

TENGCHONGITE, A NEW MINERAL OF HYDRATED CALCIUM URANYL MOLYBDATE

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Tengchongite is a new mineral discovered at uranium occurrence near Tengchong County, Yunnan Province, China, where samples were obtained from Tongbiguan village, both the new mineral and name have been approved by the Commission on New Minerals and Mineral Names of IMA by votes 17—0 with 0 abstention.

Tengchongite is discovered in an oxidized zone of the uranium occurrence within the contact of ocular migmatite and migmatite gneiss. In the vicinity there are outcrops of microcline-granite migmatite, biotite-quartz-schist and biotite-granulite, etc. Tengchongite is closely associated with studtite, calcurmolite and kiviute.

Crystals of tengchongite are mica-schistose, thin tabular to tabular on {001}, but has no regular diametric or rectangular configuration (Fig. 1). Transparent to translucent. Glassy lustre. Cleavage {001} perfect. Hardness 2 to 2.5. Density (meas.) = 4.25(2)g/cm³. No fluorescence observed under either short or long wavelength UV light.

In transmitted light the color of the crystal is yellow. Pleochroism has not been observed on cleavage plane (001). Tengchongite is biaxial negative, with 2V (meas.).

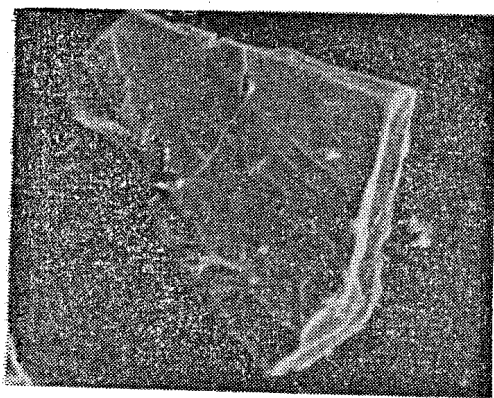


Fig. 1. BEI of tengchongite. (×300)

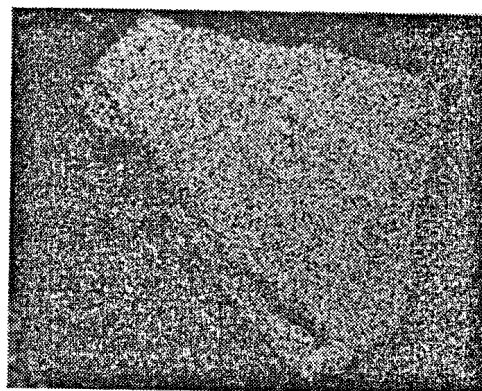


Fig. 2. X-ray image of uranium.
(×300)

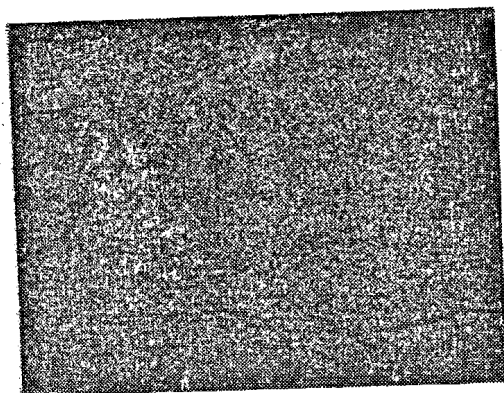


Fig. 3. X-ray image of molybdenum.
($\times 300$)

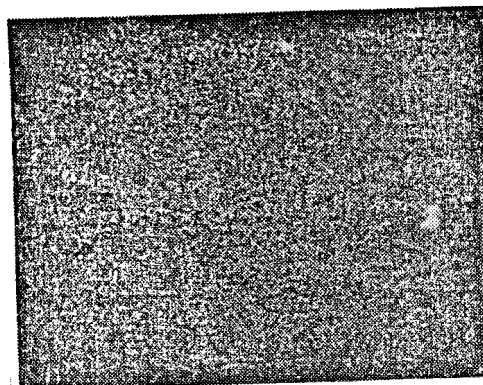


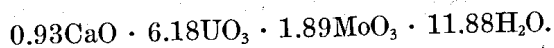
Fig. 4. X-ray image of calcium.
($\times 300$)

$= 16^\circ$, $2V(\text{calc.}) = 16^\circ$; $\alpha = 1.663 \pm 0.002$, $\beta = 1.760 \pm 0.002$, $\gamma = 1.762 \pm 0.002$.
Optical orientation: $X=c$. Comparing the optical parameters between tengchongite and calcurmolite (Table 1) the refractive index of tengchongite is greatly lower than that of calcurmolite.

Tengchongite is insoluble in 20% KOH slowly soluble in 0.1N HCl and fairly soluble in HNO_2 and H_2SO_4 .

The results of the wet chemical analysis for tengchongite are given in Table 2. The X-ray images of elements for the mineral analyzed by electron microprobe show that calcium, uranium and molybdenum are distributed homogeneously in the mineral (Figs. 2—4).

According to the recalculated analysis data in Table 2, the empirical formula of the mineral is



The ideal formula is $\text{CaO} \cdot 6\text{UO}_3 \cdot 2\text{MoO}_3 \cdot 12\text{H}_2\text{O}$.

The data in Table 2 show that the difference between tengchongite and calcurmolite in chemical components is distinct. The $(\text{UO}_3):(\text{MoO}_3)$ ration of tengchongite is 3, while that of calcurmlite is 1.

The DTA curve for tengchongite (Fig. 5) shows two obvious endothermic peaks at 83°C (dehydration) and 853°C (fusion of the mineral), respectively, and an exothermic peak at 574°C (formation of a new phase U_3O_8).

Table 1

Refractive Index of Tengchongite and Calcurmolite

	Tengchongite	Calcurmolite		
α	1.663 ± 0.002	$\gg 1.758$	1.770	1.770
β	1.760 ± 0.002		1.816—1.827	1.897
γ	1.762 ± 0.002	$\gg 1.758$	1.856—1.862	1.960
Source	this paper	[1]	[2]	[3]

When it is heated to 618°C , no obvious change appears in the configuration of the mineral. But the color becomes brown, the ordinary lustre fades and the transparency

Table 2
Chemical Analyses of Tengchongite and Calcurmolite

Oxide	Tengchongite			Calcurmolite		
	1	2	3			
UO ₃	74.30	76.64	6.18	47.73	61.26	54.59
MoO ₃	11.46	11.82	1.89	23.83	19.90	28.06
CaO	2.19	2.26	0.93	3.30	4.63	2.61
Na ₂ O	0.07					0.30
K ₂ O	0.09					
MgO	0.02					
MnO	0.02					
Al ₂ O ₃	0.66					
Fe ₂ O ₃	0.12					0.05
TiO ₂	0.07			} 2.76		0.10
ThO ₂	0.12					
SiO ₂	1.04					
P ₂ O ₅	0.28			6.18	3.86	0.21
As ₂ O ₅						
H ₂ O [±]	9.00	9.28	11.88			0.18
Total	99.44	100.00		12.90	10.90	13.52
Source	this paper			96.70	100.55	99.62
				[2]	[1]	[3]

Note: 1, Weight percent; 2, recalculated analysis; 3, oxide proportions.

decreases to opaque. The X-ray data show that new phase forms and pattern lines of U₂O₃ are observed.

When heated to 1000°C, the mineral fuses and becomes dark powder, pattern lines of U₃O₈ are also observed.

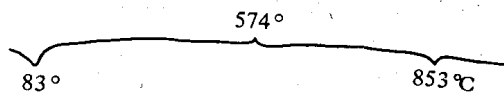


Fig. 5. DTA curve for tengchongite.

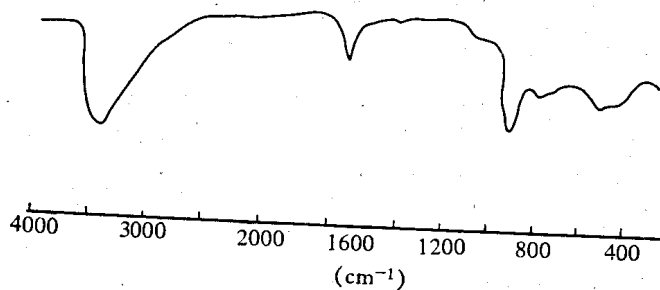


Fig. 6. IR spectrum for tengchongite.

IR spectroscopy for tengchongite (Fig. 6) shows the major uranyl band at about 920 cm^{-1} and that water molecules are present (3430 and 1640 cm^{-1}). The molybdate band appears at 780 cm^{-1} .

To find out if hydroxyl $[\text{OH}]^-$ exists in the mineral, the peak at $3200\text{--}3600\text{ cm}^{-1}$ is expanded (100 cm^{-1} of spectrum occupies 40 mm of the chart). The results indicate that there are no peaks of hydroxyl $[\text{OH}]^-$ on the spectrum.

The X-ray single-crystal of tengchongite has been studied by Weissenberg photographs. Systematic absences of reflection are hkl , $k+l=2n$; $h00$, $h=2n$; orthorhombic; space group $A 2_22$. Cell dimensions measured on four-circle diffractometer are $a_0=15.616(4)$, $b_0=13.043(6)$, $c_0=17.716(14)$. $D(\text{calc.})=4.24$. The data mentioned above are different from those of calcurmolite (see Table 3).

X-ray powder data for tengchongite are given in Table 4.

Table 3
Crystallographic Data for Tengchongite and Calcurmolite

System	Tengchongite	Calcurmolite	
	orthorhombic	monoclinic	orthorhombic
a_0	15.616 ± 0.004	17.18	16.35
b_0	13.043 ± 0.006	25.65	25.36
c_0	17.716 ± 0.014	14.96	32.97
β		$107^\circ 30' \pm 20'$	
V	3608		
Z	4	8	14
D	4.24	4.34	4.23
Source	this paper	[3]	[3]

Minerals of uranium molybdate occur rarely in nature. Minerals of uranyl molybdate containing additional cation Ca have been discovered only in USSR, such as calcurmolite. But X-ray diffraction study for calcurmolite has not been made in detail yet. Cell dimensions of calcurmolite described in literature are derived only from recalculation of X-ray powder data.

Tengchongite differs greatly from calcurmolite in chemical components, X-ray data and mineralogical characteristics.

However, perfect single crystal of tengchongite has not been found, determination of the crystal structure has not been performed so that the structure type of the mineral is not provided yet.

Type material is preserved at the Beijing Uranium Geology Research Institute.

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Table 4
X-ray Powder Data for Tengchongite and Calcumolite
(Fe radiation; Gandolfi camera 114.6mm)

Tengchongite (this paper)						Calcumolite (from [1])	
<i>I</i>	<i>d</i> (meas.)	<i>d</i> (calc.)	<i>hkl</i>	<i>I</i> ^{a)}	<i>d</i>	<i>I</i>	<i>d</i>
10	8.84	8.86	002	10	4.12	5	8.34
3	7.66	7.70	102	7	3.40	10	7.85
5	5.37	5.38	013	8	2.632		
3	4.41	4.43	{213 004}	7	2.075		
5	4.27	4.26	104	4	1.961	3	4.29
2	3.73	3.71	231	9	1.772	6	3.89
4	3.65	3.66	{024 411}	3	1.572		
3	3.51	3.50	033	3	1.430	3	3.56
7	3.38	3.37	{304 420}	2	1.382		
8	3.17	3.16	413	5	1.283	8	3.21
3	3.08	3.06	042	2	1.130		
2	3.01	3.01	{240 142}	⋮		3	2.90
2	2.76	2.76	{340 035}	3	0.993		
3	2.70	2.69	026			3	2.68
3	2.24	2.24	317			3	2.43
						2	2.24
3	2.16	2.15	{451 137}				
3	2.07	2.08	155				
4	2.04	2.04	308				
2	1.967					5	1.990
2	1.915						
1	1.859					4	1.855
<1	1.729						
						2	1.603
<1	1.568					2	1.571
<1	1.533						
<1	1.504					1	1.501
<1	1.453					1	1.473
	⋮						

a) Samples are heated to 618°C.

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