NON-METALLIC DEPOSITS AND OCCURENCES IN CUBA

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ABSTRACT

This paper resumes the main of the distribution of Non-Metallic Deposit and Occurrences in Cuba. These characteristics are expressed on the base of geographical and structural geology, the geostructural zones and lithostratigraphic formations with the description of more than 54 types of raw materials in 653 objects, taken from the actualization of the homonymous Map, scale 1:500 000, by the main authors D.P. Coutín, J. Martínez and others, published by the Geological and Paleontologycal Institute in 1988. The non-metallic minerals represent 91% and the combustibles 9% of total deposit and occurrences. Using the principal genetic and industrial types of raw materials, the relations between geostructural and formational distribution in the time and space can be distinguished as well as their main areas of appearance.

INTRODUCCTION

The Map of Non-Metallic Deposit and Mineral Occurrences of Cuba, on whose update we base this work, is the final result of the systematizing-generalization process, for each raw material, as consequence of the unification of the geologist-technological (industrial) criteria, defined from the geological generalization reports, from regional distribution plans of the mineral accumulations on detailed geological base (principal geologist-technological relationships between object and structure), maps of degree of study of the explorations and for mineralogenic aspects that provide these, considering the genetic, industrial, technological characteristics and the reserve volumes -dimensions of the accumulation. It being determined with this the principal regularities of it existence and it search and prognosis (perspective) criteria in the formation and geological bodies.

STRUCTURED - FORMATIONAL AND GEOLOGIST - TECHNOLOGICAL REGULARITIES

Cuba is a typical arch of extinct volcanic islands, folded and continentalized in the southern edge of the Bahamas Platform as a polycyclical unit of geotectonic and mineralogenic development of extreme lithological and mineralogical diversity. Characterized by a wide volcanic sequences development during Cretaceous and Paleogene, plugged by large granitoids massifs, by the presence of limited areas of the pre-Jurassic basement and by Jurassic formations of carbonated, metamorphic and more restricted evaporitic character. Exist vast ofiolite massifs to discontinuous belt manner. It is typical the shortage of molasoid sequences and a vast development of Neogene carbonated sequences and Plio-Quaternary rocks and sediments. In this context were discovered deposits of some 53 types of non- metallic raw materials that grouped more than 359 deposits and multiple occurrences.

These deposits belong to the following **principal geostructural unit**s:

COVERS

Different lithologies of sedimentary rocks. Late Neogene to Recent Quaternary Cover; deposits of clay, polymictic sand, quartz sand, bentonite, limestone-calcareous dolomite, phosphated limestone, phosphorite, marl, magnesite, kaolin, opal-chalcedony and peat, Early Neogene Cover; deposits of clay, limestone, phosphated limestone, marl, magnesite and palygorskite, Late Paleogene Cover; deposits of clay, limestone, phosphated limestone, marl, chalcedony and peat, and Upper Cretaceous Cover; deposits of calcarenite, limestone and zeolitic tuff.

STRUCTURED-FORMATIONAL ZONES

Sagua (P_2^{1-2}, sedimentary rocks); deposits of clay, limestone, marl and chalcedony, Pinar del Rio-Vertientes (P_1-P_2^2, sedimentary and scarce volcanic rocks); deposits of clay, marl, sandstone, asphaltite, chalcedony, zeolitic tuff and tuff, Maniabón-Nipe-Sierra Maestra (P^1-P^2_2, volcanic and sedimentary rocks and granitoides P_2^2); deposits of clay, barite, bentonite, limestone, marble-like limestone, chalcedony, feldspar, zeolitic tuff, granitoids, andesite, dacite, basalt and volcanic glass, Zaza (K_1^v-K_2^{cp}, volcanic and scarce sedimentary rocks, ultrabasic and basic rocks K_2^1 and granitoids K_2^{1-2}); deposits of clay, chrysotile asbestos, asphaltite, barite, limestone, kaolin, quartzite, chalcedony, garnet, jadeite, feldspar, granitoids, gabbroids, andesite, dacite, diabase, basalt, serpentinite, zeolitic tuff and volcanic glass, Esperanza-Guaniguanico-Camajuaní-Placetas (J_{1-2}-K_2^t, sedimentary rocks, ultrabasics and basics K_2^1 and granitoides K_2^{1-2}); deposits of barite, limestone, cuarcite and silicite, Remedios (J_{1-2}-K_2^m; sedimentary and evaporitic rocks); deposits of limestone-dolomite, gem salt and gypsum and Isla de la Juventud-Escambray-Puriales (J_3, sedimentary metamorphosed rocks); quartz and marble deposits.

METAMORFIC BASEMENT

PreJ?-J; metamorphic rocks; deposits of amphibole asbestos, quartzite, quartz, graphite, marble, muscovite, kyanite, garnets, feldspar, serpentinite, amphibolite and talc.

Nevertheless the extreme lithological and mineralogical diversity and the ownership to various genetic types, in the territory is manifested certain persistence in the industrial accumulations appearance that are repeated in different mineralogenetic eras. According to the abundance of it deposit and the economic relevancy of it exploitation the more important eleven matters outweigh are limestones-dolomitic limestones, clays, polymictic sands, magmatic rocks (mainly andesites), zeolitic tuffs, quartz sands, kaolins, marls, dolomites-calcareous dolomites, bentonites and marbles. More limited are exploited, feldspars, phosphorites, gypsums, magnesites, serpentinites and occurrences of variable importance of semi-precious stones (mainly chalcedonies and opals). Are exploited indistinctly more than 240 deposit, but the

exportable items relapse on marls, zeolites, serpentinites, quartz sands, and ended products as calcium carbonate and cement.

More than half of the principal matters has practical use, proven by the exploitation and utilization of the useful material in the national economy. The rest include rocks and mineral of potential use where some of them were extracted and used to less scale or were made trials of development on past eras (asbestos, barite, quartz, mica, gem salt and gypsum) and others are of new types recently technologically studied as palygorskite, wollastonite, garnet, graphite, kyanite, quartzite, silicite and volcanic glass.

PRINCIPAL GROUPS OF RAW MATERIALS

CLAY Pre-Q until Plio-Q genetic types. The *sedimentary* type is alluvial and alluvial-marine, the *residual* are weathering crusts on carbonated and metamorphic rocks and limitaly on serpentinites, gabbros and granitoids and the *hydrothermal* type by alteration of intermediate vulcanites. Form beds and irregular lenses with scarce useful thickness, montmorillonite, with some kaolinite (residual and hydrothermal types), low to mean-variable plasticity and low-mean refractority (hydrothermal and residual types). Use in massive and alleviated bricks, tiles, channeling pipes and pottery as a rule and limitaly in cement.

SAND Plio-Q genetic types. The *sedimentary* type is alluvial and marine of dunes and beaches and the *residual* type are weathering crusts on cretaceous and paleogenic granitoids. Scarce useful thickness beds and lenses, polymictic to calcareous and quartz bearing, by regions, occasionally granitoidical of feldspar and quartz (residual type) and mean-fine granularity. Use as natural arid to prepare concrete and mortars and other as correcting in cement.

QUARTZ-BEARING SAND Plio-Q alluvial-deluvial, alluvial-marine and marine fossil beaches beds, 5-10 m useful thickness and lenses (alluvial type) with minor thickness than 5m, predominantly quartz-bearing and occasionally contaminated with clays (alluvial type), mean - fine granularity and high purity of SiO_2 permitting it use in smelting molds, flat and optical glass, pastes for fine ceramics, natural arid and white cement for mortars.

ASBESTOS The *hydrothermal-metasomatic* (chrysotile) type, Cretaceous, in peridotites intensely tectonized and serpentinized, 1- 3% mineralized, 1-2 mm short fibers and semifragiles. Lengthened lenses as complex lodes and stockworks. The Jurassic *metamorphogenic* (amphibole) type, mineralize few centimeters thickness in metamorphosed sequences of green schists and serpentinized apointrusives, little volume and long-fragile fibers, being associated to talc and actinolite. Use in asbestos-cement (channeling pipes, infinite tiles and water tanks) and thermal insulator (amphibole).

ASPHALTITE Encased in Cretaceous and Paleogene rocks. Veins, lodes and bolsom bodies associated with fractured zones. Grahamite or Gilsonite, hard to brandish doughy, and in occasions half-liquid bitumen. High ashes and sulfur content limiting it quality, though in other cases have high energetic value and quality, making feasible it use in flammable, insulating, agglomerates, paintings, plastic, etc.

BARITE Jurassic, Cretaceous and Paleogene complex *hydrothermal* mineralization of barite and quartz-barite (50-90% $BaSO_4$), iron-barite and quartz-iron-barite (20-80% $BaSO_4$) and barita-Pb-Zn polymetalic (15-20% and occasional 60-70% $BaSO_4$), forming veins, lodes, lenses, nests and until bolsoms associated with tectonized zones in mineral fields. Use chemical-pharmaceutical and drilling muds.

BENTONITE The *sedimentary* type is Quaternary, alluvial and alluvial-marine, and the *vulcano-sedimentary* type is Paleogene, vulcano-hydrothermal product by low-temperature alteration on intermediate tuff rocks. Beds and lenses (alluvial) with 3-18 m useful thickness (sedimentary) and 30-40 m (vulcano-sedimentary), montmorillonitic, acceptable cationic exchange, good dispersion, low-carbonated content, high plasticity and fine granularity. Use in smelting molds, massive and alleviated bricks, pottery, drilling muds, waterproofing of soils, filtering of fats and oils, bleaching agent, soaps and other.

LIMESTONE AND DOLOMITIC LIMESTONE Massive until stratified beds and occasionally lens and isolated patches from Jurassic to Quaternary. Calcitic, with dolomite (dolomitic limestones) variable contents. They are organical, pelitomorphical, marly or tuffy limestones, limestone or limestone-dolomite and silica breccia and even calcarenites. Assorted influence of recrystalizacion, tectonic and weathering, good physical-mechanical properties and high purity average of $CaCO_3$ permitting to use them as triturating arid for concrete and mortars, decorative in plates and fragments, fusing, bearing of CaO in cement, soils improvement and lime.

KAOLIN Plio-Q genetic types. The *residual* types are weathering crusts on metamorphic rocks and in part on granitoids. The *hydrothermal* type is produced by alteration of intermediate-acid vulcanite fields. Lengthened and irregular beds and lenses with 10-20 m useful thickness average, kaolinitic, with variable quantities of montmorillonite and quartz (residual type), good plasticity and due to their physical and chemical properties has sufficient quality for it employment in chinas, crockeries, sanitary furniture and fine pottery.

KYANITE Jurassic deposit, also including its Plio-Q weathering crust. Lenses-beds where the mineral impregnates with different concentrations high degree metamorphism apoterrigenous schists, arriving even to form monokyanitic beds. They are accompanied of sillimanite, estaurolite, garnet and andalucite. Average crystals of 0.5-0.7 mm and 8-9% general rock content. Favorable chemical characteristic to produce sparkplugs, coating oven pieces and bricks between other.

QUARTZITE The Jurassic *metamorphic* types are crystalline quartzites of chalcedony or cristobalite-tridymite of very fine granularity, forming lengthened lenses, tectonically dislocated as nappes, with 10-80 m useful thickness. Action of hydrothermal solutions on vulcano-sedimentary rocks and lavas of intermediate character associated with volcanic areas formed the cretaceous *metasomatic-hydrothermal* types (secondary quartzite). They are interesting the alunite, andalucite, diaspore and monoquartzite facies. They are used in metallurgy, refractory ceramics and fertilizer (alunite).

QUARTZ The Jurassic-Cretaceous *hydrothermal* mineralization is present as veins of Alpine type and veins associated with magmatic processes, with a very assorted lie and cracked and irregular forms. Form lenses or variable size bodies with very complex internal structure associated with large mineralized zones tectonically controlled encasing in metamorphic and volcanic rocks. Milky white material and semitransparent crystals or granulated with 99.08-99.32 % SiO_2 and 0.27-0.36 % Fe_2O_3. Able for optical glass, electronics (crystals growth) and jeweler's.

DOLOMITE AND CALCAREOUS DOLOMITE Jurassic-Cretaceous and Neogene vast and potent beds affected by carst, tectonic and irregular recrystalization. Prevail by regions from dolomites to calcareous dolomites and occasionally dolomitic limestones, indicating irregular dolomitization. They are organic, pelitomorfic and organodetritic rocks of bulk-mean stratification, hard, high resistance, good physical and chemical properties (favorable content of MgO). Dolomites are used in the glass manufacture and as fertilizer, calcareous dolomites are employed in the construction.

GRAPHITE Lenses and irregular bodies of Jurassic and Cretaceous graphite schists associated with metaterrigenous schists with no longer than 6% of graphite, oscillating the carbon in 0.86-5.21%. In other regions the mineral is presented as graphite bands in gneisses and schists in contact with serpentinites. Use as smelting powder, paintings, lubricants, pencils, refractory bricks, crucibles and refractory paintings.

GARNET The Jurassic *metamorphogenic* type forms irregular bodies in potent crystalline garnet (spessartite) schists with 12-15% average contents in the rock and 1-5 mm size. Its eluvials have important concentrations, but they are oxidized in 20-40% in it's bulk. The Cretaceous *metasomatic* type is grossularite and is associated to skarn formations from intermediate vulcanites. Have little volume. Use in millstones and abrasive papers and handicrafts.

MAGNESITE The Miocene *sedimentary* type (alluvial-marine), form great size and thickness lenses (6-11m), lying to variable depth. As average magnesite is 50-60% with 30% of mixtures of palygorskite and smectites and dolomite the rest, reaching 35.67% MgO and 11.97% SiO_2 average. The Plio-Q *infiltration-residual* type is from weathered serpentinites and form irregular bodies of high purity but low MgO and high SiO_2 contents. They are employed for fertilizer and bricks and refractory powders.

MARL Paleogene and Neogene massive to stratified beds with 5-70 m useful thickness. Rocks with calcite and montmorillonite variable mixtures, compact, hard, little plastic, with oscillations in the content of CaO, occasional high silica module and processes of dolomitization. Adapted chemistry for bearing CaO in cement and massive bricks.

MARBLE Massive Jurassic beds, but they can exist among them as stratified marbles of variable thickness, color and granularity. Affected by tectonic, leakage and carst. Composition; variable calcitics (white of bulk granularity), dolomitics (cream white and light gray of saccharoidal texture) and calcic-dolomitics (dark gray of middle granularity). Of bulk-very bulk crystals with light-dark gray tones, pearly and black bands texture (free graphite). Have high content of $CaCO_3$ and very low of metallic oxides and insoluble residues. Its physical-mechanical properties and its nice drawings and colors make them able as decorative stone in plates and fragments and crushing arid for concrete.

MICA Muscovite. The Plio-Q *mechanic-residual* type is a crust on regional metamorphogenic rocks with metasomatic-hydrothermal (greissenization) superposed effects. Vast beds with 15-40 m useful thickness, 10.3% average mica content and 3-5 kg/m^3 yield by meter of thickness. The Jurassic-Cretaceous *aplitic-pegmatitic* type is encased in schistose metamorphic rocks forming quartz veins where micas occupy the edges, with average scales of 1 mm. Use in paintings, electrodes, cosmetic and insulating.

PALIGORSKITA Large Miocene marine lenses with 5 m average thickness and more than 50% of useful mineral, due to be between clayey montmorillonitic-magnesial or marly sequences. They are palygorskite-pilolites or shale-palygorskitics and marly palygorskites made from palygorskite and dolomite mixtures with some of calcite. Use as filtering lands of edible oils, bleaching-filtering of oils used lubricants and for drilling muds.

SEMIPRECIOUS STONES Different genesis and ages chalcedonies, opals and jadeites. The Jurassic, Cretaceous and Paleogene *hydrothermal* type (chalcedony) form veins, lenses, nests and amigdules, associated with intermediate vulcanites and porcelained limestones. With light gray color are accompanied of milky quartz and sometimes of amethyst. Bayate is hydrothermal-metasomatic silicite with red-yellow color associated with manganese deposit. The Plio-Q and Paleogene *sedimentary* type (chalcedony), is derived of destruction from hydrothermal types and form conglomerate beds. Gray, yellow or reddish colors are accompanied of agates and silicites. The Plio-Q *infiltration-residual* type (chalcedonies and opals) form crusts on serpentinites generating veins in it bulk or blocks and fragments coluvials. Chalcedony type cachalonga with white and white-blue colors are accompanied of amethyst and crisopase. Green, yellow, orange and black color opals, is accompanied of chalcedonies. The Cretaceous *metamorphogenic* type (jadeite), form massive bodies of jadeite green-grayish rock, monomineral, of fine granularity and is associated to serpentinized apointrusive series. All the minerals and types are used in jeweler's and handicraft.

FELDESPATIC ROCK The Cretaceous *aplite-pegmatitic* type forms dike bodies, veins and occasional lens-form bulks of quartz-feldspar (albite-oligoclase or microcline-ortose) mineralization. Chemistry varies by regions from calcic to calco-sodic and sodic-potasic, with variable iron and silica contents. The Paleogene *magmatic-extrusive* are altered and silicificated acid lava bodies with hydrothermal alteration and kaolinitization, with mainly Na-feldspar with 5,70-7,10% alkalis. Use in sanitary furniture, tiles, fine pottery, bottles, pigments and white cement.

PHOSPHATIZED ROCK The Paleogene-Neogene *sedimentary* type is forming phosphatized limestones of organic character with variable P_2O_5 percent (1-19 % and 7% average), being the phosphatizing associated to granular phosphorites and calcarenites. Massive and potent beds. The Plio-Q *residual* type are eluviums with 40 m average thickness on limestones with

variable fluor-apatite contents forming an amorphous bulk of phosphated (colophane) material, clays and silicy rocks, 25% average P_2O_5. Use in fertilizing.

MAGMATIC ROCK Cretaceous and Paleogene lithological types. *Volcanic* types have intermediate-basic (andesites, dacites, basalts and diabase) character; they are lava mantles, subvolcanic bodies and sometimes dikes. Tens meters useful thickness. *Acid intrusive* type (granitoides and granodiorites) are huge batholites and occasionally exotic blocks included in serpentinites. *Basic* type (gabbro, gabbrodiabase and troctolite) form large bodies associated with ultrabasic rocks. All rocks have hard, massive, compact, resistant character and decorating aspect (granodiorites), but they are tectonized, altered and occasionally with potent weathering crusts. Use as crushing arid in concrete by their good physical-mechanical properties and as decorative rock in fragments (granodiorite).

ROCK SALT Potent Jurassic diapires located among carbonated sequences. Salt underlay a gypsum breccia or limestones cap rock from 143-180 m depths to 1000 m, with useful thickness greater than 1000 m. They are halite matrix saline breccias where salt reaches until 80% with a percent of NaCl almost of the 100%. Able chemistry for human consumption, chemistry, pharmaceutical, leather tans, etc.

SERPENTINITE Jurassic and pre-Jurassic antigorite serpentinite bodies associated with ultrabasic massifs or different nature metamorphosed sequences, of median-reduced dimensions lying within the lizardite-crisotile serpentinite massifs in intensive fracturación and crushing zones or almost concordant bodies within schists. Light-dark green color, massive, compact, massive texture and fine-very fine granularity, without sulfurs. With high decorating aspect and blocks recovery is used as decorative stone in plates and fragments.

SILICITE **C**retaceous silicite sequence of 1-10 m fine strata interebeded with clays or argilites, marls and sandstones, quartz and chalcedony compound them with Al_2O_3 and Fe_2O_3 high contents. Compact rock, banded and occasionally porous. Able chemistry as fusing in copper industry.

TALC Jurassic-Cretaceous *hydrothermal* talcose rocks (talquites, talcose schists and talcotized serpentinites) in irregular and little volume lenses and bolsoms, associated with green schists and mafics and antigorited ultramafic rocks. Talquites have 50-80% talc and 20-30% the schists. MgO oscillates 23-28%, high Fe_2O_3 and low Al_2O_3. Favorable chemistry for paper, painting, glue, electrodes, cosmetic and corporal powders.

ZEOLITIC TUFF Potent and vast Cretaceous and Paleogene *vulcano-sedimentary* vitroclastic and cristalovitroclastic tuff beds. Made up clinoptilolite-mordenite (predominance by regions) and variable celadonite, montmorillonite and quartz contents. With 70% average zeolites in rock reaching until 85-97%. Use in puzzolana cement, animal nourishment, pharmaceutical, plastic, glues, paintings, cosmetic, nutritional industry, filtering and deodorizing.

PEAT Form beds of great territorial development and 3m general thickness in lagoon and coastal environments with wide Quaternary marsh-paralical deposits development, being mixed with peaty clays, slimes, sapropel and other. Present sufficient carbon and humus contents for it use in soils improvement and previous processing for flammable.

VOLCANIC GLASS Potent and vast Paleogene *vulcano-sedimentary* massive tuff beds, vitroclastic aleurolitic-psamitic intermediate-acids, with up to 50 m useful thickness, more than 50% of glass, less than 20% of montmorillonite and Hg, Pb, Cd, As with values belower than normal established for zeolites. Able as filtering, thermal insulator, stripped of metals, bleaching and antacid ceramics.

WOLLASTONITA Cretaceous wollastonite-garnet skarn associated with intravulcanic skarn limestone (marbled) forming potent marble-skarn bands with wollastonite and garnet variable contents according to the bands. Alternate with skarn basalts. Wollastonite is 60-70% in rock and has able chemistry to use in sparkplugs, tiles, plastic, paintings and other.

GYPSUM Jurassic deposits, some of them located tectonically (diapires) and other in situ as Eocene sedimentary bed. Tectonized ones are huge diapires (gypsum breccia) overlying halite breccia or forming imbricate lenses among not evaporite rocks. Variable quality of raw material oscillates 60-100% gypsum. In situ ones form beds of homogeneous pure gypsum forming 80% of outcrop and 2-10 m useful thickness. Used in cement (clinker) and the purest ones for orthopedics and other uses more demanding.