表 1 诺木洪地区白沙河岩组角闪辉长岩样品611-2锆石U-Pb同位素测试结果

Table 1 U-Pb Isotopic Test Results of amphibole gabbro Samples (611-2) from Baishahe Formation in Nuomuhong Area

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 分析点号 |  | 含量(×10-6) |  | 同位素比值 | | | | | | 同位素比值 | | | 年龄(Ma) | | | | | |
| Th | Pb | U | 206Pb/238U | 1σ | 207Pb/235U | 1σ | 207Pb/206Pb | 1σ | 208Pb/232Th | 1σ | 238U/232Th | 206Pb/238U | 1σ | 207Pb/235U | 1σ | 207Pb/206Pb | 1σ |
| 611-2-02 | 163 | 103.3 | 343 | 0.1585 | 0.0014 | 1.5891 | 0.0334 | 0.0722 | 0.0015 | 0.0453 | 0.0010 | 5.3055 | 949 | 7.6 | 966 | 13.1 | 992 | 41.2 |
| 611-2-03 | 263 | 174 | 266 | 0.2511 | 0.0023 | 3.4993 | 0.0618 | 0.1004 | 0.0016 | 0.0673 | 0.0011 | 1.4099 | 1444 | 12.1 | 1527 | 14.0 | 1631 | 30.7 |
| 611-2-04 | 282 | 99.1 | 917 | 0.0625 | 0.0005 | 0.5035 | 0.0106 | 0.0580 | 0.0012 | 0.0189 | 0.0003 | 4.5005 | 391 | 3.3 | 414 | 7.2 | 532 | 44.4 |
| 611-2-05 | 215 | 233 | 654 | 0.1986 | 0.0017 | 2.3319 | 0.0407 | 0.0846 | 0.0014 | 0.0580 | 0.0011 | 4.2513 | 1168 | 9.1 | 1222 | 12.4 | 1306 | 32.9 |
| 611-2-06 | 247 | 168 | 587 | 0.1460 | 0.0013 | 1.4600 | 0.0256 | 0.0721 | 0.0012 | 0.0459 | 0.0009 | 3.7245 | 878 | 7.5 | 914 | 10.6 | 991 | 39.8 |
| 611-2-07 | 257 | 138.0 | 845 | 0.0960 | 0.0008 | 0.8609 | 0.0162 | 0.0647 | 0.0012 | 0.0235 | 0.0004 | 4.7077 | 591 | 4.8 | 631 | 8.8 | 765 | 39.7 |
| 611-2-08 | 291 | 132.3 | 1212 | 0.0653 | 0.0007 | 0.4966 | 0.0100 | 0.0550 | 0.0011 | 0.0220 | 0.0006 | 10.2179 | 408 | 4.0 | 409 | 6.8 | 413 | 44.4 |
| 611-2-09 | 287 | 124 | 447 | 0.1158 | 0.0014 | 1.1396 | 0.0262 | 0.0709 | 0.0015 | 0.0377 | 0.0007 | 2.6267 | 707 | 7.9 | 772 | 12.5 | 955 | 38.0 |
| 611-2-10 | 127 | 118.2 | 473 | 0.1472 | 0.0017 | 1.3706 | 0.0260 | 0.0674 | 0.0012 | 0.0406 | 0.0008 | 5.3220 | 885 | 9.5 | 876 | 11.2 | 850 | 37.0 |
| 611-2-11 | 130 | 141.8 | 566 | 0.1506 | 0.0014 | 1.3811 | 0.0248 | 0.0662 | 0.0012 | 0.0458 | 0.0010 | 7.8223 | 905 | 8.0 | 881 | 10.6 | 813 | 37.0 |
| 611-2-12 | 614 | 179 | 1627 | 0.0584 | 0.0006 | 0.4357 | 0.0079 | 0.0538 | 0.0009 | 0.0188 | 0.0003 | 3.7940 | 366 | 3.5 | 367 | 5.6 | 361 | 37.0 |
| 611-2-13 | 196 | 166 | 333 | 0.2282 | 0.0042 | 2.8504 | 0.0721 | 0.0896 | 0.0015 | 0.0695 | 0.0011 | 2.4547 | 1325 | 22.3 | 1369 | 19.0 | 1417 | 30.4 |
| 611-2-14 | 129 | 256 | 1206 | 0.1269 | 0.0018 | 1.3601 | 0.0282 | 0.0770 | 0.0012 | 0.0926 | 0.0021 | 15.7013 | 770 | 10.5 | 872 | 12.1 | 1122 | 26.9 |
| 611-2-15 | 174 | 199.9 | 2086 | 0.0675 | 0.0008 | 0.5099 | 0.0094 | 0.0544 | 0.0009 | 0.0236 | 0.0005 | 18.0344 | 421 | 4.6 | 418 | 6.3 | 387 | 38.9 |
| 611-2-16 | 656 | 135 | 971 | 0.0619 | 0.0006 | 0.5980 | 0.0158 | 0.0698 | 0.0019 | 0.0215 | 0.0008 | 5.0207 | 387 | 3.9 | 476 | 10.1 | 924 | 56.3 |
| 611-2-17 | 80.9 | 170.1 | 1683 | 0.0677 | 0.0007 | 0.5785 | 0.0112 | 0.0615 | 0.0012 | 0.0579 | 0.0014 | 30.0448 | 422 | 4.2 | 463 | 7.2 | 657 | 42.6 |
| 611-2-18 | 27.4 | 100.03 | 930 | 0.0805 | 0.0013 | 0.6512 | 0.0180 | 0.0576 | 0.0012 | 0.0369 | 0.0016 | 53.7673 | 499 | 7.5 | 509 | 11.1 | 522 | 50.9 |
| 611-2-19 | 424 | 254 | 2120 | 0.0693 | 0.0005 | 0.6123 | 0.0110 | 0.0634 | 0.0011 | 0.0303 | 0.0006 | 7.1271 | 432 | 3.2 | 485 | 6.9 | 720 | 41.7 |
| 611-2-20 | 31.7 | 207.4 | 1235 | 0.1314 | 0.0019 | 1.2166 | 0.0261 | 0.0664 | 0.0011 | 0.0474 | 0.0015 | 59.1088 | 796 | 11.1 | 808 | 12.0 | 820 | 33.3 |
| 611-2-21 | 458 | 244.8 | 2496 | 0.0652 | 0.0008 | 0.4817 | 0.0085 | 0.0532 | 0.0008 | 0.0208 | 0.0004 | 7.6241 | 407 | 4.7 | 399 | 5.8 | 339 | 35.2 |
| 611-2-22 | 526 | 178 | 1040 | 0.0872 | 0.0016 | 0.7274 | 0.0210 | 0.0592 | 0.0011 | 0.0281 | 0.0007 | 2.8223 | 539 | 9.7 | 555 | 12.4 | 572 | 40.7 |
| 611-2-23 | 754 | 586 | 1082 | 0.2332 | 0.0033 | 2.7473 | 0.0531 | 0.0847 | 0.0014 | 0.0780 | 0.0016 | 2.0437 | 1351 | 17.1 | 1341 | 14.4 | 1309 | 31.5 |
| 611-2-24 | 28.6 | 106.5 | 1172 | 0.0650 | 0.0008 | 0.5641 | 0.0138 | 0.0622 | 0.0014 | 0.0769 | 0.0031 | 90.3702 | 406 | 4.7 | 454 | 9.0 | 680 | 48.1 |
| 611-2-25 | 527 | 188 | 968 | 0.0917 | 0.0010 | 0.8757 | 0.0186 | 0.0687 | 0.0014 | 0.0297 | 0.0006 | 2.5889 | 566 | 6.1 | 639 | 10.1 | 900 | 38.0 |
| 611-2-26 | 1009 | 880 | 10015 | 0.0607 | 0.0006 | 0.4708 | 0.0083 | 0.0557 | 0.0009 | 0.0227 | 0.0004 | 13.7686 | 380 | 3.6 | 392 | 5.7 | 439 | 4.6 |
| 611-2-27 | 329 | 159.3 | 1434 | 0.0684 | 0.0007 | 0.5080 | 0.0099 | 0.0534 | 0.0010 | 0.0226 | 0.0004 | 6.3383 | 426 | 4.0 | 417 | 6.7 | 346 | 40.7 |
| 611-2-28 | 204 | 35.8 | 195 | 0.0654 | 0.0009 | 0.4899 | 0.0148 | 0.0548 | 0.0017 | 0.0207 | 0.0004 | 1.3434 | 408 | 5.2 | 405 | 10.1 | 467 | 70.4 |
| 611-2-29 | 193 | 107 | 100 | 0.2496 | 0.0029 | 3.5864 | 0.0966 | 0.1048 | 0.0030 | 0.0793 | 0.0012 | 0.7338 | 1436 | 14.9 | 1547 | 21.4 | 1722 | 53.7 |
| 611-2-30 | 958 | 168 | 839 | 0.0659 | 0.0007 | 0.4986 | 0.0097 | 0.0548 | 0.0011 | 0.0216 | 0.0003 | 1.2265 | 411 | 4.1 | 411 | 6.6 | 406 | 44.4 |
| 611-2-31 | 387 | 193 | 1141 | 0.0842 | 0.0009 | 0.8196 | 0.0154 | 0.0703 | 0.0012 | 0.0381 | 0.0009 | 4.6791 | 521 | 5.4 | 608 | 8.6 | 937 | 35.2 |
| 611-2-32 | 748 | 601 | 1063 | 0.2182 | 0.0022 | 2.6045 | 0.0451 | 0.0861 | 0.0013 | 0.0811 | 0.0012 | 2.1485 | 1272 | 11.7 | 1302 | 12.7 | 1343 | 30.7 |
| 611-2-33 | 512 | 147.4 | 1212 | 0.0620 | 0.0006 | 0.4604 | 0.0098 | 0.0537 | 0.0011 | 0.0206 | 0.0004 | 3.2874 | 388 | 3.9 | 385 | 6.8 | 367 | 78.7 |
| 611-2-34 | 316 | 425 | 684 | 0.3017 | 0.0037 | 4.3385 | 0.0894 | 0.1039 | 0.0018 | 0.0906 | 0.0016 | 3.0360 | 1700 | 18.2 | 1701 | 17.0 | 1694 | 33.3 |

表 2 诺木洪地区白沙河岩组黑云斜长片麻岩512-17 U-Pb同位素测试结果

Table 2 Test results of U-Pb isotopic composition of biotite plagioclase gneiss (512-17) in Baishahe Formation in Nuomuhong area

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 分析点号 |  | 含量(×10-6) |  | 同位素比值 | | | | | | 同位素比值 | | | 年龄(Ma) | | | | | |
| Th | Pb | U | 206Pb/238U | 1σ | 207Pb/235U | 1σ | 207Pb/206Pb | 1σ | 208Pb/232Th | 1σ | 238U/232Th | 206Pb/238U | 1σ | 207Pb/235U | 1σ | 207Pb/206Pb | 1σ |
| 512-17-01 | 252 | 222 | 614 | 0.2131 | 0.0020 | 2.4459 | 0.0494 | 0.0824 | 0.0016 | 0.0601 | 0.0012 | 3.5834 | 1245 | 10.9 | 1256 | 14.6 | 1255 | 38.9 |
| 512-17-02 | 510 | 328 | 767 | 0.2113 | 0.0018 | 2.5022 | 0.0455 | 0.0850 | 0.0015 | 0.0577 | 0.0009 | 1.9685 | 1236 | 9.4 | 1273 | 13.2 | 1317 | 34.9 |
| 512-17-03 | 249 | 236 | 631 | 0.2208 | 0.0024 | 2.6371 | 0.0503 | 0.0859 | 0.0015 | 0.0670 | 0.0013 | 3.4752 | 1286 | 12.9 | 1311 | 14.1 | 1400 | 33.8 |
| 512-17-04 | 812 | 405 | 371 | 0.2688 | 0.0026 | 3.6024 | 0.0706 | 0.0961 | 0.0018 | 0.0736 | 0.0011 | 0.6219 | 1535 | 13.5 | 1550 | 15.6 | 1551 | 34.1 |
| 512-17-05 | 159 | 165.3 | 501 | 0.2060 | 0.0020 | 2.3911 | 0.0471 | 0.0834 | 0.0016 | 0.0576 | 0.0011 | 4.1978 | 1208 | 10.4 | 1240 | 14.1 | 1277 | 38.9 |
| 512-17-06 | 139 | 164.0 | 431 | 0.2354 | 0.0027 | 2.8398 | 0.0630 | 0.0866 | 0.0018 | 0.0701 | 0.0014 | 4.0025 | 1363 | 14.3 | 1366 | 16.7 | 1352 | 41.0 |
| 512-17-07 | 199 | 173 | 450 | 0.2138 | 0.0019 | 2.5330 | 0.0520 | 0.0850 | 0.0018 | 0.0613 | 0.0011 | 2.9232 | 1249 | 10.2 | 1282 | 15.0 | 1317 | 45.4 |
| 512-17-08 | 341 | 279 | 714 | 0.2144 | 0.0024 | 2.5030 | 0.0484 | 0.0838 | 0.0015 | 0.0638 | 0.0011 | 2.7204 | 1252 | 12.9 | 1273 | 14.1 | 1288 | 35.2 |
| 512-17-09 | 191 | 171.7 | 447 | 0.2767 | 0.0031 | 3.7704 | 0.0778 | 0.0975 | 0.0018 | 0.0308 | 0.0012 | 3.0050 | 1575 | 15.5 | 1586 | 16.6 | 1589 | 34.7 |
| 512-17-10 | 163 | 184 | 298 | 0.3171 | 0.0046 | 4.8100 | 0.0942 | 0.1095 | 0.0020 | 0.0904 | 0.0015 | 2.3725 | 1775 | 22.4 | 1787 | 16.5 | 1791 | 33.0 |
| 512-17-11 | 308 | 279 | 396 | 0.3060 | 0.0028 | 4.4749 | 0.0859 | 0.1049 | 0.0019 | 0.0899 | 0.0014 | 1.6890 | 1721 | 13.7 | 1726 | 16.0 | 1722 | 33.3 |
| 512-17-12 | 310 | 194 | 214 | 0.2830 | 0.0035 | 3.9249 | 0.0864 | 0.1000 | 0.0022 | 0.0813 | 0.0014 | 0.9015 | 1607 | 17.6 | 1619 | 17.8 | 1625 | 41.0 |
| 512-17-13 | 116 | 118.8 | 180 | 0.3162 | 0.0036 | 4.8214 | 0.1043 | 0.1099 | 0.0024 | 0.0899 | 0.0017 | 2.0687 | 1771 | 17.4 | 1789 | 18.2 | 1798 | 38.9 |
| 512-17-14 | 453 | 277 | 383 | 0.2775 | 0.0047 | 3.8232 | 0.0794 | 0.1016 | 0.0029 | 0.0684 | 0.0016 | 1.1265 | 1579 | 24.0 | 1598 | 16.8 | 1654 | 53.5 |
| 512-17-15 | 524 | 385 | 873 | 0.2260 | 0.0023 | 2.6824 | 0.0476 | 0.0853 | 0.0014 | 0.0602 | 0.0009 | 2.2313 | 1314 | 12.3 | 1324 | 13.2 | 1324 | 31.0 |
| 512-17-16 | 323 | 308 | 729 | 0.2351 | 0.0028 | 2.7879 | 0.0509 | 0.0855 | 0.0014 | 0.0685 | 0.0011 | 3.0014 | 1361 | 14.8 | 1352 | 13.7 | 1328 | 36.0 |
| 512-17-17 | 807 | 489 | 432 | 0.2820 | 0.0036 | 3.9351 | 0.0791 | 0.1006 | 0.0018 | 0.0864 | 0.0015 | 0.7123 | 1602 | 18.2 | 1621 | 16.3 | 1636 | 33.3 |
| 512-17-18 | 316 | 309 | 760 | 0.2261 | 0.0027 | 2.6220 | 0.0535 | 0.0836 | 0.0015 | 0.0698 | 0.0013 | 3.2137 | 1314 | 14.2 | 1307 | 15.0 | 1283 | 31.3 |
| 512-17-19 | 402 | 256 | 506 | 0.2242 | 0.0025 | 2.5730 | 0.0519 | 0.0828 | 0.0016 | 0.0615 | 0.0012 | 1.6718 | 1304 | 13.1 | 1293 | 14.8 | 1265 | 37.0 |
| 512-17-20 | 200 | 217 | 513 | 0.2382 | 0.0021 | 2.8443 | 0.0504 | 0.0861 | 0.0015 | 0.0689 | 0.0013 | 3.4098 | 1378 | 10.7 | 1367 | 13.3 | 1339 | 33.8 |
| 512-17-22 | 229 | 164 | 402 | 0.1998 | 0.0018 | 2.2603 | 0.0413 | 0.0814 | 0.0015 | 0.0605 | 0.0010 | 2.3746 | 1174 | 9.6 | 1200 | 12.9 | 1232 | 41.2 |
| 512-17-23 | 234 | 230 | 515 | 0.2322 | 0.0023 | 2.7962 | 0.0520 | 0.0867 | 0.0016 | 0.0748 | 0.0013 | 2.9231 | 1346 | 12.3 | 1355 | 13.9 | 1355 | 36.6 |
| 512-17-24 | 98.7 | 190.6 | 603 | 0.2207 | 0.0033 | 2.5360 | 0.0585 | 0.0825 | 0.0016 | 0.0706 | 0.0017 | 8.2490 | 1285 | 17.3 | 1282 | 16.8 | 1257 | 38.6 |
| 512-17-25 | 517 | 252 | 608 | 0.2108 | 0.0026 | 2.5169 | 0.0546 | 0.0858 | 0.0018 | 0.0461 | 0.0014 | 1.7393 | 1233 | 14.1 | 1277 | 15.8 | 1400 | 39.4 |
| 512-17-26 | 271 | 238 | 537 | 0.2318 | 0.0021 | 2.7857 | 0.0532 | 0.0863 | 0.0016 | 0.0645 | 0.0013 | 2.7316 | 1344 | 10.9 | 1352 | 14.3 | 1344 | 36.7 |
| 512-17-27 | 209 | 227 | 566 | 0.2295 | 0.0022 | 2.9104 | 0.0564 | 0.0913 | 0.0018 | 0.0632 | 0.0013 | 3.5185 | 1332 | 11.7 | 1385 | 14.7 | 1454 | 37.0 |
| 512-17-28 | 454 | 325 | 674 | 0.2259 | 0.0026 | 2.6574 | 0.0499 | 0.0847 | 0.0015 | 0.0626 | 0.0010 | 1.9946 | 1313 | 13.5 | 1317 | 13.9 | 1309 | 34.4 |
| 512-17-29 | 441 | 373 | 776 | 0.2298 | 0.0021 | 2.7315 | 0.0464 | 0.0857 | 0.0015 | 0.0693 | 0.0011 | 2.3193 | 1334 | 11.3 | 1337 | 12.7 | 1331 | 33.3 |
| 512-17-30 | 115 | 147.2 | 386 | 0.2220 | 0.0021 | 2.6868 | 0.0508 | 0.0871 | 0.0016 | 0.0712 | 0.0014 | 4.6432 | 1293 | 11.1 | 1325 | 14.0 | 1363 | 35.2 |

表 3诺木洪地区白沙河岩组变质岩主量、微量及稀土元素测试结果

Table 3 Results of major, trace and rare earth elements in metamorphic rocks of Xiaomiao Formation in Nuomuhong area

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 样品号 | 601-13 | 601-21 | 601-32 | 601-34 | 601-37 | 601-26 | 601-23 | 512-17 | 512-8 | 611-79 | 611-32 | 611-53 | 6581-2Q |
| 岩性 | 细粒斜长角闪岩 | 细粒斜长角闪岩 | 细粒糜棱岩化斜长角闪岩 | 细粒辉石斜长角闪岩 | 细粒斜长角闪岩 | 含黑云母二长片麻岩 | 角闪斜长片麻岩 | 黑云母斜长片麻岩 | 黑云母斜长片麻岩 | 变粒岩 | 眼球状细粒二长片麻岩 | 含榴辉石角闪岩 | 含榴斜长角闪岩 |
| SiO2(%) | 47.5 | 41.3 | 48.5 | 45 | 48.2 | 70.5 | 45.8 | 71.66 | 66.73 | 74.51 | 72.87 | 48.53 | 50.07 |
| TiO2(%) | 1.71 | 2.12 | 1.04 | 0.95 | 1.02 | 0.36 | 1.78 | 0.41 | 0.77 | 0.09 | 0.35 | 2.31 | 1.06 |
| Al2O3(%) | 18.8 | 15.05 | 14.5 | 18.3 | 14.5 | 13.75 | 19.45 | 14.46 | 15.02 | 15.24 | 13.25 | 14.22 | 14.18 |
| TFeO(%) | 10.66 | 20.28 | 11.16 | 8.41 | 11.28 | 2.56 | 12.22 | 2.87 | 4.64 | 0.95 | 2.38 | 14.13 | 10.79 |
| MnO(%) | 0.18 | 0.27 | 0.2 | 0.15 | 0.2 | 0.04 | 0.21 | 0.04 | 0.04 | 0.02 | 0.04 | 0.25 | 0.21 |
| MgO(%) | 5.06 | 8.16 | 8.07 | 5.52 | 8.12 | 0.91 | 5.23 | 1.17 | 2.57 | 0.33 | 0.44 | 6.31 | 8.22 |
| CaO(%) | 9.25 | 7.32 | 12.7 | 16.65 | 12.1 | 1.02 | 10.25 | 3.01 | 2.44 | 3.55 | 1.6 | 9.99 | 11.95 |
| Na2O(%) | 2.6 | 0.89 | 1.77 | 1.77 | 1.47 | 2.92 | 1.54 | 3.57 | 2.47 | 4.38 | 2.21 | 2.19 | 1.62 |
| K2O(%) | 1.54 | 1.66 | 0.18 | 0.73 | 0.41 | 6.53 | 0.96 | 1.9 | 4.08 | 0.55 | 5.58 | 0.22 | 0.16 |
| P2O5(%) | 0.33 | 0.23 | 0.08 | 0.14 | 0.08 | 0.16 | 0.36 | 0.09 | 0.08 | 0.04 | 0.04 | 0.19 | 0.08 |
| LOI | 0.98 | 0.98 | 0.5 | 1.93 | 0.8 | 0.49 | 0.56 | 0.84 | 1.03 | 0.63 | 0.85 | 0.17 | 0.29 |
| Total | 100.15 | 101.34 | 100.45 | 101.56 | 99.84 | 99.92 | 100.46 | 100.02 | 99.87 | 100.29 | 99.61 | 98.51 | 98.63 |
| Rb | 52.5 | 93 | 2.7 | 22.4 | 14.3 | 226 | 42.1 | 113.5 | 217 | 26 | 128 | 5.3 | 5.7 |
| Sr | 471 | 62.6 | 147 | 447 | 187 | 139 | 499 | 245 | 214 | 358 | 179 | 123.5 | 124.5 |
| Ba | 457 | 174 | 31.8 | 157 | 65.7 | 667 | 456 | 380 | 470 | 61 | 1275 | 50.8 | 75.5 |
| Th | 1.85 | 1.14 | 0.4 | 0.95 | 0.41 | 16.5 | 1.11 | 10.45 | 23.4 | 2.36 | 7.53 | 1.93 | 0.35 |
| U | 0.86 | 0.39 | 0.12 | 0.21 | 0.27 | 3.7 | 0.36 | 1.49 | 1.84 | 1.29 | 1.26 | 0.47 | 0.15 |
| Nb | 12 | 12.6 | 2.9 | 5.8 | 2.8 | 8.8 | 12.8 | 10.7 | 14.3 | 2.7 | 7.4 | 13.2 | 2.8 |
| Ta | 0.6 | 0.8 | 0.2 | 0.3 | 0.2 | 0.8 | 0.6 | 1 | 1 | 0.4 | 0.6 | 0.9 | 0.2 |
| Zr | 121 | 129 | 57 | 61 | 57 | 139 | 87 | 213 | 192 | 12 | 249 | 170 | 63 |
| Hf | 3.9 | 3.8 | 1.8 | 1.9 | 1.6 | 4.2 | 3.2 | 5 | 4.6 | 0.4 | 6.7 | 4.2 | 1.6 |
| Cr | 50 | 80 | 290 | 360 | 280 | 30 | 40 | 40 | 70 | 10 | 40 | 230 | 460 |
| V | 209 | 258 | 264 | 185 | 251 | 28 | 244 | 42 | 67 | 6 | 30 | 261 | 342 |
| Cs | 4.62 | 22.3 | 0.39 | 2.87 | 2.1 | 7.53 | 8.5 | 6.31 | 4.96 | 1.61 | 3.86 | 0.79 | 2.02 |
| Ga | 24.2 | 19.9 | 16.4 | 19.1 | 16.1 | 18.3 | 27.3 | 21.4 | 23.1 | 13.7 | 19.2 | 18.5 | 16.8 |
| Cl | 0.04 | 0.06 | 0.04 | 0.03 | 0.07 | 0.03 | 0.03 | 0.01 | 0.02 | 0.01 | 0.05 | 0.04 | 0.01 |
| La | 23.1 | 11.2 | 3.7 | 9 | 3.2 | 26.3 | 21.8 | 28.4 | 46.2 | 8.8 | 38.4 | 13 | 3.8 |
| Ce | 59 | 25.3 | 9.2 | 19 | 8.4 | 57.9 | 61.5 | 50.1 | 93.1 | 16.6 | 61.1 | 28.8 | 10 |
| Pr | 7.94 | 3.38 | 1.39 | 2.34 | 1.25 | 6.5 | 8.88 | 5.09 | 10.1 | 1.59 | 5.6 | 3.56 | 1.41 |
| Nd | 34.6 | 15.1 | 7 | 10.2 | 6.5 | 24.8 | 40 | 17.2 | 37.2 | 5.5 | 19.1 | 16.3 | 6.9 |
| Sm | 8.07 | 4.41 | 2.37 | 2.84 | 2.34 | 5.99 | 9.77 | 2.91 | 7.59 | 1.28 | 3.31 | 5.01 | 2.32 |
| Eu | 2.02 | 1.62 | 0.83 | 0.95 | 0.88 | 0.9 | 2.62 | 1.15 | 1.15 | 1.32 | 2.31 | 1.81 | 0.98 |
| Gd | 7.61 | 6.06 | 3.28 | 3.44 | 2.96 | 5.49 | 9.9 | 2.31 | 5.49 | 1.59 | 2.73 | 7.43 | 3.21 |
| Tb | 1.08 | 0.95 | 0.5 | 0.5 | 0.5 | 0.9 | 1.43 | 0.3 | 0.64 | 0.34 | 0.38 | 1.16 | 0.51 |
| Dy | 6.64 | 5.85 | 3.66 | 3.58 | 3.34 | 5.4 | 8.83 | 1.64 | 3.05 | 2.68 | 2.62 | 7.54 | 3.48 |
| Ho | 1.24 | 1.13 | 0.69 | 0.7 | 0.65 | 1.01 | 1.64 | 0.31 | 0.51 | 0.62 | 0.69 | 1.59 | 0.75 |
| Er | 3.51 | 3.38 | 2.18 | 2.19 | 1.97 | 3.14 | 4.86 | 0.81 | 1.24 | 1.87 | 2.63 | 4.58 | 2.12 |
| Tm | 0.46 | 0.48 | 0.27 | 0.28 | 0.29 | 0.39 | 0.65 | 0.12 | 0.16 | 0.28 | 0.52 | 0.67 | 0.32 |
| Yb | 3.2 | 3.02 | 2.01 | 1.79 | 1.92 | 2.64 | 4.38 | 0.79 | 0.91 | 1.74 | 4.52 | 4.17 | 2.1 |
| Lu | 0.46 | 0.44 | 0.29 | 0.26 | 0.32 | 0.37 | 0.62 | 0.12 | 0.13 | 0.27 | 0.84 | 0.65 | 0.31 |
| Y | 32 | 29.1 | 18.1 | 19.1 | 17.6 | 27.3 | 43.5 | 8.3 | 12.8 | 18.3 | 18.2 | 40.7 | 19.4 |
| ΣREE | 158.93 | 82.32 | 37.37 | 57.07 | 34.52 | 141.73 | 176.88 | 111.25 | 207.47 | 44.48 | 144.75 | 96.27 | 38.21 |
| LREE | 134.73 | 61.01 | 24.49 | 44.33 | 22.57 | 122.39 | 144.57 | 104.85 | 195.34 | 35.09 | 129.82 | 68.48 | 25.41 |
| HREE | 24.2 | 21.31 | 12.88 | 12.74 | 11.95 | 19.34 | 32.31 | 6.4 | 12.13 | 9.39 | 14.93 | 27.79 | 12.8 |
| LREE/HREE | 5.57 | 2.86 | 1.9 | 3.48 | 1.89 | 6.33 | 4.47 | 16.38 | 16.1 | 3.74 | 8.7 | 2.46 | 1.99 |
| LaN/YbN | 5.18 | 2.66 | 1.32 | 3.61 | 1.2 | 7.15 | 3.57 | 25.79 | 36.42 | 3.63 | 6.09 | 2.24 | 1.3 |
| δEu | 0.78 | 0.96 | 0.91 | 0.93 | 1.02 | 0.47 | 0.81 | 1.31 | 0.52 | 2.83 | 2.28 | 0.91 | 1.1 |
| δCe | 1.06 | 1 | 0.99 | 0.99 | 1.03 | 1.05 | 1.08 | 0.94 | 1.01 | 1.01 | 0.9 | 1.02 | 1.06 |
| al | 26.92 | 18.47 | 18.77 | 23.32 | 19.02 | 40.99 | 26.77 | 41.31 | 36.51 | 48 | 43.46 | 19.58 | 18.86 |
| fm | 40.36 | 61.15 | 47.29 | 33.28 | 48.32 | 17.87 | 42.5 | 20.26 | 31.94 | 6.95 | 14.92 | 50.1 | 48.43 |
| c | 24.21 | 16.37 | 29.92 | 38.68 | 28.91 | 5.75 | 25.8 | 15.77 | 10.93 | 20.48 | 9.89 | 25.03 | 28.93 |
| alk | 8.51 | 4 | 4.02 | 4.72 | 3.75 | 35.39 | 4.92 | 22.66 | 20.61 | 24.57 | 31.73 | 5.29 | 3.77 |
| c/fm | 0.6 | 0.27 | 0.63 | 1.16 | 0.6 | 0.32 | 0.61 | 0.78 | 0.34 | 2.95 | 0.66 | 0.5 | 0.6 |
| si | 115.41 | 86.03 | 106.52 | 97.32 | 107.29 | 356.68 | 106.99 | 347.43 | 275.28 | 398.28 | 405.58 | 113.4 | 113.01 |
| ti | 3.13 | 3.32 | 1.72 | 1.55 | 1.71 | 1.37 | 3.13 | 1.5 | 2.39 | 0.36 | 1.47 | 4.06 | 1.8 |
| p | 0.34 | 0.2 | 0.07 | 0.13 | 0.08 | 0.34 | 0.36 | 0.18 | 0.14 | 0.09 | 0.09 | 0.19 | 0.08 |
| k | 0.28 | 0.55 | 0.06 | 0.21 | 0.16 | 0.6 | 0.29 | 0.26 | 0.52 | 0.08 | 0.62 | 0.06 | 0.06 |
| mg | 0.45 | 0.41 | 0.56 | 0.53 | 0.56 | 0.38 | 0.43 | 0.42 | 0.49 | 0.38 | 0.24 | 0.44 | 0.57 |
| t | -5.81 | -1.9 | -15.17 | -20.07 | -13.64 | -0.15 | -3.95 | 2.89 | 4.97 | 2.96 | 1.83 | -10.74 | -13.85 |
| qz | -18.63 | -29.98 | -9.56 | -21.55 | -7.73 | 115.1 | -12.68 | 155.37 | 90.34 | 198.51 | 177.73 | -7.76 | -2.09 |

表 4 白沙河岩组含榴黑云母斜长片麻岩(611-4)电子探针测试数据

Table 4 Electronic probe test data of garnet biotite-bearing plagioclase gneiss (611-4) in Baishahe Formation

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Grt-1r | Grt-1c | Grt-1r | Grt-2c |  | Bi-1 | Bi-2 | Bi-3 |  | Pl-1 | Pl-1 |
| SiO2 | 37.17 | 36.97 | 36.93 | 37.33 | SiO2 | 34.91 | 34.63 | 34.57 | SiO2 | 61.43 | 61.11 |
| TiO2 | 0.01 | 0.02 | 0.01 | 0.01 | TiO2 | 3.29 | 3.26 | 3.35 | TiO2 | 0.00 | 0.00 |
| Al2O3 | 20.94 | 20.80 | 20.57 | 20.92 | Al2O3 | 18.29 | 18.50 | 18.02 | Al2O3 | 24.11 | 24.61 |
| Cr2O3 | 0.05 | 0.00 | 0.00 | 0.01 | Cr2O3 | 0.05 | 0.09 | 0.10 | Cr2O3 | 0.00 | 0.00 |
| FeO | 27.75 | 29.03 | 27.47 | 29.22 | FeO | 20.54 | 20.46 | 20.79 | FeO | 0.02 | 0.01 |
| MnO | 10.32 | 9.33 | 10.21 | 8.73 | MnO | 0.45 | 0.50 | 0.44 | MnO | 0.01 | 0.01 |
| MgO | 2.37 | 2.74 | 2.43 | 2.88 | MgO | 7.57 | 7.54 | 7.91 | MgO | 0.00 | 0.00 |
| NiO | 0.00 | 0.01 | 0.00 | 0.01 | NiO | 0.00 | 0.00 | 0.05 | NiO | 0.00 | 0.00 |
| ZnO | 0.05 | 0.09 | 0.00 | 0.05 | ZnO | 0.05 | 0.07 | 0.00 | ZnO | 0.04 | 0.04 |
| CaO | 1.11 | 1.34 | 1.26 | 1.27 | CaO | 0.00 | 0.00 | 0.00 | CaO | 6.84 | 6.13 |
| Na2O | 0.00 | 0.01 | 0.00 | 0.02 | Na2O | 0.08 | 0.16 | 0.10 | Na2O | 7.72 | 8.44 |
| K2O | 0.00 | 0.00 | 0.00 | 0.00 | K2O | 10.32 | 10.32 | 10.38 | K2O | 0.10 | 0.19 |
| Total | 99.77 | 100.33 | 98.88 | 100.48 | Total | 95.54 | 95.53 | 95.72 | Total | 100.27 | 100.55 |
| 以12个氧原子为标准计算的阳离子数 | | | | | 以11个氧原子为标准计算的阳离子数 | | | | 以8个氧原子为标准计算的阳离子数 | | |
| Si | 3.01 | 2.98 | 3.02 | 3.00 | Si | 2.69 | 2.68 | 2.67 | Si | 2.72 | 2.71 |
| Ti | 0.00 | 0.00 | 0.00 | 0.00 | AlⅣ | 1.31 | 1.32 | 1.33 | Al | 1.26 | 1.28 |
| Al | 2.00 | 1.98 | 1.98 | 1.98 | AlⅥ | 0.36 | 0.36 | 0.31 | Ca | 0.33 | 0.29 |
| Cr | 0.00 | 0.00 | 0.00 | 0.00 | Ti | 0.19 | 0.19 | 0.19 | Na | 0.66 | 0.72 |
| Fe3+ | 0.00 | 0.03 | 0.01 | 0.02 | Fe3+ | 0.20 | 0.19 | 0.17 | K | 0.01 | 0.01 |
| Fe2+ | 1.88 | 1.93 | 1.87 | 1.95 | Fe2+ | 1.12 | 1.14 | 1.18 | Total | 4.98 | 5.02 |
| Mn | 0.71 | 0.64 | 0.71 | 0.59 | Mn | 0.03 | 0.03 | 0.03 | An(%) | 32.69 | 28.34 |
| Mg | 0.29 | 0.33 | 0.30 | 0.34 | Mg | 0.87 | 0.87 | 0.91 | Ab(%) | 66.73 | 70.59 |
| Ca | 0.10 | 0.12 | 0.11 | 0.11 | Ca | 0.00 | 0.00 | 0.00 | Or(%) | 0.58 | 1.07 |
| Total | 7.99 | 8.01 | 7.99 | 8.00 | Na | 0.01 | 0.02 | 0.01 |  |  |  |
| XCa | 0.04 | 0.05 | 0.05 | 0.05 | K | 1.02 | 1.02 | 1.02 |  |  |  |
| XMg | 0.13 | 0.15 | 0.14 | 0.15 | Total | 7.80 | 7.81 | 7.83 |  |  |  |
| And(%) | 0.00 | 1.48 | 0.37 | 0.81 | XMg | 0.44 | 0.43 | 0.44 |  |  |  |
| Pyr(%) | 9.55 | 10.95 | 9.91 | 11.50 | XFe | 0.56 | 0.57 | 0.56 |  |  |  |
| Spe(%) | 23.57 | 21.16 | 23.70 | 19.84 |  |  |  |  |  |  |  |
| Gro(%) | 3.04 | 2.37 | 3.32 | 2.82 |  |  |  |  |  |  |  |
| Alm(%) | 62.59 | 64.04 | 62.70 | 65.00 |  |  |  |  |  |  |  |

表 5 白沙河岩组单斜辉石斜长角闪岩电子探针分析结果

Table 5 Electron probe analysis results of clinopyroxene and amphibolite in Baishahe Formation

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cpx | | | | | Hb | | | Pl | | | |
| SiO2 | 53.45 | 53.30 | 53.13 | 53.11 | SiO2 | 41.46 | 41.05 | SiO2 | 56.94 | 58.02 | 56.78 |
| TiO2 | 0.00 | 0.00 | 0.06 | 0.05 | TiO2 | 2.28 | 2.51 | TiO2 | 0.00 | 0.00 | 0.00 |
| Al2O3 | 0.30 | 0.14 | 0.60 | 0.50 | Al2O3 | 12.48 | 12.64 | Al2O3 | 27.18 | 26.66 | 27.22 |
| FeO | 8.34 | 8.76 | 9.26 | 9.47 | FeO | 16.70 | 16.15 | FeO | 0.14 | 0.14 | 0.20 |
| MnO | 0.28 | 0.35 | 0.31 | 0.31 | MnO | 0.20 | 0.31 | MnO | 0.00 | 0.03 | 0.00 |
| MgO | 12.89 | 12.69 | 12.75 | 12.49 | MgO | 9.13 | 8.89 | MgO | 0.00 | 0.00 | 0.02 |
| CaO | 25.22 | 25.74 | 24.50 | 24.58 | CaO | 12.36 | 12.37 | CaO | 9.57 | 9.03 | 9.78 |
| Na2O | 0.13 | 0.08 | 0.16 | 0.17 | Na2O | 1.74 | 1.87 | Na2O | 6.42 | 6.59 | 6.36 |
| K2O | 0.00 | 0.00 | 0.00 | 0.00 | K2O | 1.27 | 1.38 | K2O | 0.08 | 0.09 | 0.10 |
| ZnO | 0.00 | 0.08 | 0.00 | 0.00 | ZnO | 0.00 | 0.00 | ZnO | 0.01 | 0.00 | 0.01 |
| Cr2O3 | 0.03 | 0.06 | 0.00 | 0.00 | Cr2O3 | 0.07 | 0.00 | Cr2O3 | 0.06 | 0.00 | 0.00 |
| NiO | 0.04 | 0.03 | 0.00 | 0.03 | NiO | 0.00 | 0.02 | NiO | 0.02 | 0.00 | 0.01 |
| Total | 100.66 | 101.24 | 100.76 | 100.70 | Total | 97.69 | 97.19 | Total | 100.42 | 100.55 | 100.47 |
| 以6个氧原子为标准计算的阳离子数 | | | | | 以23个氧原子为标准计算的阳离子数 | | | 以8个氧原子为标准计算的阳离子数 | | | |
| Si | 1.99 | 1.98 | 1.98 | 1.99 | Si | 6.28 | 6.25 | Si | 2.55 | 2.59 | 2.55 |
| Al(ⅳ) | 0.01 | 0.00 | 0.02 | 0.01 | AlⅣ | 1.72 | 1.75 | Al | 1.44 | 1.40 | 1.44 |
| Al(ⅵ) | 0.00 | 0.00 | 0.01 | 0.01 | AlⅥ | 0.51 | 0.51 | Ca | 0.46 | 0.43 | 0.47 |
| Ti | 0.00 | 0.00 | 0.00 | 0.00 | Ti | 0.26 | 0.29 | Na | 0.56 | 0.57 | 0.55 |
| Cr | 0.00 | 0.00 | 0.00 | 0.00 | Fe3+ | 0.27 | 0.26 | K | 0.00 | 0.01 | 0.01 |
| Fe3+ | 0.02 | 0.04 | 0.03 | 0.02 | Fe2+ | 1.84 | 1.80 | Total | 5.01 | 5.00 | 5.01 |
| Fe2+ | 0.24 | 0.23 | 0.26 | 0.27 | Mn | 0.03 | 0.04 | An(%) | 44.96 | 42.84 | 45.67 |
| Mn | 0.01 | 0.01 | 0.01 | 0.01 | Mg | 2.06 | 2.02 | Ab(%) | 54.59 | 56.63 | 53.79 |
| Mg | 0.72 | 0.70 | 0.71 | 0.70 | Ca | 2.00 | 2.02 | Or(%) | 0.45 | 0.53 | 0.54 |
| Ca | 1.01 | 1.03 | 0.98 | 0.98 | Na | 0.51 | 0.55 |  |  |  |  |
| Na | 0.01 | 0.01 | 0.01 | 0.01 | K | 0.25 | 0.27 |  |  |  |  |
| K | 0.00 | 0.00 | 0.00 | 0.00 | Total | 15.73 | 15.74 |  |  |  |  |
| Total | 4.01 | 4.01 | 4.01 | 4.01 |  |  |  |  |  |  |  |
| Wo | 50.34 | 50.84 | 49.03 | 49.29 |  |  |  |  |  |  |  |
| En | 35.79 | 34.87 | 35.49 | 34.83 |  |  |  |  |  |  |  |
| Fs | 13.41 | 14.00 | 14.92 | 15.27 |  |  |  |  |  |  |  |
| Ac | 0.46 | 0.29 | 0.57 | 0.61 |  |  |  |  |  |  |  |