Wang, B., Zhou, J.B., Ding, Z.J., Wilde, S.A., Song, M.C., Zhao, T.Q., and Bao, Z.Y., 2023, Late Mesozoic magmatism and gold metallogeny of the Jiaodong Peninsula, China: A response to the destruction of the North China Craton: GSA Bulletin, https://doi.org/10.1130/B37057.1.

Supplemental Material

Text S1. Analytical Methods.

Table S1. Zircon LA–ICP–MS U–Pb data of the Linglong and Weideshan suites in the Jiaodong Peninsula, China.

Table S2. Results of Hf isotope analysis and model age calculation of zircon by LA-ICP-MS.

Table S3. Whole-rock major and trace element data for the Linglong and Weideshan suites in the Jiaodong Peninsula, China.

Table S4. Sr-Nd-Pb isotope data for the Linglong and Weideshan suites in the Jiaodong Peninsula, China.

Table S5. Previous published intrusion ages of three major generations of granitoids (Linglong, Guojialing and Weideshan) in the Jiaodong Peninsula[a].

Supplemental Text S1. ANALYTICAL METHODS

1. Zircon LA-ICP-MS U-Pb isotopic dating

Separation and cathodoluminescence (CL) images of zircon from Mesozoic granitoids were carried out by the Chengxin geological Testing Co. Ltd., Langfang, China. Zircon U–Pb dating and trace element analyses of zircons was conducted by LA–ICP–MS at the Guangzhou Tuoyan Analytical Technology Co., Ltd., Guangzhou, China. Laser sampling was performed using a NWR 193 laser ablation system. An iCAP RQ ICP–MS instrument was used to acquire ion–signal intensities. Helium was applied as a carrier gas and argon was used as the make–up gas and mixed with the carrier gas via a Y–connector before entering the MS. The spot size and frequency of the laser were set to 30 μm and 6 Hz, respectively, in this study. The energy was 3.5 J/cm^2. Zircon 91,500 (Reed, 1992) and glass NIST610 (Hinton and Upton, 1991) were used as external standards for U–Pb dating and trace element calibration, respectively. Each analysis incorporated a background acquisition of approximately 30 s followed by 40 s of data acquisition from the sample. An Excel–based software ICPMSDataCal was used to perform off–line selection and integration of background and analyzed signals, time–drift correction and quantitative calibration for U–Pb dating and trace element analysis. $^{206}Pb/^{238}U$ and $^{207}Pb/^{206}Pb$ ages were used to calculate the crystallization ages of the <1,000 Ma and >1,000 Ma zircon grains, respectively. Typical CL images are presented in Fig. 3, together with the U–Pb ages for the corresponding spots. The results for isotopic ratios and calculated ages are listed in Supplymentary Table S1.

2. *In situ* Hf isotope ratio analysis

Zircon *in situ* Hf isotopic analyses were conducted at the Guangzhou Tuoyan Analytical Technology Co., Ltd., using a Neptune Laser Ablation Multiple–Receiver LA–ICP–MS with a 193 nm laser sampling system. The laser spot diameter was 60 μm, the pulse width was 15 ns, and the abrasion material carrier gas was He. Details of the analytical procedures are available in Wu et al. (2006) and Xie et al. (2008). Measurements of the 91500 and MT zircons were conducted after every ten analyses. The standard samples 91500 and MT had $^{176}Hf/^{177}Hf$ ratios of 0.282316 ± 30 and 0.282507 ± 50, respectively. In the $\varepsilon_{Hf}(t)$ and model age calculations, the ^{176}Lu decay constant used 1.867^{-11} (Bouvier et al., 2008), and the $^{176}Lu/^{177}Hf$ and $^{176}Hf/^{177}Hf$ ratios of the present–day chondritic and depleted mantle were 0.0332 and 0.282772 (Blichert-Toft et al., 1997), and 0.0384 and 0.28325, respectively (Griffin et al., 2000). The calculation of the crustal model ages determined an average crustal value of $^{176}Lu/^{177}Hf = 0.015$ (Griffin et al., 2001). The results are listed in Supplymentary Table S2.

3. Whole–rock major and trace element analysis

A total of twenty-four fresh samples of the Linglong (12) and Weideshan (12) granitoids were selected for major, trace, and rare earth element (REE) analyses. Whole–rock samples were crushed to approximately 200 mesh in an agate mill. The analyses were performed at the Guangzhou Tuoyan Analytical Technology Co., Ltd., Guangzhou, China. The major element analyses utilized a Philips PW2404 type X–ray fluorescence spectrometer, which has an analytical precision of better than 5%. The trace element and REE concentrations were determined using an ICP–MS (Element XR). In general, the analytical results for standard rock indicated that the analytical precision was better than 5 % for major elements and 10 % for trace element and REE concentrations. The results of major and trace element analysis are listed in Supplymentary Table S3.

4. Whole–rock Sr–Nd–Pb analysis

Eight Sr–Nd–Pb isotopic analysis was carried out at the Guangzhou Tuoyan Analytical Technology Co., Ltd., Guangzhou, China. For Sr–Nd isotopic analysis, approximately 50 mg of whole–rock powder was dissolved in distilled HF–HNO_3 at 150 °C for five days. After complete dissolution, the samples were dried and dissolved in 2.5 NHCl. Strontium and neodymium were extracted by conventional ion exchange chromatographic techniques. The measured Sr and Nd isotopic ratios were normalized to $^{86}Sr/^{88}Sr$ = 0.1194 and $^{146}Nd/^{144}Nd$ = 0.7219, respectively. The reproducibility of $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ during measurement was monitored by analysis of the standards NBS987 for Sr and Shin Etou for Nd, yielding average values of 0.710243 ± 14 (2σ) and 0.512124 ± 11 (2σ), respectively. The details of the analytical techniques are described by Liang et al. (2003).

For Pb isotope measurements, samples of about 100 mg were dissolved in Teflon bombs using an HF–HNO_3 mixture. The separation of Pb was done through chromatographic columns filled with anion exchange resin Eichrom PN A8–B500–F–CL (200–400 mesh), according to procedures involving HBr. The Pb solutions were dried on a hot plate and deposited in a single Re filament using a mixture of 3 µL silica gel and 3 µL H_3PO_4 0.25 N. The isotopic analyzes were carried out using a Thermo Fisher multi–collector mass spectrometer TRITON Plus–Thermal Ionization Mass Spectrometry (TIMS), using faraday collectors in static mode. The results of Sr–Nd–Pb analysis are listed in Supplymentary Table S4.

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Table S1. Zircon LA–ICP–MS U–Pb data of the Linglong and Weideshan suites in the Jiaodong Peninsula, China.

No.	Content (ppm)		Th/U	Isotope ratio						Apparent age (Ma)					
	Th	U		$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ
Linglong suite															
Linglong intrusion (sample 21JD41)															
21JD41_1	11	327	0.03	0.0512	0.0018	0.2527	0.0085	0.0359	0.0004	256	80	229	7	227	2
21JD41_2	49	473	0.10	0.0480	0.0016	0.1647	0.0053	0.0249	0.0002	98	76	155	5	158	2
21JD41_3	24	368	0.06	0.0509	0.0018	0.1720	0.0060	0.0245	0.0003	235	84	161	5	156	2
21JD41_4	3	8	0.38	0.0696	0.0175	0.2680	0.0140	0.0377	0.0005	917	538	241	32	239	12
21JD41_5	51	435	0.12	0.0512	0.0018	0.1708	0.0062	0.0241	0.0002	250	81	160	5	153	1
21JD41_6	75	193	0.39	0.0612	0.0041	0.5632	0.1167	0.0523	0.0078	656	146	454	76	329	48
21JD41_7	50	370	0.13	0.0486	0.0019	0.1626	0.0060	0.0243	0.0003	128	91	153	5	155	2
21JD41_8	16	125	0.13	0.0481	0.0038	0.1477	0.0110	0.0225	0.0005	106	174	140	10	143	3
21JD41_9	31	266	0.12	0.0473	0.0021	0.1599	0.0070	0.0246	0.0003	65	104	151	6	157	2
21JD41_10	28	646	0.04	0.0482	0.0014	0.2420	0.0073	0.0364	0.0006	109	69	220	6	231	3
21JD41_11	8	278	0.03	0.0458	0.0020	0.1576	0.0072	0.0249	0.0003	62	97	149	6	159	2
21JD41_12	11	874	0.01	0.0504	0.0011	0.2391	0.0052	0.0344	0.0003	213	48	218	4	218	2
21JD41_13	327	1014	0.32	0.0504	0.0012	0.1779	0.0044	0.0256	0.0002	213	83	166	4	163	1
21JD41_14	40	315	0.13	0.0484	0.0020	0.1699	0.0071	0.0255	0.0003	120	98	159	6	162	2
21JD41_15	451	1075	0.42	0.0498	0.0013	0.1791	0.0048	0.0261	0.0002	187	66	167	4	166	1
21JD41_16	4	319	0.01	0.0498	0.0017	0.2239	0.0073	0.0327	0.0004	187	78	205	6	207	2
21JD41_17	170	445	0.38	0.0484	0.0014	0.1762	0.0056	0.0264	0.0004	117	64	165	5	168	2
21JD41_18	16	56	0.29	0.2137	0.0033	17.1231	0.2525	0.5810	0.0054	3000	25	2942	14	2953	22
21JD41_19	5	3	1.57	0.0649	0.0263	0.2601	0.0129	0.0357	0.0005	772	679	259	57	226	16
21JD41_20	133	629	0.21	0.0497	0.0015	0.1722	0.0051	0.0251	0.0003	189	67	161	4	160	2
21JD41_21	27	73	0.38	0.0486	0.0034	0.2404	0.0160	0.0360	0.0004	128	156	219	13	228	3
21JD41_22	26	205	0.13	0.0491	0.0037	0.1579	0.0116	0.0235	0.0004	154	170	149	10	150	3
21JD41_23	234	834	0.28	0.0489	0.0011	0.1725	0.0040	0.0255	0.0002	146	49	162	4	162	1
21JD41_24	92	413	0.22	0.0513	0.0023	0.1824	0.0085	0.0257	0.0003	254	102	170	7	163	2
21JD41_25	86	503	0.17	0.0495	0.0016	0.1706	0.0059	0.0249	0.0002	172	78	160	5	159	1

No.	Content (ppm)		Th/U	Isotope ratio						Apparent age (Ma)					
	Th	U		$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ
Linglong intrusion (sample 21JD52)															
21JD52_1	287	327	0.88	0.0506	0.0018	0.1674	0.0048	0.0252	0.0004	224	92	158	5	155	2
21JD52_2	18	27	0.67	0.0487	0.0129	0.1622	0.0420	0.0242	0.0015	134	527	153	37	154	9
21JD52_3	34	61	0.56	0.0906	0.0071	3.1473	0.2456	0.2517	0.0090	1439	143	1444	60	1447	46
21JD52_4	75	84	0.89	0.0497	0.0042	0.1790	0.0148	0.0262	0.0006	179	186	167	13	166	4
21JD52_5	229	474	0.48	0.1890	0.0038	13.9394	0.3383	0.5348	0.0130	2733	33	2746	23	2762	55
21JD52_6	72	115	0.63	0.0496	0.0045	0.1730	0.0153	0.0253	0.0006	174	198	162	13	161	4
21JD52_7	92	521	0.18	0.0494	0.0035	0.1716	0.0122	0.0252	0.0007	169	159	161	11	160	5
21JD52_8	80	121	0.66	0.0500	0.0128	0.1729	0.0433	0.0251	0.0015	193	507	162	37	160	9
21JD52_9	135	506	0.27	0.1921	0.0039	13.2241	0.3228	0.4991	0.0122	2760	33	2696	23	2610	52
21JD52_10	96	600	0.16	0.0490	0.0025	0.1661	0.0084	0.0246	0.0004	148	116	156	7	157	3
21JD52_11	97	110	0.87	0.0498	0.0041	0.1650	0.0134	0.0241	0.0005	185	181	155	12	153	3
21JD52_12	152	298	0.51	0.0642	0.0030	0.8975	0.0431	0.1014	0.0028	749	96	650	23	622	16
21JD52_13	182	228	0.80	0.0484	0.0128	0.1706	0.0442	0.0256	0.0015	116	528	160	38	163	10
21JD52_14	309	1400	0.22	0.1742	0.0035	11.2241	0.2850	0.4677	0.0119	2599	33	2542	24	2474	52
21JD52_15	244	626	0.39	0.0499	0.0024	0.1891	0.0088	0.0275	0.0004	188	106	176	8	175	3
21JD52_16	274	453	0.61	0.0490	0.0024	0.1534	0.0078	0.0227	0.0006	150	113	145	7	145	4
21JD52_17	113	353	0.32	0.0484	0.0022	0.1631	0.0073	0.0244	0.0004	120	103	153	6	156	2
21JD52_18	13	364	0.04	0.1629	0.0033	9.9671	0.2513	0.4442	0.0111	2486	34	2432	23	2369	50
21JD52_19	69	111	0.62	0.0560	0.0051	0.1918	0.0171	0.0248	0.0006	453	191	178	15	158	4
21JD52_20	204	1029	0.20	0.0519	0.0027	0.1855	0.0098	0.0259	0.0007	282	115	173	8	165	4
Cishan intrusion (sample 21JD53)															
21JD53_1	39	306	0.13	0.0468	0.0117	0.1702	0.0417	0.0264	0.0016	41	510	160	36	168	10
21JD53_2	1891	575	3.29	0.1529	0.0017	8.2485	0.1090	0.3912	0.0049	2379	19	2259	12	2128	23
21JD53_3	120	675	0.18	0.0485	0.0020	0.1632	0.0070	0.0244	0.0006	123	94	154	6	156	4
21JD53_4	209	895	0.23	0.0484	0.0015	0.1861	0.0064	0.0279	0.0007	118	73	173	5	177	4
21JD53_5	58	304	0.19	0.0492	0.0024	0.1645	0.0078	0.0242	0.0004	159	109	155	7	154	2
21JD53_6	774	936	0.83	0.0512	0.0028	0.1740	0.0096	0.0247	0.0007	248	120	163	8	157	4

No.	Content (ppm)		Th/U	Isotope ratio						Apparent age (Ma)					
	Th	U		$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ
21JD53_7	65	124	0.53	0.0488	0.0041	0.1613	0.0131	0.0240	0.0005	139	184	152	11	153	3
21JD53_8	44	317	0.14	0.0525	0.0096	0.2011	0.0359	0.0278	0.0014	306	370	186	30	177	8
21JD53_9	77	315	0.24	0.1263	0.0017	6.4919	0.0983	0.3727	0.0048	2047	24	2045	13	2042	22
21JD53_10	172	572	0.30	0.0501	0.0023	0.1742	0.0079	0.0252	0.0004	199	103	163	7	161	3
21JD53_11	131	591	0.22	0.1771	0.0037	10.1312	0.2681	0.4155	0.0108	2626	34	2447	24	2240	49
21JD53_12	261	1158	0.23	0.0588	0.0023	0.2050	0.0085	0.0253	0.0007	559	84	189	7	161	4
21JD53_13	117	133	0.88	0.0502	0.0057	0.1643	0.0182	0.0237	0.0007	205	243	155	16	151	4
21JD53_14	92	758	0.12	0.0492	0.0023	0.1724	0.0084	0.0255	0.0007	157	106	162	7	162	4
21JD53_15	120	389	0.31	0.0491	0.0021	0.1698	0.0072	0.0251	0.0004	155	97	159	6	160	2
21JD53_16	36	108	0.33	0.0502	0.0038	0.1740	0.0130	0.0251	0.0005	204	168	163	11	160	3
21JD53_17	143	449	0.32	0.0508	0.0020	0.1694	0.0068	0.0242	0.0004	232	90	159	6	154	2
21JD53_18	72	181	0.40	0.0838	0.0078	2.1157	0.1942	0.1834	0.0071	1288	171	1154	63	1085	39
21JD53_19	104	574	0.18	0.1591	0.0018	8.5421	0.1137	0.3895	0.0049	2446	19	2290	12	2120	22
21JD53_20	151	257	0.59	0.0592	0.0053	0.5613	0.0501	0.0689	0.0023	573	185	452	33	429	14
Shaizi intrusion (sample 21JD55)															
21JD55_1	727	1218	0.60	0.0503	0.0012	0.1642	0.0044	0.0236	0.0002	209	57	154	4	151	1
21JD55_2	255	806	0.32	0.0507	0.0014	0.1559	0.0043	0.0223	0.0002	233	63	147	4	142	1
21JD55_3	593	1496	0.40	0.0496	0.0011	0.1668	0.0045	0.0243	0.0003	176	52	157	4	155	2
21JD55_4	222	840	0.26	0.0488	0.0013	0.1619	0.0045	0.0241	0.0003	200	63	152	4	153	2
21JD55_5	87.9	91.2	0.96	0.0632	0.0021	1.0127	0.0337	0.1163	0.0015	717	65	710	17	709	9
21JD55_6	575	944	0.61	0.0498	0.0016	0.1615	0.0053	0.0235	0.0002	183	74	152	5	150	1
21JD55_7	318	285	1.12	0.0502	0.0021	0.1994	0.0112	0.0286	0.0009	206	96	185	10	182	6
21JD55_8	876	1910	0.46	0.0476	0.0011	0.1596	0.0037	0.0243	0.0002	80	83	150	3	155	1
21JD55_9	648	1025	0.63	0.0489	0.0016	0.1675	0.0061	0.0248	0.0004	143	78	157	5	158	2
21JD55_10	1490	2313	0.64	0.0490	0.0012	0.1683	0.0044	0.0249	0.0002	146	59	158	4	158	1
21JD55_11	202	752	0.27	0.0497	0.0016	0.1571	0.0052	0.0229	0.0002	189	76	148	5	146	1
21JD55_12	102	210	0.49	0.0460	0.0034	0.1554	0.0111	0.0249	0.0004	error		147	10	159	3
21JD55_13	64.5	85.9	0.75	0.0527	0.0047	0.1747	0.0126	0.0244	0.0005	322	204	163	11	156	3

No.	Content (ppm)		Th/U	Isotope ratio						Apparent age (Ma)					
	Th	U		$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ
21JD55_14	230	877	0.26	0.0506	0.0014	0.1624	0.0049	0.0232	0.0002	233	67	153	4	148	1
21JD55_15	284	959	0.30	0.0493	0.0012	0.1636	0.0046	0.0241	0.0004	161	57	154	4	153	3
21JD55_16	1462	774	1.89	0.0516	0.0017	0.1648	0.0051	0.0232	0.0002	265	76	155	4	148	1
21JD55_17	507	1818	0.28	0.0521	0.0012	0.1767	0.0040	0.0246	0.0002	300	52	165	3	156	1
21JD55_18	151	738	0.20	0.0498	0.0014	0.1571	0.0044	0.0229	0.0002	183	69	148	4	146	1
21JD55_19	285	255	1.12	0.0672	0.0047	0.2251	0.0164	0.0242	0.0003	843	142	206	14	154	2
21JD55_20	329	1074	0.31	0.0492	0.0011	0.1600	0.0039	0.0236	0.0003	167	54	151	3	150	2
21JD55_21	135	1283	0.11	0.0509	0.0013	0.1806	0.0049	0.0257	0.0002	235	61	169	4	164	1
21JD55_22	1287	2054	0.63	0.0500	0.0011	0.1714	0.0036	0.0249	0.0002	195	56	161	3	158	1
21JD55_23	82.8	136	0.61	0.0529	0.0028	0.1761	0.0090	0.0243	0.0004	324	119	165	8	155	2
21JD55_24	311	289	1.08	0.0497	0.0026	0.1822	0.0107	0.0264	0.0005	189	120	170	9	168	3
21JD55_25	514	1394	0.37	0.0510	0.0011	0.1689	0.0039	0.0240	0.0003	243	56	158	3	153	2
Weideshan suite															
Aishan intrusion (sample 21JD37)															
21JD37_1	277	313	0.89	0.0509	0.0021	0.1242	0.0049	0.0178	0.0002	235	64	119	4	114	2
21JD37_2	421	350	1.20	0.0536	0.0027	0.1364	0.0064	0.0185	0.0002	354	113	130	6	118	1
21JD37_3	278	389	0.71	0.0486	0.0020	0.1214	0.0047	0.0182	0.0002	128	103	116	4	116	1
21JD37_4	227	278	0.82	0.0485	0.0030	0.1280	0.0082	0.0192	0.0003	120	141	122	7	122	2
21JD37_5	369	394	0.94	0.0488	0.0025	0.1229	0.0062	0.0183	0.0002	139	120	118	6	117	1
21JD37_6	514	473	1.09	0.0482	0.0020	0.1210	0.0047	0.0183	0.0002	122	98	116	4	117	1
21JD37_7	243	301	0.81	0.0474	0.0022	0.1218	0.0056	0.0187	0.0002	78	98	117	5	120	1
21JD37_8	342	414	0.82	0.0492	0.0020	0.1273	0.0053	0.0188	0.0002	167	98	122	5	120	1
21JD37_9	395	472	0.84	0.0475	0.0021	0.1184	0.0054	0.0181	0.0002	72	117	114	5	116	1
21JD37_10	434	417	1.04	0.0470	0.0019	0.1196	0.0047	0.0185	0.0002	56	87	115	4	118	1
21JD37_11	254	374	0.68	0.0469	0.0019	0.1168	0.0047	0.0181	0.0002	56	87	112	4	116	1
21JD37_12	502	374	1.34	0.0518	0.0025	0.1291	0.0062	0.0181	0.0002	276	110	123	6	116	1
21JD37_13	262	334	0.78	0.0468	0.0018	0.1202	0.0046	0.0187	0.0002	39	89	115	4	119	1
21JD37_14	242	273	0.89	0.0616	0.0036	0.1586	0.0091	0.0188	0.0002	657	131	150	8	120	2

No.	Content (ppm)		Th/U	Isotope ratio						Apparent age (Ma)					
	Th	U		$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ
21JD37_15	200	286	0.70	0.1011	0.0099	0.2665	0.0267	0.0192	0.0002	1656	181	240	21	123	1
21JD37_16	114	161	0.71	0.0464	0.0035	0.1208	0.0085	0.0192	0.0003	20	170	116	8	122	2
21JD37_17	251	285	0.88	0.0528	0.0024	0.1348	0.0058	0.0186	0.0002	320	102	128	5	119	1
21JD37_18	175	231	0.76	0.0931	0.0056	0.2342	0.0142	0.0183	0.0003	1500	314	214	12	117	2
21JD37_19	448	463	0.97	0.0459	0.0017	0.1186	0.0046	0.0187	0.0002	54	83	114	4	119	1
21JD37_20	388	385	1.01	0.0624	0.0031	0.1586	0.0080	0.0184	0.0002	689	101	149	7	118	1
21JD37_21	297	425	0.70	0.0559	0.0025	0.1415	0.0059	0.0184	0.0002	450	100	134	5	118	2
21JD37_22	264	332	0.80	0.0487	0.0023	0.1228	0.0057	0.0183	0.0002	200	111	118	5	117	1
21JD37_23	488	534	0.91	0.0484	0.0016	0.1232	0.0040	0.0185	0.0002	117	80	118	4	118	1
21JD37_24	220	248	0.89	0.0467	0.0024	0.1204	0.0062	0.0187	0.0002	32	119	115	6	119	1
21JD37_25	157	205	0.77	0.0523	0.0031	0.1308	0.0067	0.0185	0.0003	298	131	125	6	118	2
Yashan intrusion (sample 21JD56)															
21JD56_1	968	1374	0.70	0.0499	0.0037	0.1252	0.0084	0.0188	0.0004	191	179	120	8	120	2
21JD56_2	948	1411	0.67	0.0477	0.0030	0.1273	0.0077	0.0192	0.0004	87	141	122	7	122	2
21JD56_3	689	1177	0.59	0.0523	0.0057	0.1239	0.0103	0.0182	0.0005	302	250	119	9	117	3
21JD56_4	1421	2529	0.56	0.0494	0.0027	0.1254	0.0068	0.0185	0.0003	169	132	120	6	118	2
21JD56_5	609	844	0.72	0.0501	0.0039	0.1264	0.0089	0.0189	0.0004	198	181	121	8	120	3
21JD56_6	748	1313	0.57	0.0521	0.0048	0.1260	0.0099	0.0186	0.0004	287	213	121	9	119	3
21JD56_7	1068	1926	0.55	0.0517	0.0033	0.1279	0.0075	0.0181	0.0004	272	146	122	7	116	2
21JD56_8	914	1499	0.61	0.0490	0.0041	0.1267	0.0096	0.0188	0.0005	146	185	121	9	120	3
21JD56_9	663	1374	0.48	0.0496	0.0042	0.1258	0.0098	0.0190	0.0007	176	185	120	9	121	4
21JD56_10	1336	1583	0.84	0.0501	0.0037	0.1289	0.0085	0.0192	0.0004	211	174	123	8	123	2
21JD56_11	955	1582	0.60	0.0495	0.0046	0.1243	0.0109	0.0189	0.0005	172	204	119	10	121	3
21JD56_12	1425	1703	0.84	0.0496	0.0030	0.1261	0.0072	0.0188	0.0004	189	147	121	6	120	2
21JD56_13	813	1464	0.56	0.0487	0.0039	0.1278	0.0097	0.0190	0.0004	200	109	122	9	121	3
21JD56_14	534	1167	0.46	0.0491	0.0043	0.1246	0.0101	0.0188	0.0005	154	193	119	9	120	3
21JD56_15	1053	1658	0.64	0.0494	0.0031	0.1256	0.0078	0.0185	0.0004	165	146	120	7	118	2
21JD56_16	760	1487	0.51	0.0483	0.0038	0.1262	0.0086	0.0187	0.0004	122	165	121	8	119	2

No.	Content (ppm)		Th/U	Isotope ratio						Apparent age (Ma)					
	Th	U		$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ
21JD56_17	2104	2422	0.87	0.0488	0.0030	0.1261	0.0080	0.0187	0.0005	200	76	121	7	120	3
21JD56_18	1417	1824	0.78	0.0485	0.0034	0.1245	0.0079	0.0191	0.0004	124	156	119	7	122	2
21JD56_19	1025	1858	0.55	0.0487	0.0030	0.1280	0.0076	0.0191	0.0004	132	202	122	7	122	2
21JD56_20	1141	1599	0.71	0.0497	0.0032	0.1223	0.0075	0.0182	0.0004	189	145	117	7	116	3
21JD56_21	1723	1727	1.00	0.0486	0.0031	0.1226	0.0077	0.0183	0.0003	128	148	117	7	117	2
21JD56_22	545	857	0.64	0.0493	0.0056	0.1298	0.0135	0.0193	0.0005	165	244	124	12	124	3
21JD56_23	624	1264	0.49	0.0484	0.0040	0.1222	0.0096	0.0184	0.0004	117	185	117	9	118	3
21JD56_24	458	1053	0.43	0.0512	0.0044	0.1293	0.0099	0.0196	0.0005	256	198	123	9	125	3
21JD56_25	569	1092	0.52	0.0510	0.0052	0.1207	0.0114	0.0182	0.0004	243	218	116	10	116	3
Nansu intrusion (sample 21JD57)															
21JD57_1	1668	748	2.23	0.0496	0.0023	0.1263	0.0059	0.0185	0.0003	174	107	121	5	118	2
21JD57_2	155	201	0.77	0.0532	0.0051	0.1435	0.0135	0.0196	0.0005	338	204	136	12	125	3
21JD57_3	349	327	1.07	0.0530	0.0035	0.1363	0.0087	0.0187	0.0004	329	141	130	8	119	2
21JD57_4	761	778	0.98	0.0523	0.0028	0.1486	0.0078	0.0206	0.0004	347	136	131	8	119	2
21JD57_5	149	136	1.09	0.0500	0.0045	0.1308	0.0115	0.0190	0.0004	193	196	125	10	121	3
21JD57_6	277	273	1.02	0.0471	0.0034	0.1284	0.0092	0.0198	0.0004	54	164	123	8	126	2
21JD57_7	137	159	0.86	0.0473	0.0041	0.1208	0.0102	0.0185	0.0004	62	194	116	9	118	3
21JD57_8	375	280	1.34	0.0532	0.0058	0.1470	0.0156	0.0201	0.0006	336	228	139	14	128	4
21JD57_9	341	236	1.45	0.0538	0.0049	0.1464	0.0131	0.0198	0.0005	361	194	139	12	126	3
21JD57_10	258	364	0.71	0.0527	0.0032	0.1431	0.0085	0.0197	0.0004	317	132	136	8	126	2
21JD57_11	378	383	0.99	0.0529	0.0044	0.1338	0.0109	0.0183	0.0004	326	178	128	10	117	3
21JD57_12	553	609	0.91	0.0518	0.0040	0.1277	0.0097	0.0179	0.0004	278	169	122	9	114	2
21JD57_13	278	274	1.01	0.0523	0.0033	0.1345	0.0084	0.0187	0.0004	298	138	128	7	119	2
21JD57_14	245	376	0.65	0.0494	0.0037	0.1279	0.0095	0.0188	0.0004	167	167	122	9	120	2
21JD57_15	202	200	1.01	0.0483	0.0062	0.1276	0.0160	0.0192	0.0006	114	277	122	14	122	4
21JD57_16	268	199	1.35	0.0490	0.0043	0.1369	0.0118	0.0203	0.0005	149	194	130	11	127	3
21JD57_17	1354	2756	0.49	0.0527	0.0014	0.1463	0.0040	0.0201	0.0003	116	141	124	7	124	2
21JD57_18	238	195	1.22	0.0537	0.0046	0.1473	0.0123	0.0199	0.0005	358	181	140	11	127	3

No.	Content (ppm)		Th/U	Isotope ratio						Apparent age (Ma)					
	Th	U		$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ	$^{207}Pb/^{206}Pb$	1σ	$^{207}Pb/^{235}U$	1σ	$^{206}Pb/^{238}U$	1σ
21JD57_19	385	378	1.02	0.0486	0.0029	0.1260	0.0075	0.0188	0.0003	127	136	121	7	120	2
21JD57_20	250	366	0.68	0.0457	0.0027	0.1186	0.0070	0.0188	0.0003	0	120	114	6	120	2
Weideshan intrusion (sample 21JD58)															
21JD58_01	415	356	1.17	0.0507	0.0038	0.13034	0.00947	0.01865	0.00038	226	163	124	9	119	2
21JD58_02	238	159	1.50	0.053	0.007	0.13858	0.01783	0.01895	0.00059	330	274	132	16	121	4
21JD58_03	436	302	1.44	0.0519	0.0046	0.13464	0.01166	0.0188	0.00043	283	190	128	10	120	3
21JD58_04	307	228	1.35	0.0439	0.0041	0.11223	0.01038	0.01855	0.00042	0	98	108	9	119	3
21JD58_05	160	134	1.19	0.0496	0.0062	0.1207	0.01483	0.01766	0.00051	176	269	116	13	113	3
21JD58_06	481	279	1.72	0.0441	0.0045	0.10585	0.01056	0.01742	0.00041	0	125	102	10	111	3
21JD58_07	247	251	0.99	0.0508	0.0051	0.13063	0.01286	0.01865	0.00047	232	217	125	12	119	3
21JD58_08	179	141	1.27	0.0515	0.0073	0.1326	0.01826	0.01868	0.00063	262	295	126	16	119	4
21JD58_09	446	313	1.43	0.0473	0.0041	0.12172	0.01031	0.01866	0.00041	65	194	117	9	119	3
21JD58_10	362	281	1.29	0.0514	0.0054	0.12502	0.01291	0.01764	0.00046	259	225	120	12	113	3
21JD58_11	523	389	1.34	0.0506	0.0043	0.13233	0.01096	0.01898	0.00043	221	185	126	10	121	3
21JD58_12	343	437	0.79	0.0462	0.0043	0.11339	0.01031	0.01779	0.00041	10	209	109	9	114	3
21JD58_13	235	202	1.16	0.0448	0.004	0.11618	0.01006	0.01879	0.00041	0	138	112	9	120	3
21JD58_14	108	117	0.92	0.0467	0.0068	0.11597	0.01643	0.01802	0.0006	33	315	111	15	115	4
21JD58_15	182	153	1.19	0.0434	0.0049	0.10904	0.01196	0.01822	0.00047	0	111	105	11	116	3
21JD58_16	239	276	0.87	0.0463	0.0037	0.11825	0.00927	0.01854	0.00039	11	182	114	8	119	2
21JD58_17	97	115	0.85	0.048	0.0065	0.12084	0.01593	0.01828	0.00057	96	292	116	14	117	4
21JD58_18	294	354	0.83	0.0497	0.0035	0.12841	0.00883	0.01875	0.00037	179	155	123	8	120	2
21JD58_19	959	696	1.38	0.0497	0.0024	0.1341	0.00646	0.01956	0.00032	182	110	128	6	125	2
21JD58_20	309	240	1.29	0.0463	0.0037	0.11785	0.00937	0.01847	0.00039	13	184	113	9	118	2

Table S2. Results of Hf isotope analysis and model age calculation of zircon by LA-ICP-MS.

Sample No.	t(Ma)	$^{176}Yb/^{177}Hf$	$^{176}Lu/^{177}Hf$	$^{176}Hf/^{177}Hf$	$\varepsilon_{Hf}(t)$	T_{DM1}(Ma)	T_{DM2}(Ma)	$f_{Lu/Hf}$
Linglong suite (sample 21JD41)								
21JD41_01	227.2	0.001910	0.000071	0.282235	-14.0	1401	2149	-1.00
21JD41_02	158.5	0.082801	0.003717	0.282233	-16.0	1548	2218	-0.89
21JD41_03	156.2	0.091689	0.004106	0.282251	-15.4	1539	2182	-0.88
21JD41_04	238.8	0.010523	0.000476	0.282414	-7.5	1168	1744	-0.99
21JD41_05	153.4	0.054377	0.002422	0.282238	-15.8	1485	2201	-0.93
21JD41_06	328.9	0.069901	0.002944	0.281857	-25.8	2065	2959	-0.91
21JD41_07	155.0	0.044947	0.002126	0.282134	-19.4	1624	2432	-0.94
21JD41_08	143.2	0.031632	0.001404	0.282164	-18.5	1549	2366	-0.96
21JD41_09	156.9	0.033705	0.001676	0.282195	-17.1	1517	2292	-0.95
21JD41_10	230.5	0.065655	0.002750	0.282123	-18.3	1668	2420	-0.92
21JD41_11	158.7	0.028309	0.001409	0.282219	-16.2	1472	2235	-0.96
21JD41_12	217.8	0.078180	0.003366	0.282159	-17.4	1642	2351	-0.90
21JD41_13	162.8	0.036140	0.001493	0.282118	-19.7	1618	2458	-0.96
21JD41_14	162.1	0.028213	0.001234	0.282242	-15.3	1433	2181	-0.96
21JD41_15	165.8	0.111980	0.004800	0.282075	-21.5	1841	2572	-0.86
21JD41_16	207.2	0.003265	0.000153	0.282483	-5.7	1064	1608	-1.00
21JD41_17	168.0	0.068042	0.002517	0.282164	-18.1	1597	2359	-0.92
21JD41_18	3000.0	0.044038	0.001789	0.281258	10.5	2838	2746	-0.95
21JD41_19	226.2	0.015432	0.000628	0.282132	-17.8	1563	2383	-0.98
21JD41_20	160.0	0.076054	0.003255	0.281949	-25.9	1947	2843	-0.90
21JD41_21	228.0	0.001566	0.000054	0.282161	-16.6	1500	2313	-1.00
21JD41_22	149.6	0.017199	0.000803	0.282126	-19.7	1578	2445	-0.98
21JD41_23	162.4	0.033347	0.001432	0.282335	-12.0	1309	1975	-0.96
21JD41_24	163.3	0.074863	0.003289	0.282114	-20.1	1706	2478	-0.90
21JD41_25	158.7	0.088775	0.003997	0.282429	-9.1	1264	1783	-0.88
Weideshan suite (sample 21JD37)								
21JD37_01	113.6	0.018036	0.000728	0.282243	-16.3	1413	2205	-0.98

Sample No.	t(Ma)	$^{176}Yb/^{177}Hf$	$^{176}Lu/^{177}Hf$	$^{176}Hf/^{177}Hf$	$\varepsilon_{Hf}(t)$	T_{DM1}(Ma)	T_{DM2}(Ma)	$f_{Lu/Hf}$
21JD37_02	118.3	0.016206	0.000659	0.282214	-17.2	1451	2267	-0.98
21JD37_03	116.2	0.021240	0.000845	0.282190	-18.1	1491	2322	-0.97
21JD37_04	122.3	0.018718	0.000780	0.282222	-16.8	1444	2247	-0.98
21JD37_05	116.8	0.015707	0.000652	0.282172	-18.7	1508	2362	-0.98
21JD37_06	117.0	0.021724	0.000865	0.282226	-16.8	1442	2242	-0.97
21JD37_07	119.5	0.018268	0.000747	0.282195	-17.9	1481	2310	-0.98
21JD37_08	119.8	0.022097	0.000898	0.282193	-17.9	1488	2313	-0.97
21JD37_09	115.6	0.020331	0.000821	0.282214	-17.3	1456	2269	-0.98
21JD37_10	118.4	0.025514	0.001026	0.282250	-15.9	1414	2187	-0.97
21JD37_11	115.8	0.019182	0.000799	0.282271	-15.2	1377	2142	-0.98
21JD37_12	115.7	0.014076	0.000576	0.282195	-17.9	1473	2310	-0.98
21JD37_13	119.3	0.016577	0.000661	0.282213	-17.2	1451	2268	-0.98
21JD37_14	119.9	0.019096	0.000736	0.282264	-15.4	1384	2154	-0.98
21JD37_15	122.5	0.015829	0.000644	0.282214	-17.1	1450	2264	-0.98
21JD37_16	122.4	0.016382	0.000652	0.282279	-14.8	1361	2120	-0.98
21JD37_17	118.5	0.025864	0.001020	0.282238	-16.4	1431	2214	-0.97
21JD37_18	117.0	0.014679	0.000607	0.282163	-19.0	1518	2380	-0.98
21JD37_19	119.4	0.021329	0.000846	0.282262	-15.5	1391	2161	-0.97
21JD37_20	117.6	0.018631	0.000739	0.282221	-17.0	1443	2251	-0.98
21JD37_21	117.8	0.022444	0.000899	0.282197	-17.8	1483	2306	-0.97
21JD37_22	116.8	0.019068	0.000761	0.282201	-17.7	1472	2296	-0.98
21JD37_23	118.1	0.026412	0.001076	0.282173	-18.7	1524	2360	-0.97
21JD37_24	119.5	0.014799	0.000605	0.282245	-16.1	1405	2196	-0.98
21JD37_25	117.9	0.013979	0.000558	0.282162	-19.0	1518	2382	-0.98

Table S3. Whole-rock major and trace element data for the Linglong and Weideshan suites in the Jiaodong Peninsula, China.

	Linglong suite												Weideshan suite											
	21JD41-1	**21JD41-2**	**21JD41-3**	**21JD41-4**	**21JD52-1**	**21JD52-2**	**21JD52-3**	**21JD52-4**	**21JD53-1**	**21JD53-2**	**21JD53-3**	**21JD53-4**	**21JD37-1**	**21JD37-2**	**21JD37-3**	**21JD37-4**	**21JD56-1**	**21JD56-2**	**21JD56-3**	**21JD56-4**	**21JD57-1**	**21JD57-2**	**21JD57-3**	**21JD57-4**
Major (wt%)																								
SiO_2	73.00	73.69	73.33	74.47	75.65	74.93	75.74	75.86	73.20	72.73	73.30	72.55	73.19	67.70	69.22	67.25	69.27	70.20	71.00	69.32	71.42	71.33	73.18	71.50
Na_2O	4.15	4.15	4.14	4.09	4.53	4.45	4.28	4.40	4.35	4.34	4.09	4.39	3.30	3.77	3.68	3.87	4.10	3.87	3.88	4.03	3.95	3.88	4.10	4.10
MgO	0.33	0.32	0.26	0.24	0.08	0.07	0.06	0.08	0.26	0.27	0.29	0.28	0.94	1.77	1.35	1.78	1.51	1.25	1.19	1.40	0.81	0.77	0.81	0.79
Al_2O_3	14.22	13.73	14.14	13.54	14.16	14.45	14.07	14.01	14.85	15.00	14.70	15.07	13.20	14.59	14.78	15.23	14.65	14.65	14.36	15.10	14.42	14.53	13.61	14.63
P_2O_5	0.04	0.05	0.04	0.05	0.03	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.12	0.21	0.16	0.21	0.17	0.14	0.13	0.16	0.12	0.11	0.11	0.11
K_2O	3.28	3.24	3.24	3.19	3.93	4.87	4.41	4.12	3.88	4.00	4.24	4.01	3.85	3.45	3.62	3.30	3.76	4.22	4.16	3.93	4.52	5.05	3.44	4.35
CaO	2.07	2.11	1.88	1.86	0.53	0.48	0.61	0.37	1.61	1.64	1.57	1.64	2.10	3.07	2.76	3.34	2.77	2.32	2.28	2.69	1.78	1.64	1.94	1.84
TiO_2	0.16	0.17	0.16	0.24	0.13	0.12	0.13	0.14	0.13	0.14	0.12	0.15	0.25	0.44	0.36	0.44	0.36	0.30	0.30	0.33	0.25	0.24	0.25	0.24
MnO	0.04	0.04	0.03	0.03	0.00	0.00	0.00	0.01	0.03	0.03	0.02	0.03	0.03	0.06	0.04	0.06	0.05	0.05	0.03	0.05	0.03	0.03	0.03	0.03
TFe_2O_3	1.55	1.57	1.57	1.54	0.27	0.09	0.21	0.33	1.18	1.31	1.05	1.32	2.13	3.50	2.88	3.48	2.68	2.30	2.11	2.56	1.81	1.71	1.77	1.67
LOI	0.54	0.45	0.57	0.39	0.63	0.48	0.41	0.52	0.43	0.46	0.52	0.48	0.54	1.02	0.66	0.54	0.65	0.65	0.52	0.39	0.86	0.67	0.70	0.70
Total	99.39	99.52	99.37	99.64	99.94	99.98	99.95	99.88	99.96	99.96	99.94	99.96	99.65	99.57	99.51	99.49	99.97	99.95	99.96	99.96	99.97	99.96	99.94	99.96
Fe_2O_3	0.50	0.53	0.56	0.51	0.03	(0.02)	0.02	0.04	0.16	0.32	0.12	0.30	0.52	1.27	1.15	1.19	0.78	0.74	0.86	0.91	0.74	0.56	0.48	0.59
FeO^T	1.40	1.41	1.41	1.39	0.24	0.08	0.19	0.30	1.06	1.18	0.94	1.19	1.91	3.15	2.59	3.13	2.41	2.07	1.90	2.30	1.63	1.54	1.59	1.50
FeO	0.95	0.93	0.91	0.93	0.22	0.10	0.17	0.26	0.92	0.89	0.84	0.92	1.45	2.01	1.56	2.06	1.71	1.40	1.12	1.48	0.96	1.03	1.16	0.97
Na_2O/K_2O	1.27	1.28	1.28	1.29	1.15	0.91	0.97	1.07	1.12	1.09	0.96	1.09	0.86	1.09	1.01	1.17	1.09	0.92	0.93	1.03	0.87	0.77	1.19	0.94
Na_2O+K_2O	7.43	7.39	7.38	7.28	8.46	9.32	8.69	8.52	8.23	8.34	8.33	8.40	7.16	7.21	7.30	7.17	7.86	8.09	8.04	7.96	8.47	8.93	7.54	8.45
A/NK	1.37	1.33	1.37	1.33	1.21	1.15	1.19	1.20	1.31	1.31	1.30	1.30	1.37	1.47	1.48	1.53	1.35	1.34	1.32	1.39	1.26	1.22	1.30	1.28
A/CNK	1.00	0.97	1.03	1.00	1.12	1.07	1.09	1.13	1.04	1.04	1.04	1.03	0.98	0.94	0.98	0.95	0.92	0.97	0.95	0.96	0.98	0.98	0.97	0.99
Mg#	29.42	28.52	24.43	23.75	36.99	60.64	36.14	32.44	30.39	28.99	35.36	29.59	46.55	50.00	48.11	50.31	52.74	51.84	52.77	52.00	46.99	47.15	47.55	48.38
R1	2589.95	2646.78	2624.60	2728.35	2500.63	2265.16	2484.65	2515.01	2393.62	2338.45	2410.97	2305.30	2753.88	2297.72	2403.81	2264.12	2221.03	2267.28	2338.79	2216.66	2263.53	2156.91	2574.11	2255.29
R2	516.93	511.23	491.70	477.09	338.43	338.27	344.23	318.37	476.45	483.10	470.71	484.97	529.61	702.35	652.42	744.41	658.67	597.62	584.67	653.48	513.50	498.69	514.73	523.04
Trace (ppm)																								
Li	11.8	11.3	11.4	11.4	7.4	2.65	4.81	3.92	13	12.2	11	13.2	15.1	23.7	16.6	21.5	25	12.8	14.9	18.4	17.2	17.7	19.9	17.5
Be	1.03	1.05	0.947	1.08	1.3	1.59	1.3	0.954	1.29	1.29	1.25	1.29	1.33	1.74	1.69	1.83	1.72	1.81	1.73	1.83	3.14	2.9	3.35	3.09

	Linglong suite												Weideshan suite											
	21JD4 1-1	**21JD4 1-2**	**21JD4 1-3**	**21JD4 1-4**	**21JD5 2-1**	**21JD5 2-2**	**21JD5 2-3**	**21JD5 2-4**	**21JD5 3-1**	**21JD5 3-2**	**21JD5 3-3**	**21JD5 3-4**	**21JD3 7-1**	**21JD3 7-2**	**21JD3 7-3**	**21JD3 7-4**	**21JD5 6-1**	**21JD5 6-2**	**21JD5 6-3**	**21JD5 6-4**	**21JD5 7-1**	**21JD5 7-2**	**21JD5 7-3**	**21JD5 7-4**
Sc	7.54	7.71	4.05	4.49	1.46	1.73	1.65	1.33	1.59	1.69	1.19	1.53	5.37	7.5	6.62	7.41	5.62	4.48	3.94	11.2	3.61	3.75	4.38	3.15
V	11.6	12.1	10.9	10.3	2.85	2.66	3.13	2.59	3.92	4.47	4.43	5.29	30.9	50.5	40.7	50.4	40	35	34.1	45.4	22.3	21.3	21.1	21.3
Cr	4.46	4.57	2.89	4.35	0.972	1.09	0.754	0.704	1.1	0.996	1.51	1.25	16.7	32.2	27.2	32.7	28.3	24.2	22.6	28.8	12.9	11.6	11.6	11.4
Co	1.67	1.63	1.3	1.3	0.329	0.106	0.215	0.195	0.832	0.934	0.823	0.913	4.62	8.32	6.47	8.02	7.09	5.97	5.17	6.55	3.83	3.47	3.7	3.36
Ni	1.88	1.67	1	1.42	0.701	0.472	0.607	0.53	1.32	1.36	1.19	1.29	6.97	14.5	11.2	14.1	12.2	9.61	9.09	10.6	5.75	5.21	5.75	5.37
Cu	1.93	1.86	2.13	1.62	9.45	1.04	2.71	1.45	2.29	3.1	2.37	2.64	2.72	6.72	4.67	8.45	5.6	5.27	5.6	4.72	3.93	3.85	3.82	3.8
Zn	37.9	38.3	36.5	38.2	7.02	5.17	5.12	9.2	35.6	36	29.4	37.2	30.7	52.7	34.9	48.9	55.4	39.9	30.5	40.1	25.2	24.1	24.1	23.1
Ga	15	15.4	14.9	14.8	16.7	22.2	17.6	15.4	18.4	18.9	17.4	18.1	14.3	17.8	17.1	17.9	18	17.1	16.8	17.2	19.1	18.9	18.5	19
Rb	62.1	60.6	65.9	70.1	105	129	121	106	84.2	90.8	87	85.6	112	104	106	97.5	101	106	110	102	154	174	129	151
Sr	701	705	716	701	287	202	261	244	596	640	586	614	417	626	623	676	604	535	501	594	562	509	471	522
Y	11.1	12.7	6.83	6.89	11.2	13.6	5.95	4.23	5.9	4.95	5.22	5.55	7.86	11	10.1	11.8	8.94	8.57	8.02	8.58	9.74	8.58	8.56	8.88
Zr	95	94.9	71.9	81.4	30.6	38.4	13.4	24.8	24.9	26.4	21.2	27.5	98.7	127	96.8	121	25.9	27.2	22.6	21.1	22.5	22.8	23.5	16.5
Nb	6.32	7.49	5.47	6.12	11.9	8.13	8.27	6	6.28	6.12	5.12	5.87	7.76	11.3	10.5	11.5	9.73	10.3	8.64	9.9	14.5	12.7	13.3	13.2
Cs	0.338	0.327	0.433	0.596	0.802	0.627	0.746	0.701	0.766	1.08	0.69	0.659	1.12	1.51	1.41	1.39	1.54	1.27	1.32	1.4	1.1	1.05	0.982	1.13
Ba	2080	2140	2270	2210	896	606	770	844	1796	2044	1994	1917	587	990	998	1060	817	1092	700	849	1280	1363	678	1128
La	19	14.9	20.6	18.6	5.12	2.58	2.66	3.59	28.8	35.5	27.7	30	30.2	63.9	53.4	54.4	44.9	36.1	44.6	42	56.3	48.1	47.5	39.3
Ce	32.9	27	34.6	31.1	9.7	4.67	4.58	6.83	48	62.4	47.2	51.2	60.7	112	93.2	99.1	79	63.7	75.4	74.1	95.3	79.8	80.8	72.2
Pr	3.6	3.06	3.68	3.34	1.27	0.637	0.682	0.914	5.08	6.58	4.95	5.4	6.57	11.4	9.67	10.6	8.72	7.11	7.97	8.05	10	8.68	8.76	8.01
Nd	11.9	10.7	11.4	10.4	5.19	2.53	2.65	3.68	17.7	22.1	16.7	18.3	22.8	38.3	32.3	36.7	31.4	25.6	26.6	29.5	31.6	28.4	27.7	28.4
Sm	2.07	2.07	1.61	1.52	1.29	0.772	0.726	0.919	2.31	2.65	2.22	2.35	3.39	5.1	4.41	5.26	4.02	3.59	3.49	3.81	4.29	3.89	3.58	4.03
Eu	0.709	0.667	0.571	0.594	0.358	0.277	0.349	0.384	0.68	0.791	0.732	0.736	0.924	1.27	1.07	1.28	1.06	0.929	0.913	1.02	1.05	0.98	0.849	0.961
Gd	1.87	1.96	1.29	1.32	1.04	0.733	0.594	0.701	2.15	2.33	2.09	2.11	2.31	3.67	3.13	3.67	3.75	3.13	3.23	3.39	3.94	3.35	3.55	3.4
Tb	0.292	0.312	0.189	0.187	0.232	0.207	0.132	0.129	0.268	0.258	0.236	0.247	0.321	0.483	0.411	0.487	0.464	0.389	0.395	0.425	0.468	0.43	0.413	0.417
Dy	1.7	1.93	0.97	0.98	1.43	1.42	0.744	0.641	1.25	1.11	1.17	1.19	1.39	2.02	1.75	2.11	2.04	1.81	1.77	1.84	2	1.83	1.94	1.86
Ho	0.36	0.411	0.203	0.208	0.323	0.399	0.173	0.133	0.19	0.163	0.172	0.173	0.254	0.37	0.324	0.384	0.31	0.285	0.272	0.283	0.313	0.275	0.281	0.287
Er	1.026	1.159	0.6004	0.6194	0.961	1.35	0.53	0.414	0.571	0.592	0.549	0.598	0.72295	1.0735	0.92245	1.1115	0.937	0.956	0.837	0.945	0.962	0.871	0.911	0.931
Tm	0.169	0.188	0.0967	0.0979	0.181	0.307	0.109	0.078	0.07	0.073	0.066	0.083	0.101	0.143	0.125	0.153	0.136	0.136	0.122	0.134	0.152	0.127	0.136	0.128
Yb	1.1	1.25	0.66	0.688	1.18	2.48	0.692	0.542	0.402	0.484	0.359	0.44	0.68	0.964	0.878	1.01	0.88	0.805	0.758	0.907	0.965	0.852	0.87	0.874

	Linglong suite												Weideshan suite											
	21JD41-1	21JD41-2	21JD41-3	21JD41-4	21JD52-1	21JD52-2	21JD52-3	21JD52-4	21JD53-1	21JD53-2	21JD53-3	21JD53-4	21JD37-1	21JD37-2	21JD37-3	21JD37-4	21JD56-1	21JD56-2	21JD56-3	21JD56-4	21JD57-1	21JD57-2	21JD57-3	21JD57-4
Lu	0.178	0.198	0.107	0.109	0.186	0.366	0.116	0.087	0.051	0.06	0.042	0.059	0.101	0.143	0.131	0.154	0.122	0.123	0.109	0.125	0.142	0.112	0.122	0.124
Hf	2.33	2.29	1.63	1.88	1.1	2.34	0.576	0.927	0.68	0.705	0.635	0.794	2.54	3.28	2.64	3.25	0.925	1.09	0.914	0.937	1.01	0.991	1.05	0.766
Ta	0.395	0.43	0.323	0.298	1.01	1.32	0.416	0.313	0.463	0.34	0.381	0.316	0.602	0.818	0.799	0.848	0.734	0.836	0.744	0.766	1.05	0.868	0.933	0.951
Pb	18.2	18.5	19	20.2	16.1	23.2	22.5	17.6	24.5	26.9	25.6	24.3	20.4	17.7	17.9	17.2	18.4	21	19	19.5	20.8	21.1	16.1	19.3
Th	3.65	2.93	3.93	3.63	3.58	2.92	1.98	2.14	5.93	5.38	5.23	4.95	17.6	16.8	19.8	21.9	14	14.8	15.6	14.1	22.2	22.2	24.6	23
U	0.526	0.541	0.45	0.496	1.02	1.25	0.462	0.853	0.719	0.668	0.667	0.581	2.15	2.77	2.78	2.66	1.94	2.38	2	2.14	3.56	3.21	3.84	3.45
Mo	0.050	0.587	0.724	0.356	0.06	0.037	0.085	0.083	0.087	0.152	0.054	0.151	0.650	1.878	3.201	1.036	0.173	0.191	0.576	0.2	0.302	0.344	0.286	0.487
Cd	0.013	0.011	0.023	-0.024	0.019	0.014	0.006	0.022	0.028	0.02	0.019	0.028	0.016	0.025	0.028	0.019	0.034	0.025	0.034	0.023	0.02	0.014	0.014	0.011
In	0.030	0.033	0.016	0.058	0.006	0.005	0.004	0.005	0.018	0.018	0.014	0.018	0.015	0.024	0.021	0.027	0.024	0.021	0.018	0.023	0.016	0.016	0.016	0.019
Sb	0.078	0.060	0.076	0.197	0.115	0.064	0.075	0.104	0.024	0.02	0.02	0.043	0.096	0.062	0.060	0.058	0.021	0.033	0.273	0.013	0.017	0.019	0.017	0.167
W	0.072	0.291	0.119	0.079	0.325	0.209	0.233	0.178	0.057	0.057	0.066	0.054	0.114	0.305	0.411	1.272	0.125	0.129	0.259	0.105	0.329	0.142	0.124	0.135
Tl	0.296	0.295	0.310	0.339	0.557	0.587	0.581	0.598	0.459	0.487	0.474	0.484	0.481	0.489	0.463	0.450	0.622	0.672	0.635	0.644	0.767	0.84	0.641	0.762
Bi	0.048	0.031	0.031	0.023	0.017	0.008	0.009	0.006	0.01	0.008	0.01	0.004	0.037	0.040	0.039	0.046	0.034	0.028	0.049	0.027	0.018	0.018	0.015	0.018
ΣREE	76.874	65.805	76.5771	69.7633	28.461	18.728	14.737	19.042	107.522	135.091	104.186	112.886	130.46395	240.8365	201.72145	216.4195	177.739	144.663	166.466	166.529	207.482	177.697	177.412	160.922
ΣLREE	70.179	58.397	72.461	65.554	22.928	11.466	11.647	16.317	102.57	130.021	99.502	107.986	124.584	231.97	194.05	207.34	169.1	137.029	158.973	158.48	198.54	169.85	169.189	152.901
ΣHREE	6.695	7.408	4.1161	4.2093	5.533	7.262	3.09	2.725	4.952	5.07	4.684	4.9	5.87995	8.8665	7.67145	9.0795	8.639	7.634	7.493	8.049	8.942	7.847	8.223	8.021
ΣLREE/ΣHREE	10.48	7.88	17.60	15.57	4.14	1.58	3.77	5.99	20.71	25.65	21.24	22.04	21.19	26.16	25.30	22.84	19.57	17.95	21.22	19.69	22.20	21.65	20.58	19.06
δEu	1.08	1.00	1.17	1.25	0.92	1.11	1.58	1.41	0.92	0.95	1.02	0.99	0.96	0.86	0.84	0.85	0.82	0.83	0.82	0.85	0.77	0.81	0.72	0.77
δCe	0.90	0.91	0.89	0.88	0.89	0.85	0.80	0.89	0.88	0.92	0.90	0.90	0.99	0.93	0.92	0.93	0.90	0.90	0.89	0.91	0.89	0.87	0.89	0.93
$(La/Yb)_N$	11.65	8.04	21.04	18.23	2.93	0.70	2.59	4.47	48.30	49.45	52.02	45.97	29.94	44.69	41.00	36.31	34.40	30.23	39.67	31.22	39.33	38.06	36.81	30.32
$(La/Lu)_N$	11.09	7.82	20.00	17.72	2.86	0.73	2.38	4.29	58.66	61.46	68.51	52.82	31.06	46.42	42.34	36.69	38.23	30.49	42.50	34.90	41.18	44.61	40.44	32.92
$(La/Sm)_N$	5.77	4.53	8.05	7.70	2.50	2.10	2.30	2.46	7.84	8.43	7.85	8.03	5.60	7.88	7.62	6.51	7.03	6.33	8.04	6.93	8.26	7.78	8.35	6.13
$(Ce/Y)_N$	5.77	4.53	8.05	7.70	2.50	2.10	2.30	2.46	7.84	8.43	7.85	8.03	5.60	7.88	7.62	6.51	7.03	6.33	8.04	6.93	8.26	7.78	8.35	6.13
$(Ce/Yb)_N$	7.74	5.59	13.56	11.69	2.13	0.49	1.71	3.26	30.89	33.35	34.01	30.10	23.09	30.05	27.46	25.38	23.22	20.47	25.73	21.13	25.54	24.23	24.02	21.37
$(Gd/Lu)_N$	1.31	1.23	1.50	1.51	0.70	0.25	0.64	1.00	5.24	4.83	6.19	4.45	2.84	3.19	2.97	2.96	3.82	3.16	3.68	3.37	3.45	3.72	3.62	3.41
Sr/Y	63.15	55.51	104.83	101.74	25.63	14.85	43.87	57.68	101.02	129.29	112.26	110.63	53.05	56.91	61.68	57.29	67.56	62.43	62.47	69.23	57.70	59.32	55.02	58.78
$(Gd/Yb)_N$	1.37	1.27	1.58	1.55	0.71	0.24	0.69	1.04	4.32	3.88	4.70	3.87	2.74	3.07	2.88	2.93	3.44	3.14	3.44	3.02	3.29	3.17	3.29	3.14

Table S4. Sr-Nd-Pb isotope data for the Linglong and Weideshan suites in the Jiaodong Peninsula, China.

No.	Sr		Nd						Pb					
	$^{87}Sr/^{86}Srs$	$(^{87}Sr/^{86}Sr)_i$	$^{143}Nd/^{144}Nd$	$(^{143}Nd/^{144}Nd)_i$	$\varepsilon_{Nd}(t)$	T_{DM1}(Ma)	T_{DM2}(Ma)	$f_{Sm/Nd}$	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$	$(^{206}Pb/^{204}Pb)_i$	$(^{207}Pb/^{204}Pb)_i$	$(^{208}Pb/^{204}Pb)_i$
Linglong suite (sample 21JD41)														
21JD41-1	0.712727	0.712143	0.511752	0.511642	-15.42	1957	2196	-0.47	17.19	15.46	37.83	17.14	15.46	37.72
21JD41-2	0.712724	0.712158	0.511760	0.511638	-15.50	2181	2203	-0.41	17.19	15.46	37.81	17.14	15.46	37.73
21JD41-3	0.711938	0.711332	0.511703	0.511614	-15.97	1714	2240	-0.57	17.19	15.46	37.84	17.15	15.46	37.73
21JD41-4	0.711996	0.711338	0.511694	0.511602	-16.20	1765	2259	-0.55	17.18	15.47	37.83	17.14	15.46	37.74
Weideshan suite (sample 21JD37)														
21JD37-1	0.710303	0.709000	0.511700	0.511631	-16.69	1780	2265	-0.54	17.41	15.52	38.05	17.29	15.51	37.72
21JD37-2	0.709895	0.709089	0.511699	0.511637	-16.56	1656	2255	-0.59	17.45	15.52	38.09	17.27	15.51	37.73
21JD37-3	0.709952	0.709126	0.511698	0.511634	-16.63	1684	2260	-0.58	17.47	15.52	38.15	17.29	15.52	37.73
21JD37-4	0.709765	0.709065	0.511696	0.511629	-16.73	1740	2268	-0.56	17.46	15.52	38.17	17.28	15.52	37.69

Table S5. Previous published intrusion ages of three major generations of granitoids (Linglong, Guojialing and Weideshan) in the Jiaodong Peninsula[a].

No.	Granitoid suite	Rock Unit	Method	Age (Ma)	Error (Ma)	References
1	Linglong	Cangshang	SHRIMP	166	4	Zhang et al. (2003)
2		Cangshang	LA-ICP-MS	161	2	Zhao et al. (2018)
3		Luanjiahe	LA-ICP-MS	159	2	Yang et al. (2012)
4		Cangshang	SHRIMP	154	5	Zhang et al. (2003)
5		Xincheng	LA-ICP-MS	161	2	L.Q. Yang et al. (2018)
6		Wang'ershan	LA-ICP-MS	161	2	L.Q. Yang et al. (2018)
7		Linlong	LA-ICP-MS	160	3	Ma et al. (2013)
8		Wang'ershan	LA-ICP-MS	159	1	K.F. Yang et al. (2018)
9		Luanjiahe	LA-ICP-MS	159	1	Yang et al. (2012)
10		Cuizhao	SHRIMP	158	3	Wang et al. (2011)
11		Moshan	SHRIMP	158	3	Miao et al. (1998)
12		Linglong	LA-ICP-MS	158	2	Ma et al. (2013)
13		Linglong	LA-ICP-MS	158	2	Ma et al. (2013)
14		Linglong	LA-ICP-MS	157	3	Ma et al. (2013)
15		Wang'ershan	LA-ICP-MS	149	1	Li et al. (2015)
16		Biguo	LA-ICP-MS	166	4	Jiang et al. (2012)
17		Biguo	LA-ICP-MS	166	5	Jiang et al. (2012)
18		Linglong	SIMS	166	1	Li et al. (2019)
19		Guojiadian	LA-ICP-MS	163	2	Jiang et al. (2012)
20		Damoqujia	LA-ICP-MS	160	1	Chai et al. (2020)
21		Taishang	LA-ICP-MS	160	3	L.Q. Yang et al. (2018)
22		Luoshan	LA-ICP-MS	160	3	L.Q. Yang et al. (2018)
23		Cuizhao	SHRIMP	160	3	Miao et al. (1998)
24		Xiadian	LA-ICP-MS	160	1	Ma et al. (2017)
25		Luoshan	LA-ICP-MS	159	3	K.F. Yang et al. (2018)
26		Luanjiahe	LA-ICP-MS	158	2	Yang et al. (2012)

27		Luanjiahe	SIMS	158	2	Li et al. (2019)
28		Taishang	LA-ICP-MS	158	2	K.F. Yang et al. (2018)
29		Luanjiahe	LA-ICP-MS	157	2	Yang et al. (2012)
30		Luoshan	SHRIMP	157	4	Miao et al. (1998)
31		Linglong	LA-ICP-MS	156	1	L.Q. Yang et al. (2014)
32		Linlong	LA-ICP-MS	156	1	Jiang et al. (2012)
33		Linglong	LA-ICP-MS	156	5	L.Q. Yang et al. (2014)
34		Luanjiahe	SHRIMP	154	4	Miao et al. (1998)
35		Shuangding	SHRIMP	153	4	Miao et al. (1998)
36		Biguo	SHRIMP	152	10	Miao et al. (1998)
37		Linlong	LA-ICP-MS	150	2	Jiang et al. (2012)
38		Guojiadian	LA-ICP-MS	149	2	Jiang et al. (2012)
39		Linglong	LA-ICP-MS	157	2	Zhang et al. (2010)
40		Yushan	SHRIMP	157	2	Zhang and Zhang (2007)
41		Hushan	LA-ICP-MS	153	4	K.F. Yang et al. (2018)
42		Queshan	LA-ICP-MS	156	2	Zhang and Zhang (2007)
43		Queshan	LA-ICP-MS	154	1	Zhang and Zhang (2007)
44		Duogushan	LA-ICP-MS	164	2	Wang (2012)
45		Duogushan	SHRIMP	161	1	Guo et al. (2005)
46		Wendeng	SHRIMP	160	3	Guo et al. (2005)
47		Wuzhuashan	SHRIMP	160	3	Hu et al. (2004)
48		Jiazishan	LA-ICP-MS	159	2	Wang (2012)
49		Jiazishan	LA-ICP-MS	159	1	Wang (2012)
50		Hejiadian	LA-ICP-MS	158	1	Wang (2012)
51		Washan	SHRIMP	153	2	Wang et al. (2011)
52		Duogushan	LA-ICP-MS	153	1	Wang (2012)
53		Washan	LA-ICP-MS	152	1	Zhang and Zhang (2008)
54		Linglong	LA-ICP-MS	160	3	This study
55		Linglong	LA-ICP-MS	159	4	This study

56		Cishan	LA-ICP-MS	158	3	This study
57		Cishan	LA-ICP-MS	153	3	This study
58	Guojialing	Sanshandao	LA-ICP-MS	130	1	Zhao et al. (2018)
59		Sanshandao	LA-ICP-MS	129	1	Yang et al. (2012)
60		Sanshandao	SHRIMP	128	2	Guan et al. (1998)
61		Sanshandao	LA-ICP-MS	127	2	Wang et al. (2018)
62		Xinli	LA-ICP-MS	130	0	Zhao et al. (2018)
63		Cangshang	LA-ICP-MS	131	1	Wang et al. (2018)
64		Xincheng	LA-ICP-MS	132	1	Wang et al. (2014)
65		Shangzhuang	LA-ICP-MS	132	1	Deng et al. (2015)
66		Shangzhuang	LA-ICP-MS	130	1	Cai et al. (2018)
67		Xincheng	LA-ICP-MS	129	1	Wang et al. (2014)
68		Shangzhuang	LA-ICP-MS	129	1	Yang et al. (2012)
69		Xincheng	LA-ICP-MS	128	1	Wang et al. (2014)
70		Xincheng	LA-ICP-MS	128	1	Wang et al. (2014)
71		Xincheng	LA-ICP-MS	128	1	Wang et al. (2014)
72		Congjia	SHRIMP	128	6	Guan et al. (1998)
73		Congjia	SHRIMP	127	1	Geng et al. (2016)
74		Xincheng	LA-ICP-MS	127	1	Deng et al. (2015)
75		Xincheng	LA-ICP-MS	126	1	Wang et al. (2014)
76		Xincheng	LA-ICP-MS	126	1	Zhang et al. (2019)
77		Shangzhuang	SHRIMP	126	2	Guan et al. (1998)
78		Guojialing	LA-ICP-MS	133	3	J. Zhang et al. (2010)
79		Damoqujia deposit	LA-ICP-MS	130	1	Chai et al. (2020)
80		Guojialing	SHRIMP	130	3	Guan et al. (1998)
81		Guojialing	SHRIMP	129	3	Guan et al. (1998)
82		Guojialing	LA-ICP-MS	130	2	Li et al. (2019)
83		Guojialing	SIMS	128	1	Li et al. (2019)
84	Weideshan	Gushan (Nansu)	LA-ICP-MS	120	1	Li et al. (2012)

85		Gushan (Nansu)	LA-ICP-MS	119	1	Li et al. (2012)
86		Gushan (Nansu)	LA-ICP-MS	119	1	Li et al. (2012)
87		Nansu	LA-ICP-MS	111	2	Song et al. (2020b)
88		Nansu	LA-ICP-MS	121	2	This study
89		Aishan	LA-ICP-MS	111	2	Zhang et al. (2010)
90		Aishan	SIMS	118	1	Li et al. (2019)
91		Aishan	SIMS	118	1	Li et al. (2019)
92		Aishan	LA-ICP-MS	117	1	Li et al. (2019)
93		Aishan	SIMS	115	1	Li et al. (2019)
94		Aishan	LA-ICP-MS	116	2	Goss et al. (2010)
95		Aishan	LA-ICP-MS	114	1	Song et al. (2020b)
96		Aishan	LA-ICP-MS	118	1	Song et al. (2020b)
97		Aishan	LA-ICP-MS	118	1	This study
98		Yashan	SHRIMP	118	3	Zhang and Zhang. (2007)
99		Yashan	LA-ICP-MS	116	1	Goss et al. (2010)
100		Yashan	LA-ICP-MS	114	0	Zhao et al. (2018)
101		Yashan	LA-ICP-MS	113	2	Goss et al. (2010)
102		Yashan	LA-ICP-MS	120	1	This study
103		Sanfoshan	LA-ICP-MS	120	1	Li et al. (2018)
104		Sanfoshan	LA-ICP-MS	118	1	Goss et al. (2010)
105		Taiboding	LA-ICP-MS	118	3	Tang et al. (2014)
106		Sanfoshan	LA-ICP-MS	117	1	Goss et al. (2010)
107		Sanfoshan	SHRIMP	116	3	Zhang et al. (2010)
108		Sanfoshan	LA-ICP-MS	116	2	Li et al. (2018)
109		Liudusi	LA-ICP-MS	115	2	Tang et al. (2014)
110		Haiyang	SHRIMP	115	2	Zhang and Zhang. (2007)
111		Liudusi	TIMS	115	1	Guo et al. (2005)
112		Weideshan	LA-ICP-MS	114	2	Ding et al. (2013)
113		Sanfoshan	LA-ICP-MS	114	3	Zhang et al. (2010)

114		Weideshan	LA-ICP-MS	114	1	Zhao et al. (2018)
115		Taiboding	TIMS	114	1	Guo et al. (2005)
116		Yuangezhuang	SHRIMP	113	3	Zhang and Zhang. (2007)
117		Weideshan	LA-ICP-MS	113	2	Ding et al. (2013)
118		Sanfoshan	SHRIMP	113	1	Guo et al. (2005)
119		Liudusi	LA-ICP-MS	113	2	Hu (2006)
120		Sanfoshan	LA-ICP-MS	111	2	Li et al. (2018)
121		Sanfoshan	LA-ICP-MS	111	3	Hu (2006)
122		Xiamashan	LA-ICP-MS	111	2	Hu (2006)
123		Weideshan	TIMS	108	2	Guo et al. (2005)
124		Weideshan	LA-ICP-MS	112	1	Song et al. (2020b)
125		Weideshan	LA-ICP-MS	111	1	Song et al. (2020b)
126		Weideshan	LA-ICP-MS	118	2	This study

[a] Modified from L. Zhang et al. (2020).