

Table A. Chemical composition of the granites of the Shachang complex, northeast China.

Sample	Biotite-hornblende granite					Biotite granites					Two-mica granites		
	3	17A	12A	12B	12D	6	9	14B	16	18A	18B	18C	19
SiO ₂ (wt%)	68.00	74.30	70.50	63.40	68.30	73.70	72.90	71.50	73.50	72.70	74.80	76.00	73.90
TiO ₂	0.60	0.30	0.35	0.97	0.41	0.20	0.24	0.32	0.26	0.25	0.09	0.12	0.13
Al ₂ O ₃	14.20	12.00	15.00	14.40	14.70	13.10	12.90	13.60	12.50	13.30	13.00	12.70	12.70
Fe ₂ O ₃	1.72	1.02	1.44	3.16	1.68	1.32	1.44	0.78	1.74	2.04	0.96	1.42	1.46
FeO	2.20	1.50	0.80	3.70	1.10	0.60	0.80	1.60	0.80	0.10	0.10	0.10	0.20
MnO	0.06	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MgO	0.49	0.18	0.31	0.79	0.32	0.21	0.15	0.25	0.16	0.13	0.08	0.18	0.08
CaO	1.85	1.03	0.92	2.46	1.57	1.01	1.11	1.36	1.15	0.72	0.79	0.04	0.91
Na ₂ O	3.59	3.02	4.03	4.10	3.49	3.36	3.43	3.44	3.12	3.40	3.80	2.92	3.45
K ₂ O	5.23	5.36	5.40	2.63	6.11	5.59	5.29	5.57	5.57	5.67	5.37	5.75	5.38
P ₂ O ₅	0.14	0.00	0.07	0.24	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.26	0.48	0.04	0.28	0.16	0.57	0.59	0.51	0.56	0.45	0.49	0.10	0.55
Cl	0.06	0.04	0.05	0.04	0.04	0.02	0.03	0.04	0.03	0.02	0.02	0.02	0.02
H ₂ O+	0.90	0.50	0.70	1.50	0.70	0.60	0.50	0.60	0.60	0.70	0.40	0.60	0.50
Total	99.30	99.73	99.61	97.76	98.67	100.28	99.38	99.57	99.99	99.48	99.90	99.95	99.28
O=F2	0.11	0.20	0.02	0.12	0.07	0.24	0.25	0.21	0.24	0.19	0.21	0.04	0.23
Total	99.19	99.53	99.59	97.64	98.60	100.04	99.13	99.36	99.75	99.29	99.69	99.91	99.05
Trace elements in ppm:													
Zn	87.6	60.3	51.6	124	64.1	34	39.5	49.5	59.4	35.5	21	21.6	21.8
Ga	24.7	21.8	24.5	32.3	23.6	22.2	23.8	20.2	21.9	21.9	18.6	20.1	20.9
Rb	160	273	167	116	175	333	335	295	282	350	346	321	363
Ba	2890	800	2470	1100	3440	920	864	1350	838	960	203	341	430
Nb	37	52	29	41	29	47	46	33	48	45	33	50	60
Y	51	54	26	81	42	44	52	37	84	26	52	11	59
Sr	558	142	467	434	626	169	171	296	154	212	53	26	80
Hf	15	16	14	26	12	11	11	12	15	12	6.7	10	9.3
Zr	560	506	478	1010	428	273	340	365	445	308	116	220	228
U	1.3	2	1	2.1	0.5	4.4	3.7	2.7	2.3	3.5	5.4	4.6	7.2
Th	8.1	18	6.8	10	7.2	29	22	20	25	24	51	33	36
Pb	21	37	18	16	25	31	41	36	48	32	38	44	36
Sn	<2	14	11	6	15	10	27	<2	7	35	28	33	24
La	155	252	115	200	141	189	176	249	291	186	52.7	126	131
Ce	338	529	228	466	287	363	345	447	575	357	121	275	282
Pr	39.4	57	23.4	54.7	31.2	36.2	35.8	42	60.4	31.1	10.2	25.7	29.8
Nd	154	210	90.3	220	119	111	123	128	200	105	45.6	86.4	118
Sm	22.2	27.9	13	35.7	17.7	15	18.2	14.7	28.2	13.5	8.7	12.5	20.1
Eu	3.58	1.51	2.87	3.02	3.93	1.07	1.4	1.61	1.18	1.41	0.47	0.47	0.83
Gd	14	15.4	8.3	2.41	12.1	9.1	10.9	7.2	17	7.2	7.1	5.9	13
Tb	1.8	2	1.1	3.4	1.7	1.4	1.6	1.2	2.4	1	1.1	0.7	1.8
Dy	10.7	11.2	5.9	18.3	8.9	7.7	8.8	6.1	13.3	5.6	7.2	3.1	11
Ho	1.91	1.98	1.14	3.57	1.64	1.47	1.75	1.25	2.5	1.03	1.52	0.53	2.15
Er	5.3	5.4	3	10	4.9	4.7	5.4	3.8	6.9	2.9	4.9	1.4	6.5
Tm	0.8	0.8	0.4	1.4	0.7	0.8	0.8	0.6	1.1	0.5	0.9	0.2	1
Yb	4.8	5.2	2.6	8.4	4.5	5.3	5.8	4.6	6.7	3.5	6.8	1.8	8.1
Lu	0.72	0.72	0.39	1.14	0.63	0.82	0.89	0.64	0.95	0.5	1.06	0.29	1.26

The samples were analyzed at X-Ray Assay Laboratories Ltd (Canada).

Major components by XRF, ferrous iron by potassium dichromate titration, fluorine by ion specific electrode.

Trace-elements:

Zn, Ga, Y, and Pb by ICP

REE by ICP/MS

Rb, Ba, Nb, Sr, Zr, and Sn by XRF

Hf, U, and Th by NA

Table B. U-Pb zircon data from the Shachang complex, northeast China.

Sample	Fraction	U ppm	Pb ppm	206/204 meas.	206/238 Corrected for blank	207/235	206/207	Apparent age in Ma		
								6/8	7/5	7/6
18A (A1278-GSF) - Two-mica granite										
A	+4.5/ABR pale br.	130.1	53.97	119	.2563±15	3.656±22	.1034±18	1471±8	1561±4	1686±31
B	4.3-4.5 pale br.	206.2	62.06	170	.2119±12	2.950±17	.1010±16	1238±6	1394±4	1642±30
C	4.3-4.5 ABR	875.8	176.80	271	.1609±9	2.149±13	.0967±5	961±5	1164±4	1565±10
D	4.3-4.6 yellow	2151.6	327.13	596	.1347±8	1.784±11	.0960±12	814±4	1039±4	1548±24
12D (A1283-GSF) - Biotite-hornblende granite										
A	+4.5/ABR total	94.2	31.03	584	.2887±17	4.110±25	.1033±3	1634±8	1656±5	1683±4
B	+4.5 total	118.8	36.91	1217	.2860±17	4.064±25	.1031±4	1621±8	1647±6	1680±8
C	+4.5 clear	92.5	28.90	1340	.2864±18	4.072±25	.1031±2	1623±9	1648±5	1681±4
D	+4.5 yellow	84.0	28.08	455	.2861±17	4.060±24	.1029±2	1622±9	1646±5	1677±4
1 (A1281-GSF) - Granulite										
A	+4.5 yellow	231.6	111.95	5619	.4082±23	8.972±52	.1594±1	2206±11	2335±6	2449±1
B	4.2-4.3 transp.	88.07	53.47	4318	.4509±27	9.969±59	.1604±2	2399±12	2431±5	2459±2
34A (A1359-GSF) - Granitic gneiss										
A	+4.5 transp.	33.9	17.27	2992	.4442±27	9.756±61	.1593±5	2369±12	2411±5	2448±5
B	4.3-4.5 <70 µm	196.7	70.10	4816	.3389±20	8.647±41	.1503±1	1881±10	2114±6	2349±1
C	4.3-4.5 >70 µm	175.3	62.03	3238	.3349±20	6.933±41	.1502±3	1862±10	2102±5	2347±3

Analytical methods described in Vaasjoki et al. (1991; Precambrian Research, v. 51, p. 227–243). Common lead corrections according to U-decay corrected feldspar leads (Table C). Errors refer to the last significant digits.

Description of zircons

Two-mica granite 18A (A1278-GSF): The zircons have generally a simple prismatic-pyramidal morphology typical for magmatic rocks and the grain size is relatively small, ca. 100 µm on an average. Their length/breadth (L/B) ratio is generally 1.5, which gives them a stubby appearance. Two colour varieties, yellow and pale brown occur. These were handpicked apart from two different separated fractions.

Biotite-hornblende granite 12D (A1283-GSF): The zircons have a simple prismatic-pyramidal form, the average grain size being about 70 µm. The median L/B is ca. 2, resulting in a stubby appearance. Both crystal clear and yellow colour varieties occur, and these were handpicked apart.

Granulite 1 (A1281-GSF): The zircons are roundish-oval, and it is hard to tell whether this is due to higher order index faces or whether they have a detrital origin and were abraded during transport before deposition and metamorphism. The grain size is <70 µm. Two colour varieties, pale brown and transparent occur. Both were handpicked apart from one density fraction. The investigation of this sample continues.

Granitic gneiss 34A (A1359-GSF): Also in this case the zircons are roundish-oval, and the crystal morphology is uncertain. The grain size is fine with ~ 75% being <70 µm. Three colour varieties, transparent, reddish, and pale brown occur.

Table C. Nd and Pb isotopic data on the Shachang complex, northeast China.

Sample	Sm (ppm)	Nd (ppm)	⁽¹⁾ 147Sm/ 144Nd	⁽²⁾ 143Nd/ 144Nd	⁽³⁾ ϵ	⁽⁴⁾ T-DM (Ga)	⁽⁵⁾ 206Pb/ 204Pb	⁽⁵⁾ 207Pb/ 204Pb	⁽⁵⁾ 208Pb/ 204Pb	⁽⁵⁾ U (ppm)	Pb (ppm)
Granites (initial ratios calculated at 1685 Ma)											
Biotite hornblende granite											
12D, wr	14.16	90.56	0.0946	0.51121	-5.8	2.34		14.728	15.010	34.52	0.0295 47.9
fspar								14.717	15.009	34.50	
fspar, corr. (Th/U=4)											
17B, wr	13.05	76.73	0.1029	0.51129	-6.1	2.41					
39A, wr	14.58	88.90	0.0991	0.51127	-5.8	2.36					
Biotite granites											
6, wr	22.48	173.3	0.0854	0.51112	-5.6	2.28					
16, wr	27.69	191.2	0.0876	0.51115	-5.5	2.28					
17A, wr	26.96	179.9	0.0906	0.51117	-5.8	2.32					
49, wr	27.63	195.7	0.0854	0.51112	-5.7	2.29					
18A, wr	15.84	118.9	0.0806	0.51110	-5.0	2.22		14.974	15.024	34.75	0.0618 36.2
fspar								14.945	15.021	37.72	
fspar, corr. (Th/U=4)											
Two-mica granites											
19, wr	20.00	110.7	0.1093	0.51139	-5.6	2.42					
32, wr	25.07	200.1	0.0758	0.51098	-6.2	2.27					

Country rocks (initial ratios calculated at 2500 Ma)

Granulite											
1, wr	5.37	29.31	0.1109	0.51129	1.2	2.61		14.168	14.841	33.92	0.0056 27.8
fspar								14.162	14.840	33.91	
fspar, corr. (Th/U=4)											
Granitic dike											
2, wr	4.10	30.36	0.0816	0.51082	1.5	2.56					
Granitic gneiss											
34A, wr	1.35	9.19	0.0891	0.51090	0.6	2.63		13.669	14.554	33.41	0.0115 16.0
fspar								13.649	14.551	34.39	
fspar, corr. (Th/U=4)											

(1) Error in the concentration ratios is 0.4%

(2) Normalized to $146\text{Nd}/144\text{Nd}=0.7219$ and reported relative to $143\text{Nd}/144\text{Nd}$ of 0.51185 of the La Jolla Nd standard.

External error is 0.005% (2 S.D.)

(3) Initial values. Chondritic ratios used for calculation: $143\text{Nd}/144\text{Nd}=0.51264$, $147\text{Sm}/144\text{Nd}=0.1966$. Error is ± 0.5 epsilon-units

(4) Depleted mantle model ages calculated according to DePaolo (1981)

(5) Reported relative to $206\text{Pb}/204\text{Pb}=16.937$, $207\text{Pb}/204\text{Pb}=15.491$, and $208\text{Pb}/204\text{Pb}=36.69$ of the SRM981 Pb standardExternal 2 S.D. errors are 0.15% on $206\text{Pb}/204\text{Pb}$ and $207\text{Pb}/204\text{Pb}$ and 0.2% on $208\text{Pb}/204\text{Pb}$

Reference: DePaolo, D.J., 1981, Neodymium isotopes in the Colorado Front Range and crust-mantle evolution in the Proterozoic: Nature, v. 291, p. 193–196.