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ON THE ORIGIN OF SEVERAL HEAVY CLAY LAYERS IN SOLIFLUCTION DEPOSITS OF THE BELGIAN CONDROZ

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ABSTRACT

In many places in the Belgian Condroz heavy solifluction clays occur on top of Tertiary sands. These deposits are generally found in conjunction with fair amounts of chert and silicified fossils.

In order to determine the origin of the clays, investigation of the fossils (mainly brachiopods and corals) and the granulometric and mineralogical compositions were carried out. The fauna collected in the clay deposits is typical for the upper Tournaisian and lower Viséan (Lower Carboniferous). For comparison fossils were also collected from residual clays in situ on Viséan and Tournaisian limestones. No important differences between the fossil groups could be detected. The clay mineralogical analysis also indicates that the clays in the solifluction deposits are residues of soil formation on Carboniferous limestone.

INTRODUCTION

In the Upper Oligocene all of the Ardennes peneplain was probably covered by a sedimentary complex of sands. During the following periods the greater part of this sand cover was removed by erosion; only small pockets were preserved in dolinas that formed on Carboniferous and Devonian limestones. Today remnants of this sand cover are to be found in nearly all the dolinas in the Belgian Condroz.

Deposits of heavy clays are frequently found on top of these sands. The clay deposits were eroded away in the surrounding areas during the Lower Miocene (C a l e m b e r t, 1945; G i l k i n e t, 1922) and also deposited in the dolinas.

On top of the clay deposits or, in their absence, on top of the sands, thick layers with chert or silicified fossils have been deposited by solifluction. When clearly separated, the chert clays always lie on top of the clay with fossils.

Fig. 1 is a schematical cross section of a dolina that was filled as described above. The height of the column on the left will probably have been 5-15 meters; the depth of the dolina may vary consider-

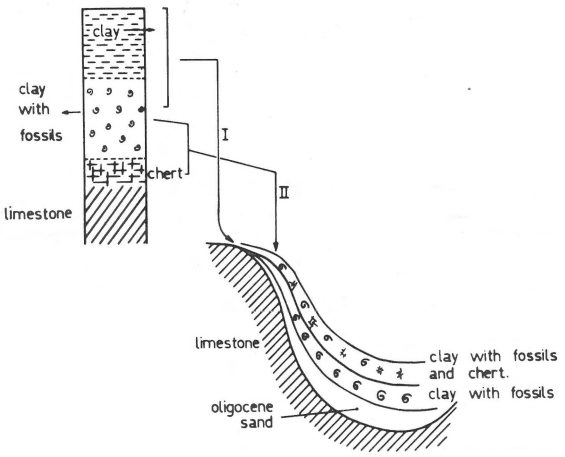

Fig. 1
Schematical cross-section through a dolina.
The succeeding erosional stages are numbered I and II.

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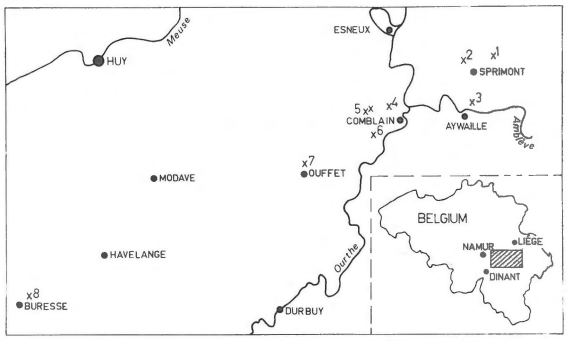

Fig. 2
Localities
1. Dam'ré; 2. Sprimont; 3. Florzé I and II; 4. Mont; 5. Ouhar I and II; 6. Bois de Comblain; 7. Ouffet; 8. Buresse.

ably (10-50 m); clay with chert or fossils generally does not exceed 2 meters.

Because the solifluctuated clays were supposed to be a weathering residue of Carboniferous limestone, a number of fossils were collected, examined and compared with the fossils of residual clays in situ.

The composition of the clay fraction of the solifluction material was compared with the residue obtained from the limestone after HCl treatment. The clay mineralogical composition of the solifluction clays is different from that of the residual clays in situ because they are considered to have originated in different climates.

The clays that are nowadays only found in solifluction deposits are supposed to have weathered from the Carboniferous limestone during the Neogene; the residual clays in situ are supposed to have

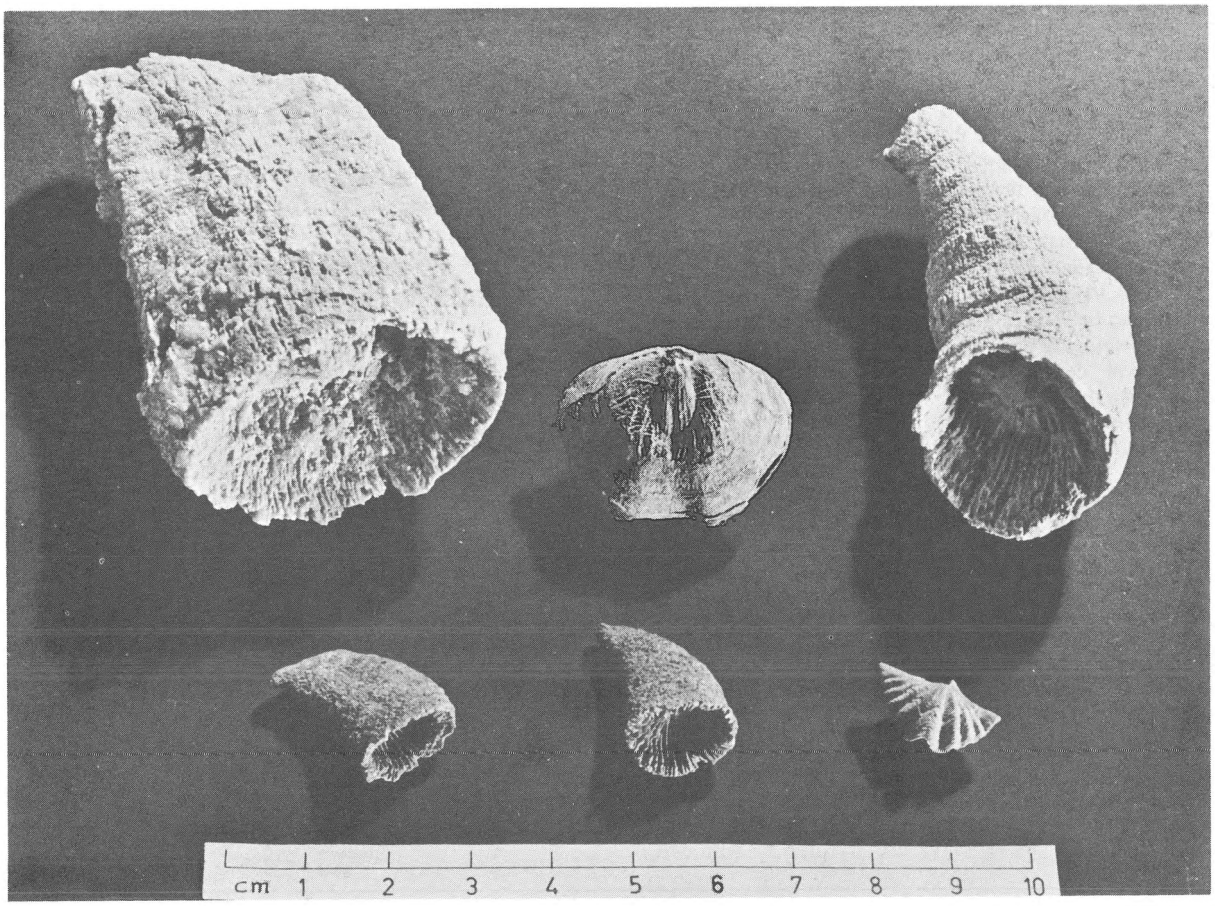

Fig. 3
Some silicified fossils.
1. *Siphonophyllia* sp., Ouhar I
2. *Cleiothyridina deroysii* (l'Eveillé), Ouhar II
3. *Cyathoclysia* sp., Ouhar I
4. *'Zaphrentis' konincki* (Edwards & Haime), Buresse
5. *Punctospirifer peracutus carinatus* (Demanet), Ouhar II.

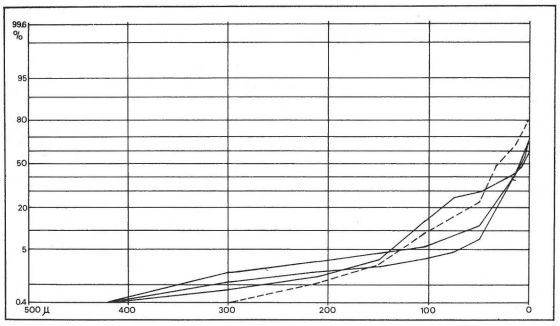

Fig. 4
Grain size frequencies of three solifluction clays from Buresse and a limestone-residue from the same locality (dashed line).

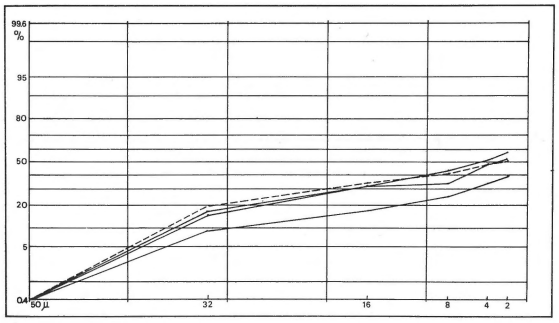

Fig. 5
Samples as in fig. 4. Fractions smaller than 50 microns taken as 100%.

originated during the Eemian stage (to be explained in a later publication).

The solifluction clays are generally light grey or white colored; the Eemian residues are yellowish brown to yellowish red.

Locations

The locations are given in fig. 2.

Exposures of solifluction deposits are: Ouhar I, Mont, Bois de Comblain, Florzé I and II, Dam'ré and Buresse.

Exposures with residual clays in situ are: Ouffet, Sprimont, Ouhar II and Florzé I.

Tournaisian limestone was investigated from: Ouhar II, Sprimont, Florzé I, Buresse, Krauthausen and Rivage. These locations are not given on the map. given on the map.

THE FOSSILS

The brachiopods and corals from the various localities are given in table I.

The locations Mont, Florzé I and II and Dam'ré are not listed in the table. They yielded some specimens of *?Palaeosmilia, Siphonophyllia* and *Syringopora.*

The brachiopod and coral assemblages listed in table I have about the same range in age. The coral faunas of Ouar I and Bois de Comblain appear to consist only of Tournaisian elements. Those of Ouhar I indicate even an upper Tournaisian age. However only a few species could be identified, since many specimens were too much altered by silicification to be recognizable.

As far as their distribution in the Belgian Dinantian is known, most of the recorded species occur from the middle Tournaisian to the middle Viséan. In table II the number of species and their stratigraphic distribution are given for each locality.

Apparently the assemblages represent several substages: middle and upper Tournaisian and lower Viséan. Fossils from different substages can have been mixed during weathering or solifluction. Fig. 3 shows some silicified fossils.

CLAY-MINERALOGICAL COMPOSITION

A mineralogical analysis was carried out on the fossil bearing clays. Peak area percentages of diffractometer traces are given in table III. The composition of the clay fraction of several limestone residues after HCl treatment are given in the same table. The composition of the solifluction clay from Buresse is very similar to that of the limestone residues. The kandite percentages may have been increased by weathering. For comparison several analyses of residual clays in situ are given. As was to be expected they are not in concordance with the others.

GRAIN-SIZE DISTRIBUTION

Investigation of the grain-size distribution of the solifluction clays and comparison with that of the limestone residues was of little help in determining the origin of the solifluction clays. Clays from

TABLE I

List of fossils from six localities and their stratigraphic distribution.
(after Vaughan, 1915; Demanet, 1958; Mortelmans, 1969)

	Tn			V			Solifluction:			In situ:		
	1	2	3	1	2	3	Ouhar I	Bois de C	Buresse	Ouhar II	Ouffet	Sprimont
ANTHOZOA												
Rugosa:												
Fasciculophyllum sp.	–	+	+	+	–	–	–	–	+	++	+	+
Cryptophyllum sp.	–	+	–	+	–	–	–	–	–	–	+	–
Cyathaxonia sp.	–	+	–	+	–	–	–	–	–	+	–	–
Amplexus sp.	–	+	+	+	?	+	–	–	+	–	–	+
Gravenia sp.	–	–	+	+	–	–	–	–	–	–	–	++
cf. 'Zaphrentis' vaughani (Douglas)	–	+	–	–	–	–	–	–	+	–	–	–
'Zaphrentis' konincki (Edwards & Haime)	–	+	++	–	–	–	–	–	+++	–	–	–
Zaphrentites sp.	–	+	+	–	–	–	–	–	++	–	–	–
Zaphrentites parallelus (Carruthers)	–	+	+	–	–	–	–	–	–	+	–	–
?Koninckophyllum tortuosum (Michelin)	–	–	+	–	–	–	+	–	+	–	–	–
Koninckophyllum sp. or other aulophyllids	–	–	+	+	+	+	–	–	+	–	–	–
cf. *Palaeosmilia aquisgranensis* (Frech)	+	–	–	–	–	–	–	+	–	–	–	–
?Cyathoclisia sp.	–	–	+	–	–	–	+	–	–	–	–	–
Caninia cornucopiae (Michelin)	–	+	++	+	–	–	–	–	++	++	++	++
Siphonophyllia sp.	–	+	++	–	–	–	++	++	++	+	–	–
cf. *Caninophyllum patulum* (Michelin)	–	–	+	–	–	–	+		–	–	–	–
Tabulata:												
Michelinia sp.	+	+	+	+	+	+	+	+	+	+	–	–
Syringopora sp.	–	+	+	+	+	+	+	–	+	–	+	–
BRACHIOPODA												
Rhipidomella michelini (l'Eveillé)	+	+	+	+	–	–	–	–	+	+	–	+
Rugoschonetes laguessianus angustus (Paeckelmann)	+	+	+	+	?	–	–	–	–	+	–	–
Pustula rugata (Thomas)	–	–	+	+	+	–	–	–	–	–	+	–
Pustula sp.	–	+	+	+	+	+	–	–	–	+	–	–
Eomarginifera derbiensis (Muir-Wood)	–	–	–	?	+	+	–	–	–	+	+	–
Pugnoides triplex (M'Coy)	–	–	–	+	–	–	–	–	–	–	–	+
Cleiothyridina deroysii (l'Eveillé)	+	+	+	?	–	–	–	–	–	++	+	+
Crurithyris urii (Fleming)	+	+	+	+	+	+	–	–	–	–	+	–
'Spirifer' attenuatus (Sowerby)	–	–	+	+	–	–	–	–	–	++	+	+
Brachythyris planatus (Phillips)	–	–	+	–	–	–	–	–	+	–	–	–
Punctospririfer moelleri (de Koninck)	–	+	?	–	–	–	–	–	–	+	–	–
Punctospirifer peracutus carinatus (Demanet)	–	+	+	–	–	–	–	–	–	–	–	+
Punctospirifer perplicatus (North)	+	?	–	–	–	–	–	–	–	–	+	–
Punctospirifer scabricosta (North)	–	–	–	–	+	–	–	–	+	–	–	–
Dielasma normale (de Koninck)	–	–	–	+	–	–	–	–	–	+	–	–
	Number of species:						6	3	14	14	9	8

Explanation:
Tn: Tournaisian; V: Viséan; –: not present; +: present; ++: abundant

Buresse have grain size frequency distributions that are very similar to those of the residue obtained from the Buresse limestone. (fig. 4 and 5)

Frequency distributions of the fractions smaller than 50 microns in the weathering residues from Ouffet, Ouhar II, Florzé I and the limestone and solifluction clays from Buresse are also very close. An admixture of Oligocene sands was often found in the 50-420 microns frequency range.

TABLE II

Number of species of rugose corals and brachiopods and their stratigraphic distribution.

Locality:	Substage:					
	Tournaisian			Viséan		
	1	2	3	1	2	3
Ouhar I	–	1	4	–	–	–
Bois de Comblain	1	1	1	–	–	–
Buresse	1	8	10	5	2	2
Ouhar II	3	10	9	8	2	2
Ouffet	3	5	5	5	3	2
Sprimont	2	6	7	6	–	1

TABLE III

Mineralogical composition of the clay fraction.

Peak Area Percentages

	Locality:	Kandite	Mica	Smectite
Solifluction clays with fossils	: Ouhar I	29	71	–
	Bois de Comblain	69	31	–
	Buresse	1	99	–
Residue limestone	: Ouhar II	+	100	–
	Buresse	+	100	–
	Sprimont	+	100	–
	Florzé I	5	95	–
	Rivage	+	100	–
	Krauthausen	–	100	–
Residual clays in situ	: Ouhar II	40	32	28
	Ouffet	39	26	35
	Sprimont	29	46	25
	Florzé	28	28	44

CONCLUSIONS

The silicified fossils found in the solifluction clays indicate a Lower Carboniferous age.

The clay mineralogical composition of the Buresse clay is the same as that of the limestone residues.

Regarding these facts and taking into account that grain-size frequencies do not contradict and even may support the hypothesis, we may consider the solifluction clays containing fossils and chert, as weathering residues derived from Carboniferous limestone.

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