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ORNAMENTAL STONE IN APRICENA BASIN: GIACIMENTOLOGY FOR PLANNING

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EXTENDED ABSTRACT

Il Bacino estrattivo di Apricena, ubicato nel settore più occidentale del Promontorio del Gargano in Provincia di Foggia, si estende su un'area di circa 15 km^2 ricadente nei territori comunali di Poggio Imperiale, Apricena e Lesina.

Dal punto di vista morfologico, il Bacino si sviluppa su un altopiano collinare, con quote comprese tra 80 e 130 m s.l.m., allungato in senso est-ovest; questo è raccordato ad oriente ai più acclivi e imponenti versanti montuosi del Promontorio mentre digrada dolcemente verso occidente. Di fatto è possibile osservare, soprattutto nella parte alta dei fronti di molte cave, la presenza di reticoli di fratture e discontinuità variamente orientati e articolati, allargati dai processi carsici, inghiottitoi, cavità e condotti, di dimensioni non elevate, e diversi orizzonti o sacche lentiformi riempite di terra rossa, tipico prodotto della dissoluzione carsica. Gli effetti di questi processi tendono via via ad attenuarsi fino a scomparire con la profondità, laddove la roccia assume la naturale compattezza e continuità.

In termini di volumi estratti, al 2014 sono stati stimati, circa 30 milioni di mc, e in alcune zone si sfiorano i 100 m di profondità, e si raggiunge quasi il livello del mare. Le indagini litostratigrafiche e le analisi litologico-petrografiche hanno consentito di ricostruire e caratterizzare le locali successioni litostratigrafiche. Queste, stratigraficamente sovrapposte senza soluzione di continuità, sono indicate con i termini delle principali varietà merceologiche coltivate in ciascuna di esse, dal basso verso l'alto sono riconoscibili: "Successione del Fiorito", "Successione del Biancone" e "Successione del Serpeggiante".

A modellare in maniera significativa le superfici topografiche dell'intera area concorrono le numerose discariche degli scarti (ravaneti) dell'attività estrattiva, che costituiscono colline artificiali molto estese e alte fino a 50 m. Si aggiunga che lo scarto prodotto e accumulato attraverso la realizzazione dei ravaneti è pari a circa il 30% del volume estratto, circa 9 milioni di mc, con occupazione di suolo vergine pari a circa 3 kmq, quantificato pari a oltre 1 milione di mc. La presenza dei ravaneti pone due problematiche: la prima riguarda i danni connessi al forte impatto ambientale e visivo da essi creato nell'intera zona, conseguenza di una evidente modificazione in elevazione della morfologia originaria superiore a 50 m; il secondo concerne le limitazioni e/o impedimenti alla coltivazione del materiale che tali ravaneti creano in aree potenzialmente sfruttabili. Considerate le dimensione dell'area e l'attività estrattiva in esercizio attualmente e programmata per i prossimi decenni appare un'utopia pensare ad un unico progetto di reintegrazione nel paesaggio di questo territorio.

E' necessario, invece, procedere al recupero e al riutilizzo dell'area, precedendo per step, ovvero cominciando da quella porzione di territorio che attualmente è sede di piccole cave oramai abbandonate da tempo e prive di futura utilizzazione per l'attività di cava, a causa dell'esaurimento del patrimonio giacimentologico, e per cui diventa pressante trovare una soluzione che permetta a questi spazi di trasformarsi da luoghi dell'abbandono a luoghi di sviluppo economico futuro.

Il progetto di recupero dell'intera area di bacino segue dunque i medesimi principi del recupero delle singole cave (area attiva, area di futura espansione, area di recupero a servizio), e pertanto si è pensato di identificare una strategia di pianificazione che preveda la suddivisione in aree a carattere e vocazioni differenti:

- le Aree Interessate da Attività Estrattiva Pregressa: aree caratterizzate da cave in esercizio o in fase di dismissione, in cui sono evidenti i segni profondi lasciati dall'antica e pregressa attività estrattiva, e dove la prosecuzione dell'attività è consentita per ampliamento o proroga della attività esistente in funzione dei fabbisogni stimati dall'Osservatorio Regionale.
- le Aree Suscettibili di Nuova Estrazione: le aree comunali e intercomunali dove è consentita l'apertura di nuove cave in funzione dei fabbisogni stimati dall'Osservatorio Regionale; coincidono con le aree più occidentali in: queste aree sarà possibile rilocalizzare le attività estrattive esistenti disperse sul territorio, favorendo la salvaguardia e tutela di aree di pregio ambientale esterne ed interne al bacino da sottoporre ad interventi di recupero ambientale;
- le Area destinata a recupero e attività a servizio delle cave: coincidenti con la parte orientale del bacino, aree compromesse da pregressa attività estrattiva caratterizzate da un elevato numero di cave abbandonate e dismesse che versano in stato di degrado paesaggistico-ambientale e che si configurano come siti il cui recupero riveste un interesse pubblico generale prioritario.

ABSTRACT

Puglia occupies a significant position in national and international fields for the production and trade of ornamental stone for both quantity and quality. The ornamental Apulian stones, thanks to the recognition of their good technical and aesthetic characteristics, have undergone considerable commercial development determined not only by the relative ease of extraction that makes them economically competitive.

The trend toward a planning policy that takes into account less land use could mean a reduction in extractive activities for the future. In fact, a greater understanding of the soil potential of the mining basins could allow optimization of cultivation and more effective planning of recoveries.

The Apricena extractive basin, located in the westernmost area of the Gargano Promontory in the province of Foggia, falls into the communes of Poggio Imperiale, Apricena and Lesina (Fig. 1). The area covered by the Apricena basin has a very large extension (about 14 km^2): this is the largest basin area recognized for the Apulia Region.

The marble deposits occur almost everyone in the formation of the lower Cretaceous. They are located to the north- western slopes of the Gargano Peninsula, on a large terrace at an altitude of 110-130 m a.s.l. shaped abrasion post - Mesozoic marine and affected by tectonic stresses of varying intensity.

The knowledge of the geological characteristics of the entire area of the mining basin of Apricena allowed to envisage the availability of the field of ornamental stones. For territorial planning through the collection and assessment of all information about the technical quality and the continuity of the limestone facies it has been possible suggest elements for estimate and availability of the main varieties of ornamental stones. This work contributes to the optimization of the methods of planning and design of the extraction of Apricena basin activities.

Key words: *ornamental stone, quarries, apricena, giacimentology*

GIACIMENTOLOGY

The geological conditions are represented by the presence of Mesozoic carbonate rocks, on which rests, in transgression, with angular unconformity, Cenozoic and Quaternary rocks of

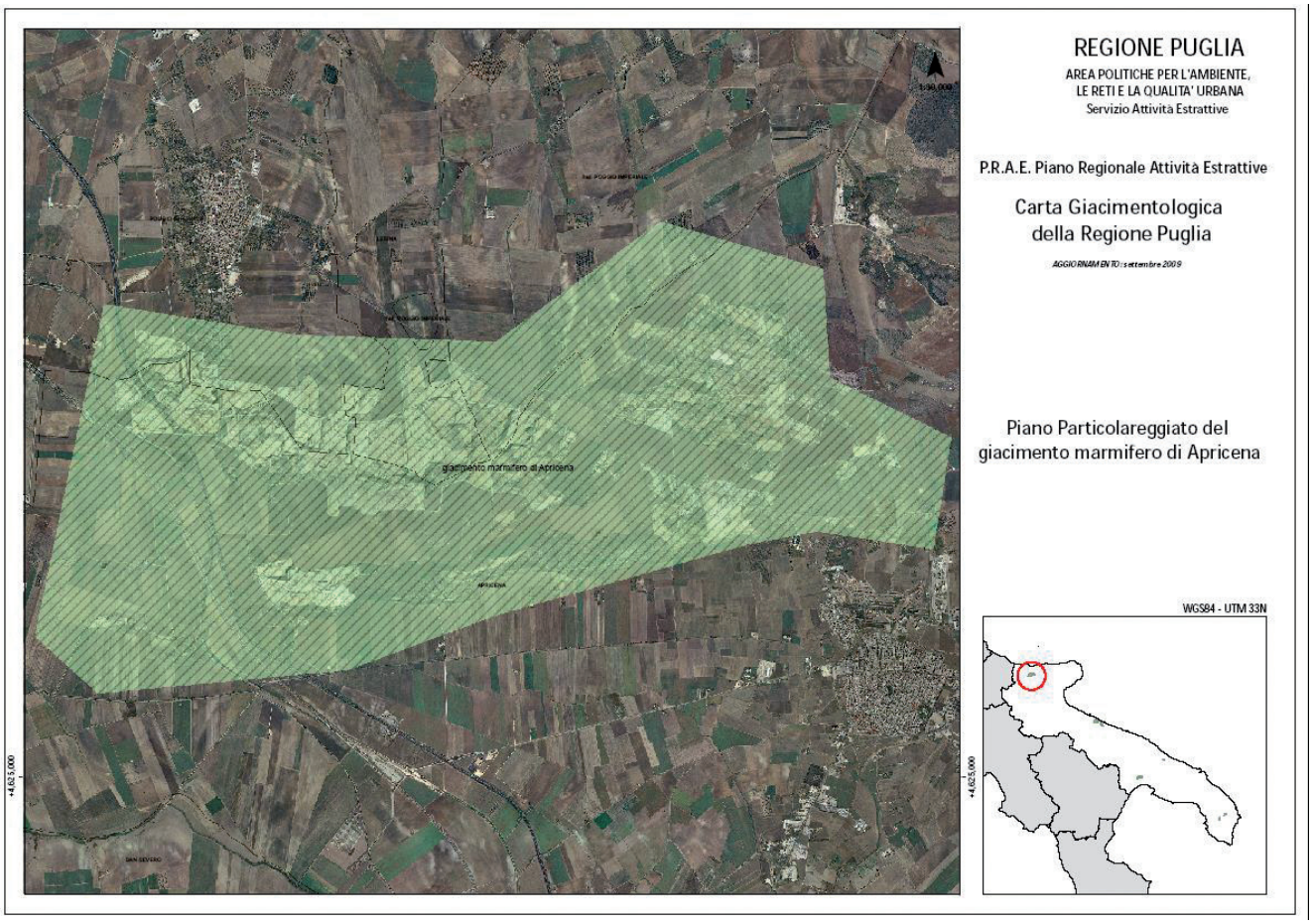

Fig. 1 - Location of mining Basin of Apricena (FG) – source Regione Puglia

various lithology (Fig. 2). The Mesozoic succession aged to Lower Cretaceous, between the Berriasian and Aptian lower. It is a succession of well stratified limestone rocks consist of micritic calcilutites whitish or light brown or pinkish, with rare and thin intercalations of greenish clay. A different heights are layers or groups of layers of limestone and limestone with stromatolitic and oolithic horizons.

Layers and banks of limestones that form the Cretaceous succession, thickness over 500 m, have an orientation approximately east-west, dipping to the south, and an inclination ranging from 5° to 30°. The general arrangement monoclinalic S-W folds is characterized by wide-ranging and normal faults, roughly parallel with the prevailing east-west directions and subject to NE- SW, with the highest throw, in some cases, up to almost 50 m.

Lithological and sedimentological point of wiew, the limestones can be related to sedimentation produced on a shallow waters, and extended in large areas of the lagoon circulation more or less restricted originated on the inner edge of the Apulian platform in the lower Cretaceous. The succession is characterized by the repetition of layers of limestone and dolomitic limestone, peritidal environment, usually organized in cyclothems, the corresponding from subtidal to sopratidal, and hydrodynamic effects show both high both low energy. Carbonatic facies are represented by fine-grained micritic limestones gray and brown, usually well stratified, in many cases with structures in planar or corrugated sheets, both from biological (stromatolites) and detrital and load structures (stylolites). The facies with the highest energy correspond to granular limestone (calcarenite) fossiliferous (rudist) generally stratified. Sometines these facies are associated at different heights stratigraphic thin intercalations of greenish limestone layers.

On the limestone just described lie, in transgression with an angular unconformity, Cenozoic rocks. The thickness varies from place to place, remaining between a few meters and 30 m. The structure is almost horizontal. In some places, the contact between the carbonate rocks and limestones are found horizons of sandy silt reddish in color.

A main system of faults, trending east-west (probably in agreement with the direction of the Rift morning and the Rift of Rignano) locally displaces some portions of the Cretaceous succession. The system of normal faults with EW directions predominantly determine fault planes dip opposite producing the lowering of the carbonate bedrock at the area of the district and Rodisani Mass. Cioccherelle. In this area had the greatest thickness of sediments calcarenitic and sandy Plio-Pleistocene, which constitute the capping of the reservoir (Fig. 3).

Somewhere the carbonate rocks are very fractured and karstified, with plenty of fillings of red earth, and with the presence of tectonic breccias.

Fig. 2 - Aerial view of Apricena basin (Photo by Scaraggi)

Ornamental stone	Thickness (m)	First choice blocks (m^3)	Rock waste (%)
Fiorito	45	3÷6	30
Biancone	80	3÷5	45
Serpeggiante	95	1.5÷3	25

Tab. 1 - First choice blocks for the main varieties of stones

In relation to the morphological conditions essentially flat, the quarries of Apricena have been and are still grown in the open pit. The extent of the cave varies between 1.5 hectares and 15 hectares (on average from 2.5 to 3.5 hectares) while the height of the fronts abatement, referring to the mean plane of the countryside and the mid-plane of the bottom of the quarry, is between 15 m and 100 m (on average 40-50 m).

The varieties of Apricena Stone, really grown on a continuous basis, are as follows: Serpeggiante, Fiorito adriatico e Biancone (Fig. 4; Tab. 1).

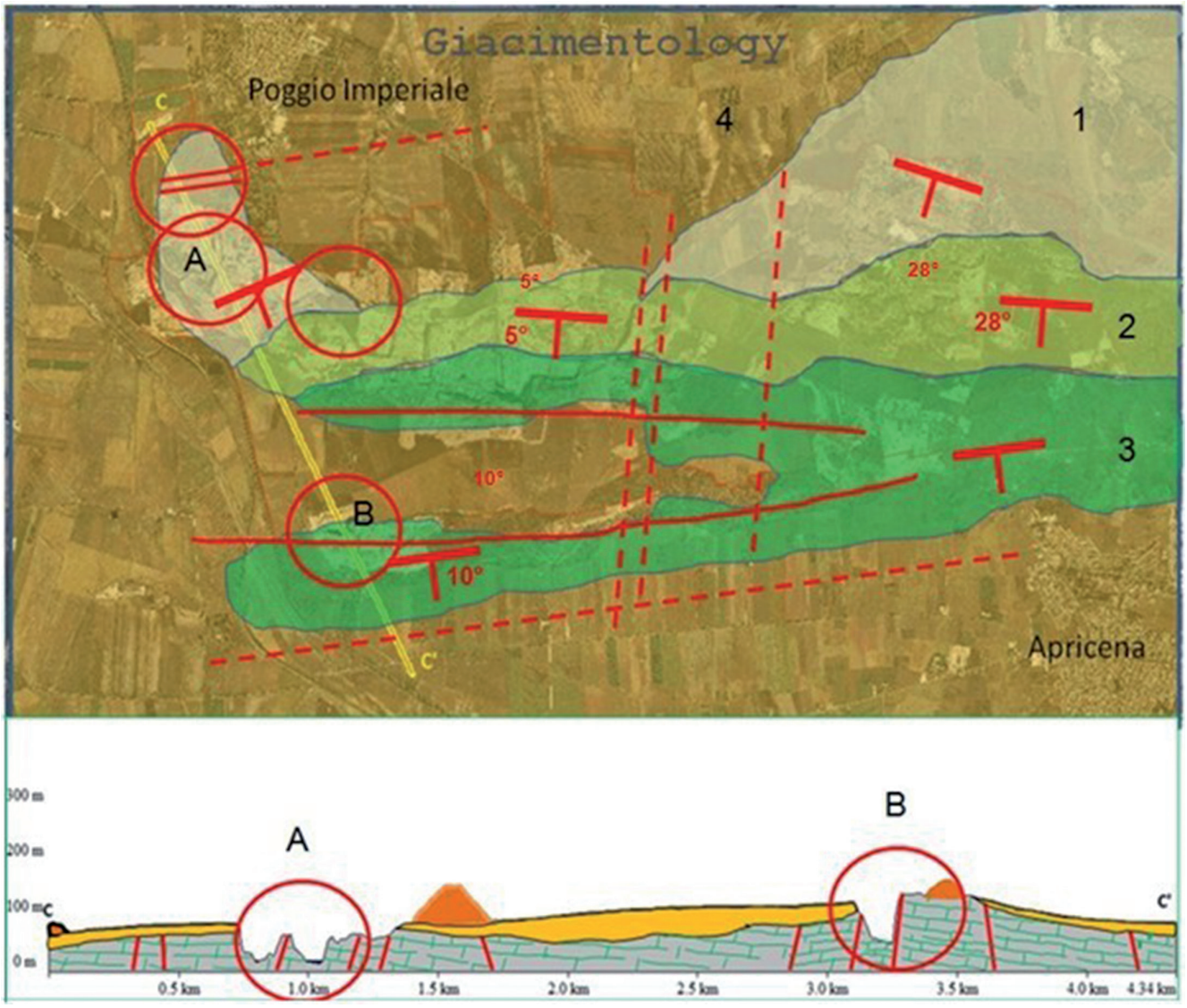

Fig. 3 - Geological map of Apricena Basin; 1 - Succession of Fiorito; 2 - Succession of Biancone; 3 - Succession of Serpeggiante; 4 - Deposits of overlay post Cretaceous

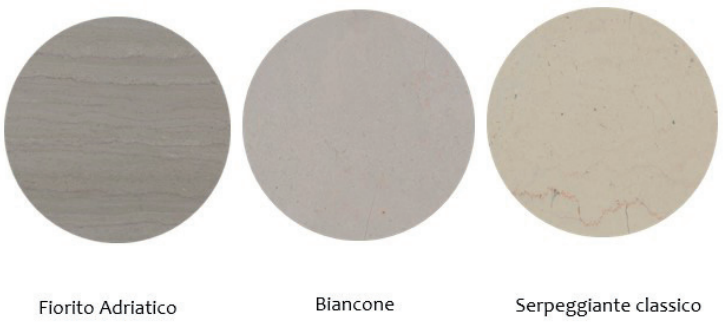

Fig. 4 - The varieties of Apricena Stone

Fiorito Adriatico

This type of ornamental stone is distinguished by compactness, continuity and for a presentation almost glowing, making it one of the nicest regional lithoid, extremely suitable for application architecture when you want to achieve a strong decorative effect. The Adriatic Flowery joins to these excellent aesthetic values, technological characteristics certainly good, with a compression resistance higher than that of the greater extra - regional competition, and with less resistance to bending of a few points to Puglia average. It‘ should be noted that the relatively low specific weight, which makes the Adriatic flowery one of the most interesting marbles. However, this is a material in which the aesthetic and chromatic prerogatives end up prevail over those technological. Like most of stone materials excavated in its area mining, the Adriatic Fiorito can count on proven reserves of good consistency. Even from this point of view, its use can be defined safely. Moreover, the satisfactory machinability of the material contributes, also in this case to keep unchanged the competitive economic level, which now constitutes one of the recurring requirements of Puglia stones, not already for a perfectibility of the quality parameter, but for a valent of quarry and organization of work, aimed at enhancing the highest degree a stone as interesting.

Biancone

It is a micritic limestone, dolomite slightly, very compact, durable and with intrinsic characters certainly uniforms. It has a conchoidal fracture ; its white powder.

Always it has a very clear background color (whitish or hazel) and does not have the bandages and the different colored veins so common and characteristics for the other varieties of the “Stone of Apricena“, or, at least, the shows always very tone attenuated. A few tiny hollowness of the rock is filled with secondary calcite and stands out as a faint darker punctuation.

This marble is devoid or almost of fractures, even of stilolitico type. About his name, remember that it is reminiscent of the classic compact limestone, milky - white, of infracretaceous titonic - aged, from the Veneto region, rich in stylolites and characterized by a very fine and typical conchoidal fracture.

Serpeggiante Classico

It is highly compact limestone, with splintery fracture and white powder. It presents some small vacuole, filled by secondary calcite. Intense the degree of diagenizzazione which has almost completely erased the original oolitic texture. The predominant background color is the warm tone, straw-yellow, passing sometimes light brown. It enlivened by winding band highlighted by an accentuation of the main color tones. Within these bands, lighter in color, can be identified minute oolitic formations. There are common red veins, in similar conditions of fracturing of the rock, in the “Apricena stone“.

The basin of Apricena consists of sequences that are characterized by the prevalence of the terms of the on these varieties: “Succession Fiorito”, “Succession Biancone” and “Succession of Serpeggiante.

“The Succession of Fiorito, about 45-50 m thick, is represented by fine-grained limestone and fine beige - brown, with streaks, and calcite veins and/or stylolites. The thickness of the layers is between 70 cm and 6 m. The bioclastic limestones are represented by bivalves, gastropods, ostracods, foraminifera and calcareous algae, are also pellets, intraclasts, stylolites, small cavities and fractures filled by calcite cement.

The interval corresponding to the succession of Biancone is about 60-70 m thick and includes fine-grained limestone and media whitish or brown-beige, with stylolites, in which the thickness of the layers is between 1 and 5 m. In these limestones are present also intraclasts and rare bioclasts (ostracods, foraminifera, calcareous algae).

The Succession of Serpeggiante is distinguished by the constant presence of rock types with distinct lamination. The thickness of the sequence is about 100 m. The foils, easily recognizable by the narrow chromatic variations, have a pattern of parallel corrugated up to deformed contours are blurred and net thickness from millimeter to centimeter. It is laminitis stromatolitiche, with places in the cavity of drying, to which alternating laminae consist pelmicrite and/or biopelmicrite. Just this typical lamination sinuous is the character according to which the sequence was called, as a whole.

Concerning the joints, their surfaces are all plane - parallel and very little rough. The distance between two discontinuities also reach values of 6 m. An optimum condition is represented by results in the inclination of the fractures, almost always perpendicular to the joints of layer. This trend, appropriately evaluated in the planning of quarried, may allow the extraction of big rectangular blocks (First choice blocks) with only the sectioning parallel to the front.

In some case the production cycle of trading blocks is preceded by the removal of the overlay that in some quarry reaches 40 m (Fig. 5).

The cultivation takes place from top to bottom with the creation of one or more tiers. The operational phases, as a rule, are the primary cut, overturning or clipping in blocks (Fig. 6). These, in relation to the quali5ty of the material and the geometric shapes are classified into three classes: first choice blocks, those with commercial size and very regular six-sided (called blocks), second choice, those with some faces that deviate from the geometric shape (called “half-blocks”), the third choice, those that do not have a regular shape (called “unformed”).

The equipment and machinery used are carefully chosen depending on the characteristics of the reservoir. The means of excavation used to a greater extent is the chain cutting. An additional technical and/or self- drilling is the explosive (“splitting

Fig. 5 - Some areas are characterized by the presence of a overlay reaches 40 m

Fig. 6 - Concerning the joints, their surfaces are all plane - parallel

dynamic"). The transformation of most of stone materials in quarry products is accomplished in numerous establishments in the area organized in automatic production lines and continuous.

DISCUSSION

The geological characteristics of the Apricena basin are particularly influenced by the geological-structural structure. The layers have plots that depending on places can reach inclinations of up to 30°. In addition, some areas are characterized by the presence of a overlay of 40 m.

In order to make a quarry significantly productive, the design of a cultivation plan must take into account the following conditions:

- type of ornamental stone;
- outcrops of ornamental stones;
- thickness of overlay;
- strike and dip of inclined bed;
- discontinuities;
- evaluation of first choice blocks.

Concerning the purposes of territorial planning, it was possible to suggest the following work hypotheses. The subdivision of Apricena basin into three major macro areas (Fig. 7):

Fig. 7 - The subdivision of Apricena basin into three major macro areas: 1 - Area Affected by Pregressive Extractive Activity; 2 - New Extractable Area; 3 - Area intended for recovery activities of quarries

- Area Affected by Pregressive Extractive Activity: areas characterized by quarries in operation or in the phase of decommissioning, where the deep signs left by the old and former mining activities are evident and where continuation of the activity is permitted for extension of existing business.
- New Extractable Area: Areas where new quarries are able to be opened; in these areas the geological conditions are favorable and well respond to the conditions indicated.
- Area intended for recovery activities of quarries: These are areas affected by past mining activities but are characterized by many abandoned quarries in which have been rapidly depleted because the layers are heavily inclined.

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