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 | 　 | 　 | 　 | 　 | 　 | 　 | 　 |