

附表 1 北山南部上中生界碎屑锆石年龄已发表数据统计表

Appendix 1 Detrital zircon samples compiled from previous studies in the southern Beishan region

| 样品         | 岩性  | 时代     | 位置   | 测年点数( <i>n</i> ) | 数据来源                       | Hf |
|------------|-----|--------|------|------------------|----------------------------|----|
| 双鹰山地块      |     |        |      |                  |                            |    |
| 11NC60     | 石英岩 | 泥盆纪    | 柳园   | 108              | Cleven et al., 2018        |    |
| 13LY13A    | 砂岩  | ? 晚石炭世 | 柳园   | 80               | Liu Qian et al., 2019      | ✓  |
| 15HLY-TW2  | 砂岩  | 早石炭世   | 红柳园  | 88               | Niu Yazhuo et al., 2021b   | ✓  |
| 14HLY-TW1  | 砂岩  | 晚石炭世   | 红柳园  | 96               | Niu Yazhuo et al., 2021b   | ✓  |
| 18SBQ-TW2  | 砂岩  | 早石炭世   | 野马井  | 93               | Niu Yazhuo et al., 2021a   | ✓  |
| LY-59      | 砂岩  | 早二叠世   | 柳园   | 90               | Wang Yu et al., 2017       |    |
| LY-92      | 砂岩  | 早二叠世   | 柳园   | 110              | Wang Yu et al., 2017       |    |
| 11NC59     | 砂岩  | 早二叠世   | 柳园   | 98               | Cleven et al., 2018        |    |
| 13LY29     | 砂岩  | 中二叠世   | 柳园   | 83               | Liu Qian et al., 2019      | ✓  |
| 14LQ125B   | 砂岩  | 中二叠世   | 古铜井  | 79               | Liu Qian et al., 2019      | ✓  |
| 16HTS-TW1  | 砂岩  | 早二叠世   | 红柳园  | 90               | Niu Yazhuo et al., 2021b   | ✓  |
| 16HLY-TW3  | 砂岩  | 早二叠世   | 红柳园  | 91               | Niu Yazhuo et al., 2021b   | ✓  |
| 16HLY-TW4  | 砂岩  | 早二叠世   | 红柳园  | 90               | Niu Yazhuo et al., 2021b   | ✓  |
| 15LYW-Z2   | 砂岩  | 早二叠世   | 红柳园  | 90               | Niu Yazhuo et al., 2021b   | ✓  |
| 16HLE-TW1  | 砂岩  | 早二叠世   | 红柳园  | 89               | Niu Yazhuo et al., 2021b   | ✓  |
| 11NJZ12    | 砂岩  | 中二叠世   | 牛圈子  | 73               | Tian Zhonghua et al., 2015 |    |
| 15SJ-Z2    | 砂岩  | 早—中二叠世 | 双井   | 81               | 张东东等, 2023                 | ✓  |
| 15TCK-Z1   | 砂岩  | 早—中二叠世 | 同昌口  | 90               | 张东东等, 2023                 | ✓  |
| 15KLS-Z1   | 砂岩  | 早—中二叠世 | 卡路山  | 84               | 张东东等, 2023                 | ✓  |
| 14GDJE-TW3 | 砂岩  | 早—中二叠世 | 古铜井  | 82               | 张东东等, 2023                 | ✓  |
| 石板山地块      |     |        |      |                  |                            |    |
| 16HLG-TW1  | 砂岩  | 早石炭世   | 石板山  | 90               | Niu Yazhuo et al., 2021a   | ✓  |
| 15BJS-TW1  | 砂岩  | 晚石炭世   | 石板山  | 92               | Niu Yazhuo et al., 2021a   | ✓  |
| 15BJS-TW2  | 砂岩  | 晚石炭世   | 石板山  | 90               | Niu Yazhuo et al., 2021a   | ✓  |
| 16YAX-TW1  | 砂岩  | 晚石炭世   | 音凹峡  | 94               | Niu Yazhuo et al., 2021a   |    |
| 16YMJ-TW6  | 砂岩  | 晚石炭世   | 野马井  | 91               | Niu Yazhuo et al., 2021a   | ✓  |
| 15HLG-Z1   | 砂岩  | 早二叠世   | 石板山  | 90               | Niu Yazhuo et al., 2021a   | ✓  |
| 15HLG-Z5   | 砂岩  | 早二叠世   | 石板山  | 88               | Niu Yazhuo et al., 2021a   | ✓  |
| 16YAX-TW3  | 砂岩  | 早二叠世   | 音凹峡  | 94               | Niu Yazhuo et al., 2021a   |    |
| 15EDJ-TW1  | 砂岩  | 中二叠世   | 音凹峡  | 91               | Niu Yazhuo et al., 2021a   |    |
| 14SBT-TW1  | 砂岩  | 早二叠世   | 野马井  | 88               | Niu Yazhuo et al., 2021a   | ✓  |
| 14YJZ-TW5  | 砂岩  | 中二叠世   | 野马井  | 88               | Niu Yazhuo et al., 2021a   | ✓  |
| LY-76      | 砂岩  | 早二叠世   | 白墩子  | 120              | Wang Yu et al., 2017       |    |
| 11NC58     | 砂岩  | 早二叠世   | 白墩子  | 97               | Cleven et al., 2018        |    |
| 13LY30     | 砂岩  | 早二叠世   | 白墩子  | 76               | Liu Qian et al., 2019      | ✓  |
| 14LQ126B   | 砂岩  | 早二叠世   | 白墩子  | 80               | Liu Qian et al., 2019      | ✓  |
| 14LQ128A   | 砂岩  | 早二叠世   | 白墩子  | 93               | Liu Qian et al., 2019      | ✓  |
| 13tzh48    | 砂岩  | 早二叠世   | 白墩子  | 72               | Tian Zhonghua et al., 2020 |    |
| 14BDZ12    | 砂岩  | ? 早二叠世 | 白墩子  | 77               | Song Dongfang et al., 2016 |    |
| 10MYXS-Z1  | 砂岩  | 早—中二叠世 | 煤窑西山 | 90               | 张东东等, 2023                 | ✓  |
| 16EBM-Z2   | 砂岩  | 早—中二叠世 | 煤窑西山 | 85               | 张东东等, 2023                 | ✓  |

## 参 考 文 献

张东东, 王建强, 牛亚卓, 张宇轩, 史冀忠, 刘兆龙. 2023. 中亚造山带北山—中二叠统物源分析及古地理意义. 地质学报, 97(2): 307~324.

Cleven N R, Lin Shoufa, Xiao Wenjiao, Davis D W, Davis B. 2018. Successive arc accretion in the southern Central Asian orogenic belt, NW China: Evidence from two Paleozoic arcs with offset magmatic periods. Geological Society of America Bulletin, 130: 537~557.

Liu Qian, Zhao Guochun, Han Yigui, Zhu Yanlin, Wang Bo, Eizenhöfer P R, Zhang Xiaoran. 2019. Detrital zircon

provenance constraints on the final closure of the middle segment of the Paleo-Asian Ocean. Gondwana Research, 69: 73~88.

Niu Yazhuo, Shi G R, Ji Wenhua, Zhou Junlin, Wang Jianqiang, Wang Kai, Bai Jianke, Yang Bo. 2021a. Paleogeographic evolution of a Carboniferous-Permian sea in the southernmost part of the Central Asian Orogenic Belt, NW China: Evidence from microfacies, provenance and paleobiogeography. Earth-Science Reviews, 220: 103738.

Niu Yazhuo, Shi G R, Wang Jianqiang, Liu Chiyang, Zhou Junlin, Lu Jincui, Song Bo, Xu Wei. 2021b. The closing of the southern branch of the Paleo-Asian Ocean: Constraints from sedimentary records in the southern Beishan region of the

- Central Asian Orogenic Belt, NW China. *Marine and Petroleum Geology*, 124: 104791.
- Song Dongfang, Xiao Wenjiao, Windley B F, Han Chunming, Yang Lei. 2016. Metamorphic complexes in accretionary orogens: Insights from the Beishan collage, southern Central Asian Orogenic Belt. *Tectonophysics*, 688: 135~147.
- Tian Zhonghua, Xiao Wenjiao, Sun Jimin, Windley B F, Glen R, Han Chunming, Zhang Zhiyong, Zhang Ji'en, Wan Bo, Ao Songjian. 2015. Triassic deformation of Permian Early Triassic arc-related sediments in the Beishan (NW China): Last pulse of the accretionary orogenesis in the southernmost Altaiids. *Tectonophysics*, 662: 363~384.
- Tian Zhonghua, Xiao Wenjiao. 2020. An Andean-type arc transferred into a Japanese-type arc at final closure stage of the Palaeo-Asian Ocean in the southernmost of Altaiids. *Geological Journal*, 55(3): 1613~1619.
- Wang Yu, Luo Zhaohua, Santosh M, Wang Shuzhi, Wang Na. 2017. The Liuyuanvolcanic belt in NW China revisited: Evidence for Permian rifting associated with the assembly of continental blocks in the Central Asian Orogenic Belt. *Geological Magazine*, 154(2): 265~285.

附表 2 北山南部上古生界岩浆锆石年龄已发表数据统计表

## Appendix 2 Magmatic zircon samples compile from previous studies in the southern Beishan region

| 样品           | 岩性       | 时代   | 位置  | 测年点数( <i>n</i> ) | 数据来源                       | Hf |
|--------------|----------|------|-----|------------------|----------------------------|----|
| 双鹰山地块        |          |      |     |                  |                            |    |
| X10-25-3     | 花岗质片麻岩   | 前寒武纪 | 古堡泉 | 16               | He Zhenyu et al., 2018     | ✓  |
| X10-27-2a    | 花岗质片麻岩   | 前寒武纪 | 古堡泉 | 14               | He Zhenyu et al., 2018     | ✓  |
| SF07         | 花岗岩      | 早泥盆世 | 辉铜山 | 16               | 李舫等,2009                   |    |
| B70823-8     | 花岗岩      | 早泥盆世 | 辉铜山 | 14               | 李舫等,2009                   | ✓  |
| DDQ09824-2.1 | 糜棱岩化花岗岩  | 早二叠世 | 东大泉 | 13               | Li Shan et al., 2013       | ✓  |
| DDQ09824-1.1 | 正长花岗岩    | 早二叠世 | 东大泉 | 23               | Li Shan et al., 2013       | ✓  |
| DDQ09824-3   | 片麻状二长花岗岩 | 早二叠世 | 东大泉 | 7                | Li Shan et al., 2013       | ✓  |
| B80628-8.2   | 正长花岗岩    | 早二叠世 | 东大泉 | 7                | Li Shan et al., 2013       | ✓  |
| XJ11-143     | 花岗岩      | 早志留世 | 明舒井 | 27               | 李小菲等,2015                  | ✓  |
| XJ11-140     | 闪长岩      | 早志留世 | 明舒井 | 30               | 李小菲等,2015                  | ✓  |
| XJ11-139     | 辉长岩      | 早志留世 | 明舒井 | 21               | 李小菲等,2015                  | ✓  |
| XJ11-150     | 辉长闪长岩    | 晚奥陶世 | 明舒井 | 15               | 李小菲等,2015                  | ✓  |
| 08L05        | 埃达克岩     | 晚泥盆世 | 柳园  | 16               | Mao Qigui et al., 2012     |    |
| LYB19        | 埃达克岩     | 志留世  | 辉铜山 | 14               | Mao Qigui et al., 2012     | ✓  |
| 10MZS04      | 片麻岩      | 晚泥盆世 | 牛圈子 | 15               | Song Dongfang et al., 2013 | ✓  |
| X10-24-4     | 花岗质片麻岩   | 前寒武纪 | 古堡泉 | 16               | 叶晓峰等,2013                  | ✓  |
| X10-27-2     | 花岗质片麻岩   | 前寒武纪 | 古堡泉 | 26               | Yuan Yu et al., 2015       | ✓  |
| X11-99-2     | 眼球状片麻岩   | 前寒武纪 | 古堡泉 | 19               | Yuan Yu et al., 2015       | ✓  |
| X11-97-2     | 花岗质片麻岩   | 前寒武纪 | 古堡泉 | 15               | Yuan Yu et al., 2015       | ✓  |
| X11-99-1     | 花岗质片麻岩   | 前寒武纪 | 古堡泉 | 20               | Yuan Yu et al., 2015       | ✓  |
| X11-100-1    | 花岗质片麻岩   | 前寒武纪 | 古堡泉 | 18               | Yuan Yu et al., 2015       | ✓  |
| X11-101-1    | 眼球状片麻岩   | 前寒武纪 | 古堡泉 | 17               | Yuan Yu et al., 2015       | ✓  |
| 4            | 花岗岩      | 晚泥盆世 | 辉铜山 | 13               | 赵泽辉等,2007                  |    |
| 3            | 花岗岩      | 早志留世 | 辉铜山 | 14               | 赵泽辉等,2007                  |    |
| 1            | 花岗闪长岩    | 晚志留世 | 柳园  | 14               | 赵泽辉等,2007                  |    |
| 08NC04A      | 变质灰层     | 前寒武纪 | 柳园  | 22               | Cleven et al., 2018        |    |
| 08NC03c      | 岩屑凝灰岩    | 奥陶纪  | 柳园  | 12               | Cleven et al., 2018        |    |
| 09DDS45-1    | 流纹岩      | 晚泥盆世 | 墩墩山 | 13               | Guo Qianqian et al., 2014  |    |
| 09DDS41-1    | 正长斑岩     | 晚泥盆世 | 墩墩山 | 20               | Guo Qianqian et al., 2014  |    |
| BS067        | 玄武岩      | 晚志留世 | 墩墩山 | 12               | 李向民等,2011                  |    |
| BS074        | 安山岩      | 晚泥盆世 | 墩墩山 | 10               | 李向民等,2011                  |    |
| 08LY02       | 玄武岩      | 晚奥陶世 | 柳园  | 18               | Mao Qigui et al., 2012     |    |
| 08LY01       | 英安岩      | 早志留世 | 柳园  | 18               | Mao Qigui et al., 2012     |    |
| 14JQZ-TW2    | 安山岩      | 早二叠世 | 碱泉子 | 14               | 牛亚卓等,2018a                 |    |
| 16HTS-TW2    | 珍珠岩      | 早二叠世 | 柳园  | 14               | 牛亚卓等,2018a                 |    |
| 18LQJ-TW1    | 流纹岩      | 早泥盆世 | 墩墩山 | 14               | 牛亚卓等,2020                  |    |
| 18HUI-TW2    | 流纹岩      | 早泥盆世 | 柳园  | 15               | 牛亚卓等,2020                  |    |
| 18YSS-TW5    | 流纹岩      | 早泥盆世 | 柳园  | 16               | 牛亚卓等,2020                  |    |
| 14SHSS-Tw1   | 流纹岩      | 早二叠世 | 沙红山 | 22               | 许伟等,2018                   | ✓  |
| 石板山地块        |          |      |     |                  |                            |    |
| BS07-17      | 角闪石花岗岩   | 晚石炭世 | 桥湾  | 15               | 冯继承等,2011                  | ✓  |
| X10-128-1    | 花岗岩      | 早志留世 | 金塔  | 13               | 贺振宇等,2014                  | ✓  |
| X10-98-2     | 糜棱岩化花岗岩  | 早志留世 | 桥湾  | 13               | 贺振宇等,2014                  | ✓  |
| X10-115-1    | 花岗闪长岩    | 前寒武纪 | 旧井  | 11               | 贺振宇等,2014                  | ✓  |
| X12-22-1     | 片麻岩      | 前寒武纪 | 旧井  | 22               | 贺振宇等,2014                  | ✓  |
| X10-116-6    | 糜棱岩化花岗岩  | 前寒武纪 | 旧井  | 24               | He Zhenyu et al., 2018     | ✓  |
| X12-11-1     | 花岗质片麻岩   | 前寒武纪 | 石板墩 | 24               | He Zhenyu et al., 2018     | ✓  |
| X12-11-4     | 花岗质片麻岩   | 前寒武纪 | 石板墩 | 24               | He Zhenyu et al., 2018     | ✓  |
| X12-10-1     | 花岗质片麻岩   | 前寒武纪 | 石板墩 | 19               | He Zhenyu et al., 2018     | ✓  |
| X11-109-1    | 角闪岩      | 前寒武纪 | 石板墩 | 22               | 姜洪颖等,2013                  | ✓  |
| X10-37-1     | 片麻岩      | 前寒武纪 | 白墩子 | 15               | 姜洪颖等,2013                  | ✓  |
| X10-37-2     | 长英质脉体    | 早二叠世 | 白墩子 | 19               | 姜洪颖等,2013                  | ✓  |
| 14SBD06      | 正片麻岩     | 晚石炭世 | 石板墩 | 20               | Song Dongfang et al., 2016 | ✓  |

续附表 2

| 样品          | 岩性      | 时代   | 位置   | 测年点数( <i>n</i> ) | 数据来源                       | Hf |
|-------------|---------|------|------|------------------|----------------------------|----|
| 14SBD04     | 正片麻岩    | 早二叠世 | 石板墩  | 23               | Song Dongfang et al., 2016 | ✓  |
| X10-7-4     | 混合片麻岩   | 前寒武纪 | 玉门关  | 18               | Yuan Yu et al., 2015       | ✓  |
| BS07-35     | 二长花岗岩   | 中二叠世 | 西涧泉子 | 11               | 张文等, 2010                  | ✓  |
| BS07-75     | 黑云花岗岩   | 早二叠世 | 音凹峡  | 20               | 张文等, 2011                  | ✓  |
| TW-2        | 二长花岗岩   | 早志留世 | 金塔   | 12               | Zhang Xinqu et al., 2008   |    |
| 15B09-4     | 花岗岩     | 中二叠世 | 野马井  | 22               | Zheng Rongguo et al., 2017 |    |
| 15BS07-1    | 闪长岩     | 中二叠世 | 野马井  | 28               | Zheng Rongguo et al., 2017 |    |
| 16HLG-TW4   | 英安岩     | 早二叠世 | 石板山  | 15               | 牛亚卓等, 2018a                |    |
| 14SHJ-TW1   | 流纹岩     | 早二叠世 | 珊瑚井  | 8                | 牛亚卓等, 2018a                |    |
| 14YJZ-TW2   | 英安岩     | 早二叠世 | 俞井子  | 14               | 牛亚卓等, 2018a                |    |
| 13GQ-TW1    | 流纹岩     | 早二叠世 | 甘泉   | 13               | 牛亚卓等, 2018b                |    |
| 13YJZ-TW1   | 英安岩     | 早二叠世 | 野马井  | 13               | 牛亚卓等, 2018b                |    |
| 14SHJ-Tw2   | 流纹岩     | 早二叠世 | 珊瑚井  | 14               | 许伟等, 2018                  | ✓  |
| 16DS-TW5    | 流纹岩     | 早二叠世 | 独山   | 28               | 许伟等, 2018                  | ✓  |
| 18SBQ-H1    | 流纹岩     | 泥盆纪  | 石板泉  | 17               | 许伟等, 2019a                 | ✓  |
| 16HHQ-TW1   | 英安岩     | 早二叠世 | 后红泉  | 15               | 许伟等, 2019b                 |    |
| 13WTG-TW1   | 安山岩     | 中二叠世 | 梧桐沟  | 12               | 许伟等, 2019b                 |    |
| TW-1        | 流纹岩     | 早二叠世 | 野马井  | 10               | Zhang Xinqu et al., 2008   |    |
| 敦煌地块        |         |      |      |                  |                            |    |
| DHF03       | 花岗质片麻岩  | 前寒武纪 | 东巴兔  | 9                | Feng Lamei et al., 2020    | ✓  |
| DHF04       | 角闪片麻岩   | 前寒武纪 | 东巴兔  | 15               | Feng Lamei et al., 2020    | ✓  |
| DHF41-6     | 花岗岩     | 前寒武纪 | 东巴兔  | 18               | Feng Lamei et al., 2020    | ✓  |
| DHF89       | 斜长片麻岩   | 早泥盆世 | 东巴兔  | 31               | Feng Lamei et al., 2020    | ✓  |
| DHF46-1     | 二长花岗岩   | 晚二叠世 | 东巴兔  | 22               | Feng Lamei et al., 2020    | ✓  |
| DHF25-3     | 花岗岩     | 早二叠世 | 东巴兔  | 29               | Feng Lamei et al., 2020    | ✓  |
| DHF21-5     | 花岗岩     | 早二叠世 | 东巴兔  | 29               | Feng Lamei et al., 2020    | ✓  |
| DHF54       | 花岗岩     | 早二叠世 | 东巴兔  | 25               | Feng Lamei et al., 2020    | ✓  |
| X10-4-1     | 角闪岩     | 前寒武纪 | 三危山  | 21               | He Zhenyu et al., 2013     | ✓  |
| X10-5-2     | 眼球状片麻岩  | 前寒武纪 | 三危山  | 24               | He Zhenyu et al., 2013     | ✓  |
| X10-1-8     | 眼球状片麻岩  | 前寒武纪 | 三危山  | 14               | He Zhenyu et al., 2013     | ✓  |
| X10-9-1     | 眼球状片麻岩  | 前寒武纪 | 三危山  | 11               | He Zhenyu et al., 2013     | ✓  |
| HLX19-2     | 角闪岩     | 前寒武纪 | 红柳峡  | 39               | Wang Zhongmei et al., 2014 | ✓  |
| HLX08-1     | 角闪岩     | 前寒武纪 | 红柳峡  | 38               | Wang Zhongmei et al., 2014 | ✓  |
| HLX04       | 花岗岩     | 早泥盆世 | 红柳峡  | 25               | Wang Zhongmei et al., 2014 | ✓  |
| HLX36-4     | 花岗岩     | 早泥盆世 | 红柳峡  | 20               | Wang Zhongmei et al., 2014 | ✓  |
| AQ10-4-1.1  | 英云片麻岩   | 前寒武纪 | 红柳峡  | 66               | Zhang Jianxin et al., 2013 | ✓  |
| AQ10-4-4.1  | 镁铁质麻粒岩  | 前寒武纪 | 红柳峡  | 10               | Zhang Jianxin et al., 2013 | ✓  |
| AQ10-4-2.2  | 英云片麻岩   | 前寒武纪 | 红柳峡  | 21               | Zhang Jianxin et al., 2013 | ✓  |
| AQ10-4-2.2  | 英云片麻岩   | 前寒武纪 | 红柳峡  | 32               | Zhang Jianxin et al., 2013 | ✓  |
| AQ10-12-2.1 | 英云片麻岩   | 前寒武纪 | 红柳峡  | 32               | Zhang Jianxin et al., 2013 | ✓  |
| AQ10-11-4.1 | 花岗闪长片麻岩 | 前寒武纪 | 红柳峡  | 18               | Zhang Jianxin et al., 2013 |    |
| AQ10-11-4.1 | 花岗闪长片麻岩 | 前寒武纪 | 红柳峡  | 28               | Zhang Jianxin et al., 2013 |    |
| T08-12-1.1  | 花岗闪长片麻岩 | 前寒武纪 | 红柳峡  | 77               | Zhang Jianxin et al., 2013 |    |
| T08-12-3.3  | 花岗闪长片麻岩 | 前寒武纪 | 红柳峡  | 9                | Zhang Jianxin et al., 2013 | ✓  |
| T08-12-3.3  | 花岗闪长片麻岩 | 前寒武纪 | 红柳峡  | 32               | Zhang Jianxin et al., 2013 | ✓  |
| 14GZ01      | 闪长岩     | 志留纪  | 瓜州   | 27               | Zhao Yan et al., 2017      | ✓  |
| 38SX        | 闪长岩     | 志留纪  | 瓜州   | 18               | Zhao Yan et al., 2017      | ✓  |
| 1304HX04    | 花岗岩     | 早泥盆世 | 早峡   | 11               | Zhao Yan et al., 2017      | ✓  |
| 1301HX01    | 花岗岩     | 早泥盆世 | 早峡   | 23               | Zhao Yan et al., 2017      | ✓  |
| 08HX-2      | 花岗岩     | 晚泥盆世 | 早峡   | 12               | Zhao Yan et al., 2017      | ✓  |
| 1307HYS07   | 花岗岩     | 晚泥盆世 | 三危山  | 22               | Zhao Yan et al., 2017      | ✓  |
| 1304SWS04   | 花岗岩     | 早泥盆世 | 三危山  | 15               | Zhao Yan et al., 2017      | ✓  |
| 22DHSK      | 花岗闪长岩   | 早泥盆世 | 三危山  | 18               | Zhao Yan et al., 2017      | ✓  |
| 35SX        | 闪长岩     | 晚泥盆世 | 蘑菇台  | 20               | Zhao Yan et al., 2017      | ✓  |
| 33SX-2      | 二长闪长岩   | 晚泥盆世 | 蘑菇台  | 17               | Zhao Yan et al., 2017      | ✓  |

续附表 2

| 样品        | 岩性    | 时代   | 位置  | 测年点数( <i>n</i> ) | 数据来源                     | Hf |
|-----------|-------|------|-----|------------------|--------------------------|----|
| 1305YLH05 | 花岗闪长岩 | 晚泥盆世 | 蘑菇台 | 23               | Zhao Yan et al., 2017    | ✓  |
| 1302YLH02 | 花岗闪长岩 | 晚泥盆世 | 蘑菇台 | 23               | Zhao Yan et al., 2017    | ✓  |
| X11-113-2 | 奥长花岗岩 | 前寒武纪 | 蘑菇台 | 19               | Zong Keqing et al., 2013 | ✓  |
| X11-114-1 | 奥长花岗岩 | 前寒武纪 | 蘑菇台 | 19               | Zong Keqing et al., 2013 | ✓  |
| X11-122-1 | 奥长花岗岩 | 前寒武纪 | 蘑菇台 | 19               | Zong Keqing et al., 2013 | ✓  |

## 参 考 文 献

冯继承, 张文, 吴泰然, 郑荣国, 罗红玲, 贺元凯. 2011. 甘肃北山桥湾北花岗岩体的年代学、地球化学及其地质意义. 北京大学学报(自然科学版), 48(1): 61~70.

贺振宇, 宗克清, 姜洪颖, 向华, 张泽明. 2014. 北山造山带南部早古生代构造演化: 来自花岗岩的约束. 岩石学报, 30(8): 2324~2338.

姜洪颖, 贺振宇, 宗克清, 张泽明, 赵志丹. 2013. 北山造山带南缘北山杂岩的锆石 U-Pb 定年和 Hf 同位素研究. 岩石学报, 29(11): 3949~3967.

李舫, 王涛, 童英, 洪大卫, 欧阳志侠. 2009. 北山柳园地区双峰山早泥盆世 A 型花岗岩的确定及其构造演化意义. 岩石矿物学杂志, 28(5): 407~422.

李向民, 余吉远, 王国强, 武鹏, 周志强. 2011. 甘肃北山红柳园地区泥盆系三个井组和墩墩山群 LA-ICP-MS 锆石 U-Pb 测年及其意义. 地质通报, 30(10): 1501~1507.

李小菲, 张成立, 李雷, 包志安, 张帮禄, 魏强. 2015. 甘肃北山明舒井岩体形成年龄、地球化学特征及其地质意义. 岩石学报, 31(9): 2521~2538.

牛亚卓, 卢进才, 刘池阳, 宋博, 史冀忠, 许伟. 2018a. 甘蒙北山地区海相二叠系时代及其区域对比. 地质学报, 92(6): 1131~1148.

牛亚卓, 卢进才, 刘池阳, 许伟, 史冀忠, 宋博. 2018b. 甘肃北山地区上石炭统一下二叠统干泉组的时代、分布及其构造意义. 地质论评, 64(4): 806~827.

牛亚卓, 宋博, 周俊林, 许伟, 史冀忠, 张宇轩, 卢进才. 2020. 中亞造山带北山南部下泥盆统火山-沉积地层的岩相、时代及古地理意义. 地质学报, 94(2): 615~633.

许伟, 徐学义, 牛亚卓, 陈高潮, 史冀忠, 魏建设, 宋博, 张宇轩. 2018. 北山南部早二叠世 A 型流纹岩地球化学特征及其地球动力学意义. 岩石学报, 34(10): 3011~3033.

许伟, 徐学义, 卢进才, 牛亚卓, 陈高潮, 史冀忠, 党彝, 宋博, 张宇轩, 张乔. 2019a. 北山野马井地区泥盆纪富钾酸性岩浆岩地球化学特征及其地质意义. 地球科学, 44(8): 2775~2793.

许伟, 徐学义, 牛亚卓, 宋博, 陈高潮, 史冀忠, 张宇轩, 李晨皓. 2019b. 北山南部二叠纪海相玄武岩地球化学特征及其构造意义. 地质学报, 93(8): 1928~1953.

叶晓峰, 宗克清, 张泽明, 贺振宇, 刘勇胜, 胡兆初, 王伟. 2013. 北山造山带南缘柳园地区新元古代花岗岩的地球化学特征及其地质意义. 地质通报, 32(Z1): 307~317.

张文, 吴泰然, 贺元凯, 冯继承, 郑荣国. 2010. 甘肃北山西洞泉子富碱高钾花岗岩体的锆石 LA-ICP-MS 定年及其构造意义. 岩石矿物学杂志, 29(6): 719~731.

张文, 冯继承, 郑荣国, 吴泰然, 罗红玲, 贺元凯, 荆旭. 2011. 甘肃北山音凹峡南花岗岩体的锆石 LA-ICPMS 定年及其构造意义. 岩石学报, 27(6): 1649~1661.

赵泽辉, 郭召杰, 王毅. 2007. 甘肃北山柳园地区花岗岩类的年代学、地球化学特征及构造意义. 岩石学报, (8): 1847~1860.

Cleven N R, Lin Shoufa, Xiao Wenjiao, Davis D W, Davis B. 2018. Successive arc accretion in the southern Central Asian orogenic belt, NW China; Evidence from two Paleozoic arcs with offset magmatic periods. Geological Society of America Bulletin, 130: 537~557.

Feng Lamei, Lin Shoufa, Li Longming, Davis D W, Song Chuanzhong, Li Jiahao, Ren Shenglian, Han Xu, Ge Yanpeng,

Lu Kejia. 2020. Constraints on the tectonic evolution of the southern central Asian orogenic belt from early Permian-middle Triassic granitoids from the central Dunhuang orogenic belt, NW China. Journal of Asian Earth Sciences, 194: 104283.

Guo Qianqian, Xiao Wenjiao, Hou Quanlin, Windley B F, Han Chunming, Tian Zhonghua, Song Dongfang. 2014. Construction of Late Devonian Dundunshan arc in the Beishan orogen and its implication for tectonics of southern Central Asian Orogenic Belt. Lithos, 184-187: 361~378.

He Zhenyu, Zhang Zeming, Zong Keqing, Dong Xin. 2013. Paleoproterozoic crustal evolution of the Tarim Craton: Constrained by zircon U-Pb and Hf isotopes of meta-igneous rocks from Korla and Dunhuang. Journal of Asian Earth Sciences, 78(12): 54~70.

He Zhenyu, Klemd R, Yan Lili, Zhang Zeming. 2018. The origin and crustal evolution of microcontinents in the Beishan orogen of the southern Central Asian Orogenic Belt. Earth-Science Reviews, 185: 1~14.

Li Shan, Wilde S A, Wang Tao. 2013. Early Permian post-collisional high-K granitoids from Liuyuan area in southern Beishan orogen, NW China: Petrogenesis and tectonic implications. Lithos, 179(10): 99~119.

Mao Qigui, Xiao Wenjiao, Fang Tonghui, Wang Jingbin, Han Chunming, Sun Min, Yuan Chao. 2012. Late Ordovician to Early Devonian adakites and Nb-enriched basalts in the Liuyuan area, Beishan, NW China: Implications for early Paleozoic slab-melting and crustal growth in the southern Altai. Gondwana Research, 22: 534~553.

Song Dongfang, Xiao Wenjiao, Han Chunming, Li Jiliang, Qu Junfeng, Guo Qianqian, Lin Lina, Zhong Mei. 2013. Progressive accretionary tectonics of the Beishan orogenic collage, southern Altai: Insights from zircon U-Pb and Hf isotopic data of high-grade complexes. Precambrian Research, 227: 368~388.

Song Dongfang, Xiao Wenjiao, Windley B F, Han Chunming, Yang Lei. 2016. Metamorphic complexes in accretionary orogens: Insights from the Beishan collage, southern Central Asian Orogenic Belt. Tectonophysics, 688: 135~147.

Wang Zhongmei, Han Chunming, Xiao Wenjiao, Wan Bo, Sakyi P A, Ao Songjian, Song Dongfang. 2014. Petrology and geochronology of Paleoproterozoic garnet-bearing amphibolites from the Dunhuang Block, eastern Tarim Craton. Precambrian Research, 255: 163~180.

Yuan Yu, Zong Keqing, He Zhenyu, Reiner Klemd, Liu Yongsheng, Hu Zhaochu, Guo Jingliang, Zhang Zeming. 2015. Geochemical and geochronological evidence for a former early Neoproterozoic microcontinent in the south Beishan orogenic belt, southernmost Central Asian Orogenic Belt. Precambrian Research, 266: 409~424.

Zhang Jianxin, Yu Shengyao, Gong Jianghua, Li Huaikun, Hou Kejun. 2013. The latest Neoproterozoic evolution of the Dunhuang block, eastern Tarim craton, northwestern China: Evidence from zircon U-Pb dating and Hf isotopic analyses. Precambrian Research, 226: 21~42.

Zhang Xihu, Su Li, Cui Xuejun, Ding Shuhong, Zhang Jianguo, Chen Li. 2008. Metallogenetic epoch and mechanism of the tungsten ore in Yushan, Beishan orogenic belt, Gansu. Chinese

Science Bulletin, 53: 1222~1230.

Zhao Yan, Sun Yong, Diwu Chunrong, Zhu Tao, Ao Wenhao, Zhang Hong, Yan Jianghao. 2017. Paleozoic intrusive rocks from the Dunhuang tectonic belt, NW China: Constraints on the tectonic evolution of the southernmost Central Asian Orogenic Belt. *Journal of Asian Earth Sciences*, 138: 562~587.

Zheng Rongguo, Li Jinyi, Xiao Wenjiao, Zhang Jin. 2017. Nature

and provenance of the Beishan complex, southernmost Central Asian Orogenic Belt. *International Journal of Earth Sciences*, 107(2): 729~755.

Zong Keqing, Liu Yongsheng, Zhang Zeming, He Zhenyu, Hu Zhaochu, Guo Jingliang, Chen Kang. 2013. The generation and evolution of Archean continental crust in the Dunhuang block, northeastern Tarim craton, northwestern China. *Precambrian Research*, 235: 251~263.

附表 3 独山地区上古生界砂岩碎屑颗粒组分统计表  
 Appendix 3 Sandstone component of Upper Paleozoic samples from the Dushan area

| 样品        | Qp | Qm  | P   | K | Lv  | Lm | Ls | M | D  | Mi. |
|-----------|----|-----|-----|---|-----|----|----|---|----|-----|
| 雀儿山群      |    |     |     |   |     |    |    |   |    |     |
| 18GQ-B5   | 61 | 246 | 20  | 2 | 35  | 0  | 0  | 6 | 0  | 150 |
| 15GQN-B5  | 25 | 134 | 65  | 1 | 140 | 7  | 0  | 1 | 1  | 146 |
| 干泉组       |    |     |     |   |     |    |    |   |    |     |
| 15GQN-B3  | 25 | 179 | 51  | 9 | 40  | 16 | 0  | 2 | 0  | 198 |
| 15GQ-B2   | 32 | 248 | 15  | 4 | 15  | 16 | 0  | 3 | 0  | 187 |
| 15GQ-B3   | 82 | 231 | 10  | 8 | 16  | 14 | 0  | 6 | 0  | 153 |
| 15GQ-B5   | 71 | 216 | 28  | 4 | 14  | 12 | 0  | 4 | 0  | 171 |
| 16DSS-B1  | 5  | 27  | 108 | 4 | 216 | 0  | 0  | 0 | 0  | 160 |
| 双堡塘组      |    |     |     |   |     |    |    |   |    |     |
| 15DSS-B12 | 3  | 63  | 54  | 3 | 256 | 0  | 0  | 0 | 4  | 137 |
| 16DSS-B28 | 6  | 43  | 113 | 2 | 164 | 0  | 0  | 3 | 0  | 189 |
| 16DSS-B29 | 4  | 68  | 89  | 1 | 207 | 0  | 0  | 0 | 3  | 148 |
| 16DSS-B43 | 3  | 84  | 47  | 0 | 262 | 0  | 0  | 0 | 0  | 124 |
| 16DSS-B45 | 5  | 84  | 87  | 6 | 244 | 0  | 0  | 2 | 2  | 90  |
| 菊石滩组      |    |     |     |   |     |    |    |   |    |     |
| 15DSS-B22 | 3  | 82  | 44  | 0 | 240 | 0  | 0  | 0 | 0  | 151 |
| 16DS-B7   | 11 | 84  | 90  | 2 | 184 | 2  | 3  | 0 | 11 | 133 |
| 16DS-B6   | 5  | 83  | 51  | 0 | 174 | 9  | 0  | 0 | 0  | 198 |
| 金塔组       |    |     |     |   |     |    |    |   |    |     |
| 16DS-B16  | 31 | 136 | 65  | 6 | 168 | 0  | 0  | 0 | 0  | 114 |
| 16DS-B17  | 60 | 118 | 50  | 4 | 181 | 2  | 0  | 0 | 0  | 105 |
| 15DSS-B23 | 2  | 28  | 71  | 0 | 265 | 0  | 0  | 0 | 0  | 154 |

注: Qp—单晶石英; Qm—多晶石英; P—斜长石; K—钾长石; Lv—火成岩岩屑; Lm—变质岩岩屑; Ls—沉积岩岩屑; M—层状硅酸盐矿物; D—重矿物; Mi—杂基和未定存疑矿物。

附表4 独山地区上古生界碎屑锆石 ICP-LA-MS 锆石 U-Pb 年龄数据  
Appendix 4 ICP-LA-MS zircon U-Pb data of Upper Paleozoic samples from the Dushan area

| 测点<br>编号                                   | 含量( $\times 10^{-6}$ ) |                   | $^{232}\text{Th}$<br>/<br>$^{238}\text{U}$ | 同位素比值                             |                                  |                                  |           | 年龄(Ma)                            |           |                                  |           |                                  |           |    |
|--|------------------------|-------------------|--|-----------------------------------|----------------------------------|----------------------------------|-----------|-----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|----|
|  | $^{206}\text{Pb}$      | $^{232}\text{Th}$ |  | $^{207}\text{Pb}/^{206}\text{Pb}$ | $^{207}\text{Pb}/^{235}\text{U}$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ | $^{207}\text{Pb}/^{206}\text{Pb}$ | $1\sigma$ | $^{207}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ |    |
| 雀儿山群(样品 15GQN-Z3, N 40°44'24" E 94°17'59") |                        |                   |  |                                   |                                  |                                  |           |                                   |           |                                  |           |                                  |           |    |
| 1  | 89                     | 104               | 0.48                                       | 0.0011                            | 0.7896                           | 0.0141                           | 0.0948    | 0.0012                            | 620       | 19                               | 591       | 8                                | 584       | 7  |
| 2  | 302                    | 1512              | 1.42                                       | 0.0012                            | 0.7967                           | 0.0124                           | 0.0747    | 0.0009                            | 1133      | 14                               | 595       | 7                                | 464       | 5  |
| 3  | 66                     | 102               | 0.45                                       | 0.0014                            | 0.5529                           | 0.0125                           | 0.0668    | 0.0009                            | 607       | 27                               | 447       | 8                                | 417       | 5  |
| 4  | 98                     | 210               | 0.61                                       | 0.0012                            | 0.5087                           | 0.0107                           | 0.0654    | 0.0008                            | 469       | 25                               | 418       | 7                                | 409       | 5  |
| 5  | 130                    | 231               | 0.51                                       | 0.0011                            | 0.5032                           | 0.0102                           | 0.0653    | 0.0008                            | 448       | 23                               | 414       | 7                                | 408       | 5  |
| 6  | 70                     | 115               | 0.48                                       | 0.0013                            | 0.5202                           | 0.0113                           | 0.0661    | 0.0009                            | 495       | 26                               | 425       | 8                                | 413       | 5  |
| 7  | 118                    | 150               | 0.37                                       | 0.0012                            | 0.5418                           | 0.0105                           | 0.0660    | 0.0008                            | 586       | 22                               | 440       | 7                                | 412       | 5  |
| 8  | 813                    | 217               | 0.61                                       | 0.0020                            | 14.0979                          | 0.1616                           | 0.5265    | 0.0061                            | 2778      | 9                                | 2756      | 11                               | 2727      | 26 |
| 9  | 267                    | 103               | 0.57                                       | 0.0015                            | 5.1149                           | 0.0739                           | 0.3355    | 0.0042                            | 1809      | 12                               | 1839      | 12                               | 1865      | 20 |
| 10   | 75                     | 142               | 0.56                                       | 0.0011                            | 0.5013                           | 0.0106                           | 0.0672    | 0.0009                            | 376       | 26                               | 413       | 7                                | 419       | 5  |
| 11   | 105                    | 175               | 0.48                                       | 0.0011                            | 0.5086                           | 0.0096                           | 0.0662    | 0.0008                            | 444       | 21                               | 417       | 6                                | 413       | 5  |
| 12   | 241                    | 235               | 0.24                                       | 0.0021                            | 0.4602                           | 0.0168                           | 0.0610    | 0.0008                            | 400       | 88                               | 384       | 12                               | 382       | 5  |
| 13   | 46                     | 135               | 0.84                                       | 0.0017                            | 0.5221                           | 0.0147                           | 0.0649    | 0.0009                            | 544       | 37                               | 427       | 10                               | 405       | 6  |
| 14   | 95                     | 143               | 0.42                                       | 0.0011                            | 0.4892                           | 0.0095                           | 0.0642    | 0.0008                            | 423       | 22                               | 404       | 6                                | 401       | 5  |
| 15   | 80                     | 137               | 0.49                                       | 0.0012                            | 0.5117                           | 0.0108                           | 0.0657    | 0.0008                            | 474       | 25                               | 420       | 7                                | 410       | 5  |
| 16   | 164                    | 230               | 0.41                                       | 0.0010                            | 0.5126                           | 0.0091                           | 0.0663    | 0.0008                            | 457       | 19                               | 420       | 6                                | 414       | 5  |
| 17   | 157                    | 252               | 0.45                                       | 0.0009                            | 0.5159                           | 0.0080                           | 0.0639    | 0.0008                            | 551       | 16                               | 422       | 5                                | 399       | 5  |
| 18   | 179                    | 339               | 0.54                                       | 0.0009                            | 0.5141                           | 0.0080                           | 0.0647    | 0.0008                            | 516       | 16                               | 421       | 5                                | 404       | 5  |
| 19   | 131                    | 232               | 0.51                                       | 0.0009                            | 0.5158                           | 0.0082                           | 0.0658    | 0.0008                            | 485       | 17                               | 422       | 6                                | 411       | 5  |
| 20   | 737                    | 202               | 0.35                                       | 0.0012                            | 4.1285                           | 0.0516                           | 0.2931    | 0.0034                            | 1664      | 10                               | 1660      | 10                               | 1657      | 17 |
| 21   | 193                    | 415               | 0.80                                       | 0.0011                            | 1.1058                           | 0.0150                           | 0.0952    | 0.0011                            | 1299      | 12                               | 756       | 7                                | 586       | 7  |
| 22   | 275                    | 240               | 0.24                                       | 0.0020                            | 0.5101                           | 0.0159                           | 0.0619    | 0.0008                            | 597       | 74                               | 419       | 11                               | 387       | 5  |
| 23   | 61                     | 162               | 0.73                                       | 0.0015                            | 0.4785                           | 0.0127                           | 0.0629    | 0.0009                            | 419       | 35                               | 397       | 9                                | 393       | 5  |
| 24   | 171                    | 266               | 0.47                                       | 0.0009                            | 0.5229                           | 0.0085                           | 0.0683    | 0.0008                            | 434       | 17                               | 427       | 6                                | 426       | 5  |
| 25   | 402                    | 618               | 0.43                                       | 0.0009                            | 0.5190                           | 0.0082                           | 0.0630    | 0.0008                            | 593       | 16                               | 424       | 5                                | 394       | 5  |
| 26   | 181                    | 555               | 0.82                                       | 0.0012                            | 0.5565                           | 0.0111                           | 0.0663    | 0.0009                            | 636       | 22                               | 449       | 7                                | 414       | 5  |
| 27   | 55                     | 63                | 0.33                                       | 0.0017                            | 0.5018                           | 0.0146                           | 0.0651    | 0.0009                            | 450       | 39                               | 413       | 10                               | 406       | 6  |
| 28   | 90                     | 152               | 0.51                                       | 0.0014                            | 0.5229                           | 0.0126                           | 0.0683    | 0.0009                            | 434       | 30                               | 427       | 8                                | 426       | 6  |
| 29   | 121                    | 212               | 0.53                                       | 0.0013                            | 0.5638                           | 0.0122                           | 0.0685    | 0.0009                            | 592       | 25                               | 454       | 8                                | 427       | 5  |
| 30   | 31                     | 57                | 0.57                                       | 0.0019                            | 0.5907                           | 0.0183                           | 0.0704    | 0.0011                            | 634       | 41                               | 471       | 12                               | 439       | 6  |
| 31   | 64                     | 73                | 0.35                                       | 0.0015                            | 0.5545                           | 0.0136                           | 0.0688    | 0.0009                            | 546       | 30                               | 448       | 9                                | 429       | 6  |
| 32   | 54                     | 121               | 0.66                                       | 0.0015                            | 0.5327                           | 0.0133                           | 0.0664    | 0.0009                            | 538       | 31                               | 434       | 9                                | 414       | 5  |
| 33   | 154                    | 181               | 0.35                                       | 0.0008                            | 0.4945                           | 0.0078                           | 0.0669    | 0.0008                            | 356       | 17                               | 408       | 5                                | 417       | 5  |
| 34   | 91                     | 200               | 0.63                                       | 0.0014                            | 0.5040                           | 0.0120                           | 0.0653    | 0.0009                            | 453       | 30                               | 414       | 8                                | 408       | 5  |
| 35   | 64                     | 170               | 0.79                                       | 0.0012                            | 0.5226                           | 0.0113                           | 0.0672    | 0.0009                            | 470       | 26                               | 427       | 8                                | 419       | 5  |



续附表 4

| 测点<br>编号 | 含量( $\times 10^{-6}$ ) |                   | $^{232}\text{Th}$<br>$/^{238}\text{U}$ | 同位素比值                             |                                  |                                  |           | 年龄(Ma)    |                                  |           |                                  |           |      |    |
|----------|------------------------|-------------------|--|-----------------------------------|----------------------------------|----------------------------------|-----------|-----------|----------------------------------|-----------|----------------------------------|-----------|------|----|
|          | $^{206}\text{Pb}$      | $^{232}\text{Th}$ |  | $^{207}\text{Pb}/^{206}\text{Pb}$ | $^{207}\text{Pb}/^{235}\text{U}$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ | $1\sigma$ | $^{207}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ |      |    |
| 36       | 36                     | 86                | 0.72                                   | 0.0016                            | 0.0543                           | 0.0149                           | 0.5032    | 0.0672    | 0.0010                           | 41        | 414                              | 10        | 420  | 6  |
| 37       | 49                     | 81                | 0.49                                   | 0.0014                            | 0.0544                           | 0.0130                           | 0.5049    | 0.0673    | 0.0009                           | 34        | 415                              | 9         | 420  | 5  |
| 38       | 183                    | 234               | 0.38                                   | 0.0008                            | 0.0532                           | 0.0074                           | 0.4919    | 0.0671    | 0.0008                           | 16        | 406                              | 5         | 419  | 5  |
| 39       | 263                    | 481               | 0.54                                   | 0.0008                            | 0.0570                           | 0.0079                           | 0.5232    | 0.0666    | 0.0008                           | 15        | 427                              | 5         | 415  | 5  |
| 40       | 124                    | 230               | 0.53                                   | 0.0010                            | 0.0578                           | 0.0092                           | 0.5188    | 0.0651    | 0.0008                           | 19        | 424                              | 6         | 407  | 5  |
| 41       | 69                     | 178               | 0.75                                   | 0.0011                            | 0.0563                           | 0.0099                           | 0.5162    | 0.0665    | 0.0008                           | 22        | 423                              | 7         | 415  | 5  |
| 42       | 45                     | 75                | 0.48                                   | 0.0016                            | 0.0571                           | 0.0138                           | 0.5189    | 0.0660    | 0.0009                           | 35        | 424                              | 9         | 412  | 6  |
| 43       | 72                     | 223               | 0.90                                   | 0.0013                            | 0.0556                           | 0.0117                           | 0.5023    | 0.0655    | 0.0009                           | 29        | 413                              | 8         | 409  | 5  |
| 44       | 156                    | 198               | 0.37                                   | 0.0010                            | 0.0565                           | 0.0088                           | 0.5151    | 0.0661    | 0.0008                           | 19        | 422                              | 6         | 413  | 5  |
| 45       | 78                     | 220               | 0.89                                   | 0.0020                            | 0.0730                           | 0.0187                           | 0.7178    | 0.0713    | 0.0010                           | 30        | 549                              | 11        | 444  | 6  |
| 46       | 84                     | 242               | 0.86                                   | 0.0014                            | 0.0564                           | 0.0126                           | 0.5213    | 0.0671    | 0.0009                           | 31        | 426                              | 8         | 419  | 5  |
| 47       | 52                     | 90                | 0.52                                   | 0.0014                            | 0.0562                           | 0.0129                           | 0.5169    | 0.0667    | 0.0009                           | 32        | 423                              | 9         | 416  | 5  |
| 48       | 55                     | 139               | 0.73                                   | 0.0013                            | 0.0573                           | 0.0118                           | 0.5208    | 0.0659    | 0.0009                           | 28        | 426                              | 8         | 412  | 5  |
| 49       | 171                    | 312               | 0.53                                   | 0.0008                            | 0.0557                           | 0.0075                           | 0.5063    | 0.0659    | 0.0008                           | 15        | 416                              | 5         | 411  | 5  |
| 50       | 33                     | 61                | 0.55                                   | 0.0015                            | 0.0538                           | 0.0137                           | 0.4943    | 0.0667    | 0.0009                           | 38        | 408                              | 9         | 416  | 5  |
| 51       | 156                    | 213               | 0.39                                   | 0.0009                            | 0.0568                           | 0.0081                           | 0.5065    | 0.0646    | 0.0008                           | 17        | 416                              | 5         | 404  | 5  |
| 52       | 75                     | 197               | 0.78                                   | 0.0012                            | 0.0552                           | 0.0105                           | 0.5055    | 0.0665    | 0.0008                           | 25        | 415                              | 7         | 415  | 5  |
| 53       | 279                    | 243               | 0.25                                   | 0.0008                            | 0.0603                           | 0.0070                           | 0.5290    | 0.0636    | 0.0007                           | 13        | 431                              | 5         | 398  | 4  |
| 54       | 98                     | 173               | 0.52                                   | 0.0010                            | 0.0550                           | 0.0089                           | 0.5049    | 0.0666    | 0.0008                           | 20        | 415                              | 6         | 415  | 5  |
| 55       | 204                    | 179               | 0.27                                   | 0.0007                            | 0.0548                           | 0.0071                           | 0.5147    | 0.0681    | 0.0008                           | 14        | 422                              | 5         | 425  | 5  |
| 56       | 475                    | 49                | 0.12                                   | 0.0011                            | 0.0984                           | 0.0420                           | 3.5500    | 0.2616    | 0.0030                           | 10        | 1538                             | 9         | 1498 | 15 |
| 57       | 306                    | 123               | 0.53                                   | 0.0013                            | 0.1013                           | 0.0567                           | 4.1597    | 0.2978    | 0.0036                           | 11        | 1666                             | 11        | 1680 | 18 |
| 58       | 77                     | 112               | 0.44                                   | 0.0010                            | 0.0562                           | 0.0095                           | 0.5269    | 0.0680    | 0.0008                           | 20        | 430                              | 6         | 424  | 5  |
| 59       | 66                     | 105               | 0.45                                   | 0.0012                            | 0.0593                           | 0.0102                           | 0.5201    | 0.0636    | 0.0008                           | 22        | 425                              | 7         | 397  | 5  |
| 60       | 134                    | 268               | 0.60                                   | 0.0008                            | 0.0554                           | 0.0079                           | 0.5066    | 0.0664    | 0.0008                           | 16        | 416                              | 5         | 414  | 5  |
| 61       | 62                     | 103               | 0.49                                   | 0.0011                            | 0.0545                           | 0.0100                           | 0.5011    | 0.0667    | 0.0008                           | 24        | 412                              | 7         | 416  | 5  |
| 62       | 68                     | 113               | 0.50                                   | 0.0011                            | 0.0563                           | 0.0101                           | 0.5219    | 0.0672    | 0.0008                           | 22        | 426                              | 7         | 419  | 5  |
| 63       | 49                     | 92                | 0.56                                   | 0.0013                            | 0.0568                           | 0.0117                           | 0.5290    | 0.0675    | 0.0009                           | 27        | 431                              | 8         | 421  | 5  |
| 64       | 201                    | 354               | 0.53                                   | 0.0008                            | 0.0541                           | 0.0072                           | 0.5023    | 0.0674    | 0.0008                           | 15        | 413                              | 5         | 420  | 5  |
| 65       | 594                    | 96                | 0.17                                   | 0.0010                            | 0.0872                           | 0.0326                           | 2.7875    | 0.2318    | 0.0026                           | 10        | 1352                             | 9         | 1344 | 14 |
| 66       | 198                    | 96                | 0.32                                   | 0.0010                            | 0.0680                           | 0.0209                           | 1.3898    | 0.1482    | 0.0018                           | 14        | 885                              | 9         | 891  | 10 |
| 67       | 40                     | 69                | 0.53                                   | 0.0014                            | 0.0574                           | 0.0126                           | 0.5419    | 0.0684    | 0.0009                           | 29        | 440                              | 8         | 427  | 5  |
| 68       | 90                     | 82                | 0.58                                   | 0.0012                            | 0.0658                           | 0.0238                           | 1.3016    | 0.1435    | 0.0018                           | 19        | 846                              | 11        | 864  | 10 |
| 69       | 185                    | 254               | 0.42                                   | 0.0008                            | 0.0552                           | 0.0080                           | 0.5189    | 0.0682    | 0.0008                           | 16        | 424                              | 5         | 425  | 5  |
| 70       | 242                    | 593               | 0.74                                   | 0.0011                            | 0.0626                           | 0.0124                           | 0.7138    | 0.0827    | 0.0010                           | 18        | 547                              | 7         | 512  | 6  |
| 71       | 361                    | 1129              | 0.95                                   | 0.0007                            | 0.0604                           | 0.0073                           | 0.5636    | 0.0676    | 0.0008                           | 12        | 454                              | 5         | 422  | 5  |
| 72       | 174                    | 311               | 0.54                                   | 0.0010                            | 0.0576                           | 0.0107                           | 0.6422    | 0.0808    | 0.0010                           | 18        | 504                              | 7         | 501  | 6  |

续附表 4

| 测点<br>编号                                 | 含量( $\times 10^{-6}$ ) |                   | $^{232}\text{Th}$<br>/<br>$^{238}\text{U}$ | 同位素比值                            |           |                                  |           | 年龄(Ma)                           |           |                                  |           |    |      |    |
|--|------------------------|-------------------|--|----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|----|------|----|
|  | $^{206}\text{Pb}$      | $^{232}\text{Th}$ |  | $^{207}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ | $^{207}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ |    |      |    |
| 73                                       | 140                    | 17                | 0.18                                       | 0.0015                           | 5.0650    | 0.0684                           | 0.3266    | 0.0039                           | 1839      | 11                               | 1830      | 11 | 1822 | 19 |
| 74                                       | 181                    | 70                | 0.47                                       | 0.0013                           | 3.7206    | 0.0511                           | 0.2709    | 0.0032                           | 1617      | 11                               | 1576      | 11 | 1545 | 16 |
| 75                                       | 38                     | 59                | 0.47                                       | 0.0015                           | 0.4929    | 0.0136                           | 0.0671    | 0.0009                           | 340       | 39                               | 407       | 9  | 419  | 5  |
| 76                                       | 244                    | 440               | 0.54                                       | 0.0007                           | 0.5014    | 0.0068                           | 0.0670    | 0.0008                           | 381       | 14                               | 413       | 5  | 418  | 5  |
| 77                                       | 198                    | 299               | 0.46                                       | 0.0010                           | 0.5126    | 0.0091                           | 0.0680    | 0.0008                           | 400       | 20                               | 420       | 6  | 424  | 5  |
| 78                                       | 107                    | 193               | 0.55                                       | 0.0011                           | 0.5280    | 0.0098                           | 0.0676    | 0.0008                           | 478       | 21                               | 430       | 6  | 422  | 5  |
| 79                                       | 118                    | 204               | 0.52                                       | 0.0011                           | 0.5555    | 0.0105                           | 0.0670    | 0.0008                           | 609       | 21                               | 449       | 7  | 418  | 5  |
| 80                                       | 82                     | 239               | 0.89                                       | 0.0011                           | 0.5394    | 0.0099                           | 0.0679    | 0.0008                           | 514       | 21                               | 438       | 7  | 424  | 5  |
| 81                                       | 62                     | 80                | 0.40                                       | 0.0015                           | 0.5179    | 0.0134                           | 0.0679    | 0.0009                           | 423       | 34                               | 424       | 9  | 424  | 6  |
| 82                                       | 91                     | 138               | 0.45                                       | 0.0010                           | 0.5103    | 0.0091                           | 0.0667    | 0.0008                           | 431       | 20                               | 419       | 6  | 416  | 5  |
| 83                                       | 136                    | 474               | 0.99                                       | 0.0010                           | 0.5213    | 0.0089                           | 0.0632    | 0.0008                           | 595       | 18                               | 426       | 6  | 395  | 5  |
| 84                                       | 146                    | 812               | 1.70                                       | 0.0010                           | 0.5110    | 0.0089                           | 0.0680    | 0.0008                           | 391       | 20                               | 419       | 6  | 424  | 5  |
| 85                                       | 113                    | 131               | 0.35                                       | 0.0011                           | 0.5106    | 0.0097                           | 0.0662    | 0.0008                           | 450       | 22                               | 419       | 6  | 413  | 5  |
| 86                                       | 62                     | 172               | 0.83                                       | 0.0018                           | 0.5488    | 0.0162                           | 0.0659    | 0.0010                           | 617       | 39                               | 444       | 11 | 411  | 6  |
| 87                                       | 312                    | 1493              | 1.46                                       | 0.0013                           | 0.5007    | 0.0117                           | 0.0675    | 0.0009                           | 363       | 30                               | 412       | 8  | 421  | 5  |
| 88                                       | 39                     | 62                | 0.48                                       | 0.0023                           | 0.4965    | 0.0203                           | 0.0665    | 0.0011                           | 375       | 62                               | 409       | 14 | 415  | 7  |
| 89                                       | 719                    | 740               | 1.22                                       | 0.0013                           | 3.5784    | 0.0482                           | 0.2646    | 0.0031                           | 1588      | 11                               | 1545      | 11 | 1513 | 16 |
| 90                                       | 88                     | 83                | 0.62                                       | 0.0017                           | 1.4105    | 0.0342                           | 0.1461    | 0.0020                           | 928       | 28                               | 893       | 14 | 879  | 11 |
| 91                                       | 305                    | 880               | 0.64                                       | 0.0017                           | 0.7823    | 0.0116                           | 0.0492    | 0.0006                           | 1885      | 12                               | 587       | 7  | 309  | 4  |
| 92                                       | 201                    | 355               | 0.52                                       | 0.0013                           | 0.4738    | 0.0111                           | 0.0650    | 0.0008                           | 323       | 31                               | 394       | 8  | 406  | 5  |
| 93                                       | 165                    | 198               | 0.34                                       | 0.0014                           | 0.4814    | 0.0119                           | 0.0624    | 0.0008                           | 450       | 32                               | 399       | 8  | 390  | 5  |
| 94                                       | 286                    | 439               | 0.81                                       | 0.0016                           | 1.3856    | 0.0259                           | 0.1164    | 0.0015                           | 1346      | 18                               | 883       | 11 | 710  | 9  |
| 95                                       | 170                    | 283               | 0.51                                       | 0.0013                           | 0.5068    | 0.0121                           | 0.0675    | 0.0009                           | 390       | 31                               | 416       | 8  | 421  | 5  |
| 干泉组(样品 15GQ-Z1, N 40°44'21" E 94°18'13") |                        |                   |  |                                  |           |                                  |           |                                  |           |                                  |           |    |      |    |
| 1  | 112                    | 153               | 0.70                                       | 0.0039                           | 1.1139    | 0.0680                           | 0.1307    | 0.0026                           | 667       | 97                               | 760       | 33 | 792  | 15 |
| 2  | 56                     | 35                | 0.56                                       | 0.0058                           | 2.7207    | 0.1810                           | 0.2325    | 0.0055                           | 1312      | 92                               | 1334      | 49 | 1347 | 29 |
| 3  | 221                    | 115               | 0.59                                       | 0.0023                           | 3.1278    | 0.0798                           | 0.2523    | 0.0035                           | 1423      | 28                               | 1440      | 20 | 1450 | 18 |
| 4  | 89                     | 175               | 0.60                                       | 0.0024                           | 0.5453    | 0.0229                           | 0.0717    | 0.0011                           | 417       | 66                               | 442       | 15 | 447  | 7  |
| 5  | 169                    | 323               | 0.61                                       | 0.0027                           | 0.6654    | 0.0301                           | 0.0830    | 0.0013                           | 534       | 71                               | 518       | 18 | 514  | 8  |
| 6  | 160                    | 41                | 0.28                                       | 0.0023                           | 3.2941    | 0.0828                           | 0.2560    | 0.0036                           | 1494      | 27                               | 1480      | 20 | 1469 | 18 |
| 7  | 330                    | 79                | 0.27                                       | 0.0026                           | 3.0722    | 0.0781                           | 0.2449    | 0.0033                           | 1446      | 56                               | 1426      | 19 | 1412 | 17 |
| 8  | 896                    | 25                | 0.02                                       | 0.0012                           | 2.3175    | 0.0374                           | 0.2070    | 0.0026                           | 1226      | 15                               | 1218      | 11 | 1213 | 14 |
| 9  | 145                    | 123               | 0.83                                       | 0.0020                           | 2.8406    | 0.0649                           | 0.2284    | 0.0031                           | 1430      | 24                               | 1366      | 17 | 1326 | 16 |
| 10                                       | 160                    | 215               | 0.43                                       | 0.0017                           | 0.5742    | 0.0167                           | 0.0735    | 0.0010                           | 479       | 41                               | 461       | 11 | 457  | 6  |
| 11                                       | 313                    | 730               | 0.67                                       | 0.0023                           | 1.2959    | 0.0221                           | 0.0666    | 0.0009                           | 2240      | 14                               | 844       | 10 | 416  | 5  |
| 12                                       | 893                    | 35                | 0.04                                       | 0.0016                           | 3.5537    | 0.0643                           | 0.2759    | 0.0035                           | 1496      | 17                               | 1539      | 14 | 1571 | 18 |
| 13                                       | 612                    | 50                | 0.10                                       | 0.0026                           | 4.7329    | 0.0938                           | 0.3103    | 0.0040                           | 1810      | 44                               | 1773      | 17 | 1742 | 20 |

续附表 4

| 测点<br>编号 | 含量( $\times 10^{-6}$ ) |                   |                  | $^{232}\text{Th}$<br>$^{238}\text{U}$ | 同位素比值                             |           |                                  |           | 年龄(Ma)                           |           |                                  |           |                                  |           |      |    |
|----------|------------------------|-------------------|------------------|---------------------------------------|-----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|------|----|
|          | $^{206}\text{Pb}$      | $^{232}\text{Th}$ | $^{238}\text{U}$ |                                       | $^{207}\text{Pb}/^{206}\text{Pb}$ | $1\sigma$ | $^{206}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ | $^{207}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ |      |    |
| 14       | 390                    | 1219              | 1644             | 0.74                                  | 0.0996                            | 0.0112    | 0.5061                           | 0.0560    | 0.0369                           | 0.0007    | 218                              | 1616      | 416                              | 38        | 233  | 5  |
| 15       | 219                    | 523               | 737              | 0.71                                  | 0.1069                            | 0.0031    | 1.0985                           | 0.0314    | 0.0745                           | 0.0011    | 31                               | 1747      | 753                              | 15        | 463  | 7  |
| 16       | 124                    | 84                | 85               | 0.99                                  | 0.1066                            | 0.0032    | 4.5553                           | 0.1350    | 0.3098                           | 0.0048    | 32                               | 1742      | 1741                             | 25        | 1740 | 23 |
| 17       | 316                    | 453               | 1158             | 0.39                                  | 0.0792                            | 0.0055    | 0.6970                           | 0.0465    | 0.0638                           | 0.0011    | 140                              | 1178      | 537                              | 28        | 399  | 7  |
| 18       | 53                     | 40                | 167              | 0.24                                  | 0.0553                            | 0.0028    | 0.5406                           | 0.0268    | 0.0709                           | 0.0012    | 82                               | 425       | 439                              | 18        | 441  | 7  |
| 19       | 202                    | 178               | 237              | 0.75                                  | 0.0768                            | 0.0036    | 2.0447                           | 0.0916    | 0.1931                           | 0.0029    | 97                               | 1116      | 1131                             | 31        | 1138 | 16 |
| 20       | 159                    | 39                | 168              | 0.23                                  | 0.0765                            | 0.0024    | 1.9980                           | 0.0561    | 0.1895                           | 0.0025    | 63                               | 1108      | 1115                             | 19        | 1118 | 14 |
| 21       | 68                     | 103               | 258              | 0.40                                  | 0.0530                            | 0.0026    | 0.4665                           | 0.0228    | 0.0639                           | 0.0010    | 82                               | 327       | 389                              | 16        | 399  | 6  |
| 22       | 395                    | 264               | 452              | 0.58                                  | 0.0803                            | 0.0024    | 2.2920                           | 0.0614    | 0.2071                           | 0.0027    | 60                               | 1204      | 1210                             | 19        | 1213 | 14 |
| 23       | 426                    | 118               | 803              | 0.15                                  | 0.0662                            | 0.0018    | 1.0941                           | 0.0268    | 0.1199                           | 0.0015    | 59                               | 812       | 750                              | 13        | 730  | 9  |
| 24       | 97                     | 127               | 323              | 0.39                                  | 0.0555                            | 0.0021    | 0.5641                           | 0.0210    | 0.0737                           | 0.0011    | 57                               | 432       | 454                              | 14        | 458  | 6  |
| 25       | 49                     | 155               | 169              | 0.92                                  | 0.0556                            | 0.0031    | 0.5428                           | 0.0300    | 0.0707                           | 0.0012    | 92                               | 438       | 440                              | 20        | 441  | 7  |
| 26       | 56                     | 63                | 186              | 0.34                                  | 0.0565                            | 0.0029    | 0.5577                           | 0.0280    | 0.0716                           | 0.0012    | 82                               | 471       | 450                              | 18        | 446  | 7  |
| 27       | 197                    | 128               | 195              | 0.66                                  | 0.0835                            | 0.0036    | 2.5900                           | 0.1046    | 0.2249                           | 0.0034    | 86                               | 1282      | 1298                             | 30        | 1308 | 18 |
| 28       | 441                    | 752               | 722              | 1.04                                  | 0.0683                            | 0.0012    | 1.4107                           | 0.0260    | 0.1499                           | 0.0019    | 19                               | 876       | 893                              | 11        | 900  | 10 |
| 29       | 68                     | 75                | 240              | 0.31                                  | 0.0556                            | 0.0025    | 0.5448                           | 0.0243    | 0.0710                           | 0.0011    | 72                               | 438       | 442                              | 16        | 442  | 7  |
| 30       | 513                    | 322               | 519              | 0.62                                  | 0.0876                            | 0.0020    | 2.9475                           | 0.0675    | 0.2440                           | 0.0033    | 24                               | 1374      | 1394                             | 17        | 1407 | 17 |
| 31       | 473                    | 85                | 375              | 0.23                                  | 0.1070                            | 0.0033    | 4.5846                           | 0.1238    | 0.3106                           | 0.0044    | 57                               | 1750      | 1746                             | 23        | 1744 | 22 |
| 32       | 27                     | 28                | 83               | 0.33                                  | 0.0577                            | 0.0038    | 0.5790                           | 0.0372    | 0.0728                           | 0.0014    | 108                              | 518       | 464                              | 24        | 453  | 8  |
| 33       | 647                    | 718               | 1330             | 0.54                                  | 0.1027                            | 0.0019    | 1.6285                           | 0.0306    | 0.1151                           | 0.0015    | 17                               | 1673      | 981                              | 12        | 702  | 8  |
| 34       | 93                     | 263               | 300              | 0.88                                  | 0.0575                            | 0.0035    | 0.5802                           | 0.0345    | 0.0732                           | 0.0014    | 98                               | 511       | 465                              | 22        | 455  | 8  |
| 35       | 94                     | 179               | 294              | 0.61                                  | 0.0575                            | 0.0022    | 0.5667                           | 0.0213    | 0.0715                           | 0.0010    | 57                               | 509       | 456                              | 14        | 445  | 6  |
| 36       | 189                    | 384               | 619              | 0.62                                  | 0.0554                            | 0.0016    | 0.5440                           | 0.0156    | 0.0713                           | 0.0010    | 40                               | 427       | 441                              | 10        | 444  | 6  |
| 37       | 114                    | 261               | 378              | 0.69                                  | 0.0563                            | 0.0020    | 0.5506                           | 0.0191    | 0.0710                           | 0.0010    | 52                               | 463       | 445                              | 12        | 442  | 6  |
| 38       | 86                     | 113               | 92               | 1.24                                  | 0.0824                            | 0.0037    | 2.4989                           | 0.1095    | 0.2200                           | 0.0039    | 58                               | 1254      | 1272                             | 32        | 1282 | 20 |
| 39       | 261                    | 397               | 852              | 0.47                                  | 0.0577                            | 0.0014    | 0.5768                           | 0.0137    | 0.0725                           | 0.0009    | 30                               | 518       | 462                              | 9         | 451  | 6  |
| 40       | 422                    | 147               | 557              | 0.26                                  | 0.0838                            | 0.0021    | 2.3730                           | 0.0590    | 0.2053                           | 0.0028    | 28                               | 1288      | 1234                             | 18        | 1204 | 15 |
| 41       | 800                    | 97                | 655              | 0.15                                  | 0.0922                            | 0.0015    | 2.9903                           | 0.0518    | 0.2353                           | 0.0029    | 16                               | 1471      | 1405                             | 13        | 1362 | 15 |
| 42       | 102                    | 56                | 86               | 0.65                                  | 0.0906                            | 0.0025    | 3.2653                           | 0.0885    | 0.2615                           | 0.0037    | 30                               | 1437      | 1473                             | 21        | 1498 | 19 |
| 43       | 117                    | 90                | 438              | 0.21                                  | 0.0559                            | 0.0024    | 0.4926                           | 0.0209    | 0.0639                           | 0.0010    | 67                               | 448       | 407                              | 14        | 399  | 6  |
| 44       | 835                    | 830               | 1864             | 0.45                                  | 0.1761                            | 0.0062    | 2.2376                           | 0.0711    | 0.0922                           | 0.0014    | 60                               | 2616      | 1193                             | 22        | 568  | 8  |
| 45       | 235                    | 178               | 256              | 0.70                                  | 0.0872                            | 0.0024    | 2.7682                           | 0.0760    | 0.2302                           | 0.0033    | 31                               | 1365      | 1347                             | 20        | 1335 | 17 |
| 46       | 147                    | 230               | 458              | 0.50                                  | 0.0561                            | 0.0018    | 0.5641                           | 0.0175    | 0.0729                           | 0.0010    | 45                               | 456       | 454                              | 11        | 454  | 6  |
| 47       | 394                    | 135               | 349              | 0.39                                  | 0.0928                            | 0.0022    | 3.3504                           | 0.0810    | 0.2618                           | 0.0036    | 26                               | 1484      | 1493                             | 19        | 1499 | 18 |
| 48       | 433                    | 168               | 405              | 0.41                                  | 0.0907                            | 0.0015    | 3.1658                           | 0.0544    | 0.2532                           | 0.0031    | 16                               | 1440      | 1449                             | 13        | 1455 | 16 |
| 49       | 212                    | 290               | 294              | 0.99                                  | 0.0735                            | 0.0024    | 1.5357                           | 0.0504    | 0.1515                           | 0.0022    | 43                               | 1028      | 945                              | 20        | 910  | 12 |
| 50       | 119                    | 275               | 412              | 0.67                                  | 0.0551                            | 0.0024    | 0.4844                           | 0.0205    | 0.0637                           | 0.0010    | 67                               | 417       | 401                              | 14        | 398  | 6  |

续附表 4

| 测点<br>编号 | 含量( $\times 10^{-6}$ ) |                   |                  | $^{232}\text{Th}$<br>$^{238}\text{U}$ | 同位素比值                             |                                  |                                  |                                   | 年龄(Ma)    |                                  |           |                                  |           |           |           |           |
|----------|------------------------|-------------------|------------------|---------------------------------------|-----------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|-----------|-----------|-----------|
|          | $^{206}\text{Pb}$      | $^{232}\text{Th}$ | $^{238}\text{U}$ |                                       | $^{207}\text{Pb}/^{206}\text{Pb}$ | $^{207}\text{Pb}/^{235}\text{U}$ | $^{206}\text{Pb}/^{238}\text{U}$ | $^{207}\text{Pb}/^{206}\text{Pb}$ | $1\sigma$ | $^{207}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ |           |           |           |
|          |                        |                   |                  |                                       |                                   |                                  |                                  |                                   |           |                                  |           |                                  |           | $1\sigma$ | $1\sigma$ | $1\sigma$ |
| 51       | 304                    | 303               | 1016             | 0.30                                  | 0.0556                            | 0.0012                           | 0.5584                           | 0.0125                            | 0.0728    | 0.0009                           | 438       | 28                               | 450       | 8         | 453       | 5         |
| 52       | 203                    | 363               | 641              | 0.57                                  | 0.0557                            | 0.0036                           | 0.5467                           | 0.0341                            | 0.0712    | 0.0010                           | 439       | 147                              | 443       | 22        | 444       | 6         |
| 53       | 33                     | 55                | 114              | 0.48                                  | 0.0555                            | 0.0045                           | 0.5026                           | 0.0400                            | 0.0658    | 0.0014                           | 430       | 140                              | 413       | 27        | 410       | 9         |
| 54       | 77                     | 158               | 262              | 0.60                                  | 0.0567                            | 0.0030                           | 0.5113                           | 0.0264                            | 0.0654    | 0.0011                           | 481       | 84                               | 419       | 18        | 408       | 7         |
| 55       | 145                    | 68                | 164              | 0.42                                  | 0.0803                            | 0.0023                           | 2.2632                           | 0.0650                            | 0.2044    | 0.0029                           | 1204      | 35                               | 1201      | 20        | 1199      | 15        |
| 56       | 18                     | 22                | 58               | 0.38                                  | 0.0574                            | 0.0054                           | 0.5753                           | 0.0534                            | 0.0727    | 0.0017                           | 508       | 166                              | 461       | 34        | 452       | 10        |
| 57       | 178                    | 406               | 564              | 0.72                                  | 0.0602                            | 0.0018                           | 0.5939                           | 0.0177                            | 0.0716    | 0.0010                           | 611       | 41                               | 473       | 11        | 445       | 6         |
| 58       | 397                    | 355               | 1364             | 0.26                                  | 0.0562                            | 0.0046                           | 0.5055                           | 0.0401                            | 0.0653    | 0.0011                           | 460       | 185                              | 415       | 27        | 408       | 6         |
| 59       | 378                    | 374               | 1378             | 0.27                                  | 0.0610                            | 0.0040                           | 0.5219                           | 0.0329                            | 0.0621    | 0.0010                           | 638       | 144                              | 426       | 22        | 388       | 6         |
| 60       | 601                    | 840               | 1992             | 0.42                                  | 0.0461                            | 0.0039                           | 0.3748                           | 0.0315                            | 0.0590    | 0.0008                           | 349       | 188                              | 323       | 23        | 370       | 5         |
| 61       | 66                     | 138               | 215              | 0.65                                  | 0.0535                            | 0.0034                           | 0.5388                           | 0.0333                            | 0.0731    | 0.0013                           | 349       | 107                              | 438       | 22        | 455       | 8         |
| 62       | 356                    | 84                | 533              | 0.16                                  | 0.0684                            | 0.0013                           | 1.4272                           | 0.0278                            | 0.1513    | 0.0019                           | 881       | 21                               | 900       | 12        | 908       | 11        |
| 63       | 34                     | 109               | 111              | 0.99                                  | 0.0548                            | 0.0037                           | 0.5428                           | 0.0360                            | 0.0718    | 0.0013                           | 405       | 115                              | 440       | 24        | 447       | 8         |
| 64       | 149                    | 145               | 477              | 0.30                                  | 0.0814                            | 0.0050                           | 0.9847                           | 0.0589                            | 0.0878    | 0.0018                           | 1231      | 85                               | 696       | 30        | 542       | 11        |
| 65       | 39                     | 64                | 124              | 0.52                                  | 0.0533                            | 0.0034                           | 0.5230                           | 0.0326                            | 0.0712    | 0.0013                           | 341       | 109                              | 427       | 22        | 443       | 8         |
| 66       | 63                     | 158               | 216              | 0.73                                  | 0.0542                            | 0.0026                           | 0.4855                           | 0.0231                            | 0.0650    | 0.0010                           | 378       | 78                               | 402       | 16        | 406       | 6         |
| 67       | 314                    | 39                | 374              | 0.10                                  | 0.0793                            | 0.0019                           | 2.1831                           | 0.0460                            | 0.1997    | 0.0025                           | 1180      | 50                               | 1176      | 15        | 1173      | 13        |
| 68       | 225                    | 833               | 757              | 1.10                                  | 0.1355                            | 0.0032                           | 1.1231                           | 0.0262                            | 0.0601    | 0.0008                           | 2170      | 22                               | 764       | 13        | 376       | 5         |
| 69       | 379                    | 73                | 165              | 0.44                                  | 0.1965                            | 0.0028                           | 14.5251                          | 0.2148                            | 0.5362    | 0.0067                           | 2797      | 11                               | 2785      | 14        | 2768      | 28        |
| 70       | 79                     | 121               | 274              | 0.44                                  | 0.0563                            | 0.0028                           | 0.5023                           | 0.0244                            | 0.0647    | 0.0011                           | 463       | 79                               | 413       | 16        | 404       | 6         |
| 71       | 198                    | 461               | 632              | 0.73                                  | 0.0611                            | 0.0037                           | 0.6677                           | 0.0391                            | 0.0792    | 0.0015                           | 644       | 94                               | 519       | 24        | 491       | 9         |
| 72       | 87                     | 82                | 278              | 0.30                                  | 0.0569                            | 0.0026                           | 0.5189                           | 0.0237                            | 0.0662    | 0.0010                           | 486       | 73                               | 424       | 16        | 413       | 6         |
| 73       | 100                    | 185               | 318              | 0.58                                  | 0.0568                            | 0.0022                           | 0.5701                           | 0.0220                            | 0.0728    | 0.0011                           | 485       | 60                               | 458       | 14        | 453       | 6         |
| 74       | 287                    | 259               | 934              | 0.28                                  | 0.0544                            | 0.0027                           | 0.4761                           | 0.0224                            | 0.0635    | 0.0009                           | 388       | 113                              | 395       | 15        | 397       | 5         |
| 75       | 436                    | 56                | 499              | 0.11                                  | 0.0790                            | 0.0018                           | 2.0693                           | 0.0395                            | 0.1900    | 0.0023                           | 1172      | 46                               | 1139      | 13        | 1121      | 12        |
| 76       | 546                    | 50                | 668              | 0.07                                  | 0.0716                            | 0.0012                           | 1.4981                           | 0.0267                            | 0.1517    | 0.0019                           | 975       | 18                               | 930       | 11        | 911       | 10        |
| 77       | 244                    | 462               | 851              | 0.54                                  | 0.0563                            | 0.0037                           | 0.4537                           | 0.0293                            | 0.0584    | 0.0009                           | 465       | 151                              | 380       | 20        | 366       | 5         |
| 78       | 74                     | 10                | 32               | 0.33                                  | 0.1794                            | 0.0039                           | 11.8148                          | 0.2574                            | 0.4777    | 0.0070                           | 2648      | 18                               | 2590      | 20        | 2517      | 30        |
| 79       | 33                     | 50                | 103              | 0.48                                  | 0.0574                            | 0.0038                           | 0.5721                           | 0.0372                            | 0.0724    | 0.0013                           | 506       | 111                              | 459       | 24        | 450       | 8         |
| 80       | 405                    | 2183              | 2083             | 1.05                                  | 0.0577                            | 0.0022                           | 0.6485                           | 0.0239                            | 0.0816    | 0.0012                           | 517       | 55                               | 508       | 15        | 505       | 7         |
| 81       | 79                     | 30                | 68               | 0.44                                  | 0.0931                            | 0.0031                           | 3.3738                           | 0.1099                            | 0.2630    | 0.0040                           | 1489      | 39                               | 1498      | 26        | 1505      | 20        |
| 82       | 106                    | 158               | 321              | 0.49                                  | 0.0537                            | 0.0025                           | 0.5322                           | 0.0245                            | 0.0719    | 0.0011                           | 357       | 76                               | 433       | 16        | 448       | 7         |
| 83       | 65                     | 94                | 205              | 0.46                                  | 0.0572                            | 0.0028                           | 0.5651                           | 0.0273                            | 0.0717    | 0.0011                           | 500       | 78                               | 455       | 18        | 446       | 7         |
| 84       | 285                    | 134               | 262              | 0.51                                  | 0.0892                            | 0.0024                           | 2.8918                           | 0.0772                            | 0.2352    | 0.0033                           | 1409      | 30                               | 1380      | 20        | 1362      | 17        |
| 85       | 75                     | 126               | 226              | 0.56                                  | 0.0545                            | 0.0033                           | 0.5462                           | 0.0327                            | 0.0727    | 0.0013                           | 393       | 103                              | 443       | 21        | 452       | 8         |
| 86       | 501                    | 1431              | 1479             | 0.97                                  | 0.0544                            | 0.0062                           | 0.4808                           | 0.0544                            | 0.0641    | 0.0012                           | 388       | 262                              | 399       | 37        | 400       | 7         |
| 87       | 558                    | 1472              | 1821             | 0.81                                  | 0.1086                            | 0.0098                           | 0.8146                           | 0.0721                            | 0.0544    | 0.0010                           | 1776      | 171                              | 605       | 40        | 342       | 6         |

续附表 4

| 测点<br>编号                                   | 含量( $\times 10^{-6}$ ) |                   | $^{232}\text{Th}$<br>/<br>$^{238}\text{U}$ | 同位素比值                             |                                  |                                  |           | 年龄(Ma)    |                                   |           |                                  |           |                                  |
|--|------------------------|-------------------|--|-----------------------------------|----------------------------------|----------------------------------|-----------|-----------|-----------------------------------|-----------|----------------------------------|-----------|----------------------------------|
|  | $^{206}\text{Pb}$      | $^{232}\text{Th}$ |  | $^{207}\text{Pb}/^{206}\text{Pb}$ | $^{207}\text{Pb}/^{235}\text{U}$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ | $1\sigma$ | $^{207}\text{Pb}/^{206}\text{Pb}$ | $1\sigma$ | $^{207}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ |
| 88   | 27                     | 30                | 0.36                                       | 0.051                             | 0.5959                           | 0.0506                           | 0.0733    | 0.0016    | 149                               | 475       | 32                               | 456       | 9                                |
| 89   | 128                    | 39                | 0.34                                       | 0.028                             | 3.1907                           | 0.0987                           | 0.2588    | 0.0038    | 37                                | 1455      | 24                               | 1484      | 20                               |
| 90   | 207                    | 401               | 0.65                                       | 0.053                             | 0.4755                           | 0.0441                           | 0.0615    | 0.0012    | 216                               | 395       | 30                               | 385       | 7                                |
| 91   | 123                    | 184               | 0.48                                       | 0.026                             | 0.5693                           | 0.0253                           | 0.0730    | 0.0011    | 71                                | 458       | 16                               | 454       | 7                                |
| 92   | 86                     | 29                | 0.71                                       | 0.048                             | 11.7446                          | 0.3108                           | 0.4754    | 0.0078    | 23                                | 2584      | 25                               | 2507      | 34                               |
| 93   | 78                     | 138               | 0.53                                       | 0.044                             | 0.5229                           | 0.0421                           | 0.0710    | 0.0015    | 144                               | 427       | 28                               | 442       | 9                                |
| 94   | 47                     | 52                | 0.89                                       | 0.069                             | 1.8523                           | 0.1653                           | 0.1791    | 0.0048    | 137                               | 1064      | 59                               | 1062      | 26                               |
| 95   | 404                    | 360               | 0.28                                       | 0.079                             | 0.5455                           | 0.0553                           | 0.0523    | 0.0012    | 217                               | 442       | 36                               | 328       | 7                                |
| 双堡塘组(样品 15DSS-Z1, N 40°33'45" E 94°04'53") |                        |                   |  |                                   |                                  |                                  |           |           |                                   |           |                                  |           |                                  |
| 1  | 59                     | 324               | 1.19                                       | 0.030                             | 0.3378                           | 0.0181                           | 0.0451    | 0.0007    | 91                                | 295       | 14                               | 284       | 5                                |
| 2  | 19                     | 47                | 0.46                                       | 0.032                             | 0.3567                           | 0.0210                           | 0.0492    | 0.0008    | 104                               | 310       | 16                               | 309       | 5                                |
| 3  | 57                     | 139               | 0.52                                       | 0.051                             | 0.3728                           | 0.0349                           | 0.0503    | 0.0011    | 170                               | 322       | 26                               | 316       | 7                                |
| 4  | 79                     | 279               | 0.69                                       | 0.024                             | 0.3465                           | 0.0157                           | 0.0475    | 0.0007    | 76                                | 302       | 12                               | 299       | 4                                |
| 5  | 21                     | 58                | 0.55                                       | 0.026                             | 0.3334                           | 0.0155                           | 0.0445    | 0.0007    | 77                                | 292       | 12                               | 281       | 4                                |
| 6  | 86                     | 200               | 0.55                                       | 0.022                             | 0.3749                           | 0.0132                           | 0.0473    | 0.0006    | 84                                | 323       | 10                               | 298       | 4                                |
| 7  | 54                     | 129               | 0.49                                       | 0.037                             | 0.3821                           | 0.0256                           | 0.0510    | 0.0009    | 118                               | 329       | 19                               | 321       | 6                                |
| 8  | 45                     | 129               | 0.58                                       | 0.077                             | 0.3455                           | 0.0474                           | 0.0455    | 0.0012    | 261                               | 301       | 36                               | 287       | 7                                |
| 9  | 36                     | 192               | 1.06                                       | 0.068                             | 0.4024                           | 0.0461                           | 0.0504    | 0.0013    | 209                               | 343       | 33                               | 317       | 8                                |
| 10   | 32                     | 56                | 0.34                                       | 0.072                             | 0.4103                           | 0.0407                           | 0.0421    | 0.0012    | 158                               | 349       | 29                               | 266       | 7                                |
| 11   | 49                     | 96                | 0.42                                       | 0.053                             | 0.3683                           | 0.0351                           | 0.0488    | 0.0012    | 172                               | 318       | 26                               | 307       | 7                                |
| 12   | 98                     | 284               | 0.56                                       | 0.160                             | 0.3434                           | 0.1027                           | 0.0468    | 0.0017    | 491                               | 300       | 78                               | 295       | 11                               |
| 13   | 35                     | 96                | 0.52                                       | 0.036                             | 0.3566                           | 0.0229                           | 0.0476    | 0.0009    | 112                               | 310       | 17                               | 300       | 5                                |
| 14   | 56                     | 185               | 0.67                                       | 0.080                             | 0.3856                           | 0.0525                           | 0.0489    | 0.0015    | 247                               | 331       | 38                               | 308       | 9                                |
| 15   | 70                     | 166               | 0.48                                       | 0.037                             | 0.3851                           | 0.0244                           | 0.0497    | 0.0008    | 149                               | 331       | 18                               | 312       | 5                                |
| 16   | 82                     | 203               | 0.49                                       | 0.028                             | 0.3475                           | 0.0183                           | 0.0485    | 0.0008    | 283                               | 303       | 14                               | 305       | 5                                |
| 17   | 32                     | 147               | 0.87                                       | 0.039                             | 0.3637                           | 0.0258                           | 0.0487    | 0.0009    | 126                               | 315       | 19                               | 307       | 6                                |
| 18   | 54                     | 138               | 0.55                                       | 0.026                             | 0.3445                           | 0.0172                           | 0.0486    | 0.0008    | 86                                | 301       | 13                               | 306       | 5                                |
| 19   | 31                     | 63                | 0.39                                       | 0.034                             | 0.3634                           | 0.0221                           | 0.0481    | 0.0009    | 104                               | 315       | 16                               | 303       | 5                                |
| 20   | 76                     | 250               | 0.68                                       | 0.046                             | 0.3547                           | 0.0303                           | 0.0483    | 0.0010    | 156                               | 308       | 23                               | 304       | 6                                |
| 21   | 26                     | 69                | 0.55                                       | 0.029                             | 0.3953                           | 0.0197                           | 0.0510    | 0.0008    | 81                                | 338       | 14                               | 321       | 5                                |
| 22   | 86                     | 306               | 0.74                                       | 0.025                             | 0.3415                           | 0.0158                           | 0.0467    | 0.0007    | 77                                | 298       | 12                               | 294       | 4                                |
| 23   | 78                     | 249               | 0.71                                       | 0.030                             | 0.3401                           | 0.0187                           | 0.0467    | 0.0008    | 95                                | 297       | 14                               | 294       | 5                                |
| 24   | 53                     | 157               | 0.56                                       | 0.035                             | 0.3374                           | 0.0219                           | 0.0468    | 0.0008    | 116                               | 295       | 17                               | 295       | 5                                |
| 25   | 59                     | 194               | 0.68                                       | 0.042                             | 0.3335                           | 0.0263                           | 0.0463    | 0.0010    | 142                               | 292       | 20                               | 292       | 6                                |
| 26   | 18                     | 53                | 0.61                                       | 0.032                             | 0.3695                           | 0.0216                           | 0.0498    | 0.0009    | 101                               | 319       | 16                               | 313       | 5                                |
| 27   | 20                     | 57                | 0.55                                       | 0.019                             | 0.3253                           | 0.0117                           | 0.0460    | 0.0006    | 57                                | 286       | 9                                | 290       | 4                                |
| 28   | 69                     | 125               | 0.37                                       | 0.036                             | 0.3421                           | 0.0225                           | 0.0456    | 0.0008    | 115                               | 299       | 17                               | 288       | 5                                |

续附表 4

| 测点<br>编号 | 含量( $\times 10^{-6}$ ) |                   | $^{232}\text{Th}$<br>/<br>$^{238}\text{U}$ | 同位素比值                             |                                  |                                  |                                   | 年龄(Ma)    |                                  |           |                                  |           |           |           |           |
|----------|------------------------|-------------------|--|-----------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|-----------|-----------|-----------|
|          | $^{206}\text{Pb}$      | $^{232}\text{Th}$ |  | $^{207}\text{Pb}/^{206}\text{Pb}$ | $^{207}\text{Pb}/^{235}\text{U}$ | $^{206}\text{Pb}/^{238}\text{U}$ | $^{207}\text{Pb}/^{206}\text{Pb}$ | $1\sigma$ | $^{207}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ |           |           |           |
|          |                        |                   |  |                                   |                                  |                                  |                                   |           |                                  |           |                                  |           | $1\sigma$ | $1\sigma$ | $1\sigma$ |
| 29       | 86                     | 388               | 0.97                                       | 0.0543                            | 0.0030                           | 0.3614                           | 0.0196                            | 0.0483    | 0.0008                           | 384       | 91                               | 313       | 15        | 304       | 5         |
| 30       | 78                     | 119               | 0.31                                       | 0.0556                            | 0.0027                           | 0.3544                           | 0.0170                            | 0.0462    | 0.0007                           | 436       | 79                               | 308       | 13        | 291       | 4         |
| 31       | 29                     | 55                | 0.39                                       | 0.0520                            | 0.0021                           | 0.3354                           | 0.0132                            | 0.0468    | 0.0007                           | 283       | 64                               | 294       | 10        | 295       | 4         |
| 32       | 55                     | 121               | 0.47                                       | 0.0506                            | 0.0060                           | 0.3354                           | 0.0390                            | 0.0481    | 0.0013                           | 221       | 212                              | 294       | 30        | 303       | 8         |
| 33       | 45                     | 103               | 0.44                                       | 0.0519                            | 0.0031                           | 0.3418                           | 0.0198                            | 0.0478    | 0.0008                           | 281       | 101                              | 299       | 15        | 301       | 5         |
| 34       | 21                     | 43                | 0.40                                       | 0.0522                            | 0.0043                           | 0.3280                           | 0.0266                            | 0.0456    | 0.0008                           | 294       | 190                              | 288       | 20        | 287       | 5         |
| 35       | 47                     | 103               | 0.43                                       | 0.0530                            | 0.0029                           | 0.3503                           | 0.0187                            | 0.0479    | 0.0008                           | 331       | 91                               | 305       | 14        | 302       | 5         |
| 36       | 33                     | 82                | 0.50                                       | 0.0524                            | 0.0056                           | 0.3362                           | 0.0362                            | 0.0466    | 0.0012                           | 301       | 189                              | 294       | 27        | 293       | 8         |
| 37       | 75                     | 264               | 0.72                                       | 0.0570                            | 0.0023                           | 0.3422                           | 0.0138                            | 0.0435    | 0.0006                           | 493       | 63                               | 299       | 10        | 275       | 4         |
| 38       | 34                     | 81                | 0.47                                       | 0.0812                            | 0.0041                           | 0.4765                           | 0.0231                            | 0.0426    | 0.0008                           | 1225      | 67                               | 396       | 16        | 269       | 5         |
| 39       | 444                    | 439               | 0.21                                       | 0.0532                            | 0.0026                           | 0.3299                           | 0.0157                            | 0.0450    | 0.0007                           | 338       | 80                               | 289       | 12        | 284       | 4         |
| 40       | 49                     | 113               | 0.47                                       | 0.0533                            | 0.0032                           | 0.3612                           | 0.0216                            | 0.0492    | 0.0009                           | 340       | 104                              | 313       | 16        | 310       | 5         |
| 41       | 14                     | 32                | 0.42                                       | 0.0568                            | 0.0071                           | 0.4024                           | 0.0494                            | 0.0514    | 0.0015                           | 485       | 220                              | 343       | 36        | 323       | 9         |
| 42       | 22                     | 45                | 0.41                                       | 0.0559                            | 0.0053                           | 0.3466                           | 0.0320                            | 0.0450    | 0.0010                           | 449       | 167                              | 302       | 24        | 283       | 6         |
| 43       | 38                     | 100               | 0.52                                       | 0.0520                            | 0.0022                           | 0.3237                           | 0.0132                            | 0.0452    | 0.0007                           | 285       | 67                               | 285       | 10        | 285       | 4         |
| 44       | 53                     | 125               | 0.45                                       | 0.0523                            | 0.0035                           | 0.3426                           | 0.0223                            | 0.0475    | 0.0009                           | 299       | 115                              | 299       | 17        | 299       | 5         |
| 45       | 153                    | 688               | 0.92                                       | 0.0563                            | 0.0028                           | 0.3483                           | 0.0168                            | 0.0448    | 0.0007                           | 466       | 78                               | 303       | 13        | 283       | 4         |
| 46       | 54                     | 111               | 0.40                                       | 0.0520                            | 0.0043                           | 0.3219                           | 0.0257                            | 0.0449    | 0.0008                           | 285       | 187                              | 283       | 20        | 283       | 5         |
| 47       | 19                     | 84                | 0.82                                       | 0.0515                            | 0.0025                           | 0.3521                           | 0.0168                            | 0.0496    | 0.0008                           | 262       | 81                               | 306       | 13        | 312       | 5         |
| 48       | 50                     | 171               | 0.69                                       | 0.0554                            | 0.0029                           | 0.3485                           | 0.0181                            | 0.0456    | 0.0008                           | 428       | 86                               | 304       | 14        | 288       | 5         |
| 49       | 154                    | 522               | 0.65                                       | 0.0524                            | 0.0057                           | 0.3449                           | 0.0367                            | 0.0477    | 0.0012                           | 302       | 195                              | 301       | 28        | 301       | 7         |
| 50       | 27                     | 83                | 0.59                                       | 0.0549                            | 0.0029                           | 0.3546                           | 0.0185                            | 0.0469    | 0.0008                           | 407       | 88                               | 308       | 14        | 295       | 5         |
| 51       | 12                     | 21                | 0.38                                       | 0.0552                            | 0.0042                           | 0.3367                           | 0.0253                            | 0.0443    | 0.0009                           | 418       | 132                              | 295       | 19        | 279       | 6         |
| 52       | 159                    | 873               | 0.94                                       | 0.0527                            | 0.0023                           | 0.3452                           | 0.0149                            | 0.0475    | 0.0007                           | 315       | 71                               | 301       | 11        | 299       | 4         |
| 53       | 256                    | 1957              | 1.47                                       | 0.0569                            | 0.0038                           | 0.3637                           | 0.0238                            | 0.0464    | 0.0009                           | 487       | 112                              | 315       | 18        | 292       | 5         |
| 54       | 19                     | 33                | 0.35                                       | 0.0481                            | 0.0015                           | 0.3359                           | 0.0103                            | 0.0506    | 0.0006                           | 106       | 49                               | 294       | 8         | 318       | 4         |
| 55       | 393                    | 132               | 0.13                                       | 0.0528                            | 0.0049                           | 0.3737                           | 0.0338                            | 0.0513    | 0.0012                           | 321       | 163                              | 322       | 25        | 323       | 7         |
| 56       | 40                     | 115               | 0.62                                       | 0.0552                            | 0.0071                           | 0.3358                           | 0.0423                            | 0.0441    | 0.0013                           | 419       | 230                              | 294       | 32        | 278       | 8         |
| 57       | 24                     | 44                | 0.39                                       | 0.0487                            | 0.0065                           | 0.3493                           | 0.0459                            | 0.0520    | 0.0015                           | 135       | 237                              | 304       | 35        | 327       | 9         |
| 58       | 81                     | 309               | 0.70                                       | 0.0538                            | 0.0033                           | 0.3590                           | 0.0216                            | 0.0484    | 0.0008                           | 361       | 105                              | 311       | 16        | 305       | 5         |
| 59       | 205                    | 940               | 0.52                                       | 0.0530                            | 0.0027                           | 0.3378                           | 0.0169                            | 0.0462    | 0.0007                           | 329       | 85                               | 296       | 13        | 291       | 4         |
| 60       | 35                     | 132               | 0.80                                       | 0.0623                            | 0.0022                           | 0.3824                           | 0.0134                            | 0.0445    | 0.0006                           | 683       | 50                               | 329       | 10        | 281       | 4         |
| 61       | 162                    | 546               | 0.67                                       | 0.0531                            | 0.0028                           | 0.3367                           | 0.0175                            | 0.0460    | 0.0007                           | 332       | 89                               | 295       | 13        | 290       | 5         |
| 62       | 15                     | 40                | 0.52                                       | 0.0540                            | 0.0061                           | 0.3375                           | 0.0374                            | 0.0453    | 0.0012                           | 373       | 202                              | 295       | 28        | 286       | 7         |
| 63       | 40                     | 91                | 0.45                                       | 0.0525                            | 0.0032                           | 0.3355                           | 0.0204                            | 0.0463    | 0.0008                           | 307       | 107                              | 294       | 15        | 292       | 5         |
| 64       | 80                     | 119               | 0.30                                       | 0.0548                            | 0.0034                           | 0.3237                           | 0.0196                            | 0.0429    | 0.0006                           | 403       | 144                              | 285       | 15        | 271       | 4         |
| 65       | 34                     | 167               | 1.09                                       | 0.0523                            | 0.0072                           | 0.3449                           | 0.0467                            | 0.0478    | 0.0015                           | 299       | 249                              | 301       | 35        | 301       | 9         |

续附表 4

| 测点<br>编号                                   | 含量( $\times 10^{-6}$ ) |                   | $^{232}\text{Th}$<br>/<br>$^{238}\text{U}$ | 同位素比值                             |                                  |                                  |           | 年龄(Ma)                            |           |                                  |           |                                  |           |      |    |
|--|------------------------|-------------------|--|-----------------------------------|----------------------------------|----------------------------------|-----------|-----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|------|----|
|  | $^{206}\text{Pb}$      | $^{232}\text{Th}$ |  | $^{207}\text{Pb}/^{206}\text{Pb}$ | $^{207}\text{Pb}/^{235}\text{U}$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ | $^{207}\text{Pb}/^{206}\text{Pb}$ | $1\sigma$ | $^{207}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ |      |    |
| 66   | 39                     | 220               | 1.18                                       | 0.0504                            | 0.0090                           | 0.3631                           | 0.0641    | 0.0523                            | 0.0019    | 212                              | 299       | 314                              | 48        | 329  | 11 |
| 67   | 380                    | 2521              | 1.29                                       | 0.0667                            | 0.0044                           | 0.3570                           | 0.0230    | 0.0388                            | 0.0006    | 828                              | 142       | 310                              | 17        | 246  | 4  |
| 68   | 17                     | 38                | 0.47                                       | 0.0539                            | 0.0017                           | 0.3350                           | 0.0104    | 0.0451                            | 0.0006    | 365                              | 46        | 293                              | 8         | 284  | 4  |
| 69   | 36                     | 88                | 0.53                                       | 0.0545                            | 0.0052                           | 0.3525                           | 0.0330    | 0.0469                            | 0.0010    | 393                              | 174       | 307                              | 25        | 295  | 6  |
| 70   | 141                    | 296               | 0.47                                       | 0.0862                            | 0.0027                           | 1.0797                           | 0.0302    | 0.0908                            | 0.0012    | 1344                             | 61        | 744                              | 15        | 560  | 7  |
| 71   | 43                     | 109               | 0.54                                       | 0.0563                            | 0.0041                           | 0.3622                           | 0.0256    | 0.0467                            | 0.0009    | 464                              | 122       | 314                              | 19        | 294  | 6  |
| 72   | 148                    | 691               | 0.94                                       | 0.0545                            | 0.0050                           | 0.3490                           | 0.0311    | 0.0464                            | 0.0011    | 393                              | 160       | 304                              | 23        | 292  | 7  |
| 73   | 60                     | 175               | 0.63                                       | 0.0562                            | 0.0030                           | 0.3483                           | 0.0181    | 0.0450                            | 0.0007    | 460                              | 86        | 303                              | 14        | 283  | 5  |
| 74   | 38                     | 184               | 0.98                                       | 0.0708                            | 0.0059                           | 0.2629                           | 0.0217    | 0.0269                            | 0.0004    | 953                              | 177       | 237                              | 17        | 171  | 3  |
| 75   | 46                     | 183               | 0.81                                       | 0.0569                            | 0.0051                           | 0.3780                           | 0.0332    | 0.0482                            | 0.0011    | 488                              | 155       | 326                              | 24        | 303  | 7  |
| 76   | 71                     | 69                | 0.24                                       | 0.0592                            | 0.0022                           | 0.3604                           | 0.0134    | 0.0441                            | 0.0006    | 576                              | 56        | 313                              | 10        | 278  | 4  |
| 77   | 31                     | 138               | 0.78                                       | 0.0540                            | 0.0071                           | 0.3414                           | 0.0442    | 0.0458                            | 0.0013    | 371                              | 238       | 298                              | 33        | 289  | 8  |
| 78   | 90                     | 405               | 0.86                                       | 0.0570                            | 0.0037                           | 0.3580                           | 0.0225    | 0.0455                            | 0.0008    | 493                              | 107       | 311                              | 17        | 287  | 5  |
| 79   | 34                     | 86                | 0.52                                       | 0.0532                            | 0.0027                           | 0.3369                           | 0.0166    | 0.0459                            | 0.0007    | 338                              | 83        | 295                              | 13        | 289  | 4  |
| 80   | 85                     | 180               | 0.44                                       | 0.0570                            | 0.0044                           | 0.3818                           | 0.0288    | 0.0486                            | 0.0010    | 492                              | 132       | 328                              | 21        | 306  | 6  |
| 81   | 42                     | 66                | 0.32                                       | 0.0525                            | 0.0057                           | 0.3432                           | 0.0363    | 0.0475                            | 0.0009    | 306                              | 246       | 300                              | 27        | 299  | 6  |
| 82   | 43                     | 160               | 0.82                                       | 0.0591                            | 0.0037                           | 0.3485                           | 0.0211    | 0.0428                            | 0.0006    | 571                              | 139       | 304                              | 16        | 270  | 4  |
| 83   | 22                     | 45                | 0.46                                       | 0.0526                            | 0.0094                           | 0.3645                           | 0.0637    | 0.0502                            | 0.0018    | 312                              | 307       | 316                              | 47        | 316  | 11 |
| 84   | 62                     | 138               | 0.47                                       | 0.0513                            | 0.0037                           | 0.3429                           | 0.0240    | 0.0485                            | 0.0009    | 255                              | 127       | 299                              | 18        | 305  | 5  |
| 85   | 63                     | 248               | 0.77                                       | 0.0535                            | 0.0017                           | 0.3679                           | 0.0115    | 0.0498                            | 0.0007    | 351                              | 47        | 318                              | 9         | 313  | 4  |
| 86   | 323                    | 809               | 0.51                                       | 0.0548                            | 0.0043                           | 0.3739                           | 0.0287    | 0.0495                            | 0.0010    | 402                              | 135       | 323                              | 21        | 312  | 6  |
| 87   | 38                     | 122               | 0.72                                       | 0.0557                            | 0.0028                           | 0.3331                           | 0.0163    | 0.0433                            | 0.0007    | 442                              | 81        | 292                              | 12        | 274  | 4  |
| 88   | 8                      | 30                | 0.68                                       | 0.0516                            | 0.0035                           | 0.3544                           | 0.0233    | 0.0498                            | 0.0009    | 269                              | 119       | 308                              | 17        | 313  | 5  |
| 89   | 16                     | 30                | 0.40                                       | 0.0521                            | 0.0048                           | 0.3287                           | 0.0297    | 0.0458                            | 0.0010    | 288                              | 165       | 289                              | 23        | 289  | 6  |
| 90   | 42                     | 194               | 0.99                                       | 0.0567                            | 0.0046                           | 0.3575                           | 0.0283    | 0.0458                            | 0.0009    | 478                              | 139       | 310                              | 21        | 288  | 6  |
| 91   | 26                     | 68                | 0.57                                       | 0.0550                            | 0.0034                           | 0.4236                           | 0.0255    | 0.0559                            | 0.0010    | 410                              | 104       | 359                              | 18        | 351  | 6  |
| 92   | 74                     | 221               | 0.61                                       | 0.0548                            | 0.0056                           | 0.3099                           | 0.0312    | 0.0410                            | 0.0010    | 405                              | 184       | 274                              | 24        | 259  | 6  |
| 93   | 46                     | 119               | 0.56                                       | 0.0554                            | 0.0028                           | 0.3281                           | 0.0164    | 0.0430                            | 0.0007    | 428                              | 83        | 288                              | 13        | 271  | 4  |
| 94   | 18                     | 36                | 0.42                                       | 0.0562                            | 0.0048                           | 0.3474                           | 0.0289    | 0.0449                            | 0.0009    | 458                              | 150       | 303                              | 22        | 283  | 6  |
| 95   | 96                     | 105               | 0.28                                       | 0.0609                            | 0.0026                           | 0.3852                           | 0.0164    | 0.0459                            | 0.0007    | 635                              | 66        | 331                              | 12        | 289  | 4  |
| 双堡塘组(样品 16DSS-Z6, N 40°33'29" E 94°05'24") |                        |                   |  |                                   |                                  |                                  |           |                                   |           |                                  |           |                                  |           |      |    |
| 1  | 16                     | 18                | 0.25                                       | 0.0530                            | 0.0061                           | 0.3635                           | 0.0413    | 0.0498                            | 0.0013    | 327                              | 207       | 315                              | 31        | 313  | 8  |
| 2  | 38                     | 135               | 0.74                                       | 0.0549                            | 0.0038                           | 0.3621                           | 0.0244    | 0.0478                            | 0.0009    | 409                              | 116       | 314                              | 18        | 301  | 6  |
| 3  | 15                     | 35                | 0.48                                       | 0.0534                            | 0.0072                           | 0.3633                           | 0.0484    | 0.0493                            | 0.0015    | 346                              | 245       | 315                              | 36        | 310  | 9  |
| 4  | 31                     | 92                | 0.61                                       | 0.0533                            | 0.0044                           | 0.3483                           | 0.0281    | 0.0474                            | 0.0010    | 343                              | 144       | 303                              | 21        | 298  | 6  |
| 5  | 215                    | 136               | 0.92                                       | 0.1116                            | 0.0030                           | 5.2579                           | 0.1428    | 0.3416                            | 0.0052    | 1826                             | 28        | 1862                             | 23        | 1895 | 25 |
| 6  | 48                     | 109               | 0.48                                       | 0.0548                            | 0.0040                           | 0.3580                           | 0.0259    | 0.0474                            | 0.0010    | 404                              | 126       | 311                              | 19        | 298  | 6  |

续附表 4

| 测点<br>编号 | 含量( $\times 10^{-6}$ ) |                   |                  | $\frac{^{232}\text{Th}}{^{238}\text{U}}$ | 同位素比值                             |          |                                  |          | 年龄(Ma)                           |          |                                  |          |                                  |          |                                   |
|----------|------------------------|-------------------|------------------|--|-----------------------------------|----------|----------------------------------|----------|----------------------------------|----------|----------------------------------|----------|----------------------------------|----------|-----------------------------------|
|          | $^{206}\text{Pb}$      | $^{232}\text{Th}$ | $^{238}\text{U}$ |  | $^{207}\text{Pb}/^{206}\text{Pb}$ | $\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $\sigma$ | $^{207}\text{Pb}/^{235}\text{U}$ | $\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $\sigma$ |                                  |          |                                   |
|          |                        |                   |                  |  |                                   |          |                                  |          |                                  |          |                                  |          | $^{207}\text{Pb}/^{235}\text{U}$ | $\sigma$ | $^{207}\text{Pb}/^{206}\text{Pb}$ |
| 7        | 8                      | 10                | 33               | 0.30                                     | 0.0568                            | 0.0153   | 0.4083                           | 0.1082   | 0.0522                           | 482      | 438                              | 348      | 78                               | 328      | 18                                |
| 8        | 27                     | 46                | 135              | 0.34                                     | 0.0500                            | 0.0049   | 0.3161                           | 0.0302   | 0.0458                           | 197      | 172                              | 279      | 23                               | 289      | 6                                 |
| 9        | 11                     | 19                | 55               | 0.36                                     | 0.0497                            | 0.0084   | 0.3260                           | 0.0540   | 0.0476                           | 179      | 281                              | 286      | 41                               | 300      | 10                                |
| 10       | 23                     | 97                | 114              | 0.86                                     | 0.0487                            | 0.0056   | 0.3107                           | 0.0354   | 0.0463                           | 131      | 206                              | 275      | 27                               | 292      | 7                                 |
| 11       | 15                     | 28                | 68               | 0.42                                     | 0.0525                            | 0.0077   | 0.3703                           | 0.0536   | 0.0511                           | 309      | 267                              | 320      | 40                               | 321      | 9                                 |
| 12       | 29                     | 93                | 132              | 0.71                                     | 0.0566                            | 0.0064   | 0.3901                           | 0.0433   | 0.0500                           | 478      | 197                              | 334      | 32                               | 314      | 9                                 |
| 13       | 13                     | 31                | 61               | 0.50                                     | 0.0535                            | 0.0089   | 0.3503                           | 0.0575   | 0.0475                           | 349      | 302                              | 305      | 43                               | 299      | 10                                |
| 14       | 12                     | 17                | 57               | 0.31                                     | 0.0535                            | 0.0085   | 0.3617                           | 0.0565   | 0.0490                           | 350      | 284                              | 314      | 42                               | 309      | 11                                |
| 15       | 41                     | 186               | 205              | 0.91                                     | 0.0498                            | 0.0044   | 0.3254                           | 0.0281   | 0.0474                           | 187      | 154                              | 286      | 22                               | 298      | 6                                 |
| 16       | 22                     | 59                | 112              | 0.53                                     | 0.0524                            | 0.0062   | 0.3191                           | 0.0373   | 0.0442                           | 304      | 212                              | 281      | 29                               | 279      | 7                                 |
| 17       | 19                     | 38                | 89               | 0.42                                     | 0.0519                            | 0.0067   | 0.3559                           | 0.0452   | 0.0497                           | 283      | 234                              | 309      | 34                               | 313      | 9                                 |
| 18       | 10                     | 12                | 45               | 0.27                                     | 0.0544                            | 0.0101   | 0.3627                           | 0.0662   | 0.0484                           | 386      | 328                              | 314      | 49                               | 305      | 11                                |
| 19       | 28                     | 54                | 135              | 0.40                                     | 0.0537                            | 0.0056   | 0.3567                           | 0.0363   | 0.0482                           | 360      | 184                              | 310      | 27                               | 303      | 7                                 |
| 20       | 60                     | 176               | 298              | 0.59                                     | 0.0506                            | 0.0032   | 0.3227                           | 0.0201   | 0.0463                           | 222      | 110                              | 284      | 15                               | 292      | 5                                 |
| 21       | 285                    | 419               | 1313             | 0.32                                     | 0.0533                            | 0.0033   | 0.3763                           | 0.0223   | 0.0512                           | 342      | 143                              | 324      | 16                               | 322      | 5                                 |
| 22       | 30                     | 85                | 150              | 0.57                                     | 0.0518                            | 0.0054   | 0.3303                           | 0.0338   | 0.0463                           | 274      | 184                              | 290      | 26                               | 292      | 7                                 |
| 23       | 10                     | 23                | 48               | 0.48                                     | 0.0532                            | 0.0109   | 0.3593                           | 0.0719   | 0.0490                           | 336      | 339                              | 312      | 54                               | 308      | 13                                |
| 24       | 45                     | 141               | 216              | 0.65                                     | 0.0534                            | 0.0044   | 0.3493                           | 0.0282   | 0.0474                           | 348      | 144                              | 304      | 21                               | 299      | 6                                 |
| 25       | 8                      | 17                | 37               | 0.46                                     | 0.0533                            | 0.0175   | 0.3552                           | 0.1149   | 0.0484                           | 341      | 501                              | 309      | 86                               | 304      | 18                                |
| 26       | 39                     | 78                | 187              | 0.42                                     | 0.0548                            | 0.0048   | 0.3497                           | 0.0302   | 0.0463                           | 405      | 153                              | 304      | 23                               | 292      | 7                                 |
| 27       | 27                     | 71                | 129              | 0.55                                     | 0.0506                            | 0.0061   | 0.3367                           | 0.0400   | 0.0483                           | 221      | 215                              | 295      | 30                               | 304      | 8                                 |
| 28       | 271                    | 181               | 1240             | 0.15                                     | 0.0530                            | 0.0022   | 0.3663                           | 0.0148   | 0.0502                           | 328      | 64                               | 317      | 11                               | 315      | 5                                 |
| 29       | 35                     | 108               | 165              | 0.65                                     | 0.0566                            | 0.0085   | 0.3814                           | 0.0561   | 0.0489                           | 475      | 264                              | 328      | 41                               | 308      | 11                                |
| 30       | 40                     | 153               | 204              | 0.75                                     | 0.0481                            | 0.0066   | 0.2992                           | 0.0404   | 0.0451                           | 105      | 235                              | 266      | 32                               | 284      | 8                                 |
| 31       | 45                     | 144               | 222              | 0.65                                     | 0.0520                            | 0.0041   | 0.3302                           | 0.0255   | 0.0461                           | 285      | 138                              | 290      | 19                               | 290      | 6                                 |
| 32       | 66                     | 125               | 300              | 0.42                                     | 0.0550                            | 0.0036   | 0.3796                           | 0.0246   | 0.0500                           | 413      | 110                              | 327      | 18                               | 315      | 6                                 |
| 33       | 59                     | 129               | 289              | 0.44                                     | 0.0532                            | 0.0037   | 0.3417                           | 0.0232   | 0.0466                           | 335      | 119                              | 298      | 18                               | 294      | 6                                 |
| 34       | 19                     | 41                | 94               | 0.43                                     | 0.0544                            | 0.0075   | 0.3464                           | 0.0467   | 0.0462                           | 386      | 246                              | 302      | 35                               | 291      | 9                                 |
| 35       | 33                     | 69                | 160              | 0.43                                     | 0.0542                            | 0.0050   | 0.3567                           | 0.0322   | 0.0477                           | 380      | 162                              | 310      | 24                               | 301      | 7                                 |
| 36       | 22                     | 72                | 111              | 0.65                                     | 0.0573                            | 0.0087   | 0.3676                           | 0.0543   | 0.0466                           | 502      | 265                              | 318      | 40                               | 293      | 10                                |
| 37       | 23                     | 54                | 110              | 0.49                                     | 0.0537                            | 0.0064   | 0.3487                           | 0.0410   | 0.0471                           | 358      | 214                              | 304      | 31                               | 297      | 8                                 |
| 38       | 80                     | 256               | 380              | 0.67                                     | 0.0534                            | 0.0034   | 0.3592                           | 0.0226   | 0.0488                           | 345      | 108                              | 312      | 17                               | 307      | 6                                 |
| 39       | 38                     | 112               | 184              | 0.61                                     | 0.0531                            | 0.0046   | 0.3497                           | 0.0296   | 0.0478                           | 332      | 151                              | 305      | 22                               | 301      | 7                                 |
| 40       | 93                     | 228               | 449              | 0.51                                     | 0.0532                            | 0.0035   | 0.3504                           | 0.0225   | 0.0478                           | 336      | 111                              | 305      | 17                               | 301      | 6                                 |
| 41       | 83                     | 175               | 418              | 0.42                                     | 0.0537                            | 0.0034   | 0.3391                           | 0.0210   | 0.0458                           | 356      | 107                              | 296      | 16                               | 289      | 5                                 |
| 42       | 37                     | 83                | 171              | 0.48                                     | 0.0542                            | 0.0056   | 0.3717                           | 0.0374   | 0.0498                           | 379      | 181                              | 321      | 28                               | 313      | 8                                 |
| 43       | 21                     | 70                | 104              | 0.67                                     | 0.0527                            | 0.0072   | 0.3460                           | 0.0464   | 0.0476                           | 315      | 245                              | 302      | 35                               | 300      | 9                                 |



续附表 4

| 测点<br>编号 | 含量( $\times 10^{-6}$ ) |                   | $^{232}\text{Th}$<br>/<br>$^{238}\text{U}$ | 同位素比值                             |           |                                  |           | 年龄(Ma)                           |           |                                  |           |     |     |     |    |
|----------|------------------------|-------------------|--|-----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|-----|-----|-----|----|
|          | $^{206}\text{Pb}$      | $^{232}\text{Th}$ |  | $^{207}\text{Pb}/^{206}\text{Pb}$ | $1\sigma$ | $^{207}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{207}\text{Pb}/^{238}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ |     |     |     |    |
| 44       | 14                     | 35                | 0.51                                       | 0.0494                            | 0.0085    | 0.3252                           | 0.0552    | 0.0478                           | 0.0016    | 165                              | 286       | 286 | 42  | 301 | 10 |
| 45       | 60                     | 132               | 0.70                                       | 0.0577                            | 0.0038    | 0.5736                           | 0.0368    | 0.0721                           | 0.0014    | 519                              | 107       | 460 | 24  | 449 | 8  |
| 46       | 17                     | 45                | 0.53                                       | 0.0560                            | 0.0103    | 0.3632                           | 0.0653    | 0.0471                           | 0.0019    | 452                              | 327       | 315 | 49  | 296 | 12 |
| 47       | 31                     | 64                | 0.43                                       | 0.0507                            | 0.0053    | 0.3326                           | 0.0340    | 0.0476                           | 0.0012    | 227                              | 184       | 292 | 26  | 300 | 7  |
| 48       | 269                    | 466               | 0.42                                       | 0.0578                            | 0.0018    | 0.4055                           | 0.0127    | 0.0509                           | 0.0007    | 523                              | 44        | 346 | 9   | 320 | 4  |
| 49       | 19                     | 32                | 0.34                                       | 0.0553                            | 0.0091    | 0.3585                           | 0.0579    | 0.0471                           | 0.0017    | 423                              | 294       | 311 | 43  | 296 | 10 |
| 50       | 26                     | 76                | 0.61                                       | 0.0515                            | 0.0056    | 0.3434                           | 0.0365    | 0.0484                           | 0.0012    | 262                              | 192       | 300 | 28  | 305 | 8  |
| 51       | 36                     | 64                | 0.36                                       | 0.0544                            | 0.0055    | 0.3507                           | 0.0346    | 0.0468                           | 0.0012    | 386                              | 178       | 305 | 26  | 295 | 7  |
| 52       | 64                     | 304               | 1.04                                       | 0.0519                            | 0.0037    | 0.3614                           | 0.0255    | 0.0505                           | 0.0010    | 282                              | 125       | 313 | 19  | 317 | 6  |
| 53       | 9                      | 12                | 0.28                                       | 0.0671                            | 0.0148    | 0.4196                           | 0.0903    | 0.0454                           | 0.0024    | 841                              | 380       | 356 | 65  | 286 | 15 |
| 54       | 52                     | 106               | 0.39                                       | 0.0514                            | 0.0045    | 0.3190                           | 0.0273    | 0.0450                           | 0.0010    | 259                              | 153       | 281 | 21  | 284 | 6  |
| 55       | 20                     | 38                | 0.40                                       | 0.0544                            | 0.0071    | 0.3520                           | 0.0449    | 0.0469                           | 0.0014    | 388                              | 231       | 306 | 34  | 296 | 9  |
| 56       | 15                     | 20                | 0.32                                       | 0.0560                            | 0.0097    | 0.4212                           | 0.0714    | 0.0546                           | 0.0021    | 452                              | 306       | 357 | 51  | 342 | 13 |
| 57       | 16                     | 40                | 0.54                                       | 0.0580                            | 0.0078    | 0.3891                           | 0.0512    | 0.0487                           | 0.0015    | 528                              | 238       | 334 | 37  | 307 | 9  |
| 58       | 38                     | 75                | 0.41                                       | 0.0501                            | 0.0064    | 0.3232                           | 0.0404    | 0.0468                           | 0.0012    | 200                              | 272       | 284 | 31  | 295 | 7  |
| 59       | 52                     | 126               | 0.52                                       | 0.0526                            | 0.0041    | 0.3547                           | 0.0270    | 0.0489                           | 0.0010    | 313                              | 135       | 308 | 20  | 308 | 6  |
| 60       | 6                      | 11                | 0.35                                       | 0.0547                            | 0.0206    | 0.3838                           | 0.1421    | 0.0509                           | 0.0037    | 399                              | 565       | 330 | 104 | 320 | 23 |
| 61       | 29                     | 54                | 0.38                                       | 0.0541                            | 0.0055    | 0.3430                           | 0.0343    | 0.0460                           | 0.0011    | 374                              | 182       | 299 | 26  | 290 | 7  |
| 62       | 53                     | 271               | 1.07                                       | 0.0514                            | 0.0035    | 0.3420                           | 0.0228    | 0.0483                           | 0.0009    | 258                              | 118       | 299 | 17  | 304 | 6  |
| 63       | 43                     | 87                | 0.42                                       | 0.0529                            | 0.0047    | 0.3530                           | 0.0308    | 0.0484                           | 0.0011    | 324                              | 156       | 307 | 23  | 305 | 7  |
| 64       | 65                     | 118               | 0.37                                       | 0.0491                            | 0.0038    | 0.3267                           | 0.0247    | 0.0483                           | 0.0010    | 153                              | 132       | 287 | 19  | 304 | 6  |
| 65       | 22                     | 59                | 0.54                                       | 0.0546                            | 0.0068    | 0.3438                           | 0.0418    | 0.0456                           | 0.0014    | 398                              | 219       | 300 | 32  | 288 | 8  |
| 66       | 30                     | 65                | 0.42                                       | 0.0484                            | 0.0050    | 0.3021                           | 0.0309    | 0.0452                           | 0.0011    | 120                              | 183       | 268 | 24  | 285 | 7  |
| 67       | 29                     | 63                | 0.43                                       | 0.0560                            | 0.0065    | 0.3548                           | 0.0402    | 0.0459                           | 0.0013    | 453                              | 204       | 308 | 30  | 290 | 8  |
| 68       | 8                      | 10                | 0.29                                       | 0.0509                            | 0.0129    | 0.3571                           | 0.0893    | 0.0509                           | 0.0023    | 237                              | 392       | 310 | 67  | 320 | 14 |
| 69       | 85                     | 196               | 0.69                                       | 0.0551                            | 0.0039    | 0.5469                           | 0.0383    | 0.0720                           | 0.0015    | 415                              | 120       | 443 | 25  | 448 | 9  |
| 70       | 31                     | 120               | 0.80                                       | 0.0533                            | 0.0052    | 0.3456                           | 0.0328    | 0.0470                           | 0.0011    | 343                              | 171       | 301 | 25  | 296 | 7  |
| 71       | 19                     | 61                | 0.62                                       | 0.0544                            | 0.0064    | 0.3341                           | 0.0386    | 0.0445                           | 0.0012    | 389                              | 210       | 293 | 29  | 281 | 8  |
| 72       | 29                     | 51                | 0.34                                       | 0.0562                            | 0.0058    | 0.3445                           | 0.0347    | 0.0445                           | 0.0011    | 460                              | 180       | 301 | 26  | 280 | 7  |
| 73       | 16                     | 38                | 0.46                                       | 0.0486                            | 0.0079    | 0.3105                           | 0.0495    | 0.0464                           | 0.0015    | 126                              | 268       | 275 | 38  | 292 | 9  |
| 74       | 29                     | 62                | 0.41                                       | 0.0568                            | 0.0068    | 0.3511                           | 0.0413    | 0.0448                           | 0.0013    | 484                              | 210       | 306 | 31  | 283 | 8  |
| 75       | 6                      | 10                | 0.35                                       | 0.0519                            | 0.0385    | 0.3333                           | 0.2439    | 0.0466                           | 0.0059    | 283                              | 1051      | 292 | 186 | 293 | 37 |
| 76       | 294                    | 478               | 0.36                                       | 0.0519                            | 0.0017    | 0.3593                           | 0.0116    | 0.0502                           | 0.0007    | 283                              | 48        | 312 | 9   | 316 | 4  |
| 77       | 35                     | 114               | 0.68                                       | 0.0526                            | 0.0050    | 0.3499                           | 0.0329    | 0.0483                           | 0.0011    | 310                              | 170       | 305 | 25  | 304 | 7  |
| 78       | 83                     | 182               | 0.44                                       | 0.0568                            | 0.0035    | 0.3547                           | 0.0216    | 0.0453                           | 0.0009    | 482                              | 101       | 308 | 16  | 286 | 5  |
| 79       | 51                     | 145               | 0.61                                       | 0.0538                            | 0.0060    | 0.3622                           | 0.0397    | 0.0488                           | 0.0013    | 362                              | 197       | 314 | 30  | 307 | 8  |
| 80       | 37                     | 97                | 0.54                                       | 0.0501                            | 0.0042    | 0.3347                           | 0.0277    | 0.0484                           | 0.0010    | 201                              | 147       | 293 | 21  | 305 | 6  |

续附表 4

| 测点<br>编号                                 | 含量( $\times 10^{-6}$ ) |                   | $^{232}\text{Th}$<br>$^{238}\text{U}$ | 同位素比值                             |                                  |                                  |           | 年龄(Ma)                            |           |                                  |           |                                  |           |      |    |    |
|--|------------------------|-------------------|---------------------------------------|-----------------------------------|----------------------------------|----------------------------------|-----------|-----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|------|----|----|
|  | $^{206}\text{Pb}$      | $^{232}\text{Th}$ |                                       | $^{207}\text{Pb}/^{206}\text{Pb}$ | $^{207}\text{Pb}/^{235}\text{U}$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ | $^{207}\text{Pb}/^{206}\text{Pb}$ | $1\sigma$ | $^{207}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ |      |    |    |
| 81                                       | 32                     | 112               | 152                                   | 0.73                              | 0.0508                           | 0.0049                           | 0.3472    | 0.0327                            | 0.0496    | 0.0012                           | 232       | 168                              | 303       | 312  | 25 | 7  |
| 82                                       | 39                     | 116               | 192                                   | 0.60                              | 0.0502                           | 0.0044                           | 0.3214    | 0.0278                            | 0.0465    | 0.0010                           | 204       | 154                              | 283       | 293  | 21 | 6  |
| 83                                       | 12                     | 22                | 51                                    | 0.43                              | 0.0569                           | 0.0087                           | 0.3937    | 0.0592                            | 0.0502    | 0.0017                           | 489       | 276                              | 337       | 315  | 43 | 10 |
| 84                                       | 48                     | 150               | 229                                   | 0.65                              | 0.0500                           | 0.0043                           | 0.3367    | 0.0282                            | 0.0488    | 0.0011                           | 197       | 149                              | 295       | 307  | 21 | 6  |
| 85                                       | 28                     | 69                | 141                                   | 0.49                              | 0.0503                           | 0.0058                           | 0.3278    | 0.0372                            | 0.0472    | 0.0013                           | 210       | 205                              | 288       | 298  | 28 | 8  |
| 86                                       | 6                      | 8                 | 30                                    | 0.28                              | 0.0540                           | 0.0165                           | 0.3552    | 0.1071                            | 0.0477    | 0.0026                           | 371       | 473                              | 309       | 300  | 80 | 16 |
| 87                                       | 55                     | 133               | 265                                   | 0.50                              | 0.0507                           | 0.0040                           | 0.3355    | 0.0261                            | 0.0480    | 0.0010                           | 226       | 139                              | 294       | 302  | 20 | 6  |
| 88                                       | 19                     | 18                | 93                                    | 0.19                              | 0.0550                           | 0.0080                           | 0.3654    | 0.0521                            | 0.0482    | 0.0016                           | 413       | 259                              | 316       | 303  | 39 | 10 |
| 89                                       | 38                     | 86                | 186                                   | 0.46                              | 0.0496                           | 0.0050                           | 0.3197    | 0.0318                            | 0.0467    | 0.0011                           | 177       | 179                              | 282       | 294  | 24 | 7  |
| 90                                       | 43                     | 89                | 208                                   | 0.43                              | 0.0511                           | 0.0042                           | 0.3369    | 0.0273                            | 0.0478    | 0.0010                           | 245       | 145                              | 295       | 301  | 21 | 6  |
| 91                                       | 90                     | 524               | 450                                   | 1.16                              | 0.0534                           | 0.0032                           | 0.3378    | 0.0196                            | 0.0459    | 0.0008                           | 347       | 99                               | 295       | 289  | 15 | 5  |
| 92                                       | 95                     | 112               | 301                                   | 0.37                              | 0.0547                           | 0.0033                           | 0.5425    | 0.0324                            | 0.0720    | 0.0013                           | 399       | 101                              | 440       | 448  | 21 | 8  |
| 93                                       | 41                     | 105               | 195                                   | 0.54                              | 0.0532                           | 0.0051                           | 0.3566    | 0.0334                            | 0.0486    | 0.0012                           | 337       | 168                              | 310       | 306  | 25 | 7  |
| 94                                       | 12                     | 16                | 54                                    | 0.29                              | 0.0547                           | 0.0108                           | 0.3770    | 0.0730                            | 0.0500    | 0.0021                           | 399       | 337                              | 325       | 315  | 54 | 13 |
| 95                                       | 29                     | 42                | 137                                   | 0.31                              | 0.0562                           | 0.0141                           | 0.3681    | 0.0907                            | 0.0476    | 0.0026                           | 458       | 409                              | 318       | 300  | 67 | 16 |
| 96                                       | 36                     | 62                | 168                                   | 0.37                              | 0.0526                           | 0.0097                           | 0.3625    | 0.0652                            | 0.0500    | 0.0020                           | 312       | 310                              | 314       | 314  | 49 | 12 |
| 金塔组(样品 16DS-Z4, N 40°32'39" E 94°06'14") |                        |                   |                                       |                                   |                                  |                                  |           |                                   |           |                                  |           |                                  |           |      |    |    |
| 1  | 211                    | 574               | 724                                   | 0.79                              | 0.0603                           | 0.0029                           | 0.5436    | 0.0258                            | 0.0654    | 0.0011                           | 613       | 73                               | 441       | 409  | 17 | 7  |
| 2  | 16                     | 59                | 80                                    | 0.75                              | 0.0559                           | 0.0078                           | 0.3666    | 0.0504                            | 0.0476    | 0.0015                           | 446       | 249                              | 317       | 300  | 37 | 9  |
| 3  | 131                    | 301               | 606                                   | 0.50                              | 0.0522                           | 0.0024                           | 0.3580    | 0.0161                            | 0.0497    | 0.0008                           | 295       | 74                               | 311       | 313  | 12 | 5  |
| 4  | 288                    | 60                | 145                                   | 0.41                              | 0.1603                           | 0.0030                           | 10.0530   | 0.1917                            | 0.4550    | 0.0063                           | 2459      | 15                               | 2440      | 2417 | 18 | 28 |
| 5  | 71                     | 168               | 231                                   | 0.73                              | 0.0578                           | 0.0034                           | 0.5715    | 0.0333                            | 0.0718    | 0.0013                           | 521       | 96                               | 459       | 447  | 22 | 8  |
| 6  | 68                     | 54                | 93                                    | 0.59                              | 0.0761                           | 0.0037                           | 1.6343    | 0.0769                            | 0.1558    | 0.0028                           | 1098      | 65                               | 984       | 933  | 30 | 15 |
| 7  | 20                     | 57                | 98                                    | 0.58                              | 0.0527                           | 0.0072                           | 0.3412    | 0.0458                            | 0.0469    | 0.0014                           | 318       | 246                              | 298       | 296  | 35 | 9  |
| 8  | 48                     | 162               | 251                                   | 0.64                              | 0.0543                           | 0.0045                           | 0.3336    | 0.0272                            | 0.0446    | 0.0010                           | 382       | 144                              | 292       | 281  | 21 | 6  |
| 9  | 56                     | 132               | 264                                   | 0.50                              | 0.0520                           | 0.0036                           | 0.3466    | 0.0239                            | 0.0484    | 0.0009                           | 284       | 122                              | 302       | 305  | 18 | 6  |
| 10                                       | 66                     | 148               | 322                                   | 0.46                              | 0.0539                           | 0.0037                           | 0.3529    | 0.0235                            | 0.0475    | 0.0009                           | 369       | 116                              | 307       | 299  | 18 | 6  |
| 11                                       | 127                    | 475               | 605                                   | 0.78                              | 0.0564                           | 0.0030                           | 0.3722    | 0.0192                            | 0.0479    | 0.0008                           | 467       | 84                               | 321       | 302  | 14 | 5  |
| 12                                       | 310                    | 447               | 986                                   | 0.45                              | 0.0609                           | 0.0019                           | 0.6032    | 0.0188                            | 0.0719    | 0.0010                           | 634       | 43                               | 479       | 448  | 12 | 6  |
| 13                                       | 51                     | 149               | 247                                   | 0.60                              | 0.0549                           | 0.0048                           | 0.3598    | 0.0308                            | 0.0475    | 0.0011                           | 409       | 152                              | 312       | 299  | 23 | 7  |
| 14                                       | 110                    | 199               | 358                                   | 0.56                              | 0.0548                           | 0.0029                           | 0.5410    | 0.0279                            | 0.0717    | 0.0012                           | 402       | 85                               | 439       | 446  | 18 | 7  |
| 15                                       | 106                    | 99                | 357                                   | 0.28                              | 0.0587                           | 0.0046                           | 0.5800    | 0.0443                            | 0.0717    | 0.0016                           | 556       | 129                              | 464       | 446  | 28 | 10 |
| 16                                       | 32                     | 59                | 154                                   | 0.39                              | 0.0499                           | 0.0064                           | 0.3335    | 0.0422                            | 0.0485    | 0.0014                           | 192       | 230                              | 292       | 305  | 32 | 9  |
| 17                                       | 24                     | 42                | 122                                   | 0.34                              | 0.0505                           | 0.0102                           | 0.3207    | 0.0636                            | 0.0460    | 0.0020                           | 219       | 326                              | 282       | 290  | 49 | 12 |
| 18                                       | 36                     | 198               | 180                                   | 1.10                              | 0.0512                           | 0.0055                           | 0.3277    | 0.0345                            | 0.0464    | 0.0012                           | 251       | 189                              | 288       | 292  | 26 | 7  |
| 19                                       | 314                    | 539               | 952                                   | 0.57                              | 0.0537                           | 0.0029                           | 0.5319    | 0.0282                            | 0.0718    | 0.0012                           | 360       | 88                               | 433       | 447  | 19 | 7  |
| 20                                       | 46                     | 50                | 215                                   | 0.23                              | 0.0515                           | 0.0048                           | 0.3489    | 0.0321                            | 0.0491    | 0.0012                           | 263       | 165                              | 304       | 309  | 24 | 7  |

续附表 4

| 测点<br>编号 | 含量( $\times 10^{-6}$ ) |                   | $^{232}\text{Th}$<br>/<br>$^{238}\text{U}$ | 同位素比值                             |                                  |                                  |                                  | 年龄(Ma)                            |                                  |                                  |                                  |                                  |                                  |           |
|----------|------------------------|-------------------|--|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------|
|          | $^{206}\text{Pb}$      | $^{232}\text{Th}$ |  | $^{207}\text{Pb}/^{206}\text{Pb}$ | $^{207}\text{Pb}/^{235}\text{U}$ | $^{206}\text{Pb}/^{238}\text{U}$ | $^{207}\text{Pb}/^{235}\text{U}$ | $^{207}\text{Pb}/^{206}\text{Pb}$ | $^{207}\text{Pb}/^{235}\text{U}$ | $^{206}\text{Pb}/^{238}\text{U}$ | $^{207}\text{Pb}/^{235}\text{U}$ | $^{206}\text{Pb}/^{238}\text{U}$ | $^{207}\text{Pb}/^{235}\text{U}$ |           |
|          |                        |                   |  |                                   |                                  |                                  |                                  |                                   |                                  |                                  |                                  |                                  |                                  | $1\sigma$ |
| 21       | 60                     | 101               | 0.57                                       | 0.0041                            | 0.6145                           | 0.0432                           | 0.0774                           | 0.0016                            | 516                              | 119                              | 486                              | 27                               | 480                              | 9         |
| 22       | 28                     | 53                | 0.39                                       | 0.0078                            | 0.3593                           | 0.0494                           | 0.0468                           | 0.0014                            | 439                              | 256                              | 312                              | 37                               | 295                              | 8         |
| 23       | 58                     | 119               | 0.44                                       | 0.0054                            | 0.3717                           | 0.0352                           | 0.0482                           | 0.0012                            | 450                              | 167                              | 321                              | 26                               | 303                              | 7         |
| 24       | 121                    | 112               | 0.30                                       | 0.0040                            | 0.5830                           | 0.0393                           | 0.0723                           | 0.0015                            | 549                              | 112                              | 466                              | 25                               | 450                              | 9         |
| 25       | 29                     | 84                | 0.59                                       | 0.0079                            | 0.3388                           | 0.0478                           | 0.0449                           | 0.0014                            | 400                              | 258                              | 296                              | 36                               | 283                              | 9         |
| 26       | 45                     | 47                | 0.23                                       | 0.0057                            | 0.3691                           | 0.0388                           | 0.0502                           | 0.0013                            | 345                              | 188                              | 319                              | 29                               | 316                              | 8         |
| 27       | 34                     | 103               | 0.70                                       | 0.0112                            | 0.3636                           | 0.0736                           | 0.0487                           | 0.0021                            | 380                              | 347                              | 315                              | 55                               | 306                              | 13        |
| 28       | 118                    | 134               | 0.30                                       | 0.0028                            | 0.4570                           | 0.0230                           | 0.0609                           | 0.0010                            | 388                              | 83                               | 382                              | 16                               | 381                              | 6         |
| 29       | 159                    | 153               | 1.17                                       | 0.0099                            | 3.7110                           | 0.1612                           | 0.2695                           | 0.0051                            | 1622                             | 53                               | 1574                             | 35                               | 1538                             | 26        |
| 30       | 319                    | 163               | 0.17                                       | 0.0038                            | 0.5659                           | 0.0369                           | 0.0723                           | 0.0014                            | 484                              | 109                              | 455                              | 24                               | 450                              | 9         |
| 31       | 74                     | 119               | 0.39                                       | 0.0102                            | 0.3857                           | 0.0684                           | 0.0496                           | 0.0021                            | 469                              | 317                              | 331                              | 50                               | 312                              | 13        |
| 32       | 86                     | 87                | 0.25                                       | 0.0123                            | 0.3529                           | 0.0823                           | 0.0494                           | 0.0025                            | 277                              | 361                              | 307                              | 62                               | 311                              | 16        |
| 33       | 11                     | 14                | 0.32                                       | 0.0524                            | 0.3785                           | 0.3900                           | 0.0524                           | 0.0079                            | 302                              | 1220                             | 326                              | 287                              | 329                              | 49        |
| 34       | 30                     | 47                | 0.34                                       | 0.0518                            | 0.3565                           | 0.0891                           | 0.0499                           | 0.0027                            | 276                              | 384                              | 310                              | 67                               | 314                              | 16        |
| 35       | 37                     | 47                | 0.31                                       | 0.0122                            | 0.5036                           | 0.1035                           | 0.0631                           | 0.0030                            | 526                              | 368                              | 414                              | 70                               | 394                              | 18        |
| 36       | 160                    | 135               | 0.37                                       | 0.0076                            | 0.6997                           | 0.0933                           | 0.0911                           | 0.0031                            | 440                              | 237                              | 539                              | 56                               | 562                              | 18        |
| 37       | 128                    | 13                | 0.16                                       | 0.0121                            | 3.4758                           | 0.5128                           | 0.3149                           | 0.0146                            | 1198                             | 221                              | 1522                             | 116                              | 1765                             | 72        |
| 39       | 23                     | 33                | 0.34                                       | 0.0296                            | 0.4581                           | 0.2377                           | 0.0593                           | 0.0061                            | 453                              | 806                              | 383                              | 166                              | 371                              | 37        |
| 40       | 18                     | 22                | 0.56                                       | 0.0468                            | 0.8277                           | 0.6126                           | 0.0957                           | 0.0097                            | 698                              | 1145                             | 612                              | 340                              | 589                              | 57        |
| 41       | 29                     | 23                | 0.18                                       | 0.0268                            | 0.6488                           | 0.2042                           | 0.0567                           | 0.0044                            | 1269                             | 544                              | 508                              | 126                              | 356                              | 27        |
| 42       | 44                     | 37                | 0.17                                       | 0.0544                            | 0.3499                           | 0.1647                           | 0.0466                           | 0.0040                            | 389                              | 721                              | 305                              | 124                              | 294                              | 25        |
| 43       | 13                     | 16                | 0.26                                       | 0.0577                            | 0.4096                           | 0.2267                           | 0.0515                           | 0.0049                            | 518                              | 916                              | 349                              | 163                              | 324                              | 30        |
| 44       | 246                    | 104               | 0.17                                       | 0.0537                            | 0.4836                           | 0.0583                           | 0.0654                           | 0.0020                            | 357                              | 217                              | 401                              | 40                               | 408                              | 12        |
| 45       | 63                     | 86                | 0.35                                       | 0.0539                            | 0.4378                           | 0.0515                           | 0.0590                           | 0.0017                            | 365                              | 211                              | 369                              | 36                               | 369                              | 11        |
| 46       | 48                     | 102               | 0.42                                       | 0.0561                            | 0.3415                           | 0.0397                           | 0.0442                           | 0.0013                            | 455                              | 208                              | 298                              | 30                               | 279                              | 8         |
| 47       | 84                     | 386               | 0.97                                       | 0.0528                            | 0.3532                           | 0.0266                           | 0.0485                           | 0.0010                            | 321                              | 133                              | 307                              | 20                               | 305                              | 6         |
| 48       | 37                     | 90                | 0.49                                       | 0.0547                            | 0.3556                           | 0.0376                           | 0.0472                           | 0.0012                            | 398                              | 190                              | 309                              | 28                               | 297                              | 8         |
| 49       | 51                     | 100               | 0.39                                       | 0.0544                            | 0.3366                           | 0.0194                           | 0.0449                           | 0.0008                            | 389                              | 97                               | 295                              | 15                               | 283                              | 5         |
| 50       | 255                    | 113               | 0.31                                       | 0.0720                            | 1.5634                           | 0.0418                           | 0.1576                           | 0.0022                            | 985                              | 32                               | 956                              | 17                               | 943                              | 12        |
| 51       | 56                     | 183               | 0.68                                       | 0.0511                            | 0.3370                           | 0.0202                           | 0.0478                           | 0.0008                            | 246                              | 105                              | 295                              | 15                               | 301                              | 5         |
| 52       | 227                    | 146               | 0.38                                       | 0.0672                            | 1.2456                           | 0.0326                           | 0.1346                           | 0.0018                            | 842                              | 32                               | 821                              | 15                               | 814                              | 10        |
| 53       | 116                    | 472               | 0.80                                       | 0.0541                            | 0.3386                           | 0.0131                           | 0.0454                           | 0.0007                            | 375                              | 60                               | 296                              | 10                               | 286                              | 4         |
| 54       | 47                     | 78                | 0.35                                       | 0.0715                            | 0.4748                           | 0.0314                           | 0.0482                           | 0.0010                            | 973                              | 100                              | 395                              | 22                               | 303                              | 6         |
| 55       | 51                     | 110               | 0.45                                       | 0.0541                            | 0.3630                           | 0.0219                           | 0.0487                           | 0.0009                            | 376                              | 104                              | 314                              | 16                               | 306                              | 5         |
| 56       | 18                     | 73                | 0.87                                       | 0.0556                            | 0.3665                           | 0.0480                           | 0.0478                           | 0.0014                            | 436                              | 239                              | 317                              | 36                               | 301                              | 9         |
| 57       | 32                     | 99                | 0.66                                       | 0.0540                            | 0.3634                           | 0.0310                           | 0.0488                           | 0.0011                            | 372                              | 152                              | 315                              | 23                               | 307                              | 7         |
| 58       | 105                    | 193               | 0.57                                       | 0.0570                            | 0.5639                           | 0.0280                           | 0.0717                           | 0.0012                            | 492                              | 80                               | 454                              | 18                               | 447                              | 7         |

续附表 4

| 测点<br>编号 | 含量( $\times 10^{-5}$ ) |                   |                  | $^{232}\text{Th}$<br>/<br>$^{238}\text{U}$ | 同位素比值                             |                                  |                                  |                                   | 年龄(Ma)    |                                  |           |                                  |           |
|----------|------------------------|-------------------|------------------|--|-----------------------------------|----------------------------------|----------------------------------|-----------------------------------|-----------|----------------------------------|-----------|----------------------------------|-----------|
|          | $^{206}\text{Pb}$      | $^{232}\text{Th}$ | $^{238}\text{U}$ |  | $^{207}\text{Pb}/^{206}\text{Pb}$ | $^{207}\text{Pb}/^{235}\text{U}$ | $^{206}\text{Pb}/^{238}\text{U}$ | $^{207}\text{Pb}/^{206}\text{Pb}$ | $1\sigma$ | $^{207}\text{Pb}/^{235}\text{U}$ | $1\sigma$ | $^{206}\text{Pb}/^{238}\text{U}$ | $1\sigma$ |
|          |                        |                   |                  |  |                                   |                                  |                                  |                                   |           |                                  |           |                                  |           |
| 59       | 73                     | 237               | 369              | 0.64                                       | 0.0527                            | 0.3336                           | 0.0203                           | 0.0008                            | 292       | 15                               | 289       | 5                                |           |
| 60       | 8                      | 12                | 35               | 0.35                                       | 0.0551                            | 0.3672                           | 0.0785                           | 0.0022                            | 318       | 58                               | 304       | 14                               |           |
| 61       | 8                      | 9                 | 34               | 0.28                                       | 0.0518                            | 0.3638                           | 0.1064                           | 0.0031                            | 315       | 79                               | 320       | 19                               |           |
| 62       | 41                     | 87                | 136              | 0.64                                       | 0.0571                            | 0.5158                           | 0.0361                           | 0.0013                            | 422       | 24                               | 409       | 8                                |           |
| 63       | 206                    | 326               | 594              | 0.55                                       | 0.0589                            | 0.5852                           | 0.0248                           | 0.0011                            | 468       | 16                               | 448       | 7                                |           |
| 64       | 3                      | 16                | 18               | 0.93                                       | 0.0798                            | 0.4656                           | 0.1785                           | 0.0037                            | 388       | 124                              | 267       | 23                               |           |
| 65       | 17                     | 75                | 85               | 0.89                                       | 0.0541                            | 0.3457                           | 0.0497                           | 0.0015                            | 301       | 37                               | 292       | 9                                |           |
| 66       | 67                     | 95                | 201              | 0.47                                       | 0.0587                            | 0.5825                           | 0.0365                           | 0.0014                            | 466       | 23                               | 448       | 8                                |           |
| 67       | 21                     | 56                | 101              | 0.56                                       | 0.0525                            | 0.3450                           | 0.0492                           | 0.0015                            | 301       | 37                               | 300       | 9                                |           |
| 68       | 12                     | 31                | 60               | 0.53                                       | 0.0523                            | 0.3466                           | 0.0781                           | 0.0023                            | 302       | 59                               | 303       | 14                               |           |
| 69       | 151                    | 379               | 491              | 0.77                                       | 0.0551                            | 0.5471                           | 0.0319                           | 0.0013                            | 443       | 21                               | 448       | 8                                |           |
| 70       | 64                     | 93                | 250              | 0.37                                       | 0.0533                            | 0.4841                           | 0.0609                           | 0.0020                            | 401       | 42                               | 411       | 12                               |           |
| 71       | 16                     | 44                | 77               | 0.58                                       | 0.0555                            | 0.3773                           | 0.0715                           | 0.0021                            | 325       | 53                               | 310       | 13                               |           |
| 72       | 243                    | 78                | 795              | 0.10                                       | 0.0539                            | 0.5318                           | 0.0228                           | 0.0011                            | 433       | 15                               | 446       | 7                                |           |
| 73       | 82                     | 186               | 396              | 0.47                                       | 0.0517                            | 0.3384                           | 0.0222                           | 0.0009                            | 296       | 17                               | 299       | 5                                |           |
| 74       | 18                     | 60                | 88               | 0.68                                       | 0.0517                            | 0.3270                           | 0.0494                           | 0.0015                            | 287       | 38                               | 289       | 9                                |           |
| 75       | 41                     | 68                | 123              | 0.56                                       | 0.0601                            | 0.5931                           | 0.0528                           | 0.0018                            | 473       | 34                               | 445       | 11                               |           |
| 76       | 88                     | 99                | 259              | 0.38                                       | 0.0571                            | 0.5827                           | 0.0463                           | 0.0017                            | 466       | 30                               | 461       | 10                               |           |
| 77       | 38                     | 86                | 186              | 0.46                                       | 0.0518                            | 0.3358                           | 0.0301                           | 0.0011                            | 294       | 23                               | 296       | 7                                |           |
| 78       | 44                     | 97                | 205              | 0.47                                       | 0.0559                            | 0.3660                           | 0.0330                           | 0.0012                            | 317       | 25                               | 299       | 7                                |           |
| 79       | 49                     | 146               | 227              | 0.64                                       | 0.0559                            | 0.3756                           | 0.0350                           | 0.0012                            | 324       | 26                               | 307       | 7                                |           |
| 80       | 47                     | 58                | 223              | 0.26                                       | 0.0502                            | 0.3342                           | 0.0274                           | 0.0010                            | 293       | 21                               | 304       | 6                                |           |
| 81       | 90                     | 77                | 268              | 0.29                                       | 0.0609                            | 0.6009                           | 0.0374                           | 0.0014                            | 478       | 24                               | 445       | 8                                |           |
| 82       | 40                     | 122               | 172              | 0.71                                       | 0.0540                            | 0.3852                           | 0.0491                           | 0.0015                            | 331       | 36                               | 325       | 9                                |           |
| 83       | 67                     | 114               | 206              | 0.55                                       | 0.0521                            | 0.5139                           | 0.0483                           | 0.0017                            | 421       | 10                               | 446       | 10                               |           |
| 84       | 107                    | 137               | 329              | 0.42                                       | 0.0617                            | 0.6213                           | 0.0364                           | 0.0014                            | 491       | 23                               | 454       | 8                                |           |
| 85       | 282                    | 72                | 193              | 0.37                                       | 0.1124                            | 5.1104                           | 0.1660                           | 0.0054                            | 1838      | 28                               | 1838      | 26                               |           |
| 86       | 73                     | 265               | 317              | 0.84                                       | 0.0488                            | 0.3454                           | 0.0373                           | 0.0013                            | 301       | 28                               | 323       | 8                                |           |
| 87       | 57                     | 115               | 177              | 0.65                                       | 0.0582                            | 0.5773                           | 0.0675                           | 0.0022                            | 463       | 43                               | 448       | 13                               |           |
| 88       | 12                     | 24                | 55               | 0.44                                       | 0.0560                            | 0.3654                           | 0.1943                           | 0.0043                            | 316       | 145                              | 298       | 27                               |           |
| 89       | 25                     | 102               | 124              | 0.82                                       | 0.0517                            | 0.3314                           | 0.0719                           | 0.0021                            | 291       | 55                               | 293       | 13                               |           |
| 90       | 14                     | 16                | 55               | 0.28                                       | 0.0491                            | 0.4100                           | 0.1629                           | 0.0044                            | 349       | 117                              | 379       | 27                               |           |
| 91       | 33                     | 22                | 144              | 0.15                                       | 0.0832                            | 0.5603                           | 0.2553                           | 0.0056                            | 452       | 166                              | 307       | 34                               |           |
| 92       | 32                     | 24                | 151              | 0.16                                       | 0.0648                            | 0.3996                           | 0.2624                           | 0.0056                            | 341       | 190                              | 282       | 34                               |           |
| 93       | 108                    | 32                | 350              | 0.09                                       | 0.0592                            | 1.0038                           | 0.2908                           | 0.0055                            | 706       | 147                              | 748       | 31                               |           |
| 94       | 109                    | 71                | 318              | 0.22                                       | 0.0593                            | 0.5762                           | 0.1317                           | 0.0039                            | 462       | 85                               | 439       | 23                               |           |
| 95       | 38                     | 76                | 178              | 0.43                                       | 0.0520                            | 0.3526                           | 0.0600                           | 0.0018                            | 307       | 45                               | 310       | 11                               |           |
| 96       | 20                     | 43                | 83               | 0.52                                       | 0.0613                            | 0.4182                           | 0.1020                           | 0.0025                            | 355       | 73                               | 312       | 15                               |           |

附表 5 独山地区上古生界碎屑锆石 Lu-Hf 年龄数据

## Appendix 5 Lu-Hf isotopic data of Upper Paleozoic detrital zircon samples from the Dushan area

| 测点编号              | 年龄(Ma) | $^{176}\text{Yb}/^{177}\text{Hf}$ | $^{176}\text{Lu}/^{177}\text{Hf}$ | $^{176}\text{Hf}/^{177}\text{Hf}$ | $2\sigma$ | $\epsilon_{\text{Hf}}(t)$ | $1\sigma$ | $T_{\text{DM1}}(\text{Ga})$ | $T_{\text{DM2}}(\text{Ga})$ | $f_{\text{Lu/Hf}}$ |
|-------------------|--------|-----------------------------------|-----------------------------------|-----------------------------------|-----------|---------------------------|-----------|-----------------------------|-----------------------------|--------------------|
| 雀儿山群(样品 15GQN-Z3) |        |                                   |                                   |                                   |           |                           |           |                             |                             |                    |
| 8                 | 2778   | 0.023575                          | 0.000589                          | 0.280902                          | 0.000020  | -4.8                      | 0.7       | 3.231                       | 3.506                       | -0.98              |
| 9                 | 1809   | 0.015642                          | 0.000411                          | 0.281544                          | 0.000022  | -3.7                      | 0.8       | 2.355                       | 2.692                       | -0.99              |
| 29                | 427    | 0.028321                          | 0.000846                          | 0.282489                          | 0.000023  | -0.9                      | 0.8       | 1.076                       | 1.464                       | -0.97              |
| 36                | 420    | 0.018912                          | 0.000511                          | 0.282511                          | 0.000032  | -0.1                      | 1.1       | 1.036                       | 1.413                       | -0.98              |
| 37                | 420    | 0.019168                          | 0.000595                          | 0.282541                          | 0.000032  | 0.9                       | 1.1       | 0.996                       | 1.347                       | -0.98              |
| 44                | 413    | 0.032424                          | 0.000897                          | 0.282483                          | 0.000037  | -1.4                      | 1.3       | 1.085                       | 1.485                       | -0.97              |
| 54                | 415    | 0.016064                          | 0.000508                          | 0.282460                          | 0.000026  | -2.1                      | 0.9       | 1.107                       | 1.530                       | -0.98              |
| 56                | 1594   | 0.100455                          | 0.003409                          | 0.282017                          | 0.000024  | 5.1                       | 0.8       | 1.858                       | 1.986                       | -0.90              |
| 57                | 1648   | 0.040351                          | 0.001097                          | 0.281828                          | 0.000023  | 2.1                       | 0.8       | 2.005                       | 2.215                       | -0.97              |
| 73                | 1839   | 0.012681                          | 0.000434                          | 0.281902                          | 0.000023  | 9.7                       | 0.8       | 1.871                       | 1.891                       | -0.99              |
| 74                | 1617   | 0.016800                          | 0.000455                          | 0.281769                          | 0.000020  | 0.0                       | 0.7       | 2.053                       | 2.321                       | -0.99              |
| 85                | 413    | 0.011667                          | 0.000393                          | 0.282508                          | 0.000014  | -0.4                      | 0.5       | 1.037                       | 1.423                       | -0.99              |
| 干泉组(15GQ-Z1)      |        |                                   |                                   |                                   |           |                           |           |                             |                             |                    |
| 3                 | 1423   | 0.017563                          | 0.000472                          | 0.281818                          | 0.000018  | -2.6                      | 0.6       | 1.987                       | 2.334                       | -0.99              |
| 4                 | 447    | 0.016848                          | 0.000524                          | 0.282494                          | 0.000017  | -0.2                      | 0.6       | 1.060                       | 1.435                       | -0.98              |
| 6                 | 1494   | 0.022268                          | 0.000593                          | 0.282008                          | 0.000018  | 5.6                       | 0.6       | 1.733                       | 1.878                       | -0.98              |
| 8                 | 1226   | 0.009854                          | 0.000362                          | 0.281932                          | 0.000017  | -2.9                      | 0.6       | 1.827                       | 2.198                       | -0.99              |
| 9                 | 1430   | 0.020498                          | 0.000553                          | 0.281897                          | 0.000018  | 0.3                       | 0.6       | 1.883                       | 2.160                       | -0.98              |
| 12                | 1496   | 0.035807                          | 0.000876                          | 0.281774                          | 0.000022  | -3.0                      | 0.8       | 2.069                       | 2.411                       | -0.97              |
| 13                | 1810   | 0.008743                          | 0.000208                          | 0.281436                          | 0.000019  | -7.2                      | 0.7       | 2.488                       | 2.911                       | -0.99              |
| 25                | 441    | 0.045563                          | 0.001037                          | 0.282715                          | 0.000039  | 7.4                       | 1.4       | 0.762                       | 0.951                       | -0.97              |
| 27                | 1282   | 0.021784                          | 0.000520                          | 0.281839                          | 0.000027  | -5.1                      | 0.9       | 1.961                       | 2.377                       | -0.98              |
| 28                | 900    | 0.093106                          | 0.002160                          | 0.282221                          | 0.000038  | -0.9                      | 1.3       | 1.502                       | 1.828                       | -0.93              |
| 29                | 442    | 0.032834                          | 0.000854                          | 0.282338                          | 0.000034  | -5.9                      | 1.2       | 1.287                       | 1.792                       | -0.97              |
| 30                | 1374   | 0.026330                          | 0.000649                          | 0.281883                          | 0.000027  | -1.6                      | 1.0       | 1.907                       | 2.230                       | -0.98              |
| 31                | 1750   | 0.089503                          | 0.002180                          | 0.281820                          | 0.000033  | 2.7                       | 1.1       | 2.076                       | 2.253                       | -0.93              |
| 34                | 455    | 0.030933                          | 0.000769                          | 0.282384                          | 0.000036  | -4.0                      | 1.2       | 1.220                       | 1.680                       | -0.98              |
| 42                | 1437   | 0.034094                          | 0.000831                          | 0.282011                          | 0.000023  | 4.2                       | 0.8       | 1.740                       | 1.921                       | -0.97              |
| 47                | 1484   | 0.039904                          | 0.001090                          | 0.282111                          | 0.000023  | 8.5                       | 0.8       | 1.612                       | 1.687                       | -0.97              |
| 49                | 910    | 0.029945                          | 0.000831                          | 0.282348                          | 0.000024  | 4.6                       | 0.8       | 1.272                       | 1.489                       | -0.97              |
| 50                | 398    | 0.029704                          | 0.000805                          | 0.282521                          | 0.000020  | -0.4                      | 0.7       | 1.030                       | 1.410                       | -0.98              |
| 53                | 410    | 0.043418                          | 0.001265                          | 0.282751                          | 0.000027  | 7.9                       | 0.9       | 0.715                       | 0.892                       | -0.96              |
| 54                | 408    | 0.041458                          | 0.001174                          | 0.282395                          | 0.000023  | -4.7                      | 0.8       | 1.217                       | 1.690                       | -0.96              |
| 61                | 455    | 0.017814                          | 0.000497                          | 0.282521                          | 0.000021  | 1.0                       | 0.7       | 1.021                       | 1.368                       | -0.99              |
| 63                | 447    | 0.045944                          | 0.001304                          | 0.282629                          | 0.000019  | 4.4                       | 0.7       | 0.890                       | 1.147                       | -0.96              |
| 69                | 2797   | 0.024934                          | 0.000694                          | 0.281052                          | 0.000020  | 0.7                       | 0.7       | 3.038                       | 3.184                       | -0.98              |
| 70                | 404    | 0.013647                          | 0.000444                          | 0.282410                          | 0.000018  | -4.1                      | 0.6       | 1.174                       | 1.648                       | -0.99              |
| 72                | 413    | 0.031570                          | 0.000899                          | 0.282368                          | 0.000020  | -5.5                      | 0.7       | 1.247                       | 1.743                       | -0.97              |
| 78                | 2648   | 0.019121                          | 0.000579                          | 0.281168                          | 0.000021  | 1.7                       | 0.7       | 2.874                       | 3.011                       | -0.98              |
| 81                | 1489   | 0.039598                          | 0.001104                          | 0.282172                          | 0.000021  | 10.8                      | 0.7       | 1.528                       | 1.551                       | -0.97              |
| 89                | 1414   | 0.028247                          | 0.000756                          | 0.282063                          | 0.000026  | 5.6                       | 0.9       | 1.664                       | 1.815                       | -0.98              |
| 92                | 2646   | 0.033573                          | 0.000904                          | 0.280899                          | 0.000028  | -8.5                      | 1.0       | 3.261                       | 3.627                       | -0.97              |
| 双堡塘组(样品 15DSS-Z1) |        |                                   |                                   |                                   |           |                           |           |                             |                             |                    |
| 20                | 304    | 0.029083                          | 0.001045                          | 0.282949                          | 0.000026  | 12.7                      | 0.9       | 0.430                       | 0.504                       | -0.97              |
| 22                | 294    | 0.040404                          | 0.001121                          | 0.282815                          | 0.000020  | 7.8                       | 0.7       | 0.622                       | 0.814                       | -0.97              |
| 23                | 294    | 0.038050                          | 0.001155                          | 0.282747                          | 0.000022  | 5.3                       | 0.8       | 0.719                       | 0.968                       | -0.97              |
| 29                | 304    | 0.051485                          | 0.001340                          | 0.282867                          | 0.000019  | 9.8                       | 0.6       | 0.551                       | 0.693                       | -0.96              |
| 43                | 285    | 0.032438                          | 0.000810                          | 0.282615                          | 0.000024  | 0.6                       | 0.9       | 0.898                       | 1.265                       | -0.98              |
| 45                | 283    | 0.034602                          | 0.000821                          | 0.282696                          | 0.000023  | 3.4                       | 0.8       | 0.784                       | 1.085                       | -0.98              |
| 49                | 301    | 0.042698                          | 0.001256                          | 0.282906                          | 0.000034  | 11.1                      | 1.2       | 0.495                       | 0.608                       | -0.96              |
| 51                | 279    | 0.048557                          | 0.001232                          | 0.282941                          | 0.000027  | 11.9                      | 0.9       | 0.445                       | 0.541                       | -0.96              |
| 55                | 323    | 0.035253                          | 0.000816                          | 0.282708                          | 0.000031  | 4.7                       | 1.1       | 0.767                       | 1.033                       | -0.98              |
| 57                | 327    | 0.033151                          | 0.000802                          | 0.282721                          | 0.000027  | 5.5                       | 0.9       | 0.750                       | 0.996                       | -0.98              |

续附表 5

| 测点编号              | 年龄(Ma) | $^{176}\text{Yb}/^{177}\text{Hf}$ | $^{176}\text{Lu}/^{177}\text{Hf}$ | $^{176}\text{Hf}/^{177}\text{Hf}$ | $2\sigma$ | $\epsilon_{\text{Hf}}(t)$ | $1\sigma$ | $T_{\text{DM1}}(\text{Ga})$ | $T_{\text{DM2}}(\text{Ga})$ | $f_{\text{Lu/Hf}}$ |
|-------------------|--------|-----------------------------------|-----------------------------------|-----------------------------------|-----------|---------------------------|-----------|-----------------------------|-----------------------------|--------------------|
| 双堡塘组(样品 16DSS-Z6) |        |                                   |                                   |                                   |           |                           |           |                             |                             |                    |
| 2                 | 301    | 0.073442                          | 0.001885                          | 0.282756                          | 0.000024  | 5.7                       | 0.8       | 0.720                       | 0.952                       | -0.94              |
| 5                 | 1826   | 0.023928                          | 0.000672                          | 0.281784                          | 0.000021  | 4.9                       | 0.7       | 2.044                       | 2.176                       | -0.98              |
| 9                 | 300    | 0.031168                          | 0.000906                          | 0.283036                          | 0.000027  | 15.8                      | 0.9       | 0.305                       | 0.308                       | -0.97              |
| 24                | 299    | 0.064621                          | 0.001665                          | 0.282755                          | 0.000034  | 5.6                       | 1.2       | 0.718                       | 0.953                       | -0.95              |
| 26                | 292    | 0.056031                          | 0.001518                          | 0.282656                          | 0.000032  | 2.0                       | 1.1       | 0.857                       | 1.179                       | -0.95              |
| 37                | 297    | 0.027563                          | 0.000900                          | 0.282798                          | 0.000023  | 7.3                       | 0.8       | 0.642                       | 0.848                       | -0.97              |
| 45                | 449    | 0.028505                          | 0.000857                          | 0.282554                          | 0.000021  | 1.9                       | 0.7       | 0.984                       | 1.304                       | -0.97              |
| 55                | 296    | 0.024755                          | 0.000808                          | 0.282807                          | 0.000024  | 7.6                       | 0.9       | 0.628                       | 0.828                       | -0.98              |
| 69                | 448    | 0.021511                          | 0.000550                          | 0.282418                          | 0.000026  | -2.8                      | 0.9       | 1.166                       | 1.604                       | -0.98              |
| 70                | 296    | 0.073667                          | 0.001948                          | 0.282917                          | 0.000032  | 11.2                      | 1.1       | 0.488                       | 0.594                       | -0.94              |
| 80                | 305    | 0.035393                          | 0.000976                          | 0.282726                          | 0.000022  | 4.9                       | 0.8       | 0.745                       | 1.006                       | -0.97              |
| 92                | 448    | 0.011657                          | 0.000403                          | 0.282571                          | 0.000015  | 2.6                       | 0.5       | 0.949                       | 1.259                       | -0.99              |
| 金塔组(样品 16DS-Z4)   |        |                                   |                                   |                                   |           |                           |           |                             |                             |                    |
| 4                 | 2459   | 0.026844                          | 0.000695                          | 0.281242                          | 0.000023  | -0.2                      | 0.8       | 2.783                       | 2.978                       | -0.98              |
| 5                 | 447    | 0.020889                          | 0.000553                          | 0.282365                          | 0.000024  | -4.7                      | 0.8       | 1.239                       | 1.723                       | -0.98              |
| 9                 | 305    | 0.035836                          | 0.000910                          | 0.282691                          | 0.000025  | 3.6                       | 0.9       | 0.794                       | 1.085                       | -0.97              |
| 10                | 299    | 0.043747                          | 0.001136                          | 0.282696                          | 0.000029  | 3.7                       | 1.0       | 0.791                       | 1.080                       | -0.97              |
| 11                | 302    | 0.036064                          | 0.001142                          | 0.282677                          | 0.000029  | 3.0                       | 1.0       | 0.818                       | 1.120                       | -0.97              |
| 12                | 448    | 0.049374                          | 0.001358                          | 0.282379                          | 0.000035  | -4.4                      | 1.2       | 1.246                       | 1.706                       | -0.96              |
| 13                | 299    | 0.034347                          | 0.000913                          | 0.282772                          | 0.000035  | 6.4                       | 1.2       | 0.679                       | 0.905                       | -0.97              |
| 14                | 446    | 0.021267                          | 0.000552                          | 0.282358                          | 0.000025  | -5.0                      | 0.9       | 1.249                       | 1.740                       | -0.98              |
| 15                | 446    | 0.021911                          | 0.000682                          | 0.282454                          | 0.000025  | -1.6                      | 0.9       | 1.120                       | 1.527                       | -0.98              |
| 16                | 305    | 0.073555                          | 0.002204                          | 0.282899                          | 0.000028  | 10.8                      | 1.0       | 0.517                       | 0.632                       | -0.93              |
| 51                | 301    | 0.061108                          | 0.001611                          | 0.282722                          | 0.000021  | 4.5                       | 0.7       | 0.764                       | 1.025                       | -0.95              |
| 56                | 301    | 0.049968                          | 0.001353                          | 0.282945                          | 0.000024  | 12.5                      | 0.8       | 0.439                       | 0.519                       | -0.96              |
| 58                | 447    | 0.038901                          | 0.000998                          | 0.282561                          | 0.000022  | 2.1                       | 0.8       | 0.979                       | 1.293                       | -0.97              |
| 62                | 409    | 0.036688                          | 0.000917                          | 0.282792                          | 0.000028  | 9.5                       | 1.0       | 0.651                       | 0.795                       | -0.97              |
| 67                | 300    | 0.023610                          | 0.000599                          | 0.282762                          | 0.000031  | 6.1                       | 1.1       | 0.688                       | 0.924                       | -0.98              |
| 68                | 303    | 0.026571                          | 0.000665                          | 0.282873                          | 0.000030  | 10.1                      | 1.1       | 0.533                       | 0.673                       | -0.98              |
| 69                | 448    | 0.044990                          | 0.001266                          | 0.282495                          | 0.000027  | -0.3                      | 0.9       | 1.079                       | 1.446                       | -0.96              |
| 72                | 446    | 0.024942                          | 0.000664                          | 0.282267                          | 0.000021  | -8.2                      | 0.7       | 1.378                       | 1.943                       | -0.98              |
| 73                | 299    | 0.036396                          | 0.000953                          | 0.282608                          | 0.000027  | 0.6                       | 0.9       | 0.912                       | 1.276                       | -0.97              |
| 83                | 446    | 0.032994                          | 0.000896                          | 0.282156                          | 0.000024  | -12.3                     | 0.9       | 1.542                       | 2.194                       | -0.97              |
| 84                | 454    | 0.035493                          | 0.001152                          | 0.282563                          | 0.000021  | 2.2                       | 0.7       | 0.980                       | 1.288                       | -0.97              |
| 85                | 1838   | 0.055576                          | 0.001604                          | 0.281567                          | 0.000019  | -3.7                      | 0.7       | 2.399                       | 2.716                       | -0.95              |
| 87                | 448    | 0.015693                          | 0.000548                          | 0.282744                          | 0.000020  | 8.7                       | 0.7       | 0.712                       | 0.874                       | -0.98              |