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AUTHIGENIC FELDSPARS FROM THE BARYTE CONCRETION FROM THE TERTIARY OF CUBA

(Plate XII—XV, Textfigs. 1—3)

Abstract: A confrontation with literature data on the authigenic feldspars showed as being new these results: 1. the presence of authigenic feldspars in the baryte concretions; 2. unusual basicity of the feldspars studied typical for labradorites: 3. the authigenic feldspars mentioned are the youngest comparing with up to the present known occurences (younger than Upper Eocene).

During an examination of an output quarry of the „Tejar Consuelo" (older name „Tejar Matos") brickworks in Havana we found the frequent occurence of concretions of remarkable appearance. Preliminary spectrographical analysis showed that they represent the baryte concretions. In thin section of one of the concretions have been found well developed authigenic feldspars. In regard to unusual paragenesis with authigenic baryte and extraordinarily young age of authigenic feldspars (they are younger than the Upper Eocene) we solved to study this occurence more detailly.

Contemporaneously with the first results we obtained the work by P. Brönnimann and D. Rigassi (1963) with detail stratigraphy of the vicinity of Havana. From the double-lined notion on the page 409 follows that already the authors mentioned found these concretions and H. H. Hess determined them as being formed of baryte.

Geology, Stratigraphy and Surrounding Rocks of the Locality

In the Consuelo brickworks and in the immediate vicinity, there occur the following formations according to P. Brönnimann's and D. Rigassi's (1963) division:

Husillo Formation — Aquitanian
Consuelo Formation — Oligocene
Universidad Formation — Príncipe Member — Middle Eocene
Universidad Formation — Toledo Member — Lower Eocene
Capdevila Formation — Lower Eocene

The concretions dealt with occur in the Consuelo Formation formed of soft rocks, which the Cuban geologists name as „margas" (marls) and O. Brönnimann and D. Rigassi (1963) as „chalk" (chalk limestones). A portion of insoluble residues (27,58 % or 31,74 %) shows that these soft rocks are represented by strongly marly limestones. The main rock-forming constituent are Coccolithophorids (Discoasterids) and Globigerinas. Of very similar lithological character is the underlying Universidad Formation (separated from the former by weak angular disturbance). The overlying Husillo Formation is also slightly discordant; it is formed of the reefal limestones.

The mentioned marly chalky limestones („marls") which afforded the baryte concretions were defined as Consuelo Formation by P. Bermúdez (1961) and placed to the upper part of the Upper Eocene. His determination was based on the association of microfauna found at the type locality in the Consuelo brickworks: *Anomalina dorri*

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C o l e, *Globorotalia cerroazulensis* C o l e, *Hantkenina alabamensis* C u s h m a n etc. The thickness of the Formation does not exceed 100 m.

P. B e r m ú d e z's (1961) stratigraphical determination was revised by P. B r ö n n i m a n n and D. R i g a s s i (1963). According to these authors the Consuelo Formation includes *Globigerina ampliapertura* and *Globigerina ciperoensis* — *Globigerina opima* Zones. From among nannofossils *Discoaster woodringi* B r a m l e t t e and R i e d e l predominates showing Oligocene age.

Description of the Outcrop

Outcrop with the baryte concretions occurs on the Antonio Soto avenida, about 400 m. from the main output wall of the Consuelo brickworks. Sequences of the Consuelo Formation are slightly folded with predominting strike 225° and dip 18° to the south. In the profile studied we may distinguish upwards these members:

a) 1.5 m. — intercalation of beds of „marls“ of 40—50 cm. in thickness with intercalations of marly shales of 5—10 cm. in thickness (three beds). A colour of the „marls“ is yellowish, sometimes they show distinct fucoid textures. Baryte concretions with radial structure, with ribs and processes on their surface are frequent; they are mainly in connection with intercalations of marly shales. The limonite „wires“ (oxidized pyritized roots plants or fillings of worm burrows) are rare. From among macrofossils there are spines of echini up to 5 cm. in length, ornamented, belonging probably to *Rhabdocidaris sanchezi* L a m b e r t; individual small tufts of the Coralline Algae.

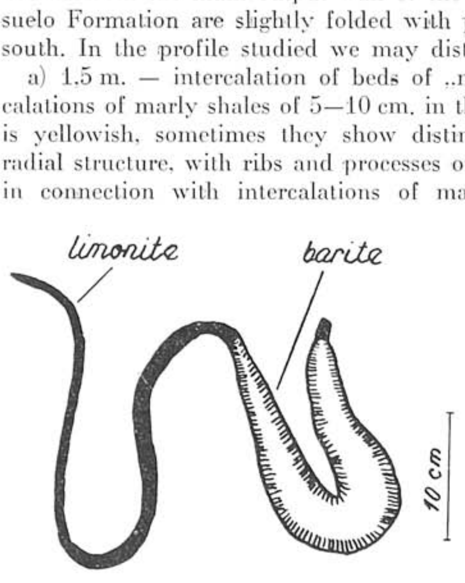

Fig. 1. Barite concretion with pyrite-limonitic

b) 3 m. — yellowish marls without fucoids and intercalations of marls. Globe-like concretions with smooth surface and usually without internal structure are rare. Very rare are cylindrical concretions, the majority of which is combined with pyrite-limonitic „wire“ or cylindre in the core (see Fig. 1). Thin folded pyrite-limonitic „wires“ are frequent.

c) Cca 8 m. — yelowish „marls“ without concretions. Frequent ocurences of limonitic-pyrite „wires“ (also thicker). Near the cross joints the „marls“ were sometimes reinforced to loafs of compact limestone clearly under affect of the underground waters. Of similar origin are irregular belts crossing obliquely stratification (Fe-migration) visible also in other beds. In some cracks are visible thin crusts of gypsum and Mn-dendrites. Several finds of spines of echini found.

d) Cca 12 m. — again variegation of thicker beds of the „marls“ (1.5—2 m.) and intercalations of marly shales (5—10 cm.). No concretions. In places where the marly beds are dark brown or pinkish, the texture of white fucoids is more distinct. The fucoids have the constant average of about 3 mm., and their course is oblique or perpendicular to stratification, in rare cases parallel. Exclusively, we may see also their branching. Present are also thin limonitic „wires“.

e) Overburden is formed of reefal limestones of the Husillo Formatio.

Macroscopical Description of Concretions

Concretions from higher beds have a normal smooth surface. Concretions from lower beds are covered by a net of ribs forming polygonal fields: some ribs project in the form of spines (Pl. XII, Fig. 1). Under the first impression, these concretions resemble melicarias (septarias with outwashed softer material between a harder filling of contraction cracks). However, the cross-sections of the concretions never show the septarium structure. This phenomenon we may explain probably by this way: the concretions formed metasomatically „volume per volume", so that the pressure of the originating concretion was of minimum value. Despite this after reaching a certain size, the growing concretion caused on its periphery the origin of radial cracks in the rock and especially it opened yet existing thin cracks. These were filled by baryte. By this way formed a base of ribs to which along the both sides adhered rhythmically new layers of baryte in the identical optical orientation, which only macroscopically have the form of filaments (Pl. XIII, Fig. 1). Larger concretions in the lower bed have some ribs longer, preferentially oriented. The reason of this is that minute cracks caused by older weak pressures were while growing preferentially used and wedge-like opened. In the lower horizon, the clearly preferential orientation have been seen in 8 concretions from 12 and strikes of the longest rib had an average value 21.7 hours. In the central horizon, 13 concretions from 29 were measured with an average value 22.1 hours (dispersion of values 21.3—24 hours). In the upper horizon only 8 concretions from 22 were convenient for determination with an average value 22.5 hours. It is not out of question that the preferential orientation corresponds to the direction of currents of the underground waters.

In the bed of only 10 cm. in thickness with most frequent occurence of the concretions, at three places were made sums with an average result after reduction — 820 concretions per 1 m^3 of a rock.

On 55 concretions was measured by the contact meter a longer axis of the concretions with a result 33 mm. (average diameter); the maximum diameter was 71 mm. If we consider an average diameter without ribs a little shorter, for instance 3 cm., than the volume of concretions forms 1.15 $^0/_0$ of the whole rock volume (for 10 cm thick bed with the maximum concentration).

The concretions are preferentially concentrated in intercalations of marly shales — they either facilitated a better migration of solutions or more clayey material had a higher original Ba content.

Calcareous fossils like spines of echini and Coralline Algae have not been used by solutions as centres of deposition. On the contrary, the pyrite cylindres formed in several cases the cores of the baryte concretions.

Microscopical Description of Concretions

The concretions have approximately sphaerolitic structure. Structure of the rock, mainly distribution of Globigerinas in the original rock and in the concretions are identical. It may serve as evidence of metasomatical replacement of the original rock, — chalky marly limestone — by baryte. Baryte replaced calcite of the basal rock — very fine-grained aggregate of the muddy structure. In this metasomatosis the majority of minute Discoasterids was disturbed, while in the surrounding mass they are very frequent. However, in walls of Globigerinas the original calcite with visible pore structure remained and only exclusively a part of shells was replaced by baryte, but never the whole shell. In a baryte individual are frequently poikiliticly closed several

Globigerine calcitic shells. In shells of Globigerinas is pure baryte (Pl. XIV, Fig. 1, Pl. XV, Fig. 2) while in the surrounding mass the baryte is overfilled by minute enclosures of calcitic dust. From the mentioned follows that the foraminiferal shells in the original deposit were clearly empty and filled only by air. Baryte in the shells of Globigerinas has the identical orientation as the crystal closing the shell, only exclusively a boundary of two optical individuals crosses the shell.

Besides foraminifers, there were found individual calcitic spines of echini untouched by barytisation and spicules of hexactinellid sponges replaced by baryte (Pl. XIV, Fig. 2). Thin section with sponge spicules shows the fragment of a sponge changed to the baryte monocrystal with uniform optical orientation in all spicules. These phenomena show a considerable resistance of calcitic organisms against barytisation and liability of siliceous organisms to metasomatic replacement by baryte.

In the basal mass of the concretions was only rarely found the clastic quartz of a silt size and minute leaves of mica. Pyrite pigment in the form of minute globules seems to be younger than baryte following sometimes its cleavage cracks. It was also found in canals of sponge spicules. The main pyrite mass is evidently older than baryte and served as embryonal center for almost all baryte concretions of the cylindrical form (Fig. 1). The pyrite cylindres represent probably fillings of worm burrows and plant roots. On their periphery they are limonitized. It is difficult to say wether the oxidation of the pyrite cylindres was before covering with baryte or after it.

The interesting phenomenon we may see in ribbed concretions: tree-like structures originated evidently by displacement of organic pigment aside during rhythmical growing of a crystal (Pl. XIII, Fig. 1). Crystals with black „fir" drowing extinct contemporaneously; „stem" of the „fir" represent the former hair crack in the rock originally filled by baryte. Along the both sides growing baryte doses followed its optical orientation. In individual cases, the principal axis runs obliquely to the orientation of „fir".

Amount of enclosed „non assimilated" calcitic dust is quite variable. In some cleaner portions, the cleavage cracks of the baryte crystals are distinct, at more contaminated places they are invisible.

We distinguish three types of the concretion centres:

a) whiter core rich in calcite; it the most frequent case showing that the concretion centres contain the main part of relicts of the original mass and were but weakly barytisated. In these concretions is unknown the „focus" — reason why the concretion originated just at this place and not at the other one.

b) Pyrite core is present in almost all concretions of the cylindrical form.

c) Dark-grey core formed of pure baryte with bituminous pigment; very rare case. This core originated probably by decay of organic remain in the centre of forming concretion and by deposition of pure baryte in so originated cavity. With such cores is connected also the occurence of the mentioned authigenic feldspars. In some cases, we found irregular masses of such baryte impregnated by bitumens. In thin sections, however, they show no traces of foraminifers; baryte originated here probably so that it penetrated to some decaying organic mass. The mentioned „fir"-like distribution of the bituminous pigment is very frequent. In isolated case we have seen crystal passing from such bituminous aggregate to the surrounding mass enclosing Globigerinas.

Chemism of Concretions

Baryte content in the baryte concretions varies at different localities all over the world (Tab. 1) from 52—86 %. In our case it was 86.56 %. Representation of other

Table 1. Comparison of chemical analyses of baryte concretions

	Oklahoma		Kerč Čuchrov %	Kai Island sea bottom Boggild %	California sea bottom Revelle — Emery			Kijev area Zarickij	Havana concretion * %	Havana surrounding rock * %
	Nichols %	Shead %			tabular inner part %	tabular outer part %	smooth %			
SiO_2	36,99	45,13	9,41	6,42	9,87	6,59	10,81	—	2,75	15,97
Al_2O_3	5,36	0,88	5,56	2,32	3,99	3,76	4,39	3,28+	2,37	7,90
Fe_2O_3	0,82	0,96	1,06	1,67	2,35	2,26	3,67		1,74	3,35
MgO	0,03	0,00	0,65	0,42	0,97	0,48	0,98	0,62	0,81	1,87
CaO	0,51	0,00		2,01	4,40	4,21	8,38	4,38	4,05	36,13
BaO	35,76	34,25	53,22	53,85	47,92	50,96	40,91	56,68	56,87	0,33
SO_3	19,20	17,87	28,12	28,56	25,02	26,42	21,33	30,43	29,41	0,23
CO_2	—	—	—	—	0,86	1,78	5,77	3,96	1,38	32,36
H_2O	0,27	0,31	1,39	2,94°	3,99°	2,97°	1,86°	0,24		
$BaSO_4$	54,41	52,12	81,88	81,85	72,94	77,54	62,24	86,30	86,56	—

+ — including TiO_2 ° — including organic mass * — analysed by A. Karelová.

constituents is in a high degree given by the type of the surrounding rock, in our case of the marly chalky limestones. The volume weight of one sample of the baryte concretion was 4,03 g/m^3.

Results of the spectral analyses are on the Table 2.

Conclusion: associations of trace elements are quite poor in all samples. It seems, the surrounding rocks are to some degree richer in trace elements than concretions, mainly in Co, P, Mn, V and Ca. Crystallisation of baryte led clearly to certain „cleaning" from the trace elements. Ba/Sr ratio was not studied, as Ba was determined on the line of 2335,3 Å. Visible part of spectrum (wavelengths longer than those of cyanogene belts) were not registrated due to small size of a board — 9 × 12.

* * *

Baryte concretions are known from several occurences. In review by R. Revelle and K. O. Emery (1951) they are recorded from the Permian sandstones from Oklahoma, Upper Cretaceous shales from the Moreno Formation (USA), Eocene clays from Luisiana; further they are quoted from the Triassic sandstones from England, Upper Liassic and Miocene of France, Oligocene of the Rhone-Hessen area; from the Cretaceous and Tertiary of Sahara; from the Jurassic and Cretaceous and also Pliocene of SSSR. In the recent marine deposits they are known from the shore of California, Ceylon and Kai Island (East Indian islands). T. Kruťa (1946) found the baryte concretions in the Miocene of ČSSR and V. P. Zarickij (1958) in the Kijev Marls of the Donbass.

On the contrary to our concretions in which spicules of the siliceous sponges were replaced perfectly by baryte and the globigerine shells partialy, several authors described concretions without any changes of fossils closed in concretions, for instance K. W. Geib (1955) — lamellibranchs and plant fragments, R. Revelle and K. O. Emery (1951) — spicules of Silicispongia, calcareous Algae, spines of echini, V. P. Zarickij (1958) — foraminifers, radiolarians and spicules of sponges.

Table 2. Semiquantitative spestral analysis of baryte concretions and surrounding rocks

	Ba	As	Ca	Co	Si	P	Al	Mn	Mg	Pb	Ga	Ti	Ni	Na	Cu	V
1. Rock between 1. and 2. horizon with concretions	3	0	1	4	1—	3	1	2—	1	4	4	3—	3	3	4	3
2. Center of individual concretion between 1. and 2. horizon	1	0	2	0	1—	0	1	4	1	4	4	3—	3	3	4	0
3. Margin of individual concretion betw. 1. and 2. hor.	1	0	2	0	1—	0	1	4	1	0	4	3—	3—	3	4	4
4. Center of concretion from the 2. horizon	1	0	3	0	1—	0	1	4	1	4	4	3—	3—	3+	4	0
5. Margin of concretion from the 2. hor.	1	0	2	0	1—	0	1	4	1	0	0	3—	4	3	3	0
6. Center of concretion from the 1. horizon	1	0	3—	0	1—	0	1	4	1	0	4	3	3	3+	3—	0
7. Margin of concretion from the 1. hor.	1	0	2	0	1—	0	1	4	1	4	0	3—	4	3	3	0
8. Surrounding rock of the 1. horizon	2—	0	1	0	1—	0	1	3	1	0	4	3—	3—	3	3—	3—
9. Rock between 2. and 3. horizons	3	0	1	0	1	0	1	3+	1	4	4	3—	4	3	3	3—
10. Surrounding rock of the 3. hor.	3	0	1	0	1	0	1	3	1	4	3—	3	3	3	3—	4
11. Concretion of the 3. horizon	1	0	2	0	1	0	1	4	1	4	0	3—	3	3—	3—	4
12. Limonitic-pyrite „wires"	3	3	3—	4—	2	0	1	4	2	0	0	0	3	0	3+	0
13. Rock under the 1. horizon	3	4	1	0	1	4	1	3	1	4	4	3—	3—	3	3	3—
14. Concretion under the 1. horizon	1	4	2	0	1	0	1	4	1	4	0	3—	3—	3	3—	0

Negative finds: Be, Pt, Ge, Mo, Sn. W, Bi, Sb, In, Te, B?, Zn.

Fe occurs in all samples in the amount of the order 0,n % except for the sample 12 where Fe forms an essential constituent.

Explanations: 1 — essential amount (n %); 2 — secondary amount (0,n %); 3 — secondary amount (0,0n—0,00n %); 4 — traces (0,00n %); — and + — relatively higher or lower amount; O — negative occurence.

Condition of sparking: spectrograph ISP-28, alternating arc 120 V/10 A, slot: 0,006 mm, Soviet spectral board — type 2, exposition: 2 × 60 sec.

To genesis of the baryte concretions: the majority of authors described the origin of the baryte concretions by the diagenetic process: percolation of the vadose waters which might gain the Ba content by extraction from some feldspars-yielding rocks. R. Revelle and K. Emery (1951) emphasized the rare occurence of the baryte concretions in the recent seas and their relationships to important fault zones. The origin of the concretions they see in ascending magmatic waters containg iones of Ba and Sr interacting with the sulphatic waters of a deposit.

Forming of the baryte concretions at the locality studied we ascribe to the underground waters. Close to the locality there is the important fault accompanied by deposits of the sub-Recent travertines and which is followed by the Almendares river. It is possible that this fault played some role in the regime of the underground waters. however, there is no reason to suppose the presence of some juvenile constituents.

Authigenic Feldspars

Diagenetic origin of authigenic feldspars is evident. As evidence of this may serve idiomorph grains, their anomalous amount and the absolute absence of the clastic feldspars as well as other terrigenous material of the similar granularity fraction in the surrounding rock and the absence of glass, pyroxenes, amphibols etc.

Practically, all grains have idiomorphic or hypidiomorphic form (Pl. XIV, Fig. 1, Pl. XV, Fig. 1, 2). The length of pillars varies between 0.176—1.056 (average 0.572 mm.). The average value of the length/width ratio is 6.22. The main amount of feldspars is in the centre of the baryte concretion.

Basicity of feldspars was measured with aid of the universal quadriaxial table of the Leitz firm using the special objective with a long working distance (UN-3 type). Vitreous segments had an refraction index $n = 1.557$ so that the angle values on the horizontal axes of the table were without correction. To control results of measurement we used three different methods of basicity determination of plagioclases:

1. Classic Fjodorov's method. The basicity was measured by:

a) orientation of the main optical directions in regard to twin elements;

b) orientation in regard to the main optical directions to the cleavage planes (010) and (001).

2. Fjodorov's application of the method of symmetrical zone.

3. Measurement of the angle of optical axes.

Results of measurement by the classic Fjodorov's method are given in the Nikitin's onequadrant diagram (Fig. 2).

At first sight it is clear that the majority of the measured feldspars is represented by labradorite (56—70 % of An). In one case was determined the occurence of acid bytownite (71—72 % of An) and in one case andesine (48 % of An). From among twinning laws the most frequent are Carlsbad and albite laws. In two cases was determined twinning by the Manebach law and in two cases by albite — Carlsbad law. The main part of the measured labradorites shows distinct zonal structure (Pl. XV, Fig. 2). In three cases the zonal labradorite had in the centre a basic „core" which differed from the marginal parts of a grain by its optical orientation and basicity. Mutual orientation of the main optical orientation in one of the mentioned cases is illustrated on the Fig. 3. Difference in the content of the anorthite constituent of the „core" and margin is 11 % (68—57 % of An). Zonal structure lowers accuracy of measuring because the grains do not extinct uniformly.

Results gained by the Fjodorov's method well agree with those gained by the method

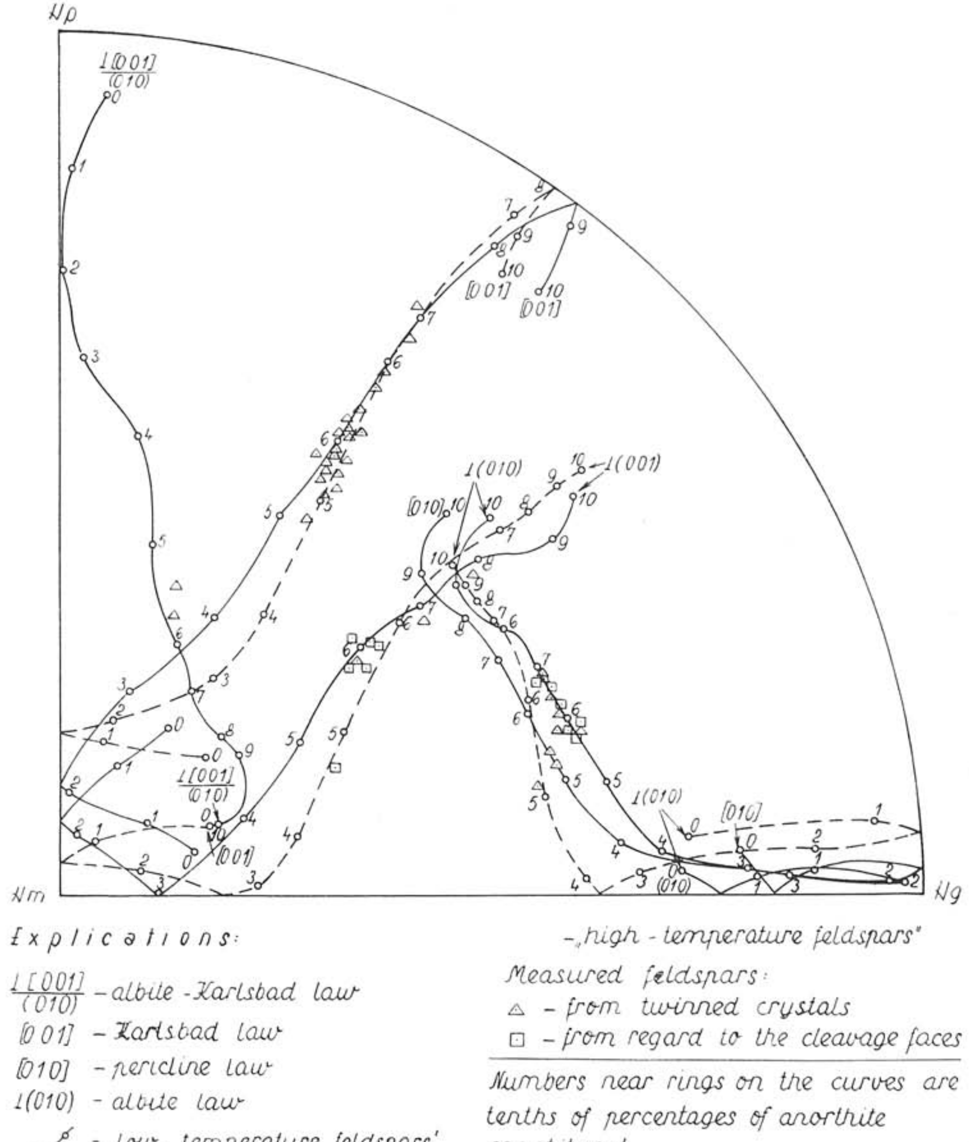

Fig. 2. Illustration of results of basicity measurements of plagioclases in Nikitin's one-quadrant diagram.

of symmetrical zone (its Fjodorov's application was used). An average difference in results of the mentioned methods was $\pm 2\,\%$.

Optic angle was mostly measured with aid of emergence of one optical axis (Tab. 3). Only rarely were recorded the emergences of both optical axes in other cases we used indirect method. Results of measurement of 2 V values are usable also for determination

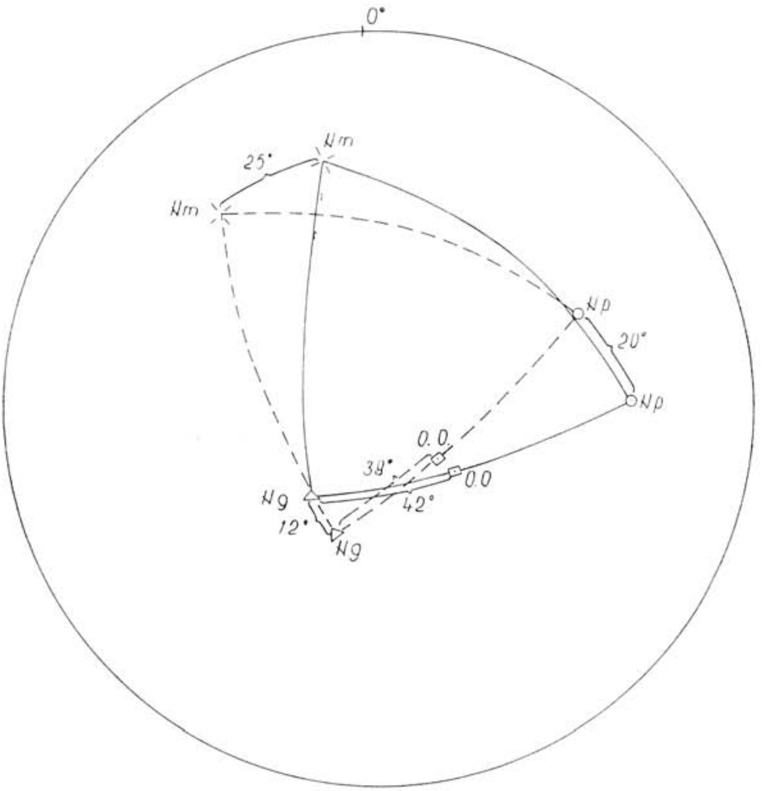

Fig. 3. Zonal authigenic plagioclase.

of basicity and are well comparable with values determined by other methods. Grains from the margins of thin sections had in all cases refractive index evidently higher than the Canada balsam.

All applied methods of basicity determination afford reasonable results and allow an idea that in labradorite optical properties of authigenic feldspars do not differ from those known in „low-tempered" labradorites from the erruptive rocks. A part of grains, however, fall in the curve of high-tempered feldspars for the Carlsbad law. The measurements made contemporaneously showed that in our case we had not the Ba-feldspars from the group of monoclinic feldspars (celsiane, hyalophane), the occurence of which we could suppose in regard to the paragenesis with baryte.

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There is a large literature on authigenic feldspars — we refer to summarisations by L. V. Pustovalov (1956), Y. Baskin (1956) and H. Füchtbauer (1957). Almost all occurences known are from the carbonatic deposits; from gypsum-anhydrite

Table 3. Results of measuring of the optical angle of authigenic plagioclases from one concretion with maximum concentration of feldspars

No.	$2V_{Ng\,(x)}$	$2V_{Ng\,(xx)}$	$2V_{Ng}$ indirects method	% An	name of plagioclase	Control methods of basicity determination cl. F. s. z.
1.	84°			68	labradorite	s. z.
2.	87°			72	bytownite	s. z. cl. F.
3.	80°			62	labradorite	cl. F.
4.	86°			70	labrad.-byt.	cl. F., s. z.
5.	84°			68	labradorite	cl. F.
6.	82°			64	labradorite	cl. F.
7.	84°			68	labradorite	s. z.
8.		81°		63	labradorite	cl. F., s. z.
9.		80°		62	labradorite	s. z.
10.	77°			57	labradorite	cl. F.
11.	80°			62	labradorite	cl. F.
12.	80°			62	labradorite	cl. F.
13.	78°			57	labradorite	cl. F.
14.	80°			52	labradorite	s. z., cl. F.
15.	78°			60	labradorite	cl. F.
16.			78°	57	labradorite	cl. F., s. z.
17.			79°	61	labradorite	cl. F.
18.			78°	60	labradorite	s. z., cl. F.
19.	80°			62	labradorite	cl. F.
20.	78°			57	labradorite	s. z., cl. F.
21.	78°			57	labradorite	cl. F.
22.	77°			57	labradorite	s. z., cl. F.
23.	84°			68	labradorite	cl. F.
24.	78°			57	labradorite	cl. F.
	77°			57	labradorite	cl. F.

Explanations: cl. F. — classic Fjodorov's method; s. z. — method of the symmetrical zone measured on the U-table.

rocks are quoted authigenic feldspars by M. Topkaya (1950). H. Füchtbauer (1956) and M. Mišík (1963). From non-calcareous sandstones were described by J. W. Gruner and A. A. Thiel (1937) and R. R. Berg (1952). Besides the mentioned their origin is known also in tuffs. We have not yet found any mentions about authigenic feldspars in concretions in literature.

H. Füchtbauer (1957) affirms that only authigenic albites and K-feldspars are well determined. He polemized with the find of authigenic oligoclase of M. Tokay (1944) and oligoclase of J. T. Singwald and Ch. Milton (1929): the author mentioned supposes that in the both mentioned cases the mineral in question was albite. L. V. Pustovalov (1956) described as being rare also anorthite. M. Topkaya (1950) described also oligoclase and andesine as very rare minerals without their constants. H. Schöner (1960) determined mixtures from albite to oligoclase ($2V_z = 80—95°$). In our material, authigenic labradorites absolutely predominate; exceptionality of composition is evidently given by different genetic conditions.

H. Füchtbauer (1950, 1957) asserted that authigenic feldspars differ by their optical angle which in albite is 5—10° higher than in magmatic rocks and in K-feldspars more than 20° lower. Similar opinion have also A. G. Kossovskaja and V. D. Šutov (1957), H. Schöner (1960) and V. D. Šutov and V. I. Muravjev

(1964). On the contrary to the authors mentioned Y. B a s k i n (1956) such differences avoided. Our results may not serve as evidence for the optical angle value to be a good criterion for the authigenic origin (see Tab. 3).

Genesis — Conclusions

From the study of locality as well as geological conditions of wider vicinity follows that concretions originated by normal late diagenetic replacement of materials and the occurences of baryte are not in connection with the volcanic action. In this Cuban province there are no traces of volcanisms in the mentioned period (i. e. Upper Eocene—Oligocene).

The concretions have been formed in epigenetic stage. Syngenetical origin is impossible as the microscopical study shows that baryte metasomatically replaces the original sediments following its structure. Epigenetical growing is evident also from the fact that baryte concretions formed frequently around the pyrite cylindres. Filling up of worm burrows and cavities after decayes plant roots by pyrite was done in a partly consolidated rock. Baryte is clearly younger than this pyrite. Ribs of the baryte concretions follow variably oriented cracks formed evidently in consolidated mass.

As at other localities with outcrops of the Consuelo Formation similar concretions have not been found, we have to suppose for the locality studied a special regime of underground waters in a partial synclinal structure. The original calcareous sediments contained a little higher amount of baryte and underground waters only displaced and concentrated it. From calculation follows that in 10 cm. thick bed with the highest concentration of concretions, the concentration reaches 1,15 % of the rock volume. Taking into consideration allochthonous enclosures calcite the baryte forms only less than 1 %.

The occurence of authigenic feldspars in the baryte concretions so far known have not yet been described. It is very rare phnenomenon also in our material. Authigenic feldspars were determined in four cases from among about 80 concretions. Current concretions have in the centre milk-white „core" with higher content of calcite contamination. Authigenic feldspars are connected mainly with concretions with darker centre composed of almost pure baryte with finaly dispersed organic mass. They probably represented a cavity after some organic mass later filled up of an aggregate of the pure baryte, with which crystallized also authigenic feldspars. The feldspars have mostly idiomorphic form, they are not always contiguous and rarely, they contain also cracks filled up of baryte (Pl. XV, Fig. 2). Their epigenetic origin is undoubtful. It is surprising that almost all measured grains belong to labradorite, while the majority of authors quote from the sedimentary rocks only authigenic albite and K-feldspars.

Up to the present described occurence of authigenic feldspars were in the Praecambrium, Palaeozoic and Mesozoic; only F o u l l o n (1891) (fide Y. B a s k i n 1956) described authigenic feldspars from the Eocene of the Rhodos island. From the mentioned follows, that to the origin of authigenic feldspars is necessary a considerable consolidation of rocks and a long time. The authigenic feldspars from our material are surely younger than their parent rock — calcareous marls of Upper Eocene or Oligocene age. These feldspars, however, might originate even in the Miocene.

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Review by K. Borza.

Explications of the Plates

Plate XII

Fig. 1. Baryte concretions from the Consuelo Formation (Upper Eosene or Oligocene). Antonoi Soto Avenida, Havana, Cuba. Slightly reduced. — Fig. 2. Traces of the submarine landslide in the Consuelo Formation (Upper Eocene or Oligocene). Consuelo (Matos) brick works, Havana, Cuba. Photo M. Mišík and L. Osvald.

Plate XIII

Fig. 1. „Tree"-shaped enclosures in the baryte crystal from the margin of the concretion. Consuelo Formation, Havana, Cuba, magn. 11 ×. — Fig. 2. Thin section from a part of the baryte concretions. Formation Consuelo, Havana, Cuba, magn. 23 ×, polarized light. Photo M. Mišík and L. Osvald.

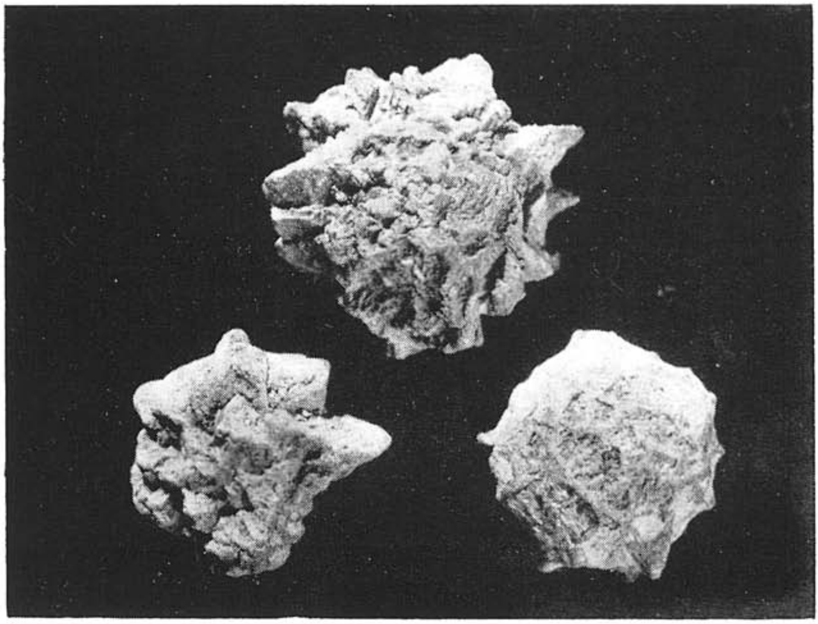
Plate XIV

Fig. 1. Authigenic feldspars in the baryte concretion. Baryte fills up also shells of Globigerinas. Dark portions are overfilled by calcite enclosures, magn. 43 ×. — Fig. 2. Spicules of Silicispongia replaced by baryte. Consuelo Formation, Havana, Cuba, magn. 43 ×. Photo L. Osvald.

Plate XV

Fig. 1. Authigenic plagioclases (labradorite) from the baryte concretion. Consuelo Formation (Upper Eocene or Oligocene), Havana, Cuba, magn. 27×, polarized light. — Fig. 2. Authigenic plagioclase (labradorite) cracked and recovered by baryte. Baryte concretion from the Consuelo Formation, Havana, Cuba. Photo L. Osvald.

Translated by V. Scheibnerová.



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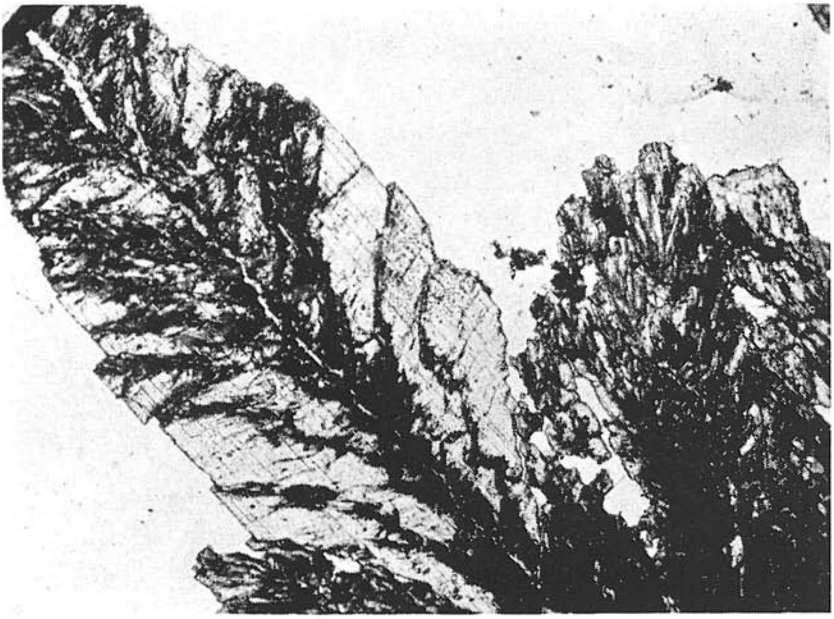

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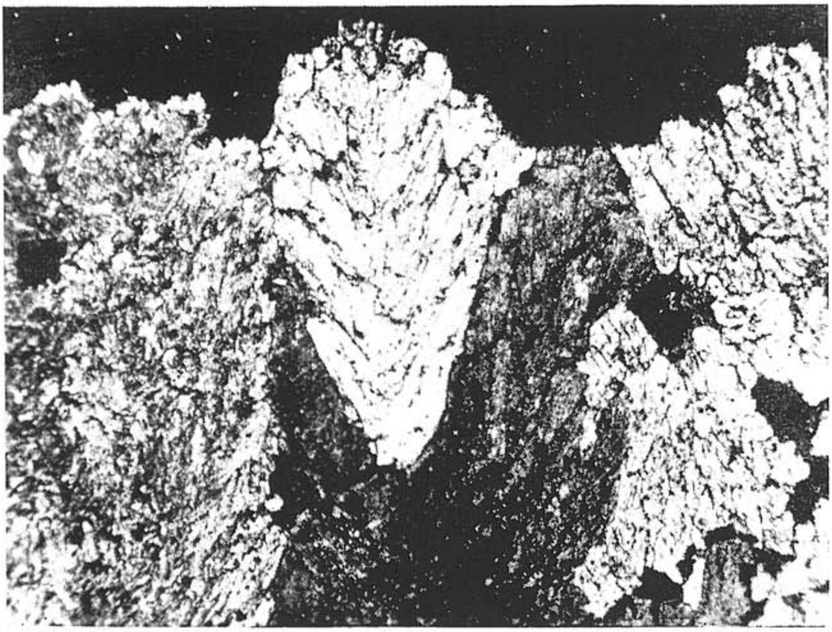

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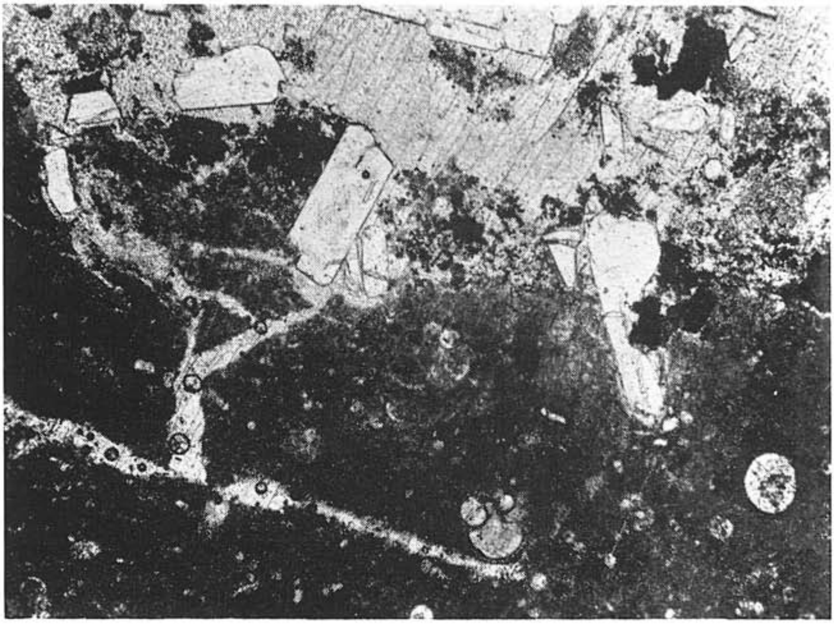

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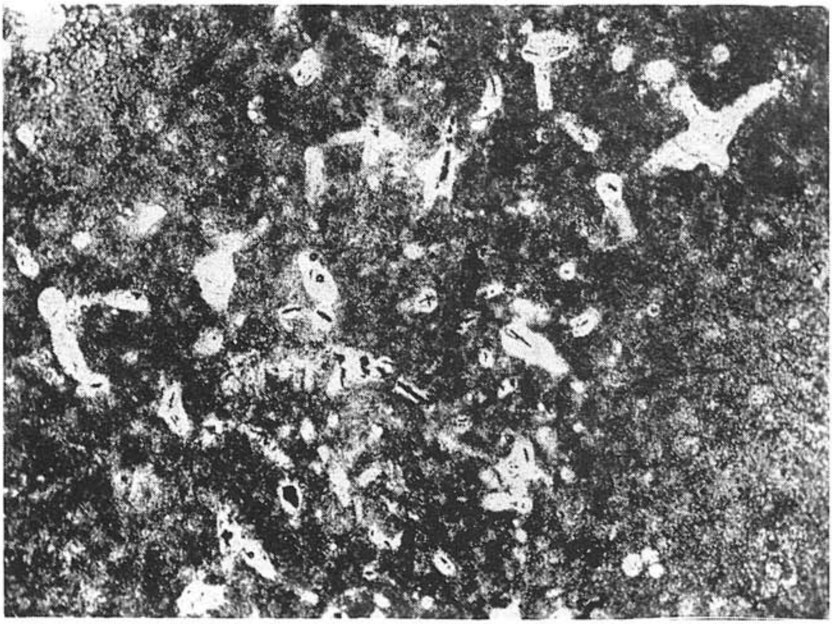

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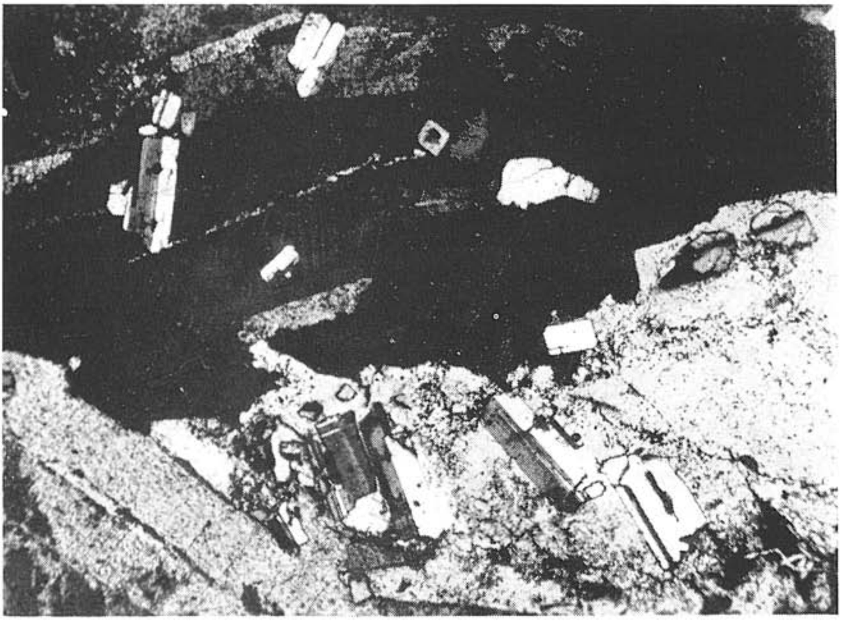

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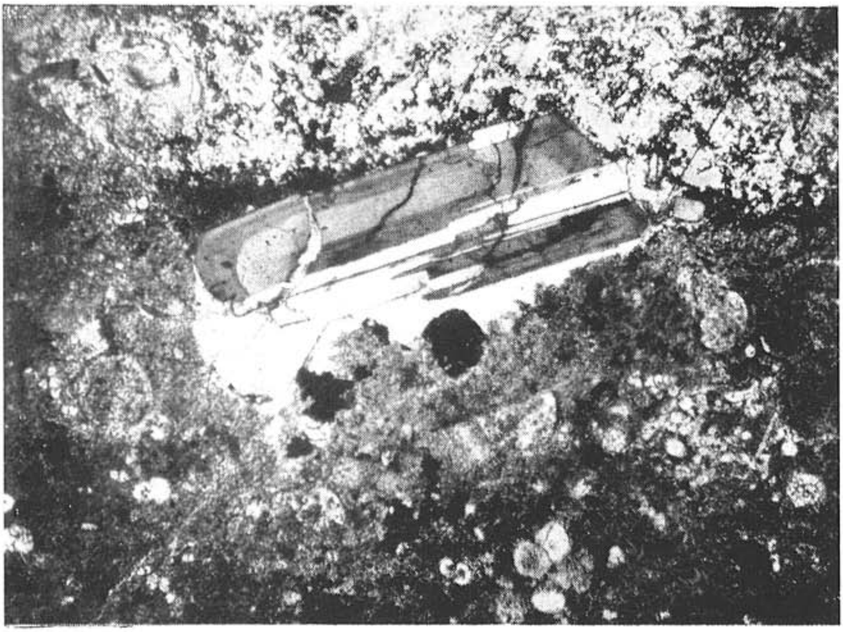

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