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GYPSUM CRYSTALS IN RUPELIAN CLAY OF BETEKOM (PROV. ANTWERPEN, BELGIUM)[1]

by

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(2 figures, 1 plate and 1 table)

RESUME.- Le gypse présent dans l'argile d'âge Rupélien à Betekom (Belgique), montre des cristaux maclés selon (100) et portant les formes {100}, {010} et {111} bien définies. Les spectres de fluorescence et de phosphorescence correspondent à ceux d'autres cristaux de gypse provenant de différentes localités de l'argile Rupélienne en Belgique. On note seulement une différence dans les spectres des cristaux de l'argile Tongrienne.

Une efflorescence de gypse sur les parois et dans les fissures de l'argilière a été étudiée avec le microscope électronique à balayage. Ces cristaux ne sont pas maclés et, en plus, leur habitus est très simple. Un spectre de fluorescence ou de phosphorescence ne peut être enregistré, mais les cristaux sont caractérisés par une cathodoluminescence extrêmement intense.

ABSTRACT.- A description is given of cruciform penetration twins occuring in the Rupelian clays near Betekom in Belgium. The twinning is at the (100) face, with well developed {110}, {010} and {111} faces. Fluorescences and phosphorescence spectra correspond closely to those of other gypsum crystals in the Rupelian clays of different localities in Belgium, but are easily distinguishable from those of gypsum crystal extracted from a Tongrian clay.

Secondary gypsum efflorescences occuring on deep cracks in the wall of the clay-pit were investigated by means of S.E.M. They proved to be single crystals of simple habit. Their fluorescence and phosphorescence emissions were to weak to be recorded. However, they show a very strong cathodoluminescence.

INTRODUCTION

Rather large, uncommon gypsum twins have been found in the Rupelian clay, in the neighbourhood of Aarschot (Prov. Antwerpen, Belgium). The clay-pit in which they occur is situated NNW of Betekom; the Belgian Lambert coordinates are x = 179,50m; y = 188,20m; z = +22,50 m. Since the part of that clay-pit is now being used as a rubbish dump, the authors think it useful to report on their findings before the locality becomes completely inaccessible.

The crystals have been observed only in the NE extension of the pit, at a depth of about 3 m below the topographic surface. In this place the clay, known stratigraphically as the "clay of Boom", is covered only by a thin layer of Quaternary sediments.

The flat crystals were found oriented parallel to the bedding plane. Discontinuous bands of marcasite and pyrite nodules, partly weathered in outcrop, are noticed at higher levels. Some of these nodules are overgrown by gypsum crystals.

The walls of the pit are characterized by cracks penetrating the clay to a depth of 4 m. These cracks are mostly covered by gel-like iron oxihydrates and locally show small gypsum efflorescences, less than 1 mm in cross-section.

CRYSTALLOGRAPHIC CHARACTERISTICS

Most of the gypsum crystals exhibit cruciform penetration twins according to (100) with well developed {110} and {011} forms (fig. 1). In a few cases an intergrowth between several of them is observed. Their size ranges from 20 x 10 x 3 cm to 2 x 1 x 0,3 cm. The {111} faces are curved as in some twins of the Montmartre type and pass gradually into the {103}. The {010} faces are rather irregular, during the growth of

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the twin the centres of both crystals probably shifted along the b-axis. A similar phenomenon is shown in the "Atlas der Kristallformen" by GOLDSCHMIDT (1918). The crystals are generally clear and translucent, except for inclusions of clay oriented according to {103}. The plate 1 : 1 shows a well developed specimen with cruciform penetration twin.

CHEMICAL AND PHYSICAL CHARACTERISTICS

The only trace element found in the gypsum crystals in noteworthy amounts is strontium. The atomic ratio Sr/Ca, determined by X-ray fluorescence, amounts to 0,002 °/o.

For recently formed crystals, the atomic ratio of Sr/Ca ranges between 0,3 and 0,7 °/o, whereas this ratio is lower than 0,05 °/o for crystals of older geological age (MÜLLER, 1964; ICART *et al.*, 1965). Therefore, it is probable that the gypsum crystals from Betekom have not been formed recently, but are the result of older diagenesis.

Fluorescence and phosphorescence spectra of the crystals have been recorded with a spectrafluorimeter Hitachi Perkin Elmer type MPF-4, using a wavelength of 254 μm and a slit width of 10 μm for excitation. The emission spectra, ranging from 260 to 500 μm and 290 to 600 μm respectively, were run with a slit width of 20 μm. Under the same conditions spectra were recorded for gypsum crystals from three other Belgian localities : Aalbeke (W-Vlaanderen), Niel (Antwerpen) and Tongeren (Limburg). The specimens of Aalbeke and Niel were found in clay deposits of a stratigraphic position, similar to that of Betekom. Fluorescence and phosphorescence maxima are summarized in table 1.

Table 1.- Fluorescence and phosphorescence maxima for gypsum crystals from different Belgian localities

Locality	Fluorescence		Phosphorescence	
	λ_{max}	Rel. Intensity	λ_{max}	Rel. Intensity
Betekom	330	49	448	65
Aalbeke	330	56	435	75
Niel	330	47	460	100
Tongeren	335	100	440	19

All fluorescence spectra of the gypsum crystals from the "clay of Boom" are alike. They are characterized by a maximum near 350 nm, a plateau at 345 nm, and two lower plateaus between 440-460 and 510-530 nm respectively. The curve of the sample from Tongeren is much steeper and shows a maximum at 335 nm (fig. 2). Moreover, its fluorescence intensity is about twice that of the other specimens, while its phosphorescence intensity is about four times lower.

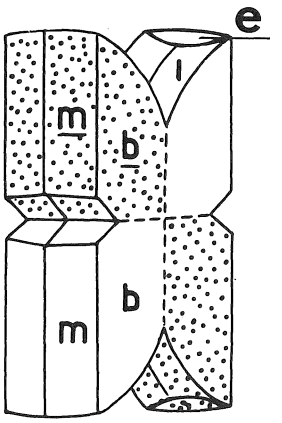

Figure 1.- Cruciform penetration twin of gypsum according to (100) b(010); m(110); l(111); e(103).

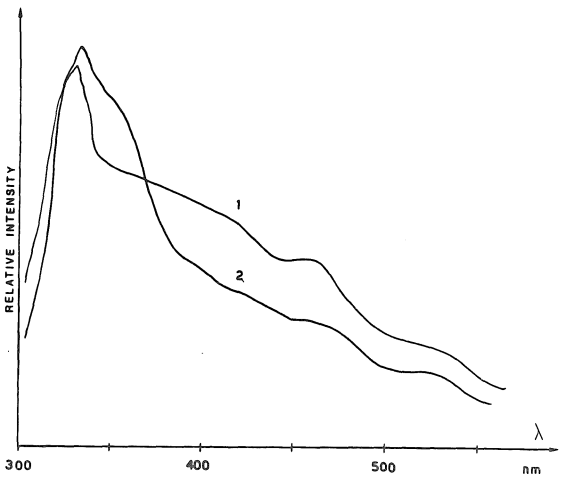

Figure 2.- Fluorescence spectra of gypsum from Betekom (1) and Tongeren (2) with a relative intensity of 90 and 30 respectively.

Excitation of the crystals from Betekom with short ultraviolet light showed a strong white fluorescence in two well defined triangular zones starting from the central point of the crystals towards both ends.

SECONDARY GYPSUM EFFLORESCENCES

As mentioned previously, small gypsum efflorescences cover the walls of deep cracks in the clay. They present themselves as either irregular clusters or spherical aggregates of radially oriented prisms.

Their crystallographic habit was examined by S.E. M. techniques. The slender prisms in the clusters are elongated according to [001] with a maximum diameter of about 50μm. They show well faced crystals with a combination {010} {111} {110}. In the rosettes the crystals are generally much smaller and their maximum diameter is 20μm. They are elongated according to [001] and consist of the forms combination : {010} {110} {111} {011} (Plate 1 : 2).

All these tiny crystals show a very strong cathodoluminescence, but the fluorescence and phosphorescence emissions were to weak to be recorded.

DISCUSSION

The arrangement of the gypsum crystals in the clay and their morphology suggest the following genesis.

The twins are formed by in situ crystallisation, as follows from the undisturbed sedimentation features. According to our interpretation of the Sr-content of the crystals, these processes are not recent. Wheathering of marcasite and pyrite grains and nodules, common in the section, liberate sulphate ions (VOCHTEN & GEYS, 1974) which may react with the calcite and/or aragonite present in the clay with formation of calcium-sulphate. The size of the gypsum twins gradually decreases from the bottom of the gypsiferous layer towards the top. Whereas the larger crystals gave regular crystallographic faces, the smaller ones, found in upper part of the section, are more or less rounded and corroded. This may be explained by the initial crystallization of gypsum taking place throughout a thick layer, whereas a later stage saw the complete or partial solution of crystals in the upper part as a result of vertically leaching solutions, which contributed to the growth of crystals in the lowest part of the section.

There is no explanation of the occurence of gypsum twins limited to this rather small zone of the clay-pit, as observed during several surveys of the pit.

ACKNOWLEDGEMENT

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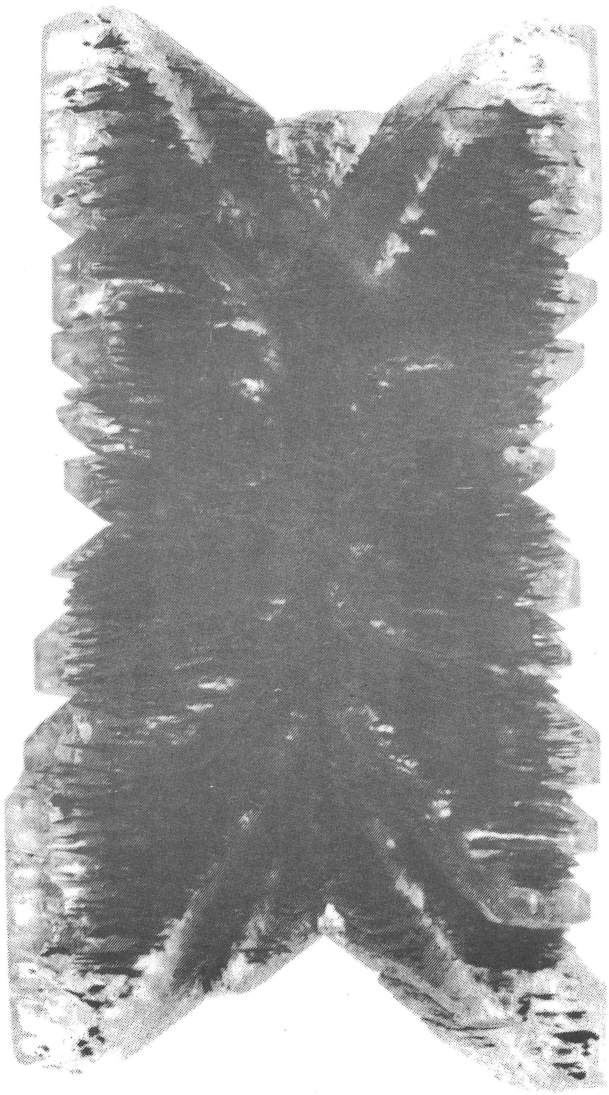
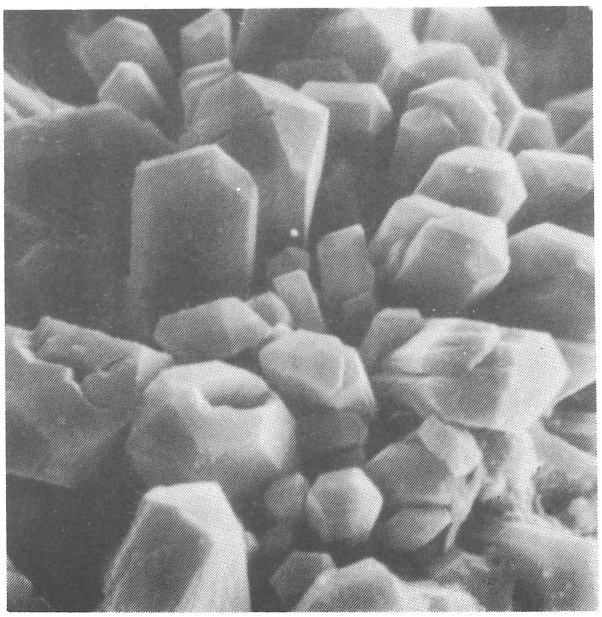
PLATE I

1. Cruciform penetration twin of gypsum of Betekom

2. Scanning electronmicrograph of the gypsum efflorescences. Magnification : 1100x.





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