

Fe-Cu-REE

U-Pb

*

Re-Os

1 2

1**

1

1

3

1

1 2

1 2

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1. 550002

2. 100049

3. 650093

1. 550002

2.

$^{207}\text{Pb}/^{206}\text{Pb}$

Th/U > 0.4

LA-ICP-MS U-Pb

1.75 ~ 1.88Ga 1.90 ~ 2.00Ga 2.02 ~ 2.20Ga 2.30 ~ 2.40Ga 200 3.0Ga

1750Ma

Re-Os 6 Re-Os

1690 ± 99Ma MSWD = 9.0 1685 ± 37Ma MSWD = 3.0

1.7Ga

REE

- 1.7Ga -

1.7Ga Columbia

- - U-Pb Re-Os

P595 P597.3 P611

2002

1

2

-

IOCG iron oxide-copper-gold

Greentree 2007 Zhao 2010 Zhao and Zhou 1

2011 - -

- 2004 Zhao 2010 Greentree and Li 2008

2009

2004 2005 Greentree and Li 2008 Zhao 2010 Zhao 1990 Hu 1991 -

and Zhou 2011 Zhao 2012 Chen and Zhou 2012

- 1.7Ga

U-Pb

1687 ± 8Ma 2008 1675 ± 8Ma Greentree 1

2008 2009 Greentree and Li 2008 Zhao and

Zhou 2011 Chen and Zhou 2012

-

1997

勤 1984 1990 1993 1993

1997 1999 2001

-

Fe-Cu-REE

LA-ICP-MS U-

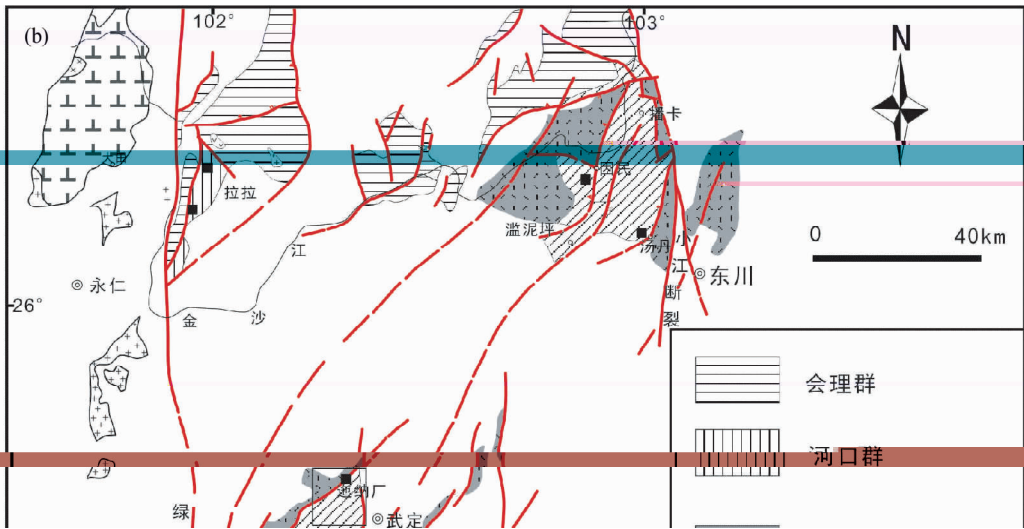
Pb

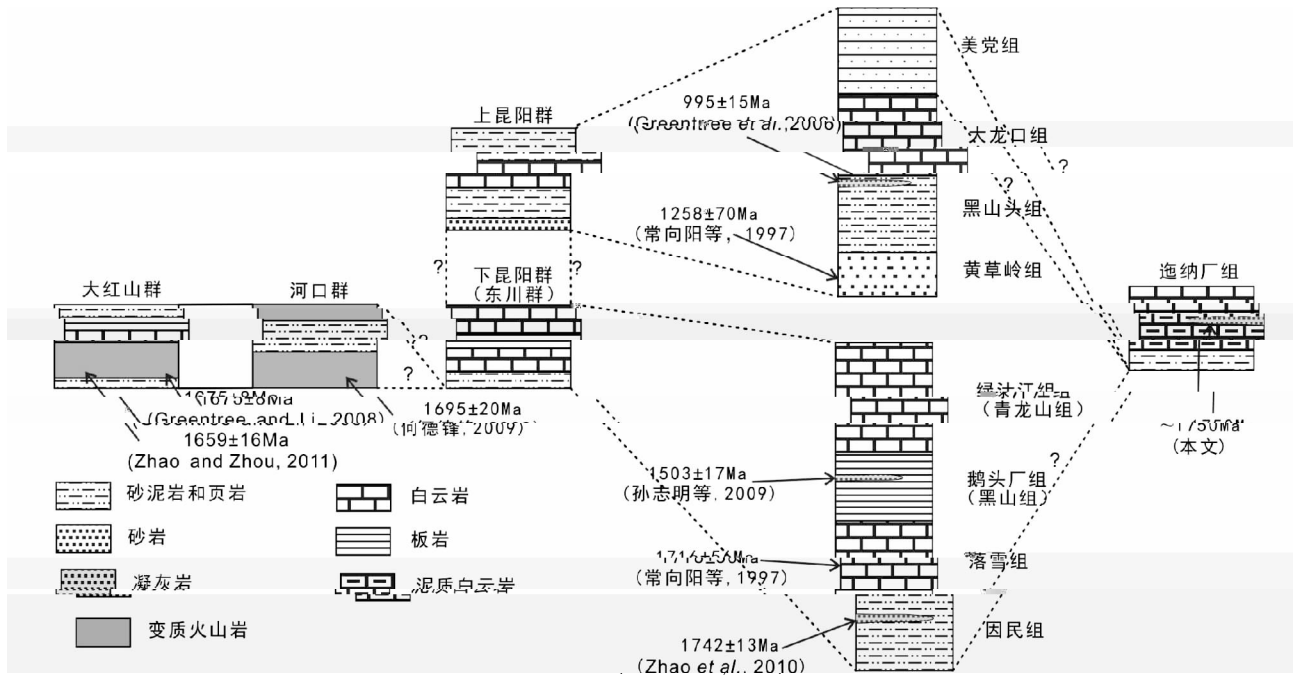
Re-Os

-

1.7Ga

Columbia Rogers and Santosh 2002 Zhao





2 Zhao and Zhou 2011

Fig.2 Stratigraphic sequences of Kuyang Group in the Kangdian region after Zhao and Zhou 2011

1032 ± 9Ma

2007

1.8 ~ 1.0Ga

400 ~ 700m

1000m 3.93 ~ 4.31m 200m

3

0.85% ~ 0.97%

41.93% ~ 44.53%

Fe-Cu-REE

2004

2004

1989

3

1cm

1mm

4a

5a b

5c d

70% 4c

5e

0.5 ~ 20cm

4b

5f

8

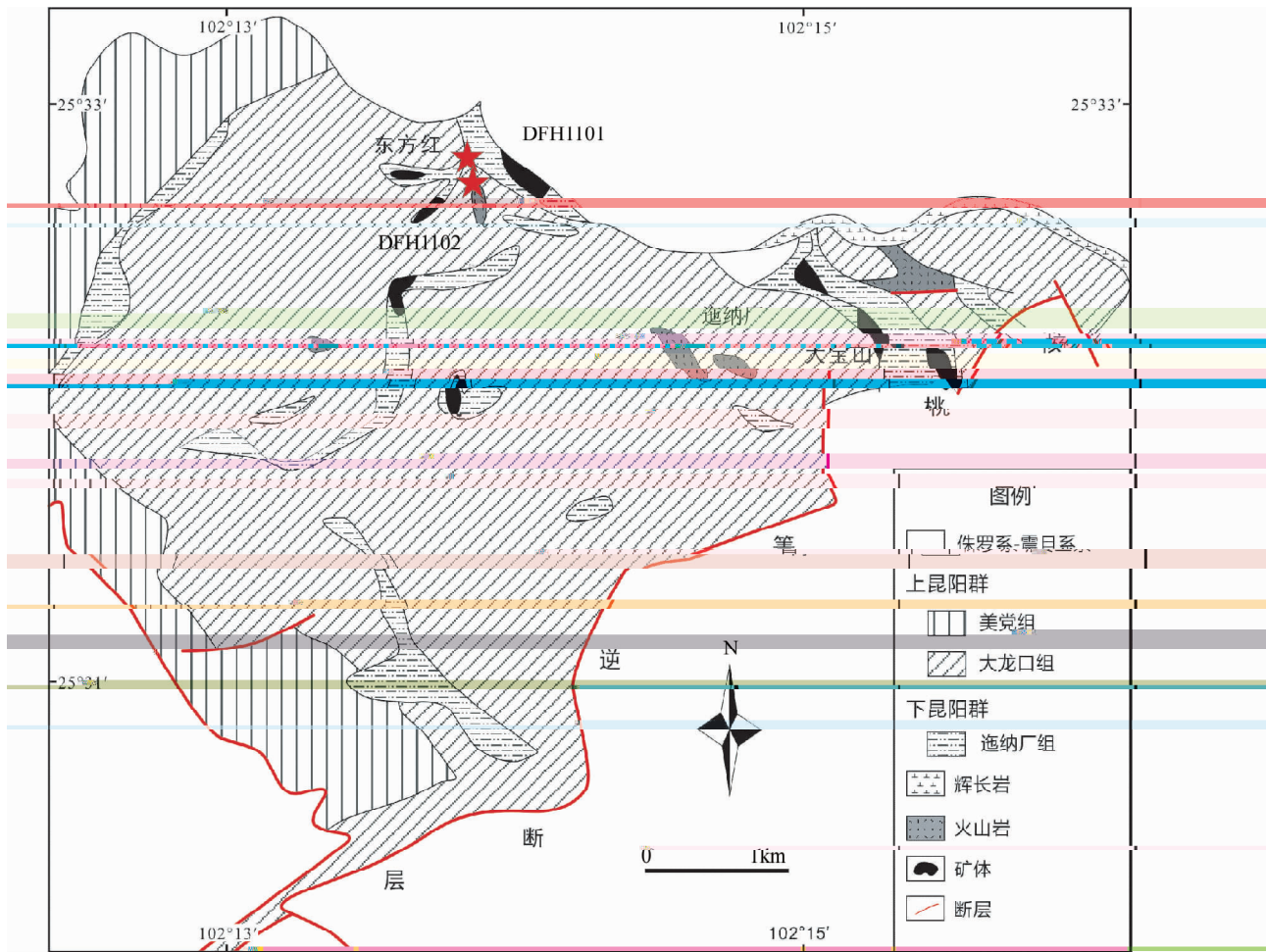
5g

3

5h

5

5i

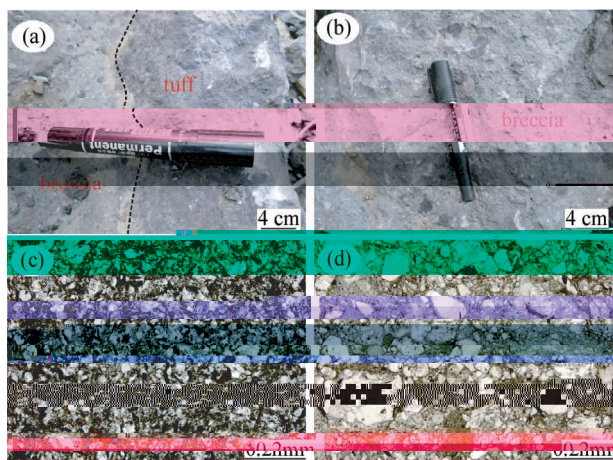


3

1990

Fig. 3 Simplified geological map of the Yinachang deposit in Wuding County Yunnan Province after Wu

1990



4

a - DFH1101 b - DFH1102
 c - tuff- breccia-
 d -

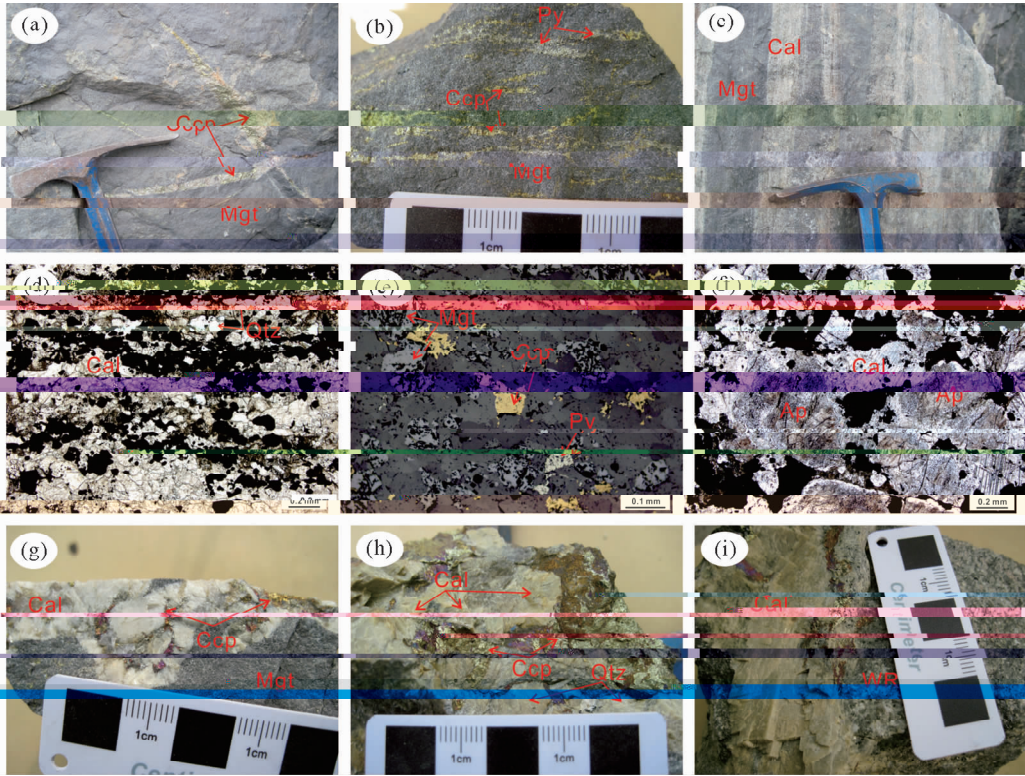
Fig. 4 Photographs and photomicrographs of the representative tuff a c and breccias b d from the Yinachang deposit

4

LA-ICP-MS U-Pb
 DFH1101 N 25°32'53.1" E 102°13'34.3"
 DFH1102 N 25°32'53.1" E 102°13'34.3"

CL

U-Pb

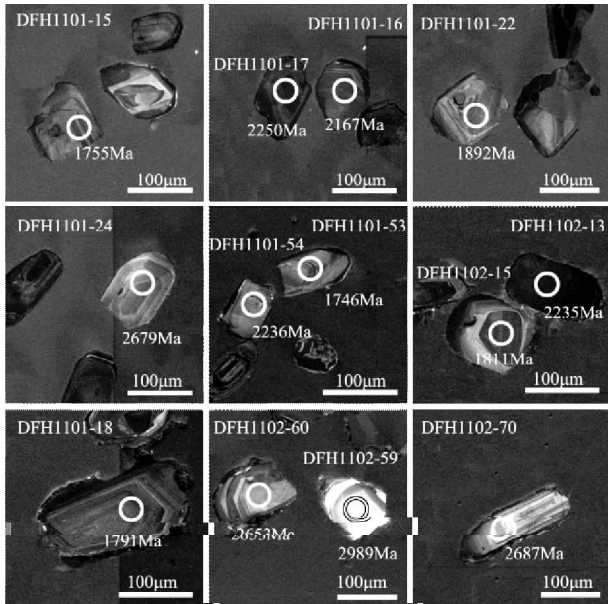


5

a b - vein-type ore c d - bedded ore e - disseminated ore f - apatite and calcite in the ore g - calcite in the magnetite ore h - calcite in the copper ore i - calcite in the wall-rock. Cep- chalcopyrite Cal- calcite Py- pyrite Mgt- magnetite Ap- apatite Qtz- quartz WR- wall-rock

Fig. 5 Photographs and photomicrographs of iron-copper ore from the Yinachang deposit

a b -vein-type ore c d -bedded ore e -disseminated ore f -apatite and calcite in the ore g -calcite in the magnetite ore h -calcite in the copper ore i -calcite in the wall-rock. Cep- chalcopyrite Cal- calcite Py- pyrite Mgt- magnetite Ap- apatite Qtz- quartz WR- wall-rock



6

Fig. 6 Representative CL images of the detrital zircon grains for tuff and breccia from the Yinachang deposit

ICP-MS	91500
Plešovice	GJ-1
Si	NIST SRM 610
2011	Zr
Liu	Liu 2010a Hu
	ICPMSDataCal
	40 ~ 60
	99%
	Re-Os
ELAN DRC-e ICP-MS	Qi 2010
¹⁹⁰ Os	¹⁸⁵ Re
	0.1g
	200°C
	12h
	Os Os 3mL
	2mol/L HCl
AG 1-X8	Re Qi 2007 2010
3mL ICP-MS	RSD% 3%

Table 1 LA-ICP-MS zircon U-Pb isotopic analyses of tuff and breccia in the Yinachang deposit

	$\times 10^{-6}$		Th/U	$^{207}\text{Pb}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{235}\text{U}$		$^{206}\text{Pb}/^{238}\text{U}$		Ma		$^{206}\text{Pb}/^{238}\text{U}$	1σ	1σ		
	Pb	Th		U	1σ	1σ	1σ	1σ	$^{207}\text{Pb}/^{206}\text{Pb}$	1σ	$^{207}\text{Pb}/^{235}\text{U}$				1σ	
DFH101																
-01	152.7	274	352	0.78	0.1089	0.0029	5.0129	0.1233	0.3251	0.0064	48	1822	21	1815	31	99%
-02	123.9	133	276	0.48	0.1356	0.0014	7.0601	0.0762	0.3757	0.0023	18	2119	10	2056	11	96%
-03	95.4	152	219	0.69	0.1186	0.0012	5.7333	0.0613	0.3492	0.0021	19	1936	9	1931	10	99%
-04	80.0	128	156	0.82	0.1324	0.0013	7.2370	0.0759	0.3950	0.0026	13	2141	9	2146	12	99%
-05	91.7	98	176	0.56	0.1431	0.0014	8.4020	0.0842	0.4240	0.0025	18	2275	9	2279	11	99%
-06	54.7	66.0	111	0.60	0.1325	0.0015	7.4449	0.0840	0.4054	0.0028	14	2166	10	2194	13	98%
-07	98.9	85.7	166	0.52	0.1521	0.0020	10.0328	0.1323	0.4764	0.0031	23	2438	12	2512	13	97%
-08	221.3	119	703	0.17	0.1074	0.0015	4.5076	0.0628	0.3019	0.0022	26	1732	12	1701	11	98%
-09	137.0	179	307	0.58	0.1244	0.0014	6.4374	0.0710	0.3727	0.0022	-14	2037	10	2042	10	99%
-10	67.5	101	172	0.59	0.1096	0.0012	5.1086	0.0595	0.3363	0.0022	21	1838	10	1869	11	98%
-11	88.0	69.5	172	0.40	0.1416	0.0014	8.7017	0.0874	0.4426	0.0027	17	2307	9	2362	12	97%
-12	92.6	97	187	0.52	0.1409	0.0013	8.3040	0.0828	0.4251	0.0028	16	2265	9	2284	12	99%
-13	53.1	98	156	0.63	0.1090	0.0020	4.5260	0.0816	0.2989	0.0026	33	1736	15	1686	13	97%
-14	151.6	45.3	297	0.15	0.1359	0.0032	8.5099	0.1912	0.4487	0.0041	8	2287	20	2389	18	95%
-15	48.3	78	118	0.66	0.1074	0.0030	4.8496	0.1339	0.3217	0.0037	52	1794	23	1798	18	99%
-16	88.3	113	193	0.58	0.1344	0.0012	7.1352	0.0668	0.3823	0.0020	15	2128	8	2087	9	98%
-17	141.2	121	309	0.39	0.1418	8 8 8 8 8 8 8 8	8 8 8 8 8 8 8 8	8 8 8 8 8 8 8 8	3	6	6					

Continued Table 1

	$\times 10^{-6}$		Th/U	Ma												
	Pb	Th		$^{207}\text{Pb}/^{206}\text{Pb}$		$^{206}\text{Pb}/^{238}\text{U}$		$^{207}\text{Pb}/^{206}\text{Pb}$		$^{207}\text{Pb}/^{235}\text{U}$		$^{206}\text{Pb}/^{238}\text{U}$				
				U	1 σ	1 σ	1 σ	1 σ	1 σ	1 σ	1 σ	1 σ	1 σ			
-36	80.9	209	1.47	0.1200	0.0013	6.3927	0.0761	0.3834	0.0029	1967	19	2031	10	2092	14	97%
-37	87.2	64.5	0.39	0.1413	0.0014	8.6286	0.0934	0.4396	0.0030	2243	18	2300	10	2349	13	97%
-38	266.3	264	0.37	0.1105	0.0011	5.0255	0.0526	0.3267	0.0018	1809	19	1824	9	1822	9	99%
-39	101.1	93.2	0.39	0.1188	0.0014	6.0271	0.0729	0.3643	0.0026	1939	21	1980	11	2002	12	98%
-40	103.0	84.7	0.43	0.1444	0.0018	8.8538	0.1100	0.4396	0.0031	2280	21	2323	11	2349	14	98%
-41	69.0	74.6	0.55	0.1341	0.0016	7.6710	0.0938	0.4103	0.0030	2154	20	2193	11	2216	13	98%
-42	88.9	142	0.67	0.1095	0.0012	5.1544	0.0604	0.3375	0.0023	1792	20	1845	10	1875	11	98%
-43	89.6	89.3	0.43	0.1452	0.0015	7.1268	0.0931	0.3524	0.0035	2300	17	2127	12	1946	17	91%
-44	266.3	264	0.37	0.1103	0.0010	4.9246	0.0457	0.3202	0.0017	1806	16	1806	8	1791	8	99%
-45	161.9	170	0.55	0.1391	0.0013	8.2752	0.0886	0.4270	0.0031	2217	16	2262	10	2292	14	98%
-46	129.0	253	0.87	0.1203	0.0012	5.6090	0.0600	0.3350	0.0022	1961	23	1917	9	1863	10	97%
-47	211.5	374	0.85	0.1389	0.0014	7.5703	0.0909	0.3905	0.0031	2213	18	2181	11	2125	14	97%
-48	109.7	155	0.67	0.1260	0.0013	6.6323	0.0745	0.3783	0.0027	2044	18	2064	10	2068	12	99%
-49	173.7	177	0.54	0.1434	0.0013	8.7362	0.0925	0.4378	0.0031	2269	15	2311	10	2341	14	98%
-50	137.0	125	0.36	0.1169	0.0011	5.4973	0.0531	0.3382	0.0019	1910	18	1900	8	1878	9	98%
-51	215.8	177	0.51	0.1799	0.0016	12.2556	0.1307	0.4904	0.0041	2654	14	2624	10	2573	18	98%
-52	98.4	41.0	0.26	0.1785	0.0017	12.9855	0.1377	0.5232	0.0036	2639	11	2679	10	2713	15	98%
-53	48.7	68.7	0.57	0.1068	0.0013	4.8869	0.0608	0.3302	0.0027	1746	22	1800	10	1839	13	97%
-54	106.4	109	0.56	0.1406	0.0015	8.4237	0.0995	0.4313	0.0031	2236	19	2278	11	2312	14	98%
-55	134.8	120	0.39	0.1266	0.0013	6.5019	0.0767	0.3693	0.0027	2052	19	2046	10	2026	13	99%
-56	73.4	196	1.40	0.1222	0.0014	5.9134	0.0683	0.3483	0.0022	1989	20	1963	10	1926	10	98%
-57	62.0	70.0	0.59	0.1379	0.0014	7.9104	0.0866	0.4133	0.0028	2211	17	2221	10	2230	13	99%
-58	36.1	69.7	0.93	0.1208	0.0016	6.0204	0.0861	0.3598	0.0031	1969	23	1979	12	1981	15	99%
-59	82.1	263	1.58	0.1116	0.0013	5.0164	0.0616	0.3236	0.0023	1828	21	1822	10	1807	11	99%
-60	187.0	197	0.56	0.1432	0.0015	8.3718	0.0911	0.4207	0.0027	2266	18	2272	10	2264	12	99%
-61	49.4	77.2	0.93	0.1454	0.0019	8.8411	0.1230	0.4378	0.0035	2294	23	2322	13	2341	16	99%
-62	123.4	92.1	0.37	0.1429	0.0015	8.1120	0.0905	0.4081	0.0025	2263	19	2244	10	2206	12	98%
-63	215.1	194	0.45	0.1451	0.0014	8.2793	0.0852	0.4102	0.0023	2289	17	2262	9	2216	10	97%
-64	133.9	124	0.42	0.1377	0.0014	7.0855	0.0792	0.3696	0.0026	2198	18	2122	10	2028	12	95%
-65	160.0	132	0.40	0.1434	0.0014	7.9348	0.0791	0.3978	0.0024	2269	17	2224	9	2159	11	97%
-66	79.1	70.6	0.41	0.1253	0.0014	6.7131	0.0808	0.3852	0.0028	2035	20	2074	11	2101	13	98%
-67	62.0	61.8	0.57	0.1456	0.0017	9.2008	0.1131	0.4555	0.0035	2295	20	2358	11	2420	16	97%
-68	63.2	77.5	0.49	0.1106	0.0014	5.2508	0.0704	0.3418	0.0027	1810	23	1861	11	1895	13	98%
-69	123.9	94.3	0.40	0.1459	0.0017	8.7938	0.1075	0.4335	0.0030	2298	19	2317	11	2321	13	99%
-70	151.1	340	1.13	0.1213	0.0013	6.1160	0.0688	0.3626	0.0024	1976	14	1993	10	1994	11	99%
-71	63.0	75.0	0.64	0.1443	0.0016	8.6918	0.0966	0.4329	0.0027	2279	19	2306	10	2319	12	99%

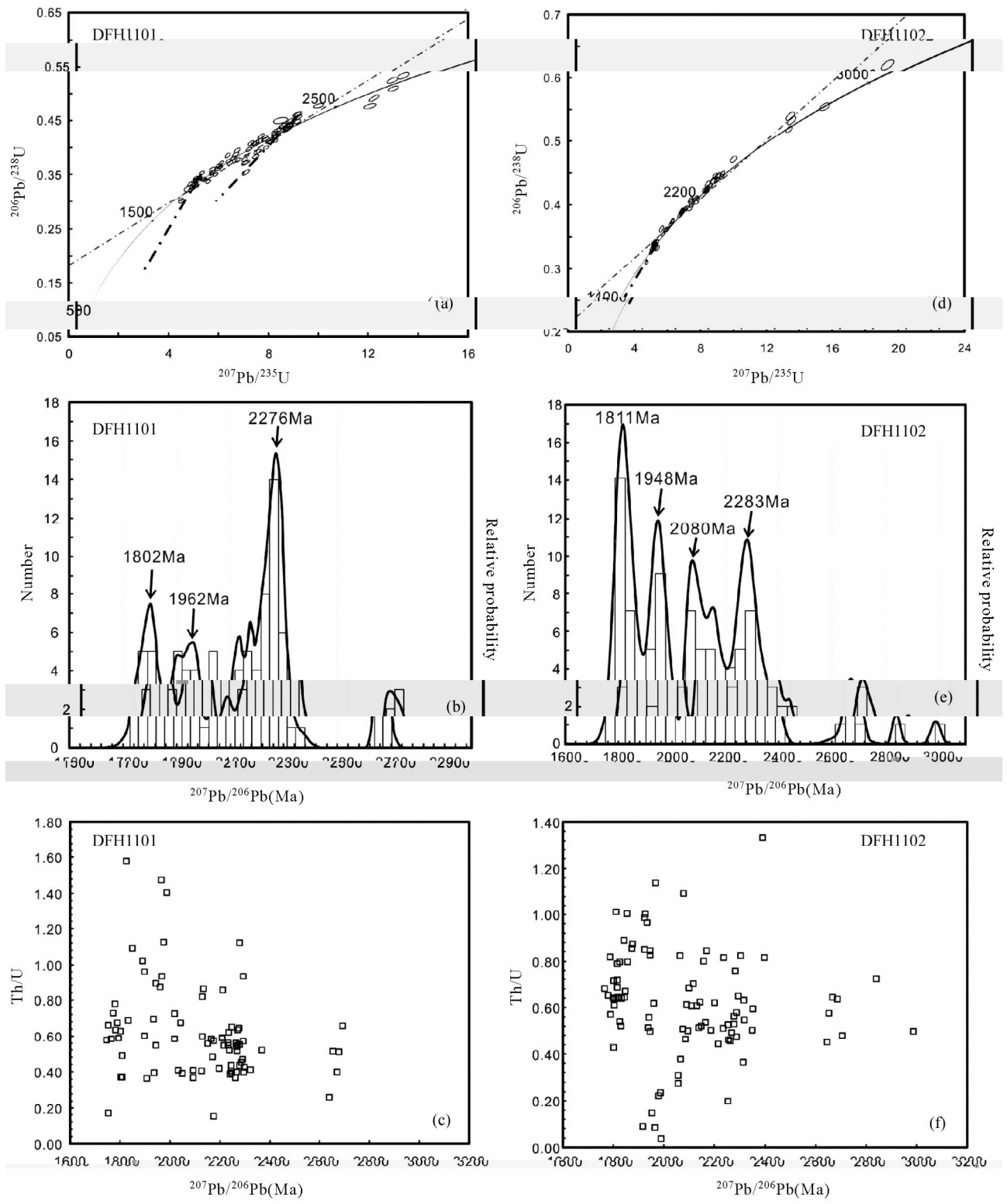
Continued Table 1

	$\times 10^{-6}$		Th/U	Ma											
	Pb	Th		$^{207}\text{Pb}/^{206}\text{Pb}$	$^{207}\text{Pb}/^{235}\text{U}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{207}\text{Pb}/^{235}\text{U}$								
-72	136.9	136	0.66	0.0018	13.0323	0.1292	0.5076	0.0030	2694	16	2682	9	2646	13	98%
-73	122.1	150	0.65	0.0014	8.3021	0.0890	0.4200	0.0027	2250	50	2265	10	2260	12	99%
-74	144.7	227	0.86	0.0013	7.7595	0.0846	0.4192	0.0030	2135	18	2204	10	2257	13	97%
-75	156.1	143	0.41	0.0013	6.7816	0.0713	0.3749	0.0023	2094	23	2083	9	2052	11	98%
-76	118.4	169	0.58	0.0013	5.0668	0.0618	0.3367	0.0025	1766	21	1831	10	1871	12	97%
-77	88.2	103	0.62	0.0015	8.5921	0.1031	0.4386	0.0035	2237	19	2296	11	2344	16	97%
-78	123.2	151	0.55	0.0012	6.1333	0.0680	0.3691	0.0027	1946	18	1995	10	2025	13	98%
-79	64.8	96.5	0.72	0.0013	6.7847	0.0806	0.3925	0.0030	2020	-14	2084	11	2134	14	97%
-80	63.0	109	0.73	0.0012	5.1333	0.0626	0.3408	0.0026	1773	20	1842	10	1890	12	97%
-81	143.8	111	0.37	0.0012	7.3295	0.0815	0.4065	0.0031	2094	17	2152	10	2199	14	97%
-82	64.1	65.3	0.55	0.0016	8.8574	0.1082	0.4419	0.0035	2280	20	2323	11	2359	16	98%
-83	133.1	168	0.59	0.0014	7.1239	0.0875	0.3709	0.0030	2211	17	2127	11	2034	14	95%
-84	79.6	109	0.60	0.0014	5.7745	0.0709	0.3580	0.0025	1898	22	1943	11	1973	12	98%
DFH1102															
-01	87.6	164	0.82	0.0012	4.9917	0.0618	0.3287	0.0025	1787	22	1818	10	1832	12	99%
-02	24.28	34.6	0.61	0.0016	5.2812	0.0836	0.3466	0.0035	1806	21	1866	14	1918	17	97%
-03	36.8	62	0.68	0.0016	4.8210	0.0728	0.3235	0.0029	1767	27	1789	13	1807	14	98%
-04	213.4	230	0.49	0.0012	7.1364	0.0634	0.3575	0.0017	2270	15	2129	8	1971	8	92%
-05	113.9	114	0.52	0.0012	7.5570	0.0714	0.4069	0.0024	2148	17	2180	8	2201	11	99%
-06	62.8	91.4	0.82	0.0016	8.9171	0.1226	0.4145	0.0041	2399	18	2330	13	2235	19	95%
-07	53.3	122	1.01	0.0013	4.8264	0.0546	0.3159	0.0018	1811	16	1790	10	1770	9	98%
-08	74.5	104	0.68	0.0015	6.7038	0.0784	0.3709	0.0025	2102	20	2073	10	2034	12	98%
-09	123.5	154	0.62	0.0014	6.9575	0.0832	0.3754	0.0031	2143	19	2106	11	2055	14	97%
-10	252.0	284	0.63	0.0018	8.1843	0.0999	0.3968	0.0026	2317	21	2252	11	2154	12	95%
-11	95.2	86.7	0.64	0.0017	13.2204	0.1292	0.5231	0.0032	2668	15	2696	9	2712	14	99%
-12	200.3	67.7	0.15	0.0012	6.0441	0.0620	0.3623	0.0020	1954	13	1982	9	1993	9	99%
-13	114.0	107	0.51	0.0013	8.3927	0.0873	0.4291	0.0030	2235	16	2274	9	2302	13	98%
-14	85.6	91.3	0.50	0.0021	6.0186	0.0983	0.3624	0.0029	1946	38	1979	14	1994	14	99%
-15	49.0	76.3	0.64	0.0014	5.0646	0.0700	0.3313	0.0029	1811	18	1830	12	1845	14	99%
-16	75.7	131	0.84	0.0014	5.9654	0.0721	0.3601	0.0025	1946	21	1971	11	1983	12	99%
-17	33.53	22.3	0.45	0.0022	13.4050	0.1688	0.5381	0.0045	2647	53	2709	12	2775	19	97%
-18	49.4	68.7	0.57	0.0012	4.9766	0.0554	0.3283	0.0023	1791	20	1815	9	1830	11	99%
-19	61.6	61.1	0.50	0.0013	7.6532	0.0773	0.4029	0.0026	2187	17	2191	9	2182	12	99%
-20	79.6	92.6	0.51	0.0012	5.8956	0.0590	0.3577	0.0022	1939	23	1961	9	1971	10	99%
-21	49.6	82.1	0.82	0.0013	6.7275	0.0734	0.3794	0.0026	2065	13	2076	10	2073	12	99%
-22	63.0	62.8	0.53	0.0015	8.5432	0.0972	0.4267	0.0029	2280	19	2291	10	2291	13	99%

	$\times 10^{-6}$		Th/U	Ma				$^{206}\text{Pb}/^{238}\text{U}$	$^{207}\text{Pb}/^{235}\text{U}$	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{206}\text{Pb}/^{238}\text{U}$	$^{207}\text{Pb}/^{235}\text{U}$	$^{206}\text{Pb}/^{238}\text{U}$	1σ	1σ	1σ	1σ	1σ	1σ	1σ
	Pb	Th		U	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{207}\text{Pb}/^{235}\text{U}$	$^{206}\text{Pb}/^{238}\text{U}$													
-23	35.9	58.6	90.3	0.65	0.1089	0.0014	4.8011	0.0596	0.3184	0.0022	1781	23	1785	10	1782	11	99%			
-24	124.4	140	328	0.42	0.1102	0.0011	4.8986	0.0548	0.3199	0.0021	1803	19	1802	9	1789	10	99%			
-25	47.3	63.4	83.8	0.76	0.1447	0.0016	8.8049	0.1078	0.4384	0.0033	2284	19	2318	11	2343	15	98%			
-26	251	503	461	1.09	0.1285	0.0011	7.0057	0.0682	0.3922	0.0024	2080	16	2112	9	2133	11	99%			
-27	264.8	149	630	0.24	0.1221	0.0010	6.3192	0.0613	0.3724	0.0023	1987	15	2021	9	2041	11	99%			
-28	115.3	209	253	0.83	0.1194	0.0011	5.8358	0.0601	0.3521	0.0022	1947	17	1952	9	1945	11	99%			
-29	55.2	102	120	0.85	0.1178	0.0013	5.7559	0.0622	0.3521	0.0020	1924	19	1940	9	1945	10	99%			
-30	136.7	271	317	0.85	0.1146	0.0012	5.2842	0.0547	0.3325	0.0020	1873	18	1866	9	1850	10	99%			
-31	30.9	60.8	69.6	0.87	0.1146	0.0016	5.2778	0.0815	0.3321	0.0029	1876	26	1865	13	1849	14	99%			
-32	23.08	50.6	50.6	1.00	0.1181	0.0018	5.4172	0.0837	0.3324	0.0028	1928	27	1888	13	1850	14	97%			
-33	90.2	114	187	0.61	0.1295	0.0013	7.0000	0.0758	0.3890	0.0027	2092	18	2111	10	2118	13	99%			
-34	42.1	58.7	71.3	0.82	0.1465	0.0016	9.0346	0.1112	0.4441	0.0031	2305	19	2342	11	2369	14	98%			
-35	71.6	158	140	1.14	0.1207	0.0013	6.1774	0.0706	0.3686	0.0027	1969	20	2001	10	2023	13	98%			
-36	22.71	23.3	45.7	0.51	0.1330	0.0018	7.4644	0.0996	0.4056	0.0033	2139	23	2169	12	2195	15	98%			
-37	104.1	91.0	198	0.46	0.1424	0.0015	8.4429	0.0923	0.4268	0.0026	2257	19	2280	10	2291	12	99%			
-38	82.6	72.3	159	0.45	0.1431	0.0017	8.4088	0.0993	0.4223	0.0028	2265	21	2276	11	2271	12	99%			
-39	24.67	22.2	50.1	0.44	0.1391	0.0019	7.8226	0.1091	0.4057	0.0034	2216	24	2211	13	2195	16	99%			
-40	70.6	86.8	143	0.61	0.1308	0.0014	7.1540	0.0789	0.3937	0.0026	2109	14	2131	10	2140	12	99%			
-41	106.1	115	227	0.51	0.1283	0.0013	6.9709	0.0784	0.3906	0.0028	2076	18	2108	10	2126	13	99%			
-42	63.38	14.7	165	0.09	0.1173	0.0012	5.7424	0.0639	0.3532	0.0024	1917	23	1938	10	1950	11	99%			
-43	61.7	62.6	112	0.56	0.1443	0.0016	8.9434	0.1008	0.4460	0.0029	2279	19	2332	10	2378	13	98%			
-44	70.20	15.1	179	0.08	0.1200	0.0013	6.0008	0.0692	0.3605	0.0026	1967	19	1976	10	1984	12	99%			
-45	33.0	74.6	74.4	1.00	0.1134	0.0015	5.2027	0.0722	0.3307	0.0026	1855	24	1853	12	1842	12	99%			
-46	142.31	13.1	354	0.04	0.1222	0.0013	6.3090	0.0731	0.3724	0.0026	1991	19	2020	10	2041	12	98%			
-47	139.7	181	338	0.54	0.1115	0.0012	5.2756	0.0639	0.3409	0.0026	1825	25	1865	10	1891	12	98%			
-48	83.7	82.5	179	0.46	0.1291	0.0014	6.9444	0.0832	0.3890	0.0028	2087	14	2104	11	2118	13	99%			
-49	37.6	80.0	83.1	0.96	0.1142	0.0015	5.3632	0.0736	0.3401	0.0028	1933	24	1879	12	1887	13	99%			
-50	79.5	72.0	143	0.50	0.1502	0.0014	9.3526	0.0946	0.4493	0.0029	2350	16	2373	9	2392	13	99%			
-51	90.4	65.8	137	0.48	0.1860	0.0018	13.3917	0.1384	0.5196	0.0033	2706	17	2708	10	2697	14	99%			
-52	76.6	135	197	0.68	0.1110	0.0012	4.7530	0.0564	0.3088	0.0019	1817	20	1777	10	1735	10	97%			
-53	69.2	47.5	13025	7.479	.11	44	909110	0.0099	0.7.69	299	2211	1	11.6.	37.0	9	0	2	7	1	8

Continued Table 1

	$\times 10^{-6}$		Th/U	Ma				1σ	1σ	1σ	1σ	1σ	1σ				
	Pb	Th		U	$^{207}\text{Pb}/^{206}\text{Pb}$	$^{206}\text{Pb}/^{238}\text{U}$	$^{207}\text{Pb}/^{206}\text{Pb}$							$^{207}\text{Pb}/^{235}\text{U}$	$^{206}\text{Pb}/^{238}\text{U}$		
	1σ	1σ		1σ	1σ	1σ	1σ							1σ	1σ		
-59	31.92	19.8	40.0	0.50	0.2197	0.0026	18.8909	0.2486	0.6217	0.0055	2989	19	3036	13	3117	22	97%
-60	55.9	47.1	82.0	0.57	0.1800	0.0020	13.4778	0.1675	0.5401	0.0042	2653	18	2714	12	2784	17	97%
-61	26.04	43.5	61.0	0.71	0.1101	0.0016	5.1550	0.0768	0.3391	0.0027	1802	26	1845	13	1882	13	98%
-62	112.5	59.0	266	0.22	0.1217	0.0014	6.3109	0.0740	0.3741	0.0024	1981	53	2020	10	2048	11	98%
-63	47.2	55.3	85.2	0.65	0.1457	0.0019	8.8067	0.1194	0.4369	0.0033	2295	22	2318	12	2337	15	99%
-64	76.7	119	185	0.64	0.1100	0.0012	5.1465	0.0640	0.3371	0.0025	1799	16	1844	11	1873	12	98%
-65	44.3	70.9	106	0.67	0.1129	0.0014	5.2148	0.0658	0.3337	0.0023	1847	23	1855	11	1856	11	99%
-66	29.14	52.5	65.9	0.80	0.1116	0.0016	5.2541	0.0746	0.3412	0.0024	1825	26	1861	12	1892	12	98%
-67	63.2	128	130	0.99	0.1179	0.0014	5.8883	0.0706	0.3604	0.0025	1925	20	1960	10	1984	12	98%
-68	51.6	65.7	126	0.52	0.1120	0.0014	5.2242	0.0701	0.3365	0.0025	1832	23	1857	11	1870	12	99%
-69	86.1	82.9	115	0.72	0.2020	0.0024	15.5602	0.1927	0.5550	0.0039	2842	14	2850	12	2846	16	99%
-70	46.0	42.0	66.2	0.64	0.1836	0.0022	13.5549	0.1696	0.5334	0.0044	2687	20	2719	12	2756	19	98%
-71	59.9	85.4	105	0.81	0.1408	0.0016	8.4530	0.1001	0.4327	0.0031	2237	20	2281	11	2318	14	98%
-72	54.9	92.8	130	0.72	0.1110	0.0013	5.1143	0.0623	0.3320	0.0023	1817	21	1838	10	1848	11	99%
-73	19.44	20.6	35.7	0.58	0.1450	0.0021	8.8198	0.1403	0.4382	0.0042	2289	24	2320	15	2343	19	99%
-74	43.9	62.1	96.8	0.64	0.1129	0.0014	5.6604	0.0775	0.3616	0.0032	1847	18	1925	12	1990	15	96%
-75	52.0	69.6	99.6	0.70	0.1313	0.0015	7.4376	0.0966	0.4073	0.0032	2117	21	2166	12	2202	15	98%
-76	51.9	81.3	128	0.64	0.1115	0.0014	5.0472	0.0683	0.3250	0.0023	1833	18	1827	11	1814	11	99%
-77	135.6	54.7	276	0.20	0.1420	0.0016	8.3715	0.0974	0.4228	0.0028	2254	20	2272	11	2273	13	99%
-78	48.6	53.1	99.1	0.54	0.1351	0.0018	7.4327	0.1073	0.3946	0.0031	2165	23	2165	13	2144	14	99%
-79	79.1	93.5	154	0.61	0.1324	0.0015	7.4413	0.0910	0.4038	0.0029	2131	20	2166	11	2187	13	99%
-80	105.5	131	236	0.56	0.1191	0.0012	5.9883	0.0654	0.3611	0.0024	1943	19	1974	10	1987	11	99%
-81	173.4	174	320	0.54	0.1476	0.0014	9.0175	0.0919	0.4386	0.0028	2318	21	2340	9	2344	12	99%
-82	150.7	227	284	0.80	0.1346	0.0013	7.4881	0.0761	0.3989	0.0024	2159	17	2172	9	2164	11	99%
-83	160.0	213	347	0.62	0.1203	0.0012	6.0871	0.0616	0.3630	0.0020	1961	23	1988	9	1996	10	99%
-84	54.2	84.6	132	0.64	0.1113	0.0014	5.0491	0.0645	0.3255	0.0022	1820	22	1828	11	1816	11	99%
-85	30.4	56.5	70.9	0.80	0.1136	0.0018	5.3533	0.0895	0.3403	0.0033	1858	29	1877	14	1888	16	99%
-86	111.2	68.5	250	0.27	0.1270	0.0014	6.7727	0.0780	0.3827	0.0025	2057	18	2082	10	2089	12	99%
-87	80.5	84.9	143	0.59	0.1507	0.0016	9.3012	0.1041	0.4435	0.0029	2353	19	2368	10	2366	13	99%
-88	44.90	36.6	97.4	0.38	0.1276	0.0015	6.9153	0.0855	0.3895	0.0028	2066	16	2101	11	2121	13	99%
-89	86.3	134	159	0.84	0.1355	0.0014	7.7422	0.0859	0.4104	0.0029	2170	17	2202	10	2217	13	99%
-90	149.3	102	331	0.31	0.1271	0.0013	6.8407	0.0719	0.3864	0.0023	2058	18	2091	9	2106	11	99%
-91	58.7	53.0	112	0.47	0.1448	0.0016	8.6416	0.1050	0.4291	0.0031	2287	19	2301	11	2302	14	99%
-92	39.6	60.6	95.7	0.63	0.1103	0.0015	5.1442	0.0720	0.3354	0.0024	1806	24	1843	12	1865	12	98%
-93	61.9	62.3	119	0.53	0.1415	0.0018	8.3089	0.1079	0.4230	0.0029	2256	50	2265	12	2274	13	99%



7 U-Pb $^{207}\text{Pb}/^{206}\text{Pb}$ Th/U- $^{207}\text{Pb}/^{206}\text{Pb}$
 Fig. 7 Plot of U-Pb concordant curve $^{207}\text{Pb}/^{206}\text{Pb}$ age frequency and Th/U- $^{207}\text{Pb}/^{206}\text{Pb}$ age diagram of the de f nf 0ræcci

Table 2 Re-Os isotope compositions for chalcopyrite from the Yinachang deposit

	^{187}Re $\times 10^{-9}$	1σ	^{187}Os $\times 10^{-9}$	1σ	Re $\times 10^{-9}$	1σ	Os $\times 10^{-9}$	1σ	Ma	1σ
YNC1006	562.306	16.269	16.881	0.314	898.253	25.989	0.023	0.006	1732	23
10YNC-40	161.659	2.145	4.455	0.061	258.242	3.426	0.017	0.001	1638	22
YNC1010	4.615	0.108	0.118	0.003	7.373	0.172	0.003	0.000	1719	20
10YNC-32	12.859	0.300	0.366	0.004	20.541	0.480	0.004	0.000	1690	20
10YNC-41	246.010	30.390	6.836	0.079	392.988	48.547	0.005	0.001	1651	19
YNC1112	4.388	0.149	0.073	0.005	7.010	0.239	0.002	0.000	1687	19

5

5.1 U-Pb

		LA-ICP-MS	U-Pb
	1 6		CL
7		U-Pb	$^{207}\text{Pb}/$
^{206}Pb		Th/U- $^{207}\text{Pb}/^{206}\text{Pb}$	
	DFH1101	2000	
84			95%
	$^{207}\text{Pb}/^{206}\text{Pb}$	$1746 \pm 22\text{Ma}$	$^{207}\text{Pb}/^{206}\text{Pb}$
	$2694 \pm 16\text{Ma}$	5	2500Ma
			1.75 ~ 1.85Ga
1.90 ~ 2.00Ga	2.20 ~ 2.35Ga		
	$^{207}\text{Pb}/^{206}\text{Pb}$		$1796 \pm 15\text{Ma}$ n
= 16	MSWD = 1.5	$2262 \pm 12\text{Ma}$ n = 34	MSWD = 3.5
		1800Ma	1960Ma
			2270Ma
7b		CL	
	6	Th/U	0.1
0.4 ~ 1.0	7c		
	DFH1102	2500	
	93		
95%	$^{207}\text{Pb}/^{206}\text{Pb}$	$1767 \pm 27\text{Ma}$	
	$^{207}\text{Pb}/^{206}\text{Pb}$	$2989 \pm 19\text{Ma}$	7
	2500Ma		1.75
~ 1.88Ga	1.90 ~ 2.00Ga	2.02 ~ 2.20Ga	2.30 ~ 2.40Ga
		$^{207}\text{Pb}/^{206}\text{Pb}$	
	$1796 \pm 9\text{Ma}$ n = 19	MSWD = 0.71	
	1800Ma	1950Ma	2080Ma
			2280Ma
7e		CL	
6	Th/U	0.2	0.4
~ 1.0	7f		
		U-Pb	

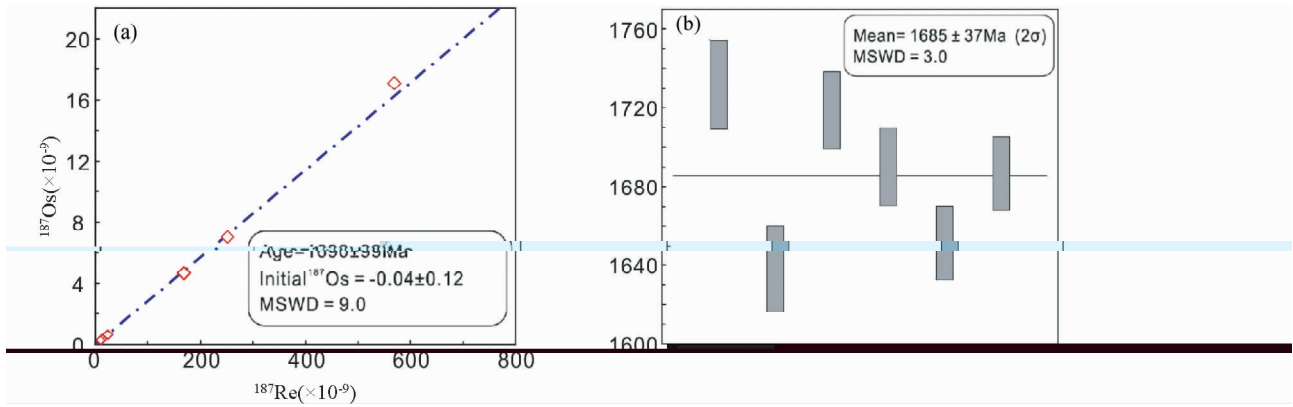
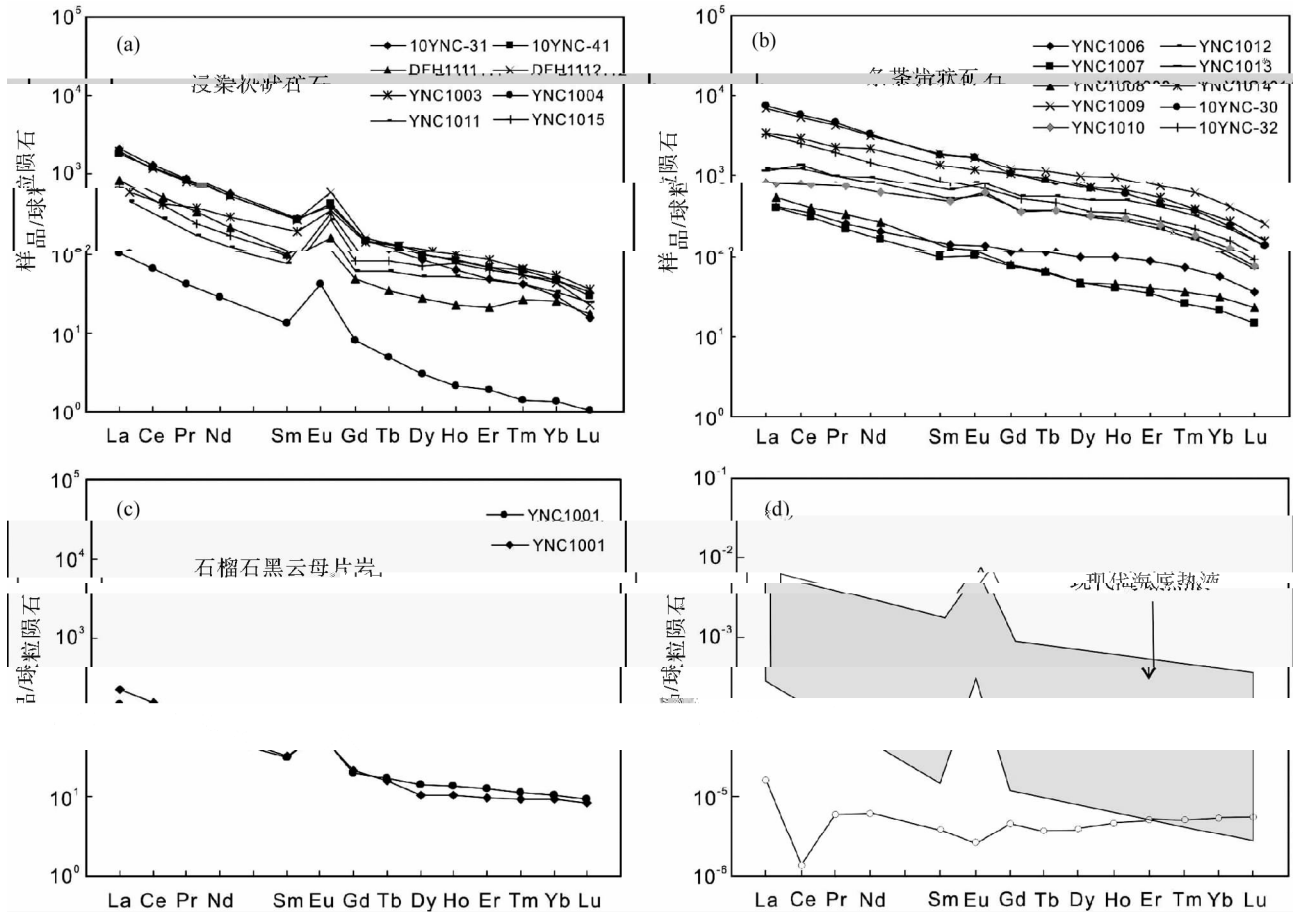


Fig. 8 Isochrone age diagram a and weighted average of model age b of Re-Os isotope for chalcopyrite of the Yinachang deposit

		$\Sigma \text{REE} = 207$		1780Ma		U-Pb	1742 ±
$\times 10^{-6} \sim 270 \times 10^{-6}$				13Ma Zhao	2010		
	La/Yb _N 14.1 ~ 23.9	La/Sm _N 4.8		U-Pb	1690 ± 32Ma Zhao	2010	
~ 7.1	LREE/HREE 11.2 ~ 16.9				1.7Ga		
		δEu				U-Pb	1711 ± 4Ma
= 2.31 ~ 2.50	$\delta\text{Ce} = 1.1$	3	9c			U-Pb	1.7Ga
				2012		2008 Greentree and Li	2008 Zhao and Zhou
6				2011			1.7Ga
6.1				± 20Ma	2009		U-Pb 1695
	1954			1710 ± 8Ma	U-Pb	2011	
			1990				
							~ 1800Ma ~ 1950Ma ~ 2080Ma
1993		1995		~ 2280Ma	2.5Ga		
	Zhang	2006	Greentree				
and Li	2008 Zhao	2010					
			LA-ICP-MS U-Pb				
	DFH1101		1746 ±				
22Ma			U 120×10^{-6} Th				
			Th/U 0.57				
	DFH1102		$^{207}\text{Pb}/^{206}\text{Pb}$				1767 ±
27Ma	U 91×10^{-6} Th 62×10^{-6}		Th/U				
0.68							
				6.2	Fe-Cu-REE		
	$^{207}\text{Pb}/^{206}\text{Pb}$	1750Ma					
1750Ma							



9 a b c
 d Craddock 2010 Elderfield and Greaves 1982
 Boynton 1984
 Fig. 9 Chondrite-normalized REE patterns for disseminated ores a banded ores b and garnet biotite schist c of the Yinachang deposit
 REE patterns for submarine hydrothermal fluids after Craddock 2010 REE pattern for seawater after Elderfield and Greaves 1982 chondrite-normalizing values after Boynton 1984

IOCG

7

1.7Ga

1
LA-ICP-MS U-Pb

1750Ma

1.7Ga Columbia
Rogers and Santosh 2002

2 Fe-Cu-REE Re-Os
1690 ± 99Ma 1.7Ga

Zhao 2002

3

Columbia
2011 Wang 2012 Yu 2012
1.7Ga

Fe-Cu

U-Pb

Re-Os

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		. 2009.		15 3 14 - 18	
	SHRIMP U-Pb				. 2008.
	28 7 896 - 900			18 7 778 - 788	
. 2008.				. 1993.	-
		1 - 95		12 1 60 - 66	
	. 1990.			. 1993.	-
	1 - 223			12 1 123 - 125	
. 1999.					
18 4	469 - 475				