Table S1. Conditions and results of experiments on synthesis of redledgeite, (Red), hawthorneite (Hwt) and lindsleyite (Ldy) at 1.8, 3.5 and 5 GPa.

Run no.	Mineral composition, wt. %	Fluid, wt.%	Content of fluid in the system, %	Run duration, h	*T*, C	*P*, GPa	Synthetic phases		
							Red	Hwt	Ldy
Ba-1	Chromite, ilmenite (1:1)	$BaCO_3$, oxalic acid (9:1)	20	24	1200	5	—	+	+
Ba-2	Chromite, ilmenite (1:1)	$BaCO_3$, oxalic acid (9:1)	10	48	1200	5	—	+	+
Ba-Ti	Chromite, rutile (1:1)	$BaCO_3$, oxalic acid (9:1)	10	24	1200	5	+	—	+
3Ba-1	Chromite, ilmenite (1:1)	$BaCO_3$, oxalic acid (9:1)	10	1	1200	3.5	—	+	+
3Ba-Ti	Chromite, rutile (1:1)	$BaCO_3$, oxalic acid (9:1)	10	1	1200	3.5	+	—	+
Ba-1.8	Chromite, ilmenite (1:1)	$BaCO_3$, oxalic acid (9:1)	10	25	100	1.8	+	+	—

Table S2. Conditions and results of experiments on synthesis of priderite, (Pdr), yimengite (Yim) and mathiasite (Mts) at 3.5 and 5 GPa, 1200 °C.

Run no.	Mineral composition, wt. %	Fluid, wt.%	Content of fluid in the system, %	Run duration, h	*P*, GPa	Synthetic phases		
						Pdr	Yim	Mts
Sp1	Chromite	K_2CO_3, oxalic acid (10:0)	30	21	5	—	—	—
Sp2	Chromite, rutile (1:1)	K_2CO_3, oxalic acid (9:1)	20	23	5	+	—	—
A1	Chromite, rutile (1:1)	K_2CO_3, oxalic acid (9:1)	10	20	5	+	—	+
A2	Chromite, rutile (2:1)	K_2CO_3, oxalic acid (9:1)	10	24	5	+	—	+
B1	Chromite, ilmenite (1:1)	K_2CO_3, oxalic acid (9:1)	10	22	5	+	+	—
B1-1	Chromite, ilmenite (1:1)	K_2CO_3, oxalic acid (7:3)	10	22	5	—	+	+
B1-2	Chromite, ilmenite (1:1)	K_2CO_3, oxalic acid (5:5)	10	22	5	—	+	—
B1-3	Chromite, ilmenite (1:1)	K_2CO_3, oxalic acid (3:7)	10	22	5	—	—	—
B1-4	Chromite, ilmenite (1:1)	K_2CO_3, oxalic acid (1:9)	10	22	5	—	—	—
B2	Chromite, ilmenite (2:1)	K_2CO_3, oxalic acid (9:1)	10	20	5	+	+	—
M-0	Chromite, ilmenite (1:1)	K_2CO_3, oxalic acid (9:1)	10	8	3.5	—	+	+
M-1	Chromite, ilmenite (1:1)	K_2CO_3, oxalic acid (7:3)	10	8	3.5	—	+	+
M-2	Chromite, ilmenite (1:1)	K2CO3, oxalic acid (5:5)	10	8	3.5	—	+	+

M-3	Chromite, ilmenite (1:1)	$K2CO3$, oxalic acid (3:7)	10	8	3.5	—	—	—
M-4	Chromite, ilmenite (1:1)	$K2CO3$, oxalic acid (1:9)	10	8	3.5	—	—	—

Table S3. Main crystallographic characteristics, details of the X-ray experiment and structure refinement parameters for the synthetic yimengite.

Chemical formula	$K_{0.90}Ti_{5.16}Cr_{2.94}Fe_{2.54}Mg_{0.87}Al_{0.22}Mn_{0.30}O_{19}$
Formula weight	923.80
Temperature, K	90
System, sp.gr., *Z*	Hexagonal, $P6_3/mmc$ (194), 4
$a = b$, Å	5.8920(2)
c, Å	23.0113(8)
V, Å^3	691.82(6)
ρ_{calc}, g/cm^{-3}	4.435
μ, mm^{-1}	9.400
F(000)	879
Radiation	Synchrotron source (λ = 0.74539 Å)
Detector	Rayonix SX165 with CCD chip
$\theta_{min}/\theta_{max}$, deg	3.71/62.98 (0.71 Å)
Ranges of indices h, k, l	$-5 \leq h \leq 8$ $-8 \leq k \leq 7$ $-29 \leq l \leq 32$
Measured reflections	4094
Independent reflections	425 R_{int} = 0.0763 R_σ = 0.0267
Number of parameters	53
S	1.102
Refinement technique; weighting scheme	Least-squares method on F^2, $w = 1/[\sigma^2(F_o^2) + (0.1002P)^2 + 3.6783P]$ где $P = (F_o^2 + 2F_c^2)/3$
R_1; wR_2 [$I \geq 2\sigma(I)$]	R_1 = 0.0470; wR_2 = 0.1528
R_1; wR_2	R_1 = 0.0527; wR_2 = 0.1625
$\Delta\varrho_{max}/\Delta\varrho_{min}$, eÅ^{-3}	1.60/-1.08

Table S4. Atomic coordinates and equivalent isotropic parameters for the synthetic yimengite.

№№	Atom	*x*	*y*	*z*	U_{eq}, Å^2
1	Ti, Mn	1/3	2/3	0.31052(8)	0.0188(6)
2	Cr,Ti,Fe	0.33366(19)	0.16683(9)	0.39311(4)	0.0204(5)
3	Fe,Mg	1/3	2/3	0.47214(8)	0.0133(6)
4	Cr,Al	0	0.000000	1/2	0.0189(7)
5	Cr,Al	0	0.000000	1/4	0.0249(7)
6	K1	2/3	0.333333	0.250000	0.0166(12)
7	O1	0.1472(4)	0.2945(9)	0.4461(2)	0.0197(9)
8	O2	2/3	0.333333	0.4402(4)	0.0208(15)
9	O3	0	0.000000	0.3469(4)	0.0226(16)
10	O4	0.4988(4)	0.5012(4)	0.35055(19)	0.0198(10)
11	O5	0.1846(7)	0.3693(14)	0.250000	0.0247(14)

Table S5. Parameters of coordination polyhedral in the structure of synthetic yimengite.

	A	M_1	M_2	M_3	M_4	M_5
№№	6	4	5	3	1	2
Metal	K^+	Cr^{3+}, Al^{3+}	Cr^{3+}, Al^{3+}	Fe^{2+}, Mg^{2+}	Mn^{2+}, Ti^{4+}	Cr^{3+}, Fe^{2+}, Ti^{4+}
Volume, $Å^3$	57.4165	9.7138	6.8720	4.0915	10.2964	10.5044
Min. $l(M-O)$, Å	2.879(5)	1.950(5)	1.886(8)	1.993(5)	1.925(4)	1.965(4)
Av. $l(M-O)$, Å	2.9156	1.9495	2.0238	1.9987	1.9991	1.9991
Max. $l(M-O)$, Å	2.952(7)	1.950(5)	2.230(10)	2.017(10)	2.058(6)	2.020(5)
Degree of distortion	0.01244	0.0	0.08144	0.00463	0.03341	0.01096

Table S6. Metal ion radii R_M and metal–oxygen bond lengths $l(M-O)$.

	Al	**Mg**	**Fe**	**Mn**	**Cr**	**Ti**
R_M, Å	1.18	1.45	1.56	1.61	1.66	1.76
$l(M-O)$, Å	1.62	1.93	2.04	2.09	2.14	2.24
Oxidation state in mineral	3+	2+	2+	2+	3+	4+

Table S7. Cation distribution in the structures of potassium and barium minerals of the magnetoplumbite group.

Mineral or synthetic analogue/structural site	***A***	M_1	M_2	M_3	M_4	M_5	**References**
Hawthorneite	Ba	Cr	Fe^{3+}	Fe^{2+}, Mg	Ti	Cr, Fe^{3+}	[28, 30]
Haggertyite	Ba, K	Ti, Fe^{3+}	Fe^{3+}	Fe^{2+}	Ti	Ti, Fe^{2+},	[28, 31]
Batiferrite	Ba	Fe^{3+}	Fe^{3+}	Fe^{2+}	Ti, Fe^{3+}	Fe^{3+}, Ti	[28]
Barioferrite	Ba	Fe^{3+}	Fe^{3+}	Fe^{3+}	Fe^{3+}	Fe^{3+}	[28]
Yimengite	K	Fe^{3+}	Fe^{3+}	Mg, Fe^{2+}	Ti	Cr	[28, 29]
Yimengite (synth.)	K	Cr, Al	Cr, Al	Fe^{2+}, Mg, Mn^{2+}	Ti	Cr, Fe^{2+}, Ti	This study