

# ON THE PHOSPHORUS-BEARING MINERAL OF THE MANGANESE OXIDE ORE DEPOSITS OF EPLÉNY AND URKUT

GY. GRASSELLY

Institute of Mineralogy, Geochemistry and Petrography,  
Attila József University, Szeged

## INTRODUCTION

The mean P content of the manganese oxide ore deposits of Eplény and Urkut is generally less than 1,00 per cent. The P frequency distribution of the two deposits is illustrated by *Figs. 1* and *2*. It is very likely to suppose that a mineral belonging to the apatite-group must be the phosphorus-bearing one. However, in consequence of the generally low P content, the small grain size of the phosphorus-bearing mineral, of its fine distribution and difficulties of its separation and enrichment, instead of correct identification merely suppositions are to be found in the literature.

K. NAGY [1953], in his investigations on the mineral association of the manganese carbonate ores of Urkut, on the basis of X-ray and D.T.A. investigations, did not succeed in identifying the phosphorus mineral.

M. SZABÓ—DRUBINA [1957], reports that in some places in the upper part of the grey carbonate deposit of Urkut the phosphorus content is quite considerable: 14—22%  $P_2O_5$  and that according to X-ray investigations these layers with considerable phosphate content contain very fine-grained fluorapatite. Unfortunately this work does not contain X-ray data.

E. NEMECZ [1960], also in connection with the Urkut manganese carbonate ores dealt with the problem of phosphorus-bearing minerals. However, the mineral could not be identified owing to its small grain size, fine distribution and relatively small amount. Lines, belonging to the phosphate mineral could not be detected on the X-ray patterns either. The enrichment by oleine flotation of the carbonate mineral similarly did not bring any results.

GY. GRASSELLY and E. KLIVÉNYI [1960a,b], dealing with the phosphorus content distribution of Urkut oxide ore deposits stated that in the Urkut manganese oxide ore deposit the P content as a rule ranges between 0,08—0,30%, and that the phosphorus-bearing is an extremely finely distributed secondary apatite-mineral, in the formation of which the role of organic life might had been quite considerable. The fact that the P content of the area shows quite a wide range can be interpreted by the sedimentary origin of the deposit, the reaccumulation processes which had taken place in the deposit and the mostly organic origin of phosphate. In regard

of the chemical analysis of a sample having relatively larger phosphate content the presence of fluorapatite has been supposed as well.

As a final result, relying upon an X-ray pattern and an data of chemical analysis, the phosphorus-bearing mineral present in manganese carbonate and oxide ores of Eplény and Urkút had so far been regarded as fluorapatite. This is scarcely enough, however, for a final decision.

Therefore it promised some interesting findings to investigate from different viewpoints samples with considerable phosphate content thus making an attempt to clear up the nature of the phosphorus-bearing mineral of the Urkút and Eplény manganese ore deposits.

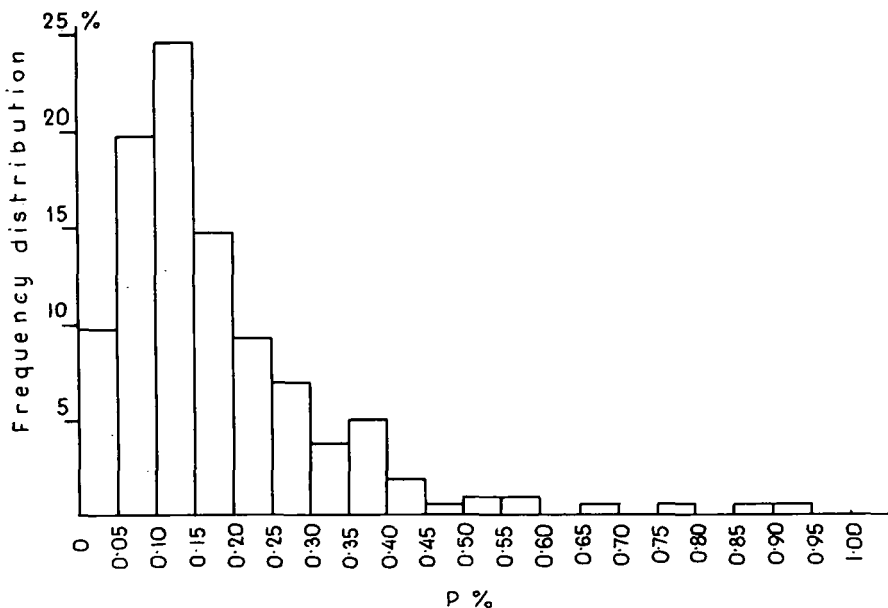


Fig. 1. Frequency distribution of P in 218 samples from Eplény manganese oxide ore deposit

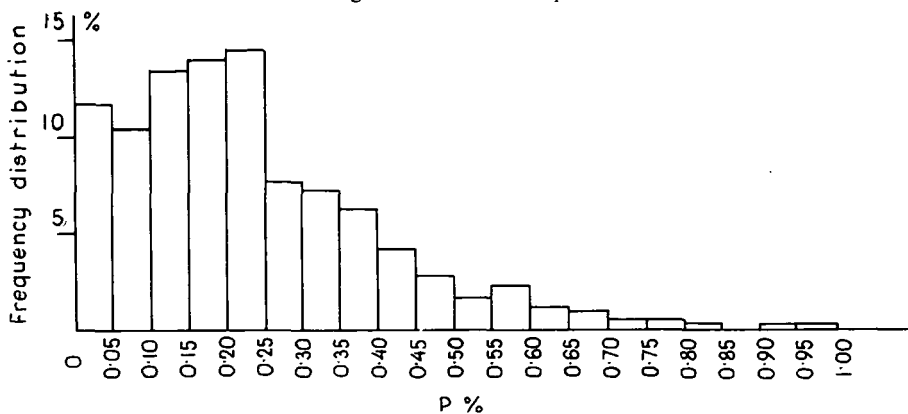


Fig. 2. Frequency distribution of P in 599 samples from Úrkút manganese oxide ore deposit

## RESULTS OF CHEMICAL ANALYSIS

To give an approximate proof of the supposition that an apatite mineral must be the phosphorus-bearing, the correlation of CaO and  $P_2O_5$ , as determined in 30 samples of the Urkut oxide deposit [GRASSELLY, 1960a] could be used. There is a positive correlation between the two values (Fig. 3) and although the correlation is not a strict one (the empiric correlation coefficient is 0,45), the connection between the two amounts can be regarded a reliable one. The correlation is weakened by the fact even if phosphorus is supposed completely belonging to apatite, calcium is surely a constituent not only of apatite but of other minerals without phosphorus content as well.

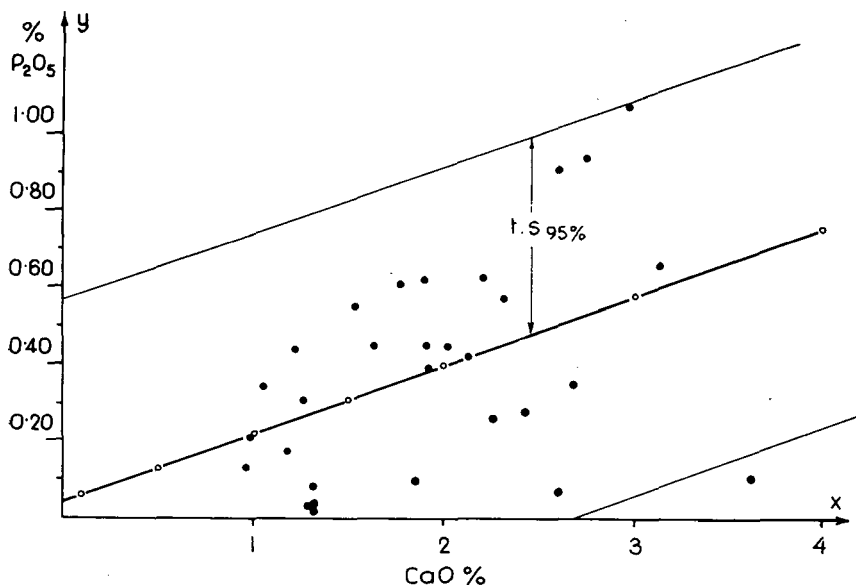


Fig. 3. Correlation between the CaO and  $P_2O_5$  content of manganese oxide ore samples from Urkut

Data of analysis of a 1,5—2 cm thick phosphate-containing lens from the Upper—Liassic dark grey radiolarian clay-marl in Eplény as well as of a sample from the immediate underlying rock of the manganese oxide deposit of Urkut (shaft No II) are summarized in Table 1.

Unfortunately this analysis — owing to the nature of the samples themselves — is not suitable for calculating the composition of the phosphate mineral present. Although the phosphate content of the samples is considerable, the phosphate component cannot be separated from other minerals present. Thus data of the analysis cannot be used for calculating the formula of the apatite mineral. The  $P_2O_5$ , F, Cl content can completely be regarded as belonging to apatite, but the same cannot be said of the other components. At most approximate calculations can be carried out, taking as a basis for calculation the  $P_2O_5$  content determined, and the following general formula:  $9CaO \cdot 3P_2O_5 \cdot CaX_2$ . A part of the CaO content belongs to apatite, the other to the calcite present. Therefore a part of  $CO_2$  also belongs to calcite, the other — although it is not proved that all what remain besides the part

necessary for calcite — belongs to apatite. The case is similar with the determination of the  $H_2O^+$  content: the sample also contains limonite as well as manganese(IV)-oxyhydrate and opal was observable, too. Thus a part of the water content does not belong to apatite, but its amount cannot be exactly given. The same can be told of the alkali content: silicates were also found in the samples, thus a part of the alkalis may belong to them, but it is not out of question that a part of them belongs to apatite.

Table 1

	Sample from Eplény (No 13)			Sample from Úrkút		
	a	b	c	a	b	c
Insoluble	25,13%			17,86%		
CaO	27,48	25,10	55,16	37,06	31,92	54,82
P <sub>2</sub> O <sub>5</sub>	19,12	19,12	42,01	24,32	24,32	41,81
Fe <sub>2</sub> O <sub>3</sub>	6,82			1,71		
Al <sub>2</sub> O <sub>3</sub>	5,48			4,39		
MnO <sub>2</sub>	0,88			2,13		
K <sub>2</sub> O	1,12			0,51		
Na <sub>2</sub> O	0,62			0,55		
CO <sub>2</sub>	2,48	0,62	1,36	5,36	1,33	2,28
Organic						
C	0,99			0,18		
H <sub>2</sub> O <sup>+</sup>	2,87	0,46	1,01	2,19	0,38	0,65
H <sub>2</sub> O <sup>-</sup>	3,57			3,55		
S	4,22			0,18		
F	0,21	0,21	0,46	0,19	0,20	0,34
Cl	—			0,02	0,02	0,03
Less O	100,99%	45,17%	100,00%	100,20%	58,17%	100,00
	1,14			0,13		
	99,85%			100,07%		

We could therefore restrict ourselves to an approximate calculation of the amount of CO<sub>2</sub> (the quantity remaining after calculating the part belonging to CaCO<sub>3</sub>) and H<sub>2</sub>O<sup>+</sup>, respectively, which likely belongs to apatite, besides the slight amount of F and Cl. Data of analyses are summarized in column *a* of Table 1, percentage amounts belonging to the phosphate component in column *b*, while column *c* contains the same amounts recalculated to 100 per cent.

Partial analytical data of another Upper—Liassic grey, fine striped nodule (Nr. 11) also from Eplény, together with analytical data of dahllite as published by D. McCONNELL [1960] are summarized in Table 2. From the analysis of dahllite only those data were considered, which components have also been used in our own analysis as constituents of apatite.

Although the calculations must be considered as approximate and whatever is the uncertainty concerning them, it appears at least that in the apatite mineral of the Úrkút and Eplény manganese ore deposit besides the slight amount of F and Cl, CO<sub>3</sub><sup>2-</sup> and OH<sup>-</sup> must also be present, thus in the light of chemical analysis it must be regarded as hydroxy-carbonate apatite with fluorine content.

This statement is supported by L. L. AMES [1959] declaring that if the CO<sub>3</sub> content is less than 10 per cent, it completely may enter the apatite lattice. Carbonate groups, as stated by D. McCONNELL [1960] substitute the phosphate groups and not the (F, OH) groups.

Table 2

	Sample (No 11.) Eplény			Dahlite D. McCONNELL, [1960]		
	a	b	c	a	b	c
CaO	47,94 %	46,00 %	54,57 %	51,44 %	51,10 %	53,67 %
P <sub>2</sub> O <sub>5</sub>	34,98	34,98	41,50	39,92	39,92	41,93
CO <sub>2</sub>	4,33	2,81	3,33	2,72	2,72	2,85
H <sub>2</sub> O <sup>+</sup>	1,90	0,21	0,24	2,83	1,03	1,08
F	0,20	0,20	0,24	0,03	0,03	0,03
Cl	0,10	0,10	0,12	0,42	0,42	0,44
		84,30 %	100,00 %		95,22 %	100,00 %

## RESULTS OF INFRARED ABSORPTION INVESTIGATIONS

A study of the infrared absorption spectra also renders an excellent possibility for the identification of phosphate minerals.

The free  $\text{PO}_4^{3-}$  ion has a  $T_d$  symmetry and accordingly in the ideal symmetry four fundamental vibrations are possible, of which, however, only two are infrared active ones, namely in the range  $950\text{--}1200\text{ cm}^{-1}$  the  $[\nu(\alpha)\text{PO}_4]$  or  $\nu_3$  stretching vibrations, and under  $650\text{ cm}^{-1}$   $[\delta(\alpha)\text{PO}_4]$  or  $\nu_4$  bending vibration. Both are triply degenerated vibrations. Thus of the fundamental bands only the absorption corresponding to  $\nu_3$  and  $\nu_4$  can be observed, the other two vibrations,  $\nu_2$  and  $\nu_1$  merely in the case when the ion configuration is modified by point groups of a lower symmetry [HERZBERG, 1945; H. MOENKE, 1962; H. H. ADLER, 1964].

All the phosphate minerals show a strong absorption between  $950\text{--}1200\text{ cm}^{-1}$  that is  $10,5\text{--}8,3\ \mu$ , while a less expressed absorption occurs under  $650\text{ cm}^{-1}$ , that is in the range of longer wavelengths.

In his publication referred to, H. MOENKE [1962] published the infrared spectra of an apatite (Kragerø, Norway) and a phosphorite (Florida, U.S.A.). The characteristic absorption bands of  $\text{PO}_4^{3-}$  of the apatite recordings appear at the following wave length:

$$1095, 1050, 965\text{ cm}^{-1}, \text{ and } 605, 579, 574\text{ cm}^{-1},$$

$$9,13, 9,52, 10,36\ \mu, \text{ and } 16,52, 17,27, 17,42\ \mu,$$

while at the Florida phosphorite:

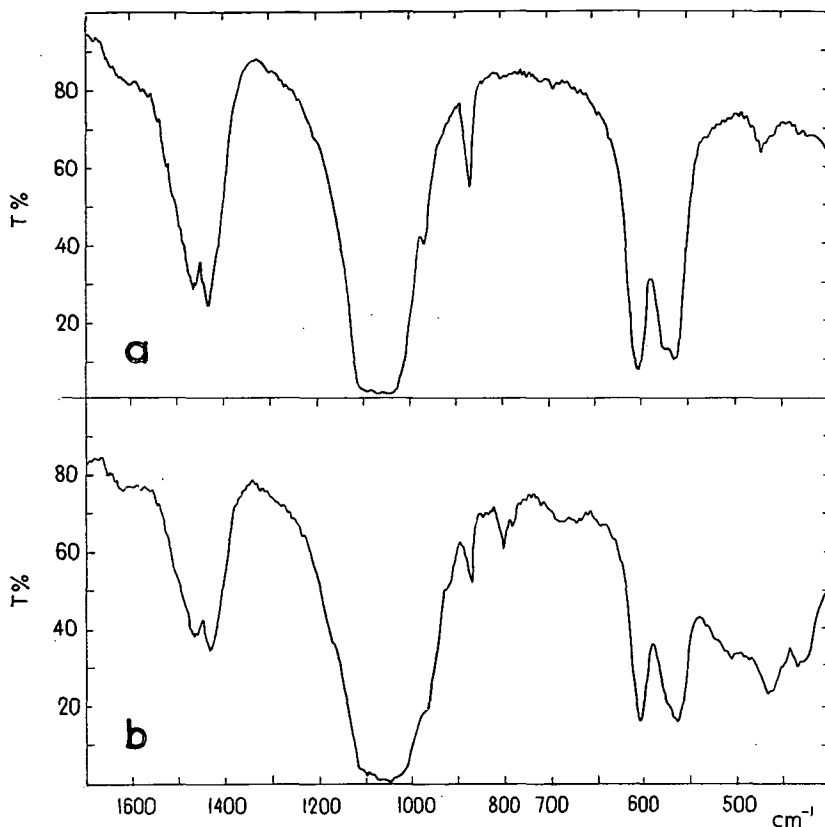
$$1105, 1050, 970\text{ cm}^{-1}, \text{ and } 610, 580, 572\text{ cm}^{-1},$$

$$9,04, 9,52, 10,30\ \mu, \text{ and } 16,33, 17,24, 17,48\ \mu.$$

There are other two bands in the Florida phosphorite, namely at  $1435\text{ cm}^{-1}$  and  $1460\text{ cm}^{-1}$ , which are not contained in the spectrum of the Kragerø apatite. These two bands appear quite strongly in spectra of the Urkut and Eplény samples as well. In this range the  $\text{CO}_3$  group shows strong absorption. The sometimes appearing double band likely can be ascribed to the fact that a well defined carbonate (calcite, manganocalcite or perhaps rodochroizite) may appear in the sample, but the  $\text{CO}_3$  group is present partly as a constituent of „phosphorite“.

Infrared spectra of the Eplény and Urkut samples are represented in *Fig. 4*. The spectrum of a Florida phosphorite is also included for sake of comparison.

The places of absorption bands observed in the spectra and characteristic for  $\text{PO}_4^{3-}$  are summarized in Table 3. Absorption bands appearing between  $1425\text{--}1450\text{ cm}^{-1}$ , characteristic for the  $\text{CO}_3$  group are also included.



*Fig. 4* Infrared spectra of the samples investigated  
*a)* Sample No. 11 from Eplény deposit  
*b)* Sample No. 13 from Eplény deposit

The infrared spectra shown in *Fig. 4*, and the absorption bands summarized in Table 3, respectively, are in good agreement with HERZBERG's statement [1945], namely that vibrations  $\nu_3$  and  $\nu_1$  for the  $\text{PO}_4^{3-}$  ion are at  $1082\text{ cm}^{-1}$  ( $9,2\ \mu$ ) and  $980\text{ cm}^{-1}$  ( $10,2\ \mu$ ), respectively. These frequencies, depending on the crystal structure, may alter to a certain extent.

H. H. ADLER [1964], dealing with the symmetry and substitution effect of the pyromorphite series, refers to the apatite-series as well, and remarks that vibration  $\nu_3$  consists of two infrared active modes, namely bands appearing at  $9,16\ \mu$  ( $1080\text{ cm}^{-1}$ ) and  $9,62\ \mu$  ( $1040\text{ cm}^{-1}$ ) correspond to this vibration, while the band appearing at  $10,35\ \mu$  ( $960\text{ cm}^{-1}$ ) corresponds to vibration  $\nu_1$ . These bands — with but a slight difference — have also been found in the spectra of samples from Eplény and Urkut.

R. B. FISCHER and CH. E. RING [1957] stated that when investigating fluorapatite and hydroxyapatite mixtures from a quantitative viewpoint, first of all the study of bands between 15–24  $\mu$  was fruitful. According to ADLER [1964] their

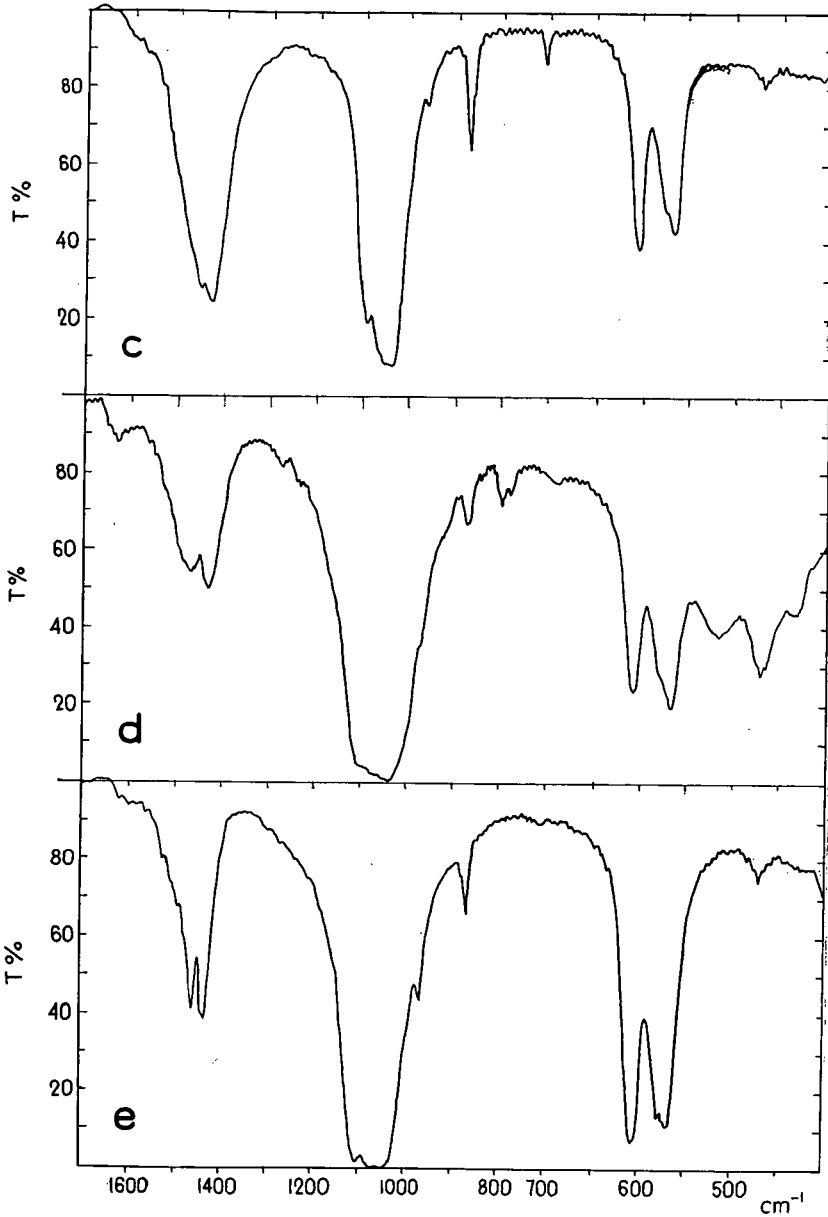


Fig. 4/2 Infrared spectra of the samples investigated

- c) Sample from the manganese oxide deposit of Úrkút
- d) Sample from the immediate underlying rock of the manganese oxide deposit of Úrkút
- e) „Phosphorite”, Florida

Table 3

PO<sub>4</sub> infrared absorption bands of samples from the Eplény and Urkut manganese ore deposit, with large phosphate content, in the range 16–18 μ and 9–10,5 μ

	a		b		c		d		e	
	Eplény, Sample No. 11		Eplény, Sample No. 13		Úrkút, Shaft No. II.				Phosphorite, Florida	
					from oxide deposit		from under- laying rock of oxide de- posit			
	cm <sup>-1</sup>	μ	cm <sup>-1</sup>	μ	cm <sup>-1</sup>	μ	cm <sup>-1</sup>	μ	cm <sup>-1</sup>	μ
PO <sub>4</sub> <sup>3-</sup>	565	17,69	565	17,69	565	17,69	565	17,69	567	17,63
	575	17,3	575	17,3	575	17,3	575	17,3	577	17,33
	604	16,55	603	16,58	604	16,55	605	16,5	603	16,58
	969	10,31	970	10,30	969	10,31	970	10,3	969	10,31
	1070	9,34	1040	9,61	1050	9,52	1040	9,61	1060	9,43
	1090	9,17	1090	9,17	1090	9,17	1080	9,25	1085	9,21
CO <sub>3</sub> <sup>2-</sup>	1432	6,98	1431	6,99	1430	6,99	1430	6,99	1430	6,99
	1458	6,86	1465	6,82	1460	6,85	1458	6,86	1460	6,85
	1469	6,81					1472	6,79		

correspond to  $\nu_4$  fundamental vibration. According to R. B. FISCHER and CH. E. RING if fluorapatite is dominant in the sample, the band appears at 17,5 μ, and on the contrary, the more considerable the amount of hydroxyapatite, this band is more and more displaced towards 17,8 μ. In connection with the change fluorapatite: hydroxyapatite ratio this displacement of the band from 17,5 μ towards 17,8 μ is accompanied by a change of the form of bands appearing between 16,6–17,8 μ.

In the samples investigated at present the characteristic band mentioned by R. B. FISCHER and CH. E. RING is at 17,69 μ as seen in the Table 3, thus it is nearer 17,8 μ, characteristic for hydroxyapatite, than to 17,5 μ characteristic for fluorapatite. The considerable carbonate and OH-content of the samples — although they cannot be in their complete amount ordered to the phosphate component — is in accordance with the infrared spectra, what indicates that we have a carbonate hydroxyapatite with F-content.

## RESULTS OF X-RAY STUDIES

Although the inhomogeneity of the samples made possible only some informatory records, the X-ray diffraction pattern of the samples had been taken by Cu/Ni radiation. Table 4 shows  $d$  values as obtained for the Eplény No. 11 and No. 13 samples and for the Urkut one. The Table 4 contains only diffraction lines which likely come from the apatite component. We have omitted from the Table a number of lines of fairly slight intensity, coming from other minerals present. The X-ray diffraction pattern has been taken in the range  $2\theta$  25–55°. For sake of comparison some  $d$  values of francolite by GRUNER and MCCONNELL [1937] of dahllite by MCCONNELL [1960] and for fluorapatite (also by MCCONNELL) of the A.S.T.M. card are also enlisted.

The  $d$  values as obtained for the samples studied are quite similar to those taken for comparison, perhaps most of all to those of francolite. Although the diffraction



Table 4

X-ray diffraction data of the samples; Cu/Ni radiation

Sample Nr. 11 from Eplény		Sample Nr. 13 from Eplény		Sample from Úrkút		Francolite [GRUNER, MCCON- NELL, 1937]			Dahllite [MCCONNELL, 1960]		Fluorapatite [A. S. T. M.]	
d	I	d	I	d	I	hkl	d	I	d	I	d	I
						200			4,094	1		
						111			3,899	2		
3,443	m	3,451	m	3,442	w	002	3,437	1	3,446	3	3,44	20
3,174	vw	3,172	w	3,165	w	102	3,160	0,5				
3,086	m	3,093	w	3,098	vw							
3,067	w					120	3,050	3	3,095	3	3,07	30
2,794	vs	2,800	vs	2,797	vs	121	2,789	10	2,823	10	2,81	100
2,787	vs	2,797	vs	2,791	s				2,785}		2,78	40
2,693	m	2,704	m	2,700	m	300	2,694	6	2,729	8	2,71	60
2,622	w	2,624	w	2,617	w	202	2,622	3	2,636	2	2,63	30
2,505	vw	2,497	w			301	2,507	0,5	2,537	1	2,53	5
				2,277	vw	122	2,289	0,5			2,30	5
2,245	w					130	2,242	2	2,271	3	2,26	20
2,137	w			2,144	vw	131	2,131	1	2,135	1	2,14	10
2,060	vw					113			2,066	1	2,06	10
				2,033	vw	132 $\beta$	2,067	0,5				
1,934	w	1,938	w	1,942	vw	123 $\beta$	2,026	0,5				
1,883	vw	1,883	vw	1,876	vw	222	1,931	3	1,950	3	1,94	40
						132	1,880	1	1,896	1	1,89	10
						230			1,878	1		
1,839	m	1,839	vw	1,836	vw	120	1,836	3			1,84	60
1,796	vw					231	1,795	2	1,812	1	1,80	30
1,768	vw	1,770	vw			140	1,764	2	1,787	1	1,77	30
1,750	vw	1,750	vw			402	1,745	2	1,760	1	1,75	30
						303			1,758}			
1,722	w	1,720	w	1,718	vw	004	1,721	2	1,723	1	1,72	30

vw: very weak; w: weak; m: middle; s: strong; vs: very strong

pattern of francolite and fluorapatite is very similar, according to MCCONNELL [1952] reflexion 300 of francolite is of greater intensity than reflexion 121, however, the same is reversely valid for fluorapatite. The diffraction patterns of the Eplény and Úrkút samples have as the most intensive — in an order of decreasing intensity — diffraction lines corresponding to reflexions 121, 300 and 202. Accordingly fluorapatite would have been supposed if the slight fluor content of the sample and the place of characteristic bands in the infrared spectra did not contradict this. It must be noted that in the comparative data in Table 4, reflexion 121 is the most intensive for all the three apatite minerals and reflexion 300 is somewhat weaker.

X-ray data of the Úrkút and Eplény phosphate mineral have good agreement in respect to several lines with X-ray data of an U-containing phosphate (Pécseley) investigated by J. KISS and K. VIRÁGH [1959]. The authors referred to regard the phosphate studied by them as a carbonate apatite with fluor content. The present studies are in good accordance with this view.

The analytical and X-ray data of the Úrkút and Eplény phosphate mineral are quite similar to those given by R. ORTMANN [1960] for the phosphate mineral in Dukaj, Albany. The author, considering chemical composition, regards the phosphate component a carbonate hydroxyapatite, near to dahllite.

## CONCLUSIONS

On comparing results of chemical analysis, infrared absorption and X-ray diffraction, in spite of the uncertainties coming from the inhomogeneity of the material, we have come to the conclusion that it is not reasonable to maintain the general designation „fluorapatite” for the phosphate mineral of the Urkut and Eplény manganese ore deposit, since it would only be justified to use, if — as pointed out by McCONNELL [1958] — the amount of CO<sub>2</sub> and H<sub>2</sub>O content were less than 1 per cent and the F content exceeded 3 per cent. By approximative calculations — only considering components belonging to apatite — and calculating the results for 100 per cent, the CO<sub>2</sub> and H<sub>2</sub>O content of the samples of Urkut and Eplény phosphate mineral is over 2 and even 3 per cent, and the F content in each sample is below 1%. On the basis of chemical analysis hydroxy-carbonate-apatite with fluor content can be considered. The place of bands between 17,5—17,8  $\mu$  in the infrared absorption spectra, more correctly, their displacement towards 17,8  $\mu$  similarly indicates that hydroxy-carbonate-apatite with some fluor content must be considered. X-ray diffraction data of samples are nearest to those of francolite. Francolite is essentially carbonate apatite. However, as the F content is low, and in the lattice of the phosphate component the presence of CO<sub>3</sub><sup>2-</sup> and OH<sup>-</sup> groups is obvious, as proved by infrared investigations, by all probability, the phosphorus-bearing mineral of the Urkut and Eplény manganese ore deposit is dahllite, what designation according to McCONNELL [1958] is correct for hydroxy-carbonate apatite of phosphate sediments, with low F content.

## ACKNOWLEDGEMENT

The writer expresses his distinguished thanks to MRS. ILONA KISPÉTER for the chemical analyses, to MR. ÁKOS BERTALAN for obtaining the X-ray patterns and to MR. JÓZSEF MEZŐSI for his kind comments as well as to MR. NÁNDOR MAREK for the infrared spectra.

## REFERENCES

- ADLER, HANS H. [1964]: Infrared Spectra of Phosphates. — *The Amer. Miner.* 49, 1002—1015.
- AMES, L. L. [1959]: The Genesis of Carbonate Apatites. — *Econ. Geol.* 54, 829—841.
- FISCHER, R. B., C. E. RING [1957]: Quantitative Infrared Analysis of Apatite Minerals. — *Anal. Chem.* 29, 431—434.
- GRASSELLY, GY., E. KLIVÉNYI [1960a]: Data on the Phosphorous Content and Organic Remains of Manganese Oxide Ores from Urkut. — *Acta Miner. Petr. Univ. Szegediensis* 13, 3—8.
- GRASSELLY, GY. [1960b]: Report on the Investigations of Phosphorous Content of Manganese Oxide Ores from Urkut. — Manuscript, Only in Hungarian.
- GRUNER, JOHN W., DUNCAN McCONNELL [1937]: The Problem of the Carbonate-Apatites. The Structure of Francolite. — *Z. f. Kristallogr. (A)* 97, 208—215.
- HERZBERG, G. [1945]: Molecular Spectra and Molecular Structure. II. Infrared and Raman Spectra of Polyatomic Molecules. — D. Van Nostrand Co., Inc., New York.
- KISS, J., K. VIRÁGH [1959]: An Uranium-bearing Phosphatic Rock in the Triassic of the Balaton Uplands around Pécsely. — *Földtani Közöny* 59, 85—97. In Hungarian with an English summary.
- McCONNELL, DUNCAN [1952]: The Problem of the Carbonate Apatites. IV. Structural Substitutions Involving CO<sub>3</sub> and (OH). — *Bull. Soc. Franç. Minér. Crist.* 75, 428—445.
- McCONNELL, DUNCAN [1958]: The Apatite-like Mineral of Sediments. — *Econ. Geol.* 53, 110—111.
- McCONNELL, DUNCAN [1960]: The Crystal Chemistry of Dahllite. — *The Amer. Miner.* 45, 209—216.
- MOENKE, H. [1962]: *Mineralspektren*. — Akademie Verlag, Berlin.

- NAGY, K. [1955]: Mineralogical Characteristics of the Manganese Ore Deposit of Urkut, Bakony Mountains, Hungary. — *Földtani Közlöny* 85, 145—152. In Hungarian with an English summary.
- NEMECZ, E. [1960]: Report on the Investigations of Manganese Carbonate Ores from Úrkút. — Manuscript, only in Hungarian.
- ORTMAN, RENATE [1960]: Mineralogische Untersuchungen des Phosphatkalks von Dukaj bei Tepelene (Albanien). — *Z. f. angew. Geol.* 6, 259—262.
- SZABÓ—DRUBINA, MRS. M. [1957]: Caractère géologique et minéralogique sédimentaire des minerais de manganèse de la Hongrie. — *Földtani Közlöny* 87, 261—273. In Hungarian with a French summary.

PROF. DR. GYULA GRASSELLY  
Institute of Mineralogy, Geochemistry and  
Petrography  
Attila József University at Szeged  
Táncsics M. u. 2.  
Szeged, Hungary