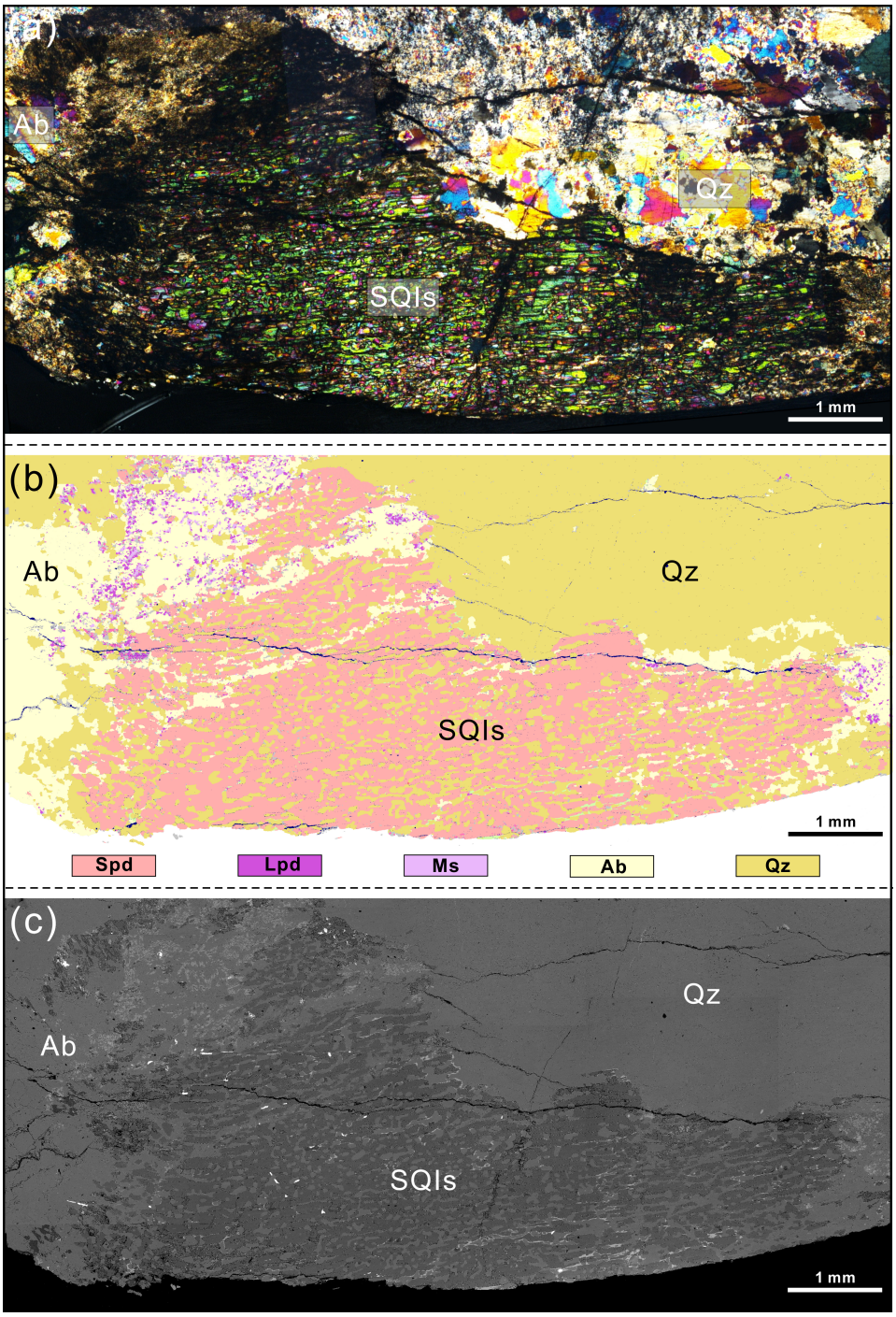
SUPPLEMENTAL



Supplemental Figure 1. Photomicrograph (**a**), colored image (**b**) and BSE image (**c**) of SQIs from Spd subzone.

Abbreviations: SQIs: spodumene + quartz intergrowths; Spd: spodumene; Lpd: lepidolite; Ms: muscovite; Ab: albite; Qz: quartz.

Supplemental Table 1. Petrographic internal zonation of the Nanyangshan pegmatite.

Zones	Subzones	Rock-forming minerals	Lithium minerals	Tourmaline color	Other rare-element minerals
Contact zone		Qz, Ab, Kfs, Cal, Dol, Srl		black	Cst, CGM, Zr, Brl
Border zone		Ab, Qz			Cst, CGM, Zr, Brl
Wall zone		Ab, Qz, Ms, Kfs, Srl		black	Cst, CGM, Zr, Brl
Intermediate zone	Spodumene subzone	Ab, Qz, Ms, Kfs	Spd (+++), Mbs (+), Lhp (+), Elb (+), Lpd (+)	blue	Cst, CGM, MGM, Zr, Brl, Pol
	Montebrasite subzone	Ab, Qz, Kfs	Mbs (+++), Spd (++), Elb (++), Lhp (+), Lpd (+)	green	
	Elbaite subzone	Ab, Qz	Elb (+++), Lpd (++), Mbs (+)	pink	
	Lepidolite subzone	Ab, Qz	Lpd (+++), Elb (+)	pink	
Core		Qz			

+++: major; ++: moderate; +: minor.

Main rock-forming minerals: Cal: calcite, Dol: dolomite, Kfs: K-feldspar, Qz: quartz, Ms: muscovite, Srl: schorl.

Lithium minerals: Spd: spodumene, Mbs: montebrasite, Lhp: lithiophilite, Elb: elbaite, Lpd: lepidolite.

Other rare-element minerals: Cst: cassiterite, CGM: columbite-group minerals, MGM: microlite-group minerals, Zr: zircon, Brl: beryl, Pol: pollucite.

Supplemental Table 2. Whole-rock major- and minor-element compositions of Li mineralization zones in the Nanyangshan, Tanco, Greenbushes, Highbury, and Harding pegmatites.

Pegmatite	Nanyangshan						Tanco[1]	Greenbushes[2]	Highbury[3]	Harding[4]
	Border zone	Wall zone	Intermediate zone							
			Spd subzone	Mbs subzone	Elb subzone	Lpd subzone				
SiO_2 (wt.%)	70.07	70.33	73.97	72.60	73.33	63.15	55.26–76.34	73.74	75.76	75.24
TiO_2	-	0.01	0.01	0.02	0.01	-	0.01	0.19	0.09	0.05
Al_2O_3	17.17	16.68	16.14	14.49	16.08	20.43	12.82–23.79	13.94	15.83	14.42
FeOt	0.09	0.56	0.43	0.25	0.14	0.03	0.07–0.17	0.85	0.23	0.48
MnO	0.12	0.12	0.12	0.09	0.03	0.16	0.25–0.48		0.06	0.18
MgO	0.04	0.03	0.03	0.05	0.03	0.05	0.01	0.16	0.14	0.01
CaO	0.57	0.35	0.27	0.22	0.61	0.34	0.09–0.20	0.45	0.11	0.20
Na_2O	9.94	5.50	4.50	2.80	3.39	3.75	1.15–3.38	2.57	3.15	4.23
K_2O	0.17	3.87	0.83	1.22	1.56	4.64	3.18–7.76	1.50	2.08	2.74
H_2O	0.58	0.49	0.58	0.62	0.51	0.61	0.18–2.44		0.60	
LOI	0.61	1.14	0.91	1.16	2.10	3.27				
Total	99.88	99.59	99.98	99.95	99.22	98.68	99.83–99.97	102.30	100.02	98.33
Li_2O	0.04	0.10	1.66	2.68	1.13	2.07	0.16–2.99	2.74	2.03	0.65
P_2O_5	0.48	0.41	0.53	3.75	0.30	0.18	0.61–1.43	0.20	0.03	0.13
B_2O_3	-	0.01	0.13	0.37	1.04	0.12	0.01–0.06			
F	0.03	0.09	0.15	0.57	1.00	2.03	0.02–1.51			0.64

[1]: Contents of Li mineralization zones in Stilling et al. (2006); [2]: Partington et al. (1995); [3]: Thomas et al. (1994); [4]: Burnham and Nekvasil (1986).

Supplemental Table 3. EPMA data for spodumene from the Spd and Mbs subzones.

Content	Spd subzone		Mbs subzone
	Spodumene	Spodumene in SQIs	Spodumene
	n = 8	n = 4	n = 7
	Mean (Std)	Mean (Std)	Mean (Std)
SiO_2 (wt.%)	64.16 (0.51)	64.33 (0.15)	64.64 (0.53)
Al_2O_3	26.51 (0.50)	26.92 (0.05)	26.67 (0.29)
FeO	0.42 (0.15)	0.37 (0.09)	0.01 (0.00)
MnO	0.03 (0.04)	0.05 (0.03)	0.03 (0.01)
CaO	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Li_2O*	7.91 (0.07)	7.95 (0.04)	8.02 (0.06)
Na_2O	0.13 (0.02)	0.14 (0.03)	0.13 (0.02)
K_2O	0.01 (0.01)	-	0.01 (0.00)
Total	99.17 (0.24)	99.78 (0.19)	99.51 (0.55)
Calculated on the basis of Si = 2 (apfu)			
Si (apfu)	2.00 (0.00)	2.00 (0.00)	2.00 (0.00)
Al	0.97 (0.03)	0.99 (0.00)	0.97 (0.01)
Fe	0.01 (0.00)	0.01 (0.00)	0.00 (0.00)
Mn	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Ca	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Li*	0.99 (0.00)	0.99 (0.00)	0.99 (0.00)
Na	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
K	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

*: calculated by Li (apfu) = 1 − (Na + K); -: below detection limit.

Supplemental Table 4. EMPA analysis of analcime−pollucite-series from the Nanyangshan pegmatite.

Content	Cs-bearing analcime									Na-bearing pollucite		Max	Min	Ave
SiO_2	57.39	54.41	55.44	54.91	52.59	51.92	51.52	52.08	47.65	43.67	43.48	57.39	43.48	51.37
Al_2O_3	20.49	22.32	20.11	19.78	21.07	20.06	20.39	20.55	18.77	16.52	16.83	22.32	16.52	19.72
FeO	0.05	-	-	-	-	-	0.02	0.01	0.01	-	-	0.05	0.01	0.02
MgO	-	0.01	-	0.02	0.01	0.01	-	0.01	-	0.01	0.02	0.02	-	0.01
CaO	0.03	0.03	0.01	0.01	0.02	0.02	0.01	0.01	-	0.01	0.03	0.03	-	0.02
Na_2O	11.19	10.03	10.23	9.55	7.99	7.81	7.46	5.31	5.23	1.24	1.34	11.19	1.24	7.03
K_2O	0.06	0.08	0.07	0.06	0.06	0.07	0.07	0.08	0.02	0.08	0.10	0.10	0.02	0.07
Rb_2O	-	-	-	-	-	0.02	-	-	0.01	0.40	0.31	0.40	0.01	0.19
Cs_2O	3.40	4.36	7.02	9.46	12.08	13.18	14.90	15.65	23.70	35.28	35.91	35.91	3.40	15.90
H_2O*	8.52	8.37	7.98	7.60	7.18	6.97	6.71	6.58	5.06	2.52	2.43	8.52	2.43	6.36
Total	101.13	99.60	100.86	101.40	100.99	100.06	101.08	100.26	100.44	99.74	100.45	101.40	99.60	100.55
Calculated atoms based on O = 6 (apfu)														
Si	2.12	2.05	2.11	2.11	2.06	2.08	2.07	2.10	2.06	2.09	2.07	2.12	2.05	2.08
Al	0.89	0.99	0.90	0.90	0.97	0.95	0.96	0.97	0.96	0.93	0.95	0.99	0.89	0.94
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.80	0.73	0.75	0.71	0.61	0.61	0.58	0.41	0.44	0.12	0.12	0.80	0.12	0.54
K	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00
Rb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00
Cs	0.05	0.07	0.11	0.16	0.20	0.23	0.25	0.27	0.44	0.72	0.73	0.73	0.05	0.29
OH*	0.95	0.93	0.89	0.84	0.80	0.77	0.75	0.73	0.56	0.28	0.27	0.95	0.27	0.71
Poll[a]	6%	9%	13%	18%	25%	27%	30%	39%	44%	84%	84%	84%	6%	34%

*: calculated by OH (apfu) = 1 – Cs; [a]: calculated as the atomic ratio Cs/ (Cs + Na + K + Rb + Fe + Mg + Ca).

$Poll_0$-$Poll_5$: analcime; $Poll_5$-$Poll_{50}$: Cs-bearing analcime; $Poll_{50}$-$Poll_{95}$: Na-bearing pollucite; $Poll_{95}$-$Poll_{100}$: pollucite.

Supplemental Table 5. EPMA element content data for montebrasite from the Spd, Mbs and Elb subzones.

Content	Spd subzone n = 5			Mbs subzone n = 9			Elb subzone n = 5		
	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave
P_2O_5 (wt.%)	47.72	46.44	47.11	48.54	46.65	47.76	48.28	46.24	47.23
SiO_2	0.09	0.03	0.05	0.08	-	0.03	0.05	0.01	0.03
TiO_2	0.12	0.01	0.09	0.14	-	0.04	0.13	0.02	0.06
Al_2O_3	36.42	35.47	36.01	35.93	34.33	35.34	36.70	34.22	35.58
FeO	0.11	0.02	0.04	0.03	-	0.01	0.05	-	0.01
MnO	0.16	-	0.04	0.04	-	0.01	0.01	-	0.01
Li_2O*	10.03	9.75	9.90	10.21	9.80	10.04	10.13	9.69	9.91
Na_2O	0.02	-	-	0.05	-	0.01	0.06	0.03	0.04
K_2O	0.01	-	-	0.01	-	-	0.02	-	0.01
H_2O[a]	5.89	4.97	5.45	5.15	3.27	4.57	4.26	3.11	3.63
F	2.26	0.36	1.13	5.79	2.00	3.14	6.01	3.54	4.98
Total	100.93	99.26	99.82	102.30	99.62	100.96	102.65	100.34	101.50
F=O	-0.15	-0.95	-0.47	-0.84	-2.43	-1.32	-1.49	-2.52	-2.09
Subtotal	99.98	98.78	99.34	100.42	98.64	99.64	100.12	98.84	99.40
Based on P+Si = 1 (apfu)									
P (apfu)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Si	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.09	1.04	1.06	1.07	0.99	1.03	1.10	0.99	1.05
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Li*	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Na	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OH[a]	0.97	0.82	0.91	0.84	0.54	0.75	0.72	0.52	0.61
F	0.18	0.03	0.09	0.46	0.16	0.25	0.48	0.28	0.39
F/(F+OH)	18%	3%	9%	46%	16%	25%	48%	28%	39%

*: calculated by Li (apfu) = 1 – (Ti + Fe + Mn + Na + K); [a]: calculated by OH (apfu) = 1 – F; -: below detection limit.

Supplemental Table 6. EPMA element content data for lithiophilite from the Spd and Mbs subzones.

Content	Spd subzone n = 7			Mbs subzone n = 6		
	Max	Min	Ave	Max	Min	Ave
P_2O_5 (wt.%)	45.23	44.35	44.86	45.15	44.44	44.82
SiO_2	0.06	0.00	0.02	0.12	-	0.04
TiO_2	-	-	-	-	-	-
Al_2O_3	0.03	-	0.01	0.06	-	0.02
CaO	0.14	0.03	0.07	1.53	0.05	0.38
MgO	0.04	0.02	0.03	0.04	-	0.03
FeO	10.00	9.51	9.70	0.69	0.38	0.57
MnO	35.74	34.39	35.14	45.47	43.80	44.80
Li_2O*	9.53	9.33	9.44	9.51	9.35	9.42
Na_2O	0.04	-	0.01	0.06	-	0.04
K_2O	0.01	-	-	0.04	0.01	0.02
Total	100.21	98.49	99.29	101.01	99.11	100.13
Based on O = 4 (apfu)						
P	1.00	1.00	1.00	1.00	1.00	1.00
Si	0.00	0.00	0.00	0.00	0.00	0.00
Ti	0.00	0.00	0.00	0.00	0.00	0.00
Al	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.00	0.00	0.00	0.04	0.00	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.22	0.21	0.21	0.02	0.01	0.01
Mn	0.79	0.76	0.78	1.02	0.97	1.00
Li*	1.00	1.00	1.00	1.00	1.00	1.00
Na	0.00	0.00	0.00	0.00	0.00	0.00
K	0.00	0.00	0.00	0.00	0.00	0.00

*: calculated by Li (apfu) = 1 − (Na + K); -: below detection limit.

Supplemental Table 7. Compositional analysis of elbaite from the Nanyangshan pegmatite.

Content	Spd subzone n = 9 Mean (Std)	Mbs subzone n = 13 Mean (Std)	Elb subzone n = 11 Mean (Std)	Lpd subzone n = 7 Mean (Std)
SiO_2 (wt.%)	35.92 (0.65)	36.92 (0.89)	37.71 (0.35)	37.42 (0.24)
TiO_2	0.04 (0.03)	0.04 (0.04)	0.01 (0.03)	0.01 (0.01)
Al_2O_3	37.26 (0.57)	37.63 (0.71)	41.35 (0.32)	41.09 (0.68)
FeO	7.16 (1.44)	5.04 (1.79)	0.34 (0.24)	0.11 (0.04)
MgO	0.06 (0.02)	0.08 (0.05)	-	0.02 (0.04)
CaO	0.16 (0.05)	0.21 (0.06)	0.37 (0.06)	0.61 (0.22)
MnO	0.58 (0.21)	1.04 (0.45)	1.06 (0.35)	1.18 (0.08)
Na_2O	2.62 (0.20)	2.52 (0.20)	1.98 (0.15)	1.88 (0.08)
K_2O	0.02 (0.01)	0.02 (0.01)	0.01 (0.01)	0.01 (0.01)
F	0.90 (0.10)	0.98 (0.14)	0.85 (0.03)	0.88 (0.07)
Li_2O*	1.43 (0.28)	1.70 (0.25)	2.18 (0.03)	2.56 (0.06)
H_2O^a	3.24 (0.04)	3.25 (0.08)	3.43 (0.02)	3.41 (0.04)
$B_2O_3{}^b$	10.64 (0.10)	10.76 (0.13)	11.10 (0.04)	11.08 (0.05)
Subtotal	100.03 (0.63)	100.2 (0.60)	100.39 (0.12)	100.24 (0.39)
O = F	0.38 (0.04)	0.41 (0.06)	0.36 (0.01)	0.37 (0.03)
Total	99.65 (0.63)	99.78 (0.57)	100.03 (0.12)	99.87 (0.38)
Structural formula based on 31 anions (O, OH, F)				
Si (apfu)	5.87 (0.07)	5.96 (0.08)	5.91 (0.04)	5.87 (0.06)
Al^{iv}	0.13 (0.07)	0.06 (0.06)	0.09 (0.04)	0.13 (0.06)
B^b	3.00 (0.00)	3.00 (0.00)	3.00 (0.00)	3.00 (0.00)
AlviZ	6.00 (0.00)	6.00 (0.00)	6.00 (0.00)	6.00 (0.00)
AlviY	1.04 (0.06)	1.10 (0.10)	1.54 (0.05)	1.46 (0.04)
Ti	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Mg	0.02 (0.00)	0.02 (0.01)	0.00 (0.00)	0.01 (0.01)
Mn	0.08 (0.03)	0.14 (0.06)	0.14 (0.05)	0.16 (0.01)
Fe^{2+}	0.98 (0.20)	0.68 (0.25)	0.04 (0.03)	0.01 (0.01)
Li*	0.94 (0.18)	1.10 (0.15)	1.38 (0.02)	1.61 (0.03)
Ca	0.03 (0.01)	0.04 (0.01)	0.06 (0.01)	0.10 (0.04)
Na	0.83 (0.06)	0.79 (0.07)	0.60 (0.05)	0.57 (0.02)
K	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
OH^a	3.53 (0.05)	3.50 (0.07)	3.58 (0.02)	3.57 (0.03)
F	0.47 (0.05)	0.50 (0.07)	0.42 (0.02)	0.43 (0.03)

*: measured by LA−ICP−MS; [a]: calculated by OH (apfu) = 4 − F; [b]: Based on B (apfu) = 3; -: below detection limits.

Supplemental Table 8. Compositional analysis of lepidolite from the Nanyangshan pegmatite.

Content	Spd subzone n = 10 Mean (Std)	Mbs subzone n = 6 Mean (Std)	Elb subzone n = 6 Mean (Std)	Lpd subzone n = 7 Mean (Std)
SiO_2 (wt.%)	50.21 (1.45)	52.10 (0.94)	51.67 (1.42)	52.92 (1.03)
Al_2O_3	23.40 (1.43)	22.52 (0.19)	23.15 (1.10)	22.77 (1.81)
FeO	2.25 (0.70)	0.52 (0.42)	0.00 (0.01)	0.04 (0.02)
MnO	0.54 (0.08)	0.39 (0.14)	0.12 (0.06)	0.26 (0.05)
MgO	0.12 (0.02)	0.03 (0.03)	0.01 (0.01)	0.01 (0.01)
CaO	0.06 (0.04)	0.05 (0.07)	0.03 (0.03)	0.03 (0.02)
Na_2O	0.20 (0.05)	0.14 (0.05)	0.13 (0.02)	0.18 (0.05)
K_2O	9.92 (0.31)	10.32 (0.15)	10.16 (0.19)	9.99 (0.31)
Rb_2O	2.18 (0.57)	1.34 (0.17)	2.24 (0.90)	1.56 (0.06)
Cs_2O	0.84 (0.40)	0.88 (0.15)	0.82 (0.09)	1.13 (0.35)
F	5.77 (0.55)	6.84 (0.18)	6.87 (0.38)	7.22 (0.43)
Li_2O*	5.22 (0.39)	5.99 (0.22)	6.26 (0.31)	6.51 (0.20)
H_2O^a	1.69 (0.27)	1.23 (0.07)	1.23 (0.16)	1.12 (0.21)
Subtotal	102.42 (0.76)	102.37 (0.58)	102.68 (0.95)	103.56 (0.66)
O = F	2.43 (0.23)	2.88 (0.08)	2.89 (0.16)	3.04 (0.18)
Total	99.99 (0.72)	99.49 (0.52)	99.78 (0.92)	100.52 (0.68)
Calculated on the base of 22 atoms				
Si (apfu)	6.81 (0.17)	6.98 (0.08)	6.91 (0.13)	6.97 (0.17)
Al^{iv}	1.19 (0.17)	1.02 (0.08)	1.09 (0.13)	1.03 (0.17)
Al^{vi}	2.55 (0.07)	2.53 (0.03)	2.56 (0.07)	2.52 (0.10)
Fe	0.26 (0.08)	0.06 (0.05)	0.00 (0.00)	0.00 (0.00)
Mn	0.06 (0.01)	0.04 (0.02)	0.01 (0.01)	0.03 (0.01)
Mg	0.02 (0.00)	0.01 (0.01)	0.00 (0.00)	0.00 (0.00)
Ca	0.01 (0.01)	0.01 (0.01)	0.00 (0.00)	0.00 (0.00)
Na	0.05 (0.01)	0.04 (0.01)	0.03 (0.01)	0.04 (0.01)
K	1.71 (0.04)	1.76 (0.02)	1.73 (0.03)	1.68 (0.05)
Rb	0.19 (0.05)	0.12 (0.01)	0.19 (0.08)	0.13 (0.00)
Cs	0.05 (0.02)	0.05 (0.01)	0.05 (0.01)	0.06 (0.02)
F	2.47 (0.24)	2.90 (0.07)	2.91 (0.15)	3.02 (0.18)
Li*	2.85 (0.18)	3.23 (0.12)	3.37 (0.15)	3.46 (0.11)
OH^a	1.53 (0.24)	1.10 (0.07)	1.09 (0.15)	0.98 (0.18)

*: measured by LA−ICP−MS; [a]: calculated by OH (apfu) = 4 – F.

Supplemental Table 9. Mass balance calculation of SQIs.

Step 1: Conversion of volume percents to weight percents of spodumene and quartz (SQIs)			Step 2: EPMA compositions of spodumene and quartz (SQIs)			Step 3: Reconstruction of the pre-intergrowth				Composition of SQIs (diameter = 100 μm)			
	Spodumene	Quartz		Spodumene	Quartz		Spodumene	Quartz	Precursor		zone 1 (Ave) n = 21	zone 2 (Ave) n = 20	zone 3 (Ave) n = 24
Volume %	57.00	43.00	Li_2O	7.95		Li_2O	4.86		4.86	Li_2O*	4.90	4.80	4.82
Density	3.15	2.65	Al_2O_3	26.92		Al_2O_3	16.47		16.47	Al_2O_3	16.57	17.60	15.96
Weight%	61.18	38.82	SiO_2	64.33	100.00	SiO_2	39.36	38.82	78.18	SiO_2	78.88	77.25	77.53
			Total	99.20	100.00	Total	60.69	38.82	99.51	Total	100.35	99.66	98.31

*: The amount of Li_2O was calculated on the basis of stoichiometry.

Supplementary methods

1. Procedure for whole-rock trace-element analysis. Prepared samples were added to $LiBO_2$–$Li_2B_4O_7$, mixed well, and fused in a furnace at 1025 °C. The resulting melt was then cooled and dissolved in an acid mixture containing nitric, hydrochloric, and hydrofluoric acids. This solution was analyzed by ICP–MS. Some of the solution was also added to GEO-AR01/GEO-4ACID and analyzed by ICP–AES.

2. Analysis conditions and standards for mineral major-element analysis. Analysis conditions involved an acceleration voltage of 15 kV, a probe current of 20 nA, a counting time of 10 s, and a beam diameter of 5 μm for lepidolite, montebrasite and analcime–pollucite and 1 μm for other minerals. Natural minerals (apatite, fayalite, hornblende, pollucite, rutile, scheelite, and topaz) were used as standards. All data were corrected by using standard ZAF correction procedures.

3. Analysis conditions and standards for mineral trace-element analysis. All analyses were conducted on polished thin sections with operating conditions varying according to the minerals involved, namely, a spot size of 30 μm at a repetition rate of 4 Hz with a maximum energy of 150 mJ for lepidolite, and a 30 μm beam diameter at a repetition rate of 6Hz with a maximum energy of 80 mJ for elbaite. External calibration used United States Geological Survey standards (BCR-2G and GSE-1G) and National Institute of Standards samples (SRM 612 and SRM 610) with Si as the internal standard to correct for instrument drift. Off-line data processing was performed using the ICPMSDataCal 10 program (Liu et al. 2008).