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Research Advances

New Zircon U-Pb Age of Late Devonian Tuff in Guangxi, South China and the Significance for the Paleo-Tethys Branch Ocean

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Objective

The eastern extending range of the Paleo-Tethys Ocean in southwest China has always been focused and controversial. At the beginning of this century some scholars proposed that the Paleo-Tethys Branch Ocean may extend to the Babu–Pingxiang and Cengxi areas along the stouthwestern margin of the South China Block (Cai and Zhang, 2009). However, the pivotal proof of Late Paleozoic ophoilite and magmatic rocks was absent or sporadical in the Guangxi Zhuang Autonomous Region, resulting in insufficient evidence to support this viewpoint. For the first time this work reported the Late Devonian tuff in the Qinzhou area in the south of the Guangxi Zhuang Autonomous Region and conducted zircon U-Pb dating on it in order to constrain the extension of the Paleo-Tethys Ocean in the South China Block.

Methods

One tuff rock sample (No. DBC10) was collected from Banchen in the Qinzhou area of the Guangxi Zhuang Autonomous Region (Figs. 1a and 1b; 22°17′23″; 108°43′ 2″), South China. The tuff layer was sandwiched in Devonian siliceous rock (Fig. 1c). Zircons were firstly separated from the sample using conventional density and magnetic separation techniques, and were then polished for back-scattered electron (BSE) and cathodoluminescence (CL) imaging on a JXA-8100. U-Pb ages for the magmatic zircons were determined on an Agilent 7700a. All analyses were conducted at the State Key Laboratory of Geological Processes and Mineral Resources (GPMR), China University of Geoscience (Wuhan). Errors on individual analyses are given at 1σ. All measurements were normalized relative to standard zircons 91500 and GJ-1. Age and probability density plots were calculated using the Isoplot program 3.0.

Results

The grey-green tuff sample was mainly composed of volcanic debris with diameter <2 mm. Zircons in the tuff sample are transparent to semi-transparent, subhedral to euhedral, with length ranging from 100–150 μm and aspect rations close to 2:1. Most grains show oscillatory zoning in cathodoluminescence (CL) images (Fig. 1d), and with high Th/U ratio (>0.3), indicating a magmatic source. Eighteen analyses on 18 zircons grains were undertaken and 17 of them with concordance >90% (Appendix 1). Seven points are with U-Pb age of older than 600 Ma when eleven grains have U-Pb age ranging from 380 to 350 Ma and with an average age of 361.0±7.3 Ma (Fig. 1d; MSWD=2.1, n=11). This zircon U-Pb age indicate that the tuff was formed in the Late Devonian.

Conclusion

As the Late Devonian–Early Carboniferous MORB-type metabasalts rock and OIB-type basalts were reported in the Babu and Napo areas of northwest Qinfang area (Huang et al., 2014; Huang Hu et al.,2017), the Late Devonian tuff in the study area could be related to this Late Devonian oceanic basin opening. This is the most east area that Late Devonian rock was reported in southwest China. These magma records, associated with coeval deep sea silicalite deposition in the two basins indicate that the Youjiang Basin and Qinfang Trough were under the control of the Paleo-Tethys branch ocean during the Late Paleozoic. And the Paleo-Tethys branch Ocean

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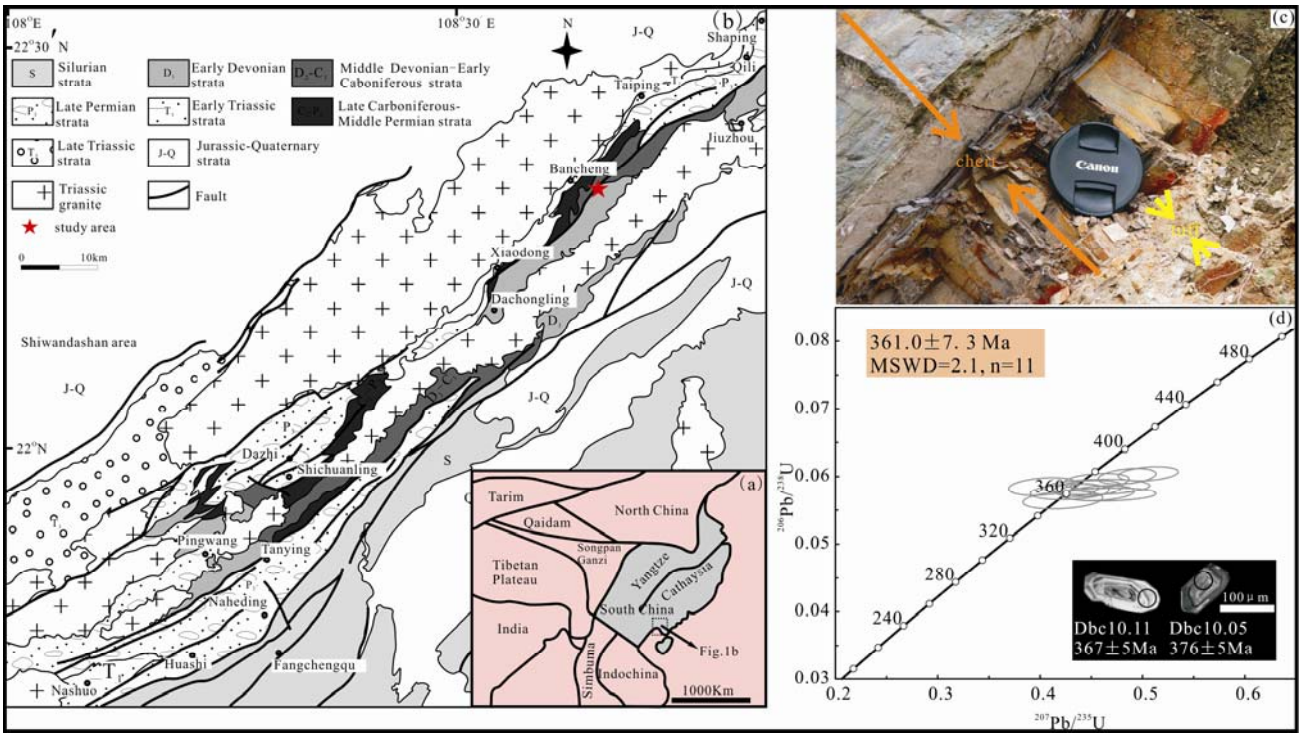

Fig. 1. (a), Tectonic framework of the East Asia; (b), Simplified geological map of the Qinfang Trough and location of the study area; (c), Filed photo for the Late Devonian chert and tuff; (d), Concordia diagram and cathodoluminescence (CL) images of representative zircons for the tuff sample.

probably began rifting along the southwestern margin of the South China Block during the Late Devonian and extended to east to the Qinfang Trough.

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Table 1 Appendix

Analysis spots	Th ppm	U ppm	Th/U	$^{207}Pb/^{206}Pb$ Ratio	1σ	$^{207}Pb/^{235}U$ Ratio	1σ	$^{206}Pb/^{238}U$ Ratio	1σ	$^{207}Pb/^{206}Pb$ Age(Ma)	1σ	$^{206}Pb/^{238}U$ Age(Ma)	1σ	Concordance
DBC10-01	187	493	0.38	0.0595	0.0044	0.4670	0.0306	0.0573	0.0006	587	161	359	4	92%
DBC10-02	174	436	0.40	0.0703	0.0022	1.2856	0.0400	0.1324	0.0013	1000	63	801	8	95%
DBC10-03	126	309	0.41	0.0558	0.0026	0.4550	0.0212	0.0593	0.0007	456	104	372	5	97%
DBC10-04	451	1273	0.35	0.0548	0.0016	0.4384	0.0124	0.0580	0.0006	467	67	363	4	98%
DBC10-05	233	601	0.39	0.0584	0.0022	0.4850	0.0187	0.0600	0.0008	543	88	376	5	93%
DBC10-06	190	347	0.55	0.0563	0.0029	0.4470	0.0223	0.0582	0.0008	465	117	365	5	97%
DBC10-07	461	503	0.92	0.0688	0.0023	1.4197	0.0488	0.1487	0.0019	892	63	894	11	99%
DBC10-08	202	611	0.33	0.0726	0.0025	0.9919	0.0372	0.0978	0.0013	1011	70	602	8	84%
DBC10-09	396	609	0.65	0.0601	0.0022	0.5056	0.0194	0.0604	0.0007	606	80	378	4	90%
DBC10-10	476	641	0.74	0.0670	0.0022	1.1675	0.0391	0.1259	0.0012	839	69	764	7	97%
DBC10-11	114	210	0.55	0.0511	0.0031	0.4032	0.0224	0.0585	0.0009	256	137	367	5	93%
DBC10-12	59	182	0.32	0.0549	0.0034	0.4222	0.0257	0.0565	0.0009	409	137	354	5	99%
DBC10-13	281	382	0.74	0.0733	0.0032	1.8333	0.0881	0.1800	0.0020	1020	91	1067	11	99%
DBC10-14	459	648	0.71	0.0533	0.0029	0.4289	0.0253	0.0577	0.0008	343	124	362	5	99%
DBC10-15	608	974	0.62	0.0782	0.0037	1.5802	0.0825	0.1453	0.0019	1152	95	875	11	90%
DBC10-16	204	454	0.45	0.0561	0.0040	0.4554	0.0342	0.0584	0.0007	454	159	366	5	96%
DBC10-17	223	414	0.54	0.0575	0.0028	0.4583	0.0223	0.0575	0.0007	522	73	361	5	93%
DBC10-18	222	663	0.34	0.0681	0.0023	1.3481	0.0485	0.1423	0.0018	872	71	857	10	98%