volume that could be disintegrated inside the host unity which is limited by a discontinuity system; this control on the size and the shape could be a heritage from an endogenous system. Second, the hollow begins their development starting from this initial pattern on a single inner rock surface inside the host rock volume; since then, the main control variable concerns to the feedback relations between the structural and environmental conditions: a diverse differentiation usually appears in an active and non-active inner rock surface with regard to the weathering progress; later events can destroy the initial hollows pattern.

TERM	MAIN FEATURES	EQUIVALENT TERM
cachola pena	Equal-dimensional host block Well-defined rounded cavity Common inner alveoli The largest forms	Basal tafone Boulder tafone Tortoiseshell rocks
cachola laxe cachola lapa	Hetero-dimensional host block Hollow enlarged between joints Basal or lateral location Occasional inner alveoli	Basal tafone Sheet tafone Side-wall tafone
cachola fungo	Steeped or flared host rock Asymmetric hollowing out wall Rarely inner alveoli	Scarp foot cave Mushroom forms

*from Vidal Romaní et al. (1979); Twidale (1982); Vidal Romaní (1983 & 1989)

Table 3. Hollow types related to structural control (Galicia, Spain)*

The successive stages of the hollowing out in a host rock had been really named with different terms. This assertion may be proved in the research at this time, for instance from Italy (MARTINI, 1978) and from Finland (KEJONEN et al., 1988). However, in the last monographic publication of the twenty century dealing to the granite landforms (VIDAL ROMANÍ and TWIDALE, 1998) the main form types are described to look at a new conceptual sense of their nomenclature.

Photo 1. Alveoli pattern in the Ons Island (Galicia, Spain).

Photo 2. Complex of cavities in Achiras granite (Argentina).

TERMINOLOGY RELATED TO GRANITE FORMS LINEAGE

The mentioned terminology was understood as a descriptive and a conceptual tool according to the knowledge progress about the granite landforms. Generally, it was assumed that the different stages of the recorded forms were single components of the whole landscape. From this reasoning the cavernous rocks are identified as limited forms to be studied. The cited reports displayed their particular conditions, selecting the shape and the measure range starting from the most unusual cases. So, it was very difficult to explain the genetic and the evolutionary events related to these forms. However, if we consider these forms as the components of a geomorphologic continuum, their measures can provide a significant information (Fig. 6).

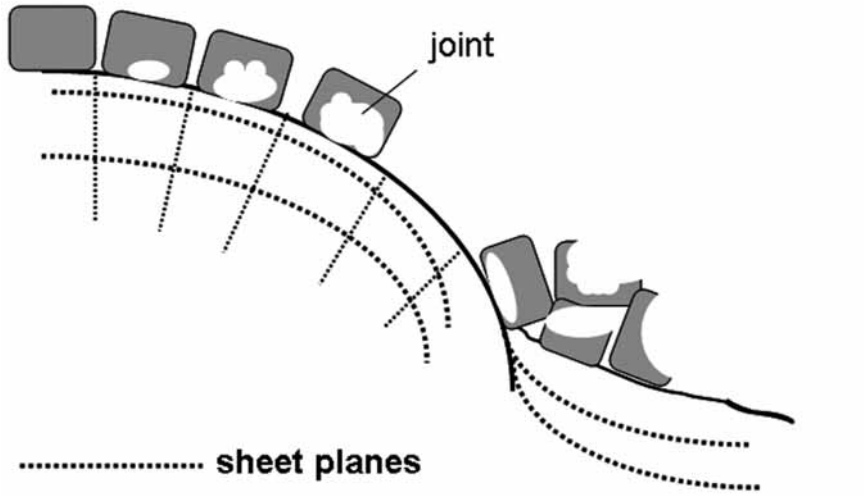

Fig. 6 Evolution of a granite slope with cacholas from Vidal Romaní et al (1984).

Found at many positions and climatic contexts, the development pattern of the cavernous features involves a complex progression from fresh to failed granite volume (Photo 2) reflecting cumulative changes in the structural and in the mineralogical rock properties. Today, the research clearly works on a self-destructive dynamical model of the hollows growth. This progression really proceeds in time periods where different evolutionary phases are more or less fit to a sustainable growth in size (UÑA ÁLVAREZ, 2004). The duration of each of these phases can be very variable and the current morphology of cavities in the field indicates a partial self-organization system, also subject to divergent pathways. The essential nature of their evolution is always an irreversible process (Fig. 7).

The terminology meaning could be less uncertain if the cavities are considered as multistage entities from a holistic model, the natural system. The key provided by the spatial location can be a valuable criterion from minor to medium topographic and morphologic scale; the key provided by the development stage can be a valuable criterion to a long time scale. But the derived nomenclature does not design unequivocally the wide hollows types observed according to the size, the inner walls stage, the preserved visor features

or the shape of the opening in the outer shell of rock (Photos 3, 4, 5). In order to define a nomenclature system associated with this conceptual sense, it is necessary to open the genetic and evolutionary model prevailing until today. It is necessary to think about the cavities morphological features as the development stages associated to many implied events with a granite outcrop history.

Therefore, we find in the field research a great variety in their location and their shape properties. For instance, a wide diversity appears in the features of their inner walls which can be regular, flaked, ribbed, honeycombed or scalloped, so that we must consider the possible generative fields with regard to a possible lineage of granite forms (VIDAL ROMANÍ et al., 2004).

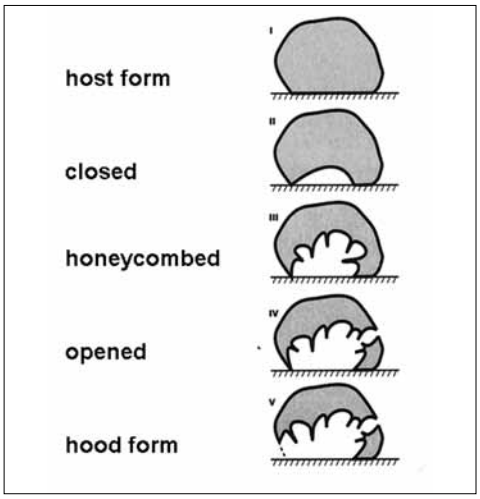

Fig. 7 Development stages in a boulder tafone (from Vidal Romani & Yepes, 2004).

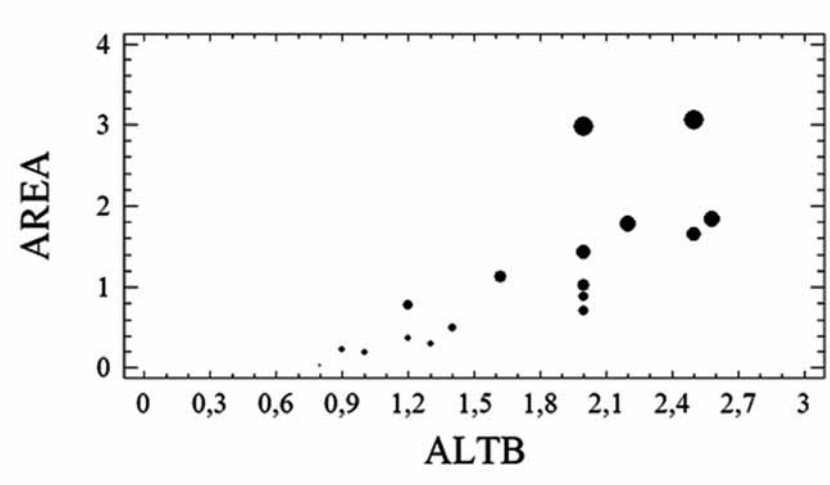

Fig. 8 Relation between block size and cavity area in Galicia (Spain).

The shape, the size and the different development stages of the cavities may be related to the behaviour of the main control variables already mentioned (Fig. 8). In fact, only so can be recognised the range of generative conditions and their features related to the age(s) from latent to primary hollows forms, later subject of weathering modifications (VIDAL ROMANI et al, 2006 o.c.). The vast majority of hollows inverse or laterally disposed on granite rocks clearly start from a fracture plane whatever their orientation and some few on

weathered surfaces or xenoliths (TWIDALE and VIDAL ROMANÍ, 2005 o.c.). This condition in most cases is field present: the cavities are related to the joint system which limits their host rock volume; and a recent empirical research demonstrates that the size and the geometry of this host rock have a significant control on the size and the shape of these cavities (UÑA ÁLVAREZ and VIDAL ROMANÍ, 2006). The generic approach supposes that several morphogenetic fields can explain the control conditions related with the origin and the development of the hollow forms. So, the forms are termed according to the field research at an endogenous, subsoil or surface environment. The *printed tafoni* or *latent tafoni* name the lacunars spaces delimited by the rock discontinuities at the apical or inner zone of a granite outcrop. Later evolution of this initial pattern can be recognised in the *primary endogenous tafoni* at the granite landscape. The *primary exogenous tafoni* can also exist associated to the natural relationships between a jointed rock volume and the subsoil or the external agencies. Whatever of these forms can be degraded in *secondary tafoni* forms until their last ruined. Along this entire evolutionary path only some cavernous forms retain their generic design, for instance a single cavity basal, reflecting an invariant morphogenetic set. In order to identify the possible morphogenetic type, we need to go on with a mixed spatial, morphological and statistical-dimensional research approach.

Photo 3. Cavernous form very developed in Achiras granite (Argentina).

Photo 4. Complex cavernous form in Achiras granite (Argentina).

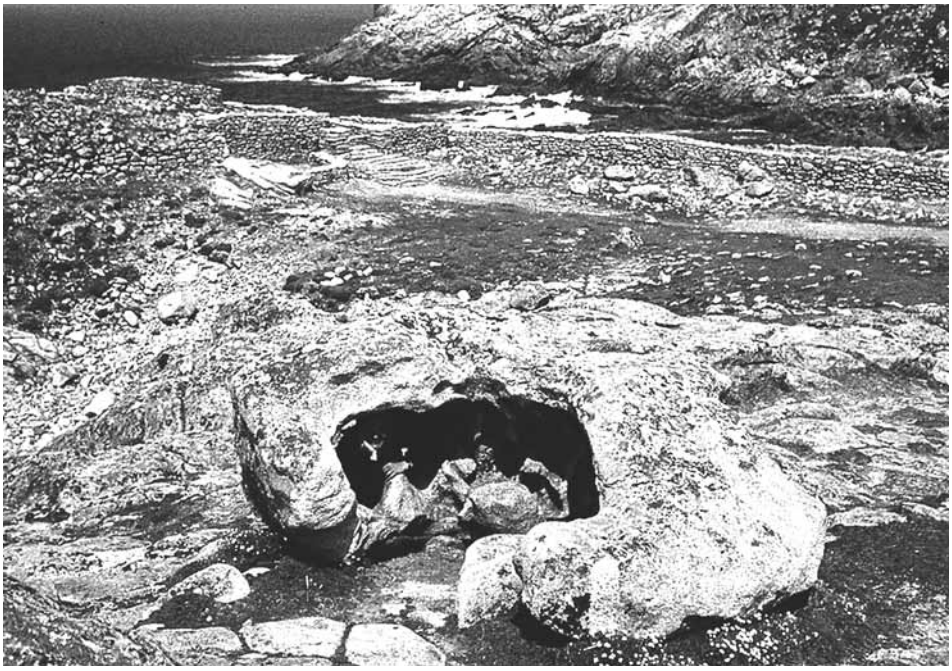

Photo 5. Basal form with lateral window in Baroña, Galicia (Spain).

FINAL STATEMENT

The tafone or cavernous granite forms typically show a size range from several centimetres to several metres in opening diameter and their perpendicular axis. Such variation of the size can provide a confused genetic meaning related to the identification of some alveolar forms. The alveoli are really discriminating by their small dimension but over all the morphological key concerns to their inherent closed pattern (honeycombed). And in the conceptual sense of the terminology we are usually dealing to inner alveoli of the cavities which reflect an anisotropic development stage. These forms were already explained with a different morphogenetic approach at the twenty century beginning.

USEFUL TERMINOLOGY APPLIED	
Tafone (Tafoni)	Cavern (Cavernous weathering)
Taffone (Taffoni)	Cavernous rock surface
Basal tafone (or taffone)	Basal cavern, Basal cave
Boulder tafone	Tortoiseshell rock
Sheet tafone (or taffone)	Rock niche, Rock hollow
Sidewall tafone (or taffone)	Scarp foot cave, Mushroom rock
MAIN FEATURES FIELD OBSERVED	
Diverse opening plane shape	spherical, hemispherical, elliptical, irregular
Cross-section in arch shape	hemispherical, hemi-ellipsoidal
Inner walls concave surface	regular, flaked, honeycombed, ribbed, scalloped
Diverse external walls stage	fluting, hollowing, preservation of visor or hood
Connecting to the outside	occasional by windows in the outer shell of rocks

Table 4. The most common terms and features of granite cavities studied.

The description and the nomenclature of the cavities studied in granite terrains over time notes many common features from the morphological types differentially named (Table 4). At successive research approaches these features were included in a nomenclature scheme based on several key criterions (i.e. location in host rock, development stage). Also, they were used to explain the cavities from a single or mixed action of the exogenous agencies. A similar approach was retained to these landforms research in non-granite terrains where the morphological features closed by the terms are also confused; therefore, similar terminology problems are present in non-granite terrains. And in this case the researches equally noted that in the hollows pattern there is a control "by the internal fabric of the rock on where tafoni develop" (McBRIDE & PICARD, 2000: 878). So, a different conceptual and a different methodological approach are necessary. Some former ideas and some current prospects mentioned can provide the keys in order to clarify the future nomenclature framework.

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