**Supplementary table 2. Major and trace element concentrations of the Paleoproterozoic granitoids from the Liaodong Peninsula.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Pluton name | Hupiyu | Simenzi | Muniu | Niejiaweizi | Longjiapu |
| Sample | 18YK03-1 | 18YK02-1 | 18YK01-1 | 18DD26-2 | 18DD25-3 | 18DD25-2 | 18DD22-1 | 18XY11-3 | 18XY11-2 | 18DD30-3 | NJW-TY1 | NJW-TY2 | NJW-TY3 | NJW-TY4 | 18XY13-3 | 18XY13-2 |
| SiO2 | 75.18  | 77.61  | 75.29  | 75.42  | 72.25  | 71.71  | 71.05  | 76.82  | 76.53  | 73.38  | 73.86  | 73.46  | 73.04  | 73.78  | 74.01  | 77.38  |
| TiO2 | 0.16  | 0.15  | 0.22  | 0.21  | 0.27  | 0.28  | 0.39  | 0.28  | 0.26  | 0.07  | 0.13  | 0.06  | 0.13  | 0.12  | 0.04  | 0.04  |
| Al2O3 | 12.10  | 10.52  | 10.86  | 11.34  | 12.42  | 12.60  | 12.55  | 11.00  | 11.07  | 14.22  | 14.28  | 14.20  | 14.45  | 14.33  | 15.08  | 12.71  |
| TFe2O3 | 1.65  | 1.73  | 3.09  | 2.81  | 3.67  | 3.67  | 4.90  | 2.06  | 2.41  | 0.75  | 0.85  | 0.85  | 0.85  | 0.83  | 0.30  | 0.30  |
| FeO | 0.71  | 0.41  | 1.04  | 1.29  | 2.09  | 2.23  | 1.76  | 1.16  | 0.96  | 0.48  | 0.55  | 0.64  | 0.68  | 0.71  | 0.14  | 0.45  |
| MnO | 0.03  | 0.02  | 0.04  | 0.04  | 0.05  | 0.06  | 0.07  | 0.02  | 0.04  | 0.02  | 0.02  | 0.02  | 0.02  | 0.02  | 0.01  | 0.01  |
| MgO | 0.10  | 0.04  | 0.08  | 0.05  | 0.05  | 0.06  | 0.13  | 0.36  | 0.41  | 0.29  | 0.40  | 0.41  | 0.38  | 0.35  | 0.14  | 0.13  |
| CaO | 0.92  | 0.77  | 0.90  | 1.11  | 1.63  | 1.60  | 0.96  | 0.90  | 1.05  | 1.26  | 1.92  | 2.03  | 2.11  | 1.98  | 1.62  | 1.87  |
| Na2O | 3.34  | 3.16  | 3.44  | 2.87  | 3.27  | 3.08  | 3.46  | 2.86  | 2.96  | 4.61  | 4.16  | 4.47  | 4.59  | 4.29  | 4.79  | 4.18  |
| K2O | 4.84  | 4.25  | 4.17  | 5.04  | 5.02  | 5.62  | 4.96  | 3.95  | 3.66  | 4.09  | 3.64  | 3.57  | 3.33  | 3.48  | 2.70  | 2.16  |
| P2O5 | 0.02  | 0.01  | 0.02  | 0.02  | 0.03  | 0.02  | 0.04  | 0.04  | 0.03  | 0.02  | 0.04  | 0.03  | 0.02  | 0.09  | 0.01  | 0.01  |
| LOl | 0.69  | 0.85  | 0.89  | 0.33  | 0.48  | 0.38  | 0.62  | 0.86  | 0.76  | 0.84  | 0.32  | 0.24  | 0.39  | 0.43  | 0.94  | 0.83  |
| Mg# | 0.11  | 0.04  | 0.05  | 0.03  | 0.03  | 0.03  | 0.05  | 0.26  | 0.25  | 0.44  | 0.48  | 0.49  | 0.47  | 0.46  | 0.47  | 0.47  |
| K2O/Na2O | 1.45  | 1.34  | 1.21  | 1.76  | 1.54  | 1.83  | 1.43  | 1.38  | 1.24  | 0.89  | 0.88  | 0.80  | 0.73  | 0.81  | 0.56  | 0.52  |
| A/CNK | 0.98  | 0.94  | 0.92  | 0.93  | 0.90  | 0.90  | 0.98  | 1.04  | 1.03  | 0.99  | 1.00  | 0.95  | 0.96  | 0.99  | 1.10  | 1.01  |
| A/NK | 1.13  | 1.07  | 1.07  | 1.12  | 1.15  | 1.13  | 1.13  | 1.22  | 1.25  | 1.18  | 1.32  | 1.27  | 1.30  | 1.32  | 1.40  | 1.38  |
| La | 66.17  | 67.61  | 33.98  | 27.58  | 25.64  | 19.88  | 29.04  | 61.25  | 52.32  | 4.82  | 5.08  | 4.19  | 2.86  | 1.77  | 1.67  | 1.88  |
| Ce | 142.56  | 141.77  | 81.43  | 68.56  | 70.36  | 55.26  | 62.86  | 141.95  | 122.62  | 8.92  | 11.80  | 9.52  | 6.53  | 4.84  | 2.72  | 3.16  |
| Pr | 14.70  | 15.03  | 9.67  | 7.04  | 6.74  | 5.93  | 7.23  | 16.59  | 13.80  | 0.99  | 1.64  | 1.42  | 1.03  | 0.77  | 0.32  | 0.36  |
| Nd | 51.46  | 52.58  | 37.61  | 26.22  | 25.80  | 23.64  | 27.34  | 62.12  | 51.36  | 3.46  | 5.88  | 5.02  | 3.45  | 2.73  | 1.10  | 1.22  |
| Sm | 8.99  | 9.25  | 8.13  | 5.59  | 5.99  | 5.76  | 5.30  | 12.05  | 10.75  | 0.67  | 0.84  | 0.85  | 0.58  | 0.43  | 0.22  | 0.24  |
| Eu | 1.11  | 1.14  | 1.32  | 1.02  | 1.17  | 1.14  | 1.67  | 2.03  | 1.99  | 0.41  | 1.01  | 1.01  | 1.00  | 1.06  | 0.41  | 0.48  |
| Gd | 8.06  | 8.33  | 8.04  | 5.71  | 6.25  | 6.20  | 5.07  | 9.72  | 9.34  | 0.60  | 0.68  | 0.69  | 0.56  | 0.41  | 0.22  | 0.25  |
| Tb | 1.19  | 1.21  | 1.25  | 0.89  | 0.99  | 1.01  | 0.73  | 1.14  | 1.15  | 0.08  | 0.11  | 0.09  | 0.09  | 0.06  | 0.03  | 0.04  |
| Dy | 7.47  | 7.67  | 8.08  | 5.87  | 6.53  | 6.75  | 4.64  | 5.19  | 5.25  | 0.46  | 0.64  | 0.62  | 0.45  | 0.38  | 0.23  | 0.33  |
| Ho | 1.55  | 1.59  | 1.70  | 1.24  | 1.38  | 1.41  | 0.95  | 0.77  | 0.75  | 0.09  | 0.13  | 0.12  | 0.12  | 0.10  | 0.05  | 0.08  |
| Er | 4.41  | 4.54  | 4.84  | 3.61  | 4.03  | 4.05  | 2.68  | 1.61  | 1.52  | 0.24  | 0.32  | 0.17  | 0.19  | 0.20  | 0.15  | 0.23  |
| Tm | 0.66  | 0.68  | 0.74  | 0.53  | 0.60  | 0.59  | 0.40  | 0.19  | 0.17  | 0.04  | 0.04  | 0.05  | 0.03  | 0.03  | 0.02  | 0.04  |
| Yb | 4.20  | 4.33  | 4.75  | 3.38  | 3.86  | 3.59  | 2.56  | 1.00  | 0.98  | 0.21  | 0.34  | 0.31  | 0.19  | 0.20  | 0.15  | 0.25  |
| Lu | 0.62  | 0.64  | 0.73  | 0.50  | 0.57  | 0.50  | 0.40  | 0.14  | 0.14  | 0.03  | 0.08  | 0.06  | 0.06  | 0.05  | 0.02  | 0.04  |
| Y | 47.22  | 48.32  | 51.66  | 31.46  | 36.62  | 36.72  | 23.24  | 19.84  | 20.07  | 2.85  | 4.02  | 3.92  | 3.64  | 3.33  | 1.75  | 2.51  |
| ΣREE | 313.1  | 316.4  | 202.3  | 157.7  | 159.9  | 135.7  | 150.9  | 315.7  | 272.1  | 21.0  | 28.6  | 24.1  | 17.1  | 13.0  | 7.3  | 8.6  |
| LREE/HREE | 10.12  | 9.91  | 5.71  | 6.26  | 5.61  | 4.63  | 7.65  | 14.99  | 13.10  | 11.01  | 11.26  | 10.40  | 9.16  | 8.09  | 7.28  | 5.89  |
| (La/Yb)N | 11.30  | 11.21  | 5.13  | 5.86  | 4.77  | 3.97  | 8.13  | 44.02  | 38.23  | 16.28  | 10.72  | 9.70  | 10.80  | 6.35  | 7.79  | 5.43  |
| δEu | 0.39  | 0.39  | 0.49  | 0.55  | 0.58  | 0.58  | 0.97  | 0.55  | 0.59  | 1.93  | 3.96  | 3.91  | 5.29  | 7.61  | 5.73  | 6.00  |
| δCe | 1.07  | 1.04  | 1.09  | 1.18  | 1.28  | 1.23  | 1.03  | 1.07  | 1.09  | 0.95  | 1.00  | 0.95  | 0.93  | 1.02  | 0.85  | 0.88  |
| Li | 4.80  | 4.63  | 5.84  | 2.33  | 3.63  | 4.41  | 3.83  | 35.58  | 30.02  | 17.38  | 12.2 | 11.7 | 12.7 | 14.8 | 19.57  | 25.70  |
| Sc | 1.93  | 1.93  | 4.16  | 2.72  | 3.37  | 3.36  | 4.35  | 2.70  | 3.41  | 1.20  | 2.57 | 1.54 | 2.33 | 2.33 | 0.63  | 0.83  |
| Ti | 1013  | 1034  | 1704  | 1105  | 1400  | 1418  | 2128  | 1804  | 1607  | 384  | 779.15  | 371.60  | 779.15  | 719.22  | 251  | 266  |
| V | 1.11  | 1.11  | 2.18  | 1.12  | 1.34  | 1.19  | 3.79  | 2.44  | 3.07  | 5.48  | 7.42 | 7.15 | 9.58 | 7.48 | 1.88  | 1.65  |
| Cr | -  | - | -  | 0.75  | 1.72  | 0.67  | 2.01  | -  | -  | 3.54  | 10.10 | 10.40 | 12.40 | 13.70 | -  | -  |
| Co | 0.42  | 0.43  | 0.92  | 0.71  | 0.71  | 0.74  | 1.20  | 1.16  | 1.47  | 1.07  | 2.15 | 2.05 | 2.60 | 2.14 | 0.67  | 0.73  |
| Ni | 0.67  | 0.66  | 2.40  | 2.14  | 1.21  | 0.57  | 0.91  | 0.46  | 0.54  | 0.68  | 3.52 | 3.45 | 3.06 | 2.57 | 1.23  | 1.70  |
| Ga | 22.92  | 23.36  | 26.22  | 18.78  | 20.54  | 18.14  | 18.48  | 15.58  | 15.78  | 19.21  | 14.1 | 13.0 | 13.6 | 14.1 | 14.48  | 14.95  |
| Rb | 141  | 147  | 145  | 134  | 118  | 128  | 113  | 149  | 130  | 171  | 65.1 | 59.0 | 59.5 | 59.3 | 72  | 65  |
| Sr | 65  | 66  | 90  | 115  | 115  | 162  | 131  | 246  | 219  | 330  | 593 | 605 | 625 | 625 | 647  | 700  |
| Zr | 232  | 236  | 384  | 302  | 292  | 329  | 379  | 386  | 455  | 61  | 91.0 | 83.5 | 114 | 84.5 | 96  | 95  |
| Nb | 41.06  | 42.02  | 44.92  | 14.66  | 18.05  | 17.07  | 10.19  | 17.25  | 17.45  | 6.37  | 5.13 | 4.56 | 4.45 | 4.84 | 1.52  | 2.19  |
| Ba | 757  | 769  | 1020  | 1074  | 1106  | 1262  | 1606  | 2167  | 2010  | 1639  | 2159 | 2193 | 2527 | 2322 | 686  | 617  |
| Hf | 5.14  | 5.29  | 7.32  | 7.12  | 6.75  | 7.74  | 8.83  | 7.28  | 8.18  | 1.63  | 4.18 | 3.51 | 4.71 | 3.64 | 2.24  | 2.27  |
| Ta | 1.37  | 1.47  | 1.40  | 0.90  | 1.14  | 1.17  | 0.64  | 0.82  | 0.57  | 0.37  | 0.58 | 0.25 | 0.15 | 0.24 | 0.10  | 0.14  |
| Th | 19.14  | 19.80  | 14.16  | 10.60  | 11.23  | 9.64  | 6.46  | 23.71  | 19.46  | 5.47  | 2.00 | 1.09 | 0.95 | 0.78 | 0.14  | 0.14  |
| U | 2.64  | 2.72  | 2.58  | 1.40  | 1.03  | 1.00  | 0.67  | 3.70  | 3.04  | 1.36  | 0.64 | 0.51 | 0.29 | 0.32 | 0.42  | 0.44  |
| Sr/Y | 1.38  | 1.37  | 1.73  | 3.65  | 3.15  | 4.40  | 5.62  | 12.42  | 10.93  | 116.02  | 147.51  | 154.34  | 171.70  | 187.69  | 369.40  | 278.29  |
| Tzr (℃) | 819 | 821 | 863 | 840 | 829 | 838 | 864 | 879 | 896 | 705 | 737 | 725 | 751 | 731 | 750 | 746 |

**Major elements are reported in wt.%, trace and REE concentrations are reported in ppm. (La/Yb)N = (La/0.687)/(Yb/0.493). EuN/EuN\* = 2\*(Eu/0.168)/((Sm/0.444) + (Gd/0.596)); CeN/CeN\* = 2\*(Ce/1.775)/((La/0.687) + (Pr/0.276)).** **Tzr (℃) =12900/[2.95+0.85M+ln(496000/Zrmelt)]；M=(Na+K+2Ca)/(Al\*Si) cation ration**