LA-ICP-MS Zircon U-Pb Age of Newly Discovered Hatu Tectonic Mélange in the West Junggar, Xinjiang, NW China

DUAN Fenghao[1], LI Yongjun[1, 2*], ZHI Qian[1], YANG Gaoxue[1,2], LUO Xin[1] and LI Yuhang[1]

[1] *School of Earth Science and Resources, Chang'an University, Xi'an 710054, Shaanxi, China*
[2] *Key Laboratory for the study of Focused Magmatism and Giant Ore Deposits, MNR, Xi'an 710054, Shaanxi, China*

[*]Corresponding author. E-mail: yongjunl@chd.edu.cn

Objective

The West Junggar, situated in the southwestern segment of the Central Asian Orogenic Belt, is considered to be an important area for Phanerozoic crustal growth owing to the excellent exposures of diverse rock types and multiple generations of structures and magmatic rocks. Recently, a new tectonic mélange has been identified in the southern West Junggar during geological mapping at a scale of 50000. This work presents new geochronological data for the basalts within the newly discovered mélange to determine its formation age, which will have important implications for the evolutionary history of the Junggar Ocean during early Paleozoic.

Methods

LA-ICP-MS zircon U-Pb isotopic dating was conducted at the Key Laboratory for the Study of Focused Magmatism and Giant Ore Deposits, MNR, Xi'an Center of Geological Survey, CGS. Laser sampling was performed using a GeoLas Pro. An Agilent 7700x ICP-MS instrument was used to acquire ion-signal intensities. The Agilent Chemstation was utilized for the acquisition of each individual analysis, and zircon 91500 was used as external standard for U-Pb dating. Time-dependent drifts of U-Th-Pb isotopic ratios were corrected using a linear interpolation (with time). Uncertainty of preferred values for the external standard 91500 was propagated to the ultimate results of the samples. Trace element compositions of zircons were calibrated againstreference materials (NIST610) combined with Si as internal standardization.

Results

The newly discovered tectonic mélange, located north of Hatu gold mine, is distributed in a NE-trending along the Hatu Fault, and the overall extension is greater than 6 km long, the width is 0.13–1.2 km, and is generally in fault contact with its surrounding Devonian and Carboniferous volcano-sedimentary strata in the north and south, respectively. The Hatu tectonic mélange is composed of matrix and tectonic slices. The sizes of slices range from several to tens of meters, and mainly consist of gray-green basalts and purplish red manganese-bearing cherts on fresh outcrop in color with the lack of the mantle peridotite unit (Fig. 1a). Through analysis under microscope, the basalts generally have mylonitic or blastoporphyritic textures, with plagioclase (5%–25%), homblende (~5 %) and clinopyroxene (~1%) phenocrysts up to 1.2 mm long in a groundmass of fine-grained to microcrystalline plagioclase (40%–65%) and clinopyroxene (~2%), some of the phenocrysts have been replaced by sericite, and the mafic minerals are generally replaced by chlorite and actinolite.

One basalt sample from the Hatu tectonic mélange was chosen for age determination. Zircon grains separated from the basalt have well-developed but incomplete crystal morphology, and are half-baked with indistinct or no growth zoning textures, and also lack visible inherited cores in cathodoluminescence images (Fig. 1b), which indicate representative basic magmatic origin zircons. The grains are 20–185 μm long and 25–70 μm wide with length-width ratios of 1:1 to 3:1. Six measuring zircons within the basalt have variable Th (76–329 ppm) and U (165–837 ppm) concentrations, and display relatively high Th/U ratios of 0.25–0.94 (Appendix 1), and also exhibit favourable positive correlations between Th and U, suggesting their magmatic origin. LA-ICP-MS zircon U-Pb isotopic dating indicate that the concordant $^{206}Pb/^{238}U$ ages of 6 zircon grains range from 412 Ma to 443 Ma and form a coherent group with a weighted mean $^{206}Pb/^{238}U$ age of 428±14 Ma (n=6, MSWD=0.35) (Fig. 1b). All spots are distributed closely along the concordance curve, and thus the Middle Silurian age of 428±14 Ma represents the crystallization age of the basalt.

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/1755-6724.14309.

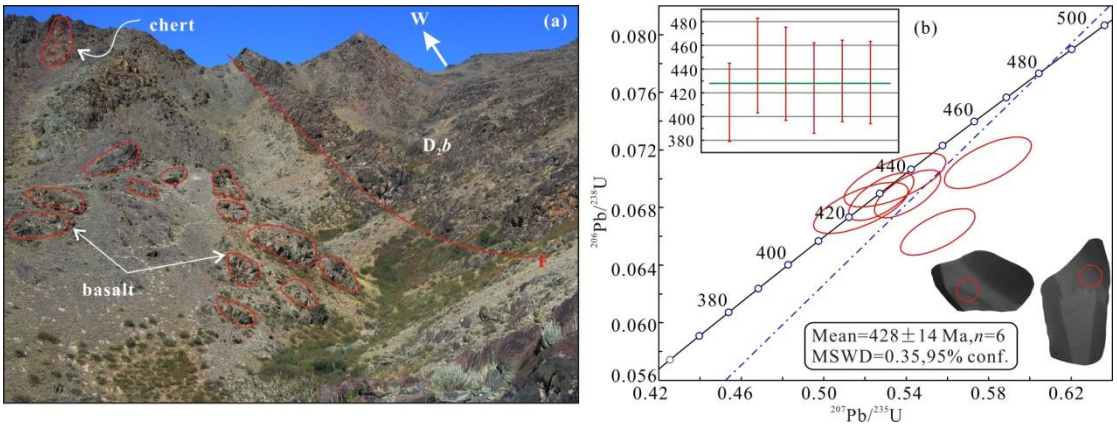

Fig.1. Field photographs of typical outcrop (a), U-Pb concordia diagram of zircon grains for the basalts (b) within the Hatu tectonic mélange in southern West Junggar

Conclusions

The newly discovered Hatu tectonic mélange in southern West Junggar mainly consists of basalts and manganese-bearing cherts. New LA-ICP-MS zircon U-Pb isotopic dating data indicate that the basalts were formed in the Middle Silurian time, which further suggest that the studied Hatu tectonic mélange and the southwest Precambrian-Silurian Mayile ophiolitic mélange (Yang et al., 2012) may belong to the same tectonic belt, and the line connecting these two mélanges possibly delineates a large tectonic boundary in the region.

Petrologic constituent and geochronology of the Hatu tectonic mélange in southern West Junggar can provide the fundamental substance and precise constraints for the establishment of the accretionary complex belt and the process of accretion and emplacement, which may furnish basis for the study of the tectonic evolution of the Junggar Ocean during early Paleozoic.

Acknowledgements

We are grateful to the Prof. Hao Ziguo for his constructive comments and suggestions that have substantially improved the presentation of the paper. This study is supported by the Special Fund for Basic Scientific Research of Central Colleges, Chang'an University (grant Nos. 300102278713 and 300102278108), the Sub Project of "National Key Research and Development Plan of China"-"Study on the Distribution Rule of Tianshan-Altai Bulk Minerals and Evaluation of Deep Resource Potential" (grant No.2018YFC0604001), the National Natural Science Foundation of China (grant Nos. 41273033 and 41303027) and the Xinjiang Geological Exploration Fund (grant No. A16-1-LQ14).

References

Yang, G.X., Li, Y.J., Santosh, M., Gu, P.Y., Yang, B.K., Zhang, B., Wang, H.B., Zhong, X., Tong, L.L., 2012. A Neoproterozoic seamount in the Paleoasian Ocean: Evidence from zircon U-Pb geochronology and geochemistry of the Mayile ophiolitic mélange in West Junggar, NW China. *Lithos*, 140–141: 53–65.

Appendix 1 LA-ICP-MS zircon U-Pb isotopic analysis of the basalts within the Hatu tectonic mélange

Spot	Isotope content (ppm)			Isopotic ratios						Age (Ma)					
	Th	U	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
HT-1	127	511	0.25	0.06198	0.00168	0.56411	0.01477	0.06601	0.00132	673	26	454	10	412	8
HT-2	329	351	0.94	0.05912	0.00182	0.57962	0.01723	0.0711	0.00146	572	32	464	11	443	9
HT-3	215	327	0.66	0.05545	0.00217	0.53455	0.02015	0.06991	0.00153	430	46	435	13	436	9
HT-4	76	165	0.46	0.05527	0.00207	0.51802	0.01874	0.06797	0.00145	423	44	424	13	424	9
HT-5	322	556	0.58	0.05687	0.00143	0.54063	0.01315	0.06895	0.00136	486	24	439	9	430	8
HT-6	279	837	0.33	0.05569	0.00141	0.52791	0.01292	0.06875	0.00135	440	25	430	9	429	8