Table S1. Operating conditions for the LA-ICP-MS equipment.

Laboratory & Sample Preparation	
Laboratory name	Géosciences Rennes, UMR CNRS 6118, Rennes, France
Sample type/mineral	Columbite and monazite
Sample preparation	Conventional mineral separation, 1 inch resin mount, 1µm polish to finish
Imaging	Backscattered Imaging: Hitachi S4800 SEM
Laser ablation system	
Make, Model & type	ESI NWR193UC, Excimer
Ablation cell	ESI NWR TwoVol2
Laser wavelength	193 nm
Pulse width	< 5 ns
Fluence	8.8 J/cm^{-2}
Repetition rate	4 Hz (columbite); 2 Hz (Monazite)
Spot size	30 µm (columbite); 10 µm (monazite)
Sampling mode / pattern	Single spot
Carrier gas	100% He, Ar make-up gas and N2 (3 ml/mn) combined using in-house smoothing device
Background collection	20 seconds
Ablation duration	60 seconds
Wash-out delay	15 seconds
Cell carrier gas flow (He)	0.75 l/min
ICP-MS Instrument	
Make, Model & type	Agilent 7700x, Q-ICP-MS
Sample introduction	Via conventional tubing
RF power	1350W
Sampler, skimmer cones	Ni
Extraction lenses	X type
Make-up gas flow (Ar)	0.85 l/min
Detection system	Single collector secondary electron multiplier
Data acquisition protocol	Time-resolved analysis
Scanning mode	Peak hopping, one point per peak
Detector mode	Pulse counting, dead time correction applied, and analog mode when signal intensity > ~ 106 cps
Masses measured	^{204}(Hg + Pb), ^{206}Pb, ^{207}Pb, ^{208}Pb, ^{232}Th, ^{238}U
Integration time per peak	10-30 ms
Sensitivity / Efficiency	28000 cps/ppm Pb (50µm, 10Hz)
Data Processing	
Gas blank	20 seconds on-peak
Calibration strategy	GJ1 zircon standard (columbite) and Moacir monazite (monazite) standard used as primary reference material, 91500 and Manangoutry used as secondary reference material (quality control)
Reference Material info	GJ1, Jackson et al. [98] Moacir, Gasquet et al. [99] 91500, Wiedenbeck et al. [100] Manangoutry, Paquette and Tiepolo [101]
Data processing package used	GLITTER ® Van Achterbergh et al. [102]
Quality control / Validation	91500: Concordia age = 1066.3 ± 8.9 Ma (N=6; MSWD=0.29) Manangoutry: Concordia age = 545 ± 10 Ma (N=9; MSWD=2.4)

Table S2. Representative electron-microprobe analyses of columbite from the Mayo Salah pluton (MsLF)

Petrography (Subgroup)	**Microgranular fine-grained muscovite leucogranite (MsLF)**										
Zone	Rim				Core						
Analysis	ct33	c3-1	c4-2	c5-1	c2-1	c5-3	c4-1	c1-1	c1-2	c2-11	c3-1
Na_2O (wt.%)	0.00	0.03	0.01	0.00	0.01	0.04	0.02	0.01	0.00	0.04	0.00
CaO	0.01	0.08	0.00	0.03	0.03	0.08	0.01	0.04	0.07	0.03	0.00
Al_2O_3	0.00	0.00	0.01	0.04	0.03	0.04	0.00	0.03	0.02	0.03	0.00
FeO	2.39	3.23	4.16	5.11	3.57	7.71	4.52	3.28	3.94	6.71	7.29
MnO	15.01	16.20	14.30	13.72	15.94	12.00	15.03	14.62	14.30	11.00	11.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
TiO_2	1.05	1.12	0.84	1.58	0.94	1.67	1.11	1.07	0.84	1.54	1.68
Nb_2O_5	31.84	57.17	51.66	50.67	56.52	65.91	62.24	57.67	57.03	64.60	67.11
Ta_2O_5	46.11	18.39	24.12	25.86	18.85	8.23	14.04	20.23	21.73	14.02	9.87
SnO_2		0.17	0.00	0.29	0.24	0.02	0.00	0.04	0.15	0.16	0.06
WO_3	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00
UO_2	-	-	-	-	-	-	-	0.00	0.00	0.06	0.04
Sc_2O_3	-	-	-	-	-	-	-	0.04	0.03	0.00	0.07
Y_2O_3	-	-	-	-	-	-	-	0.38	0.33	0.55	0.40
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
O=F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	96.41	96.43	95.10	97.39	96.13	95.75	96.97	97.43	98.44	98.75	97.52
Structural formula calculated on the basis of O = 6 atoms											
Na (apfu)	0.000	0.004	0.001	0.000	0.001	0.005	0.002	0.001	0.000	0.005	0.000
Ca	0.001	0.005	0.000	0.002	0.002	0.005	0.001	0.003	0.005	0.002	0.000
Al	0.000	0.000	0.001	0.003	0.002	0.003	0.000	0.002	0.001	0.002	0.000
Fe	0.143	0.170	0.228	0.274	0.189	0.389	0.231	0.171	0.205	0.335	0.362
Mn	0.912	0.862	0.793	0.745	0.854	0.613	0.779	0.772	0.754	0.556	0.554
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000
Ti	0.057	0.053	0.041	0.076	0.045	0.076	0.051	0.050	0.039	0.069	0.075
Nb	1.033	1.623	1.529	1.468	1.616	1.796	1.721	1.626	1.604	1.743	1.803
Ta	0.900	0.314	0.429	0.451	0.324	0.135	0.234	0.343	0.368	0.228	0.159
Sn	0.000	0.004	0.000	0.007	0.006	0.000	0.000	0.001	0.004	0.004	0.001
W	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Sc	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.000	0.004
Y	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.011	0.017	0.013
Sum	3.045	3.037	3.022	3.031	3.039	3.025	3.018	2.987	2.992	2.962	2.971
Mn#	0.864	0.836	0.777	0.731	0.819	0.612	0.771	0.819	0.786	0.624	0.604
Ta#	0.466	0.162	0.219	0.235	0.167	0.070	0.119	0.174	0.186	0.115	0.081
A site	0.001	0.009	0.001	0.002	0.003	0.010	0.003	0.004	0.005	0.007	0.000
B site	1.055	1.031	1.021	1.022	1.045	1.004	1.010	0.948	0.960	0.893	0.916
C site	1.989	1.994	1.999	2.002	1.991	2.008	2.006	2.035	2.027	2.062	2.056

Mn# = Mn/(Mn+Fe). Ta# = Ta/(Ta+Nb)

Table S3. Representative electron-microprobe analyses of columbite from the Mayo Salah pluton (MsLC)

Petrography (subgroup)	**Porphyric medium- to coarse-grained muscovite leucogranite (MsLC)**											
Zone	Rim						Core					
Analysis	c1-2	c1-3	c1-4	c6-1	c2-2	Range (n = 19)	c1-1	c4-1	c3-1	c3-4	c1-2	Range (n = 41)
Na_2O (wt.%)	0.09	0.07	0.00	0.04	0.00	0.00-0.09	0.04	0.00	0.07	0.02	0.02	0.00-0.21
CaO	0.10	0.03	0.00	0.07	0.00	0.00-0.18	0.07	0.04	0.02	0.01	0.08	0.00-0.13
Al_2O_3	0.00	0.00	0.00	0.00	0.00	0.00-0.08	0.00	0.00	0.00	0.00	0.00	0.00-0.03
FeO	3.34	2.93	3.18	1.89	1.55	1.55-8.55	4.06	4.44	5.20	5.55	9.23	2.13-9.23
MnO	15.04	14.04	15.82	14.92	14.24	10.50-15.82	15.59	16.46	13.48	13.72	9.68	9.68-17.74
MgO	0.00	0.00	0.00	0.02	0.00	0.00-0.04	0.03	0.00	0.00	0.00	0.00	0.00-0.07
TiO_2	0.86	1.14	0.71	1.24	1.79	0.00-2.74	1.47	1.36	0.97	1.43	2.49	0.00-3.42
Nb_2O_5	52.33	35.00	59.74	32.65	35.53	32.65-68.15	70.69	71.26	71.76	68.97	70.03	58.64-72.33
Ta_2O_5	29.69	46.59	20.07	44.63	43.33	5.89-46.59	9.13	9.60	8.69	7.76	5.34	5.34-19.21
SnO_2	-	-	-	0.14	0.50	0.00-0.50	-	-	0.00	0.07	0.38	0.00-0.38
WO_3	-	-	-		0.00	0.00-0.00	-	-	0.00	0.00	0.00	0.00-0.00
UO_2	0.11	0.13	0.06	-	0.30	0.00-0.62	0.50	0.24	0.37	0.54	0.22	0.00-0.80
Sc_2O_3	-	-	-	-	0.09	0.00-0.16	-	-	0.01	0.06	0.15	0.00-0.15
Y_2O_3	0.46	0.36	0.37	-	0.25	0.14-0.83	0.36	0.36	0.35	0.23	0.61	0.13-0.61
F	0.00	0.00	0.00	0.05	0.02	0.00-0.09	0.00	0.02	0.00	0.00	0.00	0.00-0.45
O=F	0.00	0.00	0.00	0.02	0.01	0.00-0.04	0.00	0.01	0.00	0.00	0.00	0.00-0.19
Total	102.02	100.29	99.95	95.63	97.59	95.00-102.02	101.94	103.77	100.92	98.36	98.23	95.21-103.77
Structural formula calculated on the basis of O = 6 atoms												
Na (apfu)	0.011	0.009	0.000	0.006	0.000	0.000-0.011	0.004	0.000	0.008	0.002	0.002	0.000-0.023
Ca	0.007	0.002	0.000	0.005	0.000	0.000-0.012	0.004	0.002	0.001	0.001	0.005	0.000-0.008
Al	0.000	0.000	0.000	0.000	0.000	0.000-0.006	0.000	0.000	0.000	0.000	0.000	0.000-0.002
Fe	0.173	0.168	0.162	0.113	0.090	0.090-0.422	0.193	0.208	0.249	0.272	0.447	0.112-0.447
Mn	0.790	0.813	0.815	0.907	0.836	0.524-0.914	0.750	0.780	0.654	0.682	0.475	0.475-0.941
Mg	0.000	0.000	0.000	0.002	0.000	0.000-0.004	0.003	0.000	0.000	0.000	0.000	0.000-0.006
Ti	0.040	0.059	0.032	0.067	0.093	0.000-0.141	0.063	0.057	0.042	0.063	0.108	0.000-0.145
Nb	1.467	1.082	1.643	1.060	1.114	1.060-1.851	1.816	1.803	1.858	1.830	1.833	1.639-1.865
Ta	0.501	0.866	0.332	0.871	0.817	0.094-0.871	0.141	0.146	0.135	0.124	0.084	0.084-0.311
Sn	0.000	0.000	0.000	0.004	0.014	0.000-0.014	0.000	0.000	0.000	0.002	0.009	0.000-0.009
W	0.000	0.000	0.000	0.000	0.000	0.000-0.000	0.000	0.000	0.000	0.000	0.000	0.000-0.000
U	0.002	0.002	0.001	0.000	0.005	0.000-0.008	0.006	0.003	0.005	0.007	0.003	0.000-0.011
Sc	0.000	0.000	0.000	0.000	0.005	0.000-0.008	0.000	0.000	0.000	0.003	0.008	0.000-0.008
Y	0.015	0.013	0.012	0.000	0.009	0.000-0.030	0.011	0.011	0.011	0.007	0.019	0.000-0.019
Sum	3.005	3.015	2.998	3.047	2.988	2.958-3.049	2.992	3.014	2.962	2.993	2.992	2.958-3.083
Mn#	0.820	0.829	0.834	0.889	0.903	0.554-0.903	0.795	0.790	0.724	0.715	0.515	0.515-0.894
Ta#	0.254	0.445	0.168	0.451	0.423	0.049-0.451	0.072	0.075	0.068	0.063	0.044	0.044-0.160
A site	0.017	0.011	0.000	0.011	0.000	0.000-0.017	0.009	0.002	0.009	0.003	0.007	0.000-0.027
B site	0.963	0.981	0.977	1.023	0.926	0.877-1.030	0.946	0.988	0.903	0.954	0.922	0.891-1.055
C site	2.024	2.022	2.021	2.002	2.058	1.996-2.074	2.037	2.020	2.051	2.036	2.063	1.979-2.068

Mn# = Mn/(Mn+Fe). Ta# = Ta/(Ta+Nb)

Table S4. Representative electron-microprobe analyses of columbite from the Mayo Salah pluton (MsLCm)

Petrography	**Porphyric medium- to coarse-grained muscovite leucogranite manganese oxide-bearing (MsLCm)**							
Zone					Core			
Analysis	1-c1-1	1-c1-4	CT-4	CT-6	CT-12	CT-14	CT-16	Range (n = 10)
Na_2O (wt.%)	0.05	0.00	0.00	0.01	0.04	0.01	0.01	0.00-0.05
CaO	0.06	0.04	0.05	0.15	0.03	0.03	0.08	0.00-0.27
Al2O3	0.00	0.00	0.02	0.43	0.12	0.05	0.49	0.00-0.49
FeO	8.35	5.73	5.81	6.03	6.83	5.45	6.82	5.45-8.83
MnO	10.59	13.69	14.67	13.97	12.96	14.07	11.98	10.10-14.67
MgO	0.00	0.02	0.03	0.02	0.03	0.00	0.00	0.00-0.07
TiO2	1.77	1.53	1.94	2.07	1.81	1.51	2.14	1.19-2.34
Nb2O5	69.10	68.69	68.22	68.30	71.36	70.55	72.22	66.42-72.22
Ta2O5	6.23	6.54	6.70	8.16	5.64	6.87	5.76	5.29-8.16
SnO2	0.17	0.27	0.05	0.11	0.20	0.00	0.14	0.00-0.27
WO3	0.00	0.00	-	-	-	-	-	0.00-0.00
ThO2	0.00	0.00	-	-	-	-	-	0.00-0.00
UO2	0.47	0.03	-	-	-	-	-	0.03-0.55
Sc2O3	0.08	0.01	-	-	-	-	-	0.01-0.08
Y2O3	0.34	0.38	-	-	-	-	-	0.34-0.43
ZrO2	-	-	0.46	0.25	0.25	0.33	0.00	0.00-0.48
SiO2	0.00	0.00	0.00	0.06	0.00	1.20	0.00	0.00-1.20
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00-0.00
O=F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00-0.00
Total	97.21	96.93	97.95	99.56	99.27	100.07	99.64	95.56-100.07
Structural formula calculated on the basis of O = 6 atoms								
Na (apfu)	0.006	0.000	0.000	0.001	0.004	0.001	0.001	0.000-0.006
Ca	0.004	0.003	0.003	0.009	0.002	0.002	0.005	0.000-0.017
Al	0.000	0.000	0.001	0.029	0.008	0.003	0.033	0.000-0.033
Fe	0.412	0.284	0.284	0.291	0.328	0.258	0.324	0.258-0.439
Mn	0.529	0.686	0.727	0.682	0.629	0.675	0.576	0.508-0.727
Mg	0.000	0.002	0.003	0.002	0.003	0.000	0.000	0.000-0.006
Ti	0.078	0.068	0.085	0.090	0.078	0.064	0.091	0.053-0.104
Nb	1.842	1.838	1.806	1.779	1.850	1.805	1.854	1.779-1.854
Ta	0.100	0.105	0.107	0.128	0.088	0.106	0.089	0.085-0.131
Sn	0.004	0.006	0.001	0.003	0.005	0.000	0.003	0.000-0.006
W	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000-0.000
Th	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000-0.000
U	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000-0.007
Sc	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000-0.004
Y	0.011	0.012	0.000	0.000	0.000	0.000	0.000	0.000-0.014
Zr	0.000	0.000	0.013	0.007	0.007	0.009	0.000	0.000-0.014
Si	0.000	0.000	0.000	0.003	0.000	0.068	0.000	0.000-0.068
Sum	2.995	3.004	3.031	3.023	3.002	2.991	2.976	2.976-3.036
Mn#	0.562	0.708	0.719	0.701	0.658	0.723	0.640	0.537-0.723
Ta#	0.051	0.054	0.056	0.067	0.045	0.055	0.046	0.045-0.067
A site	0.010	0.003	0.003	0.010	0.006	0.003	0.006	0.000-0.017
B site	0.940	0.972	1.016	1.003	0.968	0.936	0.933	0.933-1.036
C site	2.045	2.030	2.012	2.006	2.028	1.984	2.037	1.984-2.045

Mn# = Mn/(Mn+Fe). Ta# = Ta/(Ta+Nb)