Supplementary Table 1. Major elements and relevant parameters of the Taiyuan Formation samples

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NO. |  | Mass fraction of the major elements (*wt*/10−2) | | | | | | | | | L.O.I |
| CaO | SiO2 | Fe2O3 | Al2O3 | MgO | MnO | K2O | P2O5 | SO3 |
| T2-1 | *L*1 | 42.97 | 6.97 | 6.07 | 1.80 | 1.71 | 0.40 | 0.31 | 0.20 | 0.17 | 39.10 |
| T2-2 | 41.14 | 7.18 | 7.63 | 2.11 | 1.81 | 0.40 | 0.40 | 0.18 | 0.16 | 38.72 |
| T2-3 | 45.58 | 6.08 | 1.66 | 2.25 | 0.91 | 0.10 | 0.37 | 0.12 | 1.98 | 40.51 |
| Y2-1 | 52.21 | 2.58 | 1.70 | 0.75 | 0.89 | 0.21 | 0.11 | 0.08 | 0.13 | 41.05 |
| Y2-2 | 51.83 | 2.19 | 1.70 | 0.49 | 0.98 | 0.18 | 0.09 | 0.09 | 0.18 | 41.92 |
| Y2-3 | 51.32 | 3.88 | 1.44 | 0.98 | 0.76 | 0.18 | 0.20 | 0.21 | 0.08 | 40.64 |
| ZZ-1 | 52.55 | 1.66 | 1.52 | 0.41 | 0.81 | 0.30 | 0.07 | 0.10 | 0.12 | 42.14 |
| ZZ-2 | 50.43 | 4.64 | 1.65 | 0.94 | 0.80 | 0.29 | 0.21 | 0.29 | 0.13 | 40.27 |
| ZZ-3 | 52.03 | 2.56 | 1.51 | 0.71 | 0.79 | 0.29 | 0.11 | 0.21 | 0.24 | 41.21 |
| T5-1 | 44.71 | 8.77 | 2.86 | 2.90 | 0.97 | 0.13 | 0.41 | 0.22 | 0.80 | 37.93 |
| T5-2 | 42.80 | 11.23 | 3.18 | 3.93 | 0.87 | 0.16 | 0.53 | 0.33 | 0.84 | 35.82 |
| T7-1 | 45.84 | 8.84 | 2.03 | 2.53 | 0.91 | 0.13 | 0.35 | 0.27 | 0.33 | 38.35 |
| T7-2 | 36.80 | 16.66 | 2.44 | 5.39 | 0.94 | 0.11 | 0.75 | 0.48 | 1.24 | 34.43 |
| Y1-1 | 45.81 | 8.24 | 2.55 | 2.38 | 0.92 | 0.22 | 0.36 | 0.16 | 0.24 | 38.56 |
| Y1-2 | 44.51 | 11.16 | 2.58 | 2.79 | 0.84 | 0.16 | 0.39 | 0.23 | 0.77 | 36.09 |
| Avg. | 46.70 | 6.84 | 2.70 | 2.02 | 0.99 | 0.22 | 0.31 | 0.21 | 0.49 | 39.12 |
| T2-4 | *L*2 | 52.66 | 1.24 | 1.89 | 0.30 | 1.13 | 0.15 | 0.05 | 0.07 | 0.39 | 41.83 |
| T2-5 | 50.62 | 2.52 | 1.53 | 0.88 | 1.00 | 0.11 | 0.06 | 0.05 | 0.38 | 42.56 |
| T2-6 | 50.79 | 2.88 | 1.36 | 0.88 | 1.18 | 0.08 | 0.12 | 0.04 | 0.62 | 41.62 |
| Y2-4 | 47.13 | 16.28 | 1.46 | 0.62 | 0.76 | 0.11 | 0.08 | 0.09 | 0.78 | 32.30 |
| Y2-5 | 52.41 | 1.08 | 1.81 | 0.29 | 0.94 | 0.11 | 0.02 | 0.05 | 0.19 | 42.81 |
| Y2-6 | 46.25 | 6.68 | 2.61 | 1.40 | 1.45 | 0.12 | 0.26 | 0.07 | 2.25 | 38.31 |
| Y3-3 | 46.99 | 6.30 | 2.57 | 1.81 | 1.31 | 0.23 | 0.47 | 0.13 | 0.48 | 39.37 |
| Y3-4 | 52.72 | 2.00 | 1.69 | 0.55 | 0.62 | 0.25 | 0.12 | 0.14 | 0.70 | 40.84 |
| ZZ-4 | 51.56 | 2.15 | 1.16 | 0.50 | 0.87 | 0.10 | 0.09 | 0.00 | 0.00 | 42.63 |
| ZZ-5 | 52.90 | 1.38 | 1.08 | 0.48 | 0.85 | 0.10 | 0.06 | 0.04 | 0.28 | 42.52 |
| T5-3 | 39.82 | 18.61 | 2.66 | 4.54 | 0.75 | 0.08 | 0.73 | 0.22 | 0.70 | 31.28 |
| T5-4 | 46.29 | 10.48 | 1.91 | 2.68 | 0.70 | 0.07 | 0.43 | 0.15 | 0.56 | 36.37 |
| T5-5 | 46.52 | 9.15 | 1.60 | 2.00 | 0.75 | 0.09 | 0.37 | 0.17 | 0.69 | 38.22 |
| T7-3 | 42.44 | 13.87 | 2.03 | 4.55 | 0.68 | 0.08 | 0.52 | 0.11 | 1.07 | 34.18 |
| T7-4 | 46.17 | 9.64 | 1.93 | 2.97 | 0.78 | 0.09 | 0.34 | 0.09 | 1.07 | 36.59 |
| T7-5 | 43.44 | 12.56 | 1.84 | 3.74 | 0.79 | 0.09 | 0.52 | 0.10 | 0.99 | 35.61 |
| Y1-3 | 46.16 | 0.78 | 1.56 | 3.20 | 0.78 | 0.05 | 0.32 | 0.09 | 0.61 | 38.10 |
| Y1-4 | 51.62 | 3.52 | 0.92 | 1.07 | 0.63 | 0.04 | 0.13 | 0.10 | 0.31 | 41.32 |
| Y1-5 | 50.78 | 3.93 | 1.63 | 1.03 | 0.82 | 0.09 | 0.13 | 0.07 | 0.47 | 40.74 |
| Avg. | 48.28 | 6.58 | 1.75 | 1.76 | 0.88 | 0.11 | 0.25 | 0.09 | 0.66 | 38.80 |
| T2-7 | *L*3 | 53.91 | 2.36 | 0.89 | 0.51 | - | 0.09 | 0.03 | 0.10 | 0.19 | 41.65 |
| T2-8 | 55.38 | 0.78 | 0.49 | 0.32 | 0.49 | 0.05 | 0.02 | 0.04 | 0.14 | 42.52 |
| T2-9 | 52.27 | 0.68 | 0.38 | 0.24 | 1.26 | 0.05 | 0.02 | 1.65 | 0.10 | 43.12 |
| Y2-7 | 49.66 | 5.43 | 1.79 | 0.95 | 0.99 | 0.08 | 0.10 | 0.05 | 0.61 | 39.92 |
| Y2-8 | 54.33 | 1.29 | 0.87 | 0.38 | - | 0.04 | 0.04 | 0.08 | 0.46 | 42.23 |
| Y2-9 | 54.87 | 0.79 | 0.65 | 0.38 | - | 0.03 | 0.04 | 0.03 | 0.26 | 42.61 |
| Y2-10 | 50.09 | 5.89 | 1.43 | 0.85 | 0.87 | 0.07 | 0.18 | 0.12 | 1.02 | 39.17 |
| Y3-1 | 50.71 | 4.70 | 1.08 | 0.49 | 0.97 | 0.09 | 0.12 | 0.10 | 0.47 | 40.96 |
| Y3-2 | 41.19 | 30.33 | 0.86 | 0.53 | 0.67 | 0.07 | 0.10 | 0.10 | 0.64 | 25.29 |
| ZZ-6 | 50.17 | 7.15 | 0.74 | 0.57 | 0.72 | 0.04 | 0.09 | 0.06 | 0.19 | 40.03 |
| ZZ-7 | 44.33 | 12.81 | 2.30 | 1.08 | 1.51 | 0.14 | 0.19 | 0.09 | 0.53 | 36.80 |
| T5-6 | 48.04 | 7.25 | 0.98 | 2.06 | 1.18 | 0.05 | 0.30 | 0.07 | 0.68 | 39.18 |
| T5-7 | 50.24 | 5.42 | 0.91 | 1.45 | 0.87 | 0.06 | 0.23 | 0.07 | 0.56 | 39.93 |
| T7-6 | 41.65 | 14.17 | 2.92 | 3.66 | 0.83 | 0.12 | 0.50 | 0.41 | 2.25 | 33.11 |
| T7-7 | 49.84 | 7.27 | 1.11 | 1.24 | 0.63 | 0.05 | 0.15 | 0.18 | 0.67 | 38.39 |
| T7-8 | 45.10 | 13.98 | 1.56 | 1.91 | 0.69 | 0.06 | 0.23 | 0.17 | 1.24 | 34.74 |
| Avg. | 49.49 | 7.52 | 1.19 | 1.04 | 0.73 | 0.07 | 0.15 | 0.21 | 0.63 | 38.73 |
| T2-10 | *L*4 | 54.49 | 0.54 | 0.18 | 0.07 | 0.80 | 0.04 | 0.01 | 0.03 | 0.13 | 43.45 |
| T2-11 | 55.59 | 0.55 | 0.15 | 0.16 | - | 0.04 | 0.01 | 0.09 | 0.11 | 43.06 |
| Y2-11 | 54.57 | 0.66 | 0.54 | 0.18 | 0.66 | 0.08 | 0.03 | 0.03 | 0.32 | 42.64 |
| Y2-12 | 52.99 | 0.48 | 1.27 | 0.17 | 1.14 | 0.05 | 0.02 | 0.04 | 0.22 | 43.25 |
| ZZ-8 | 43.38 | 28.47 | 0.98 | 0.21 | 0.53 | 0.10 | 0.03 | 0.26 | 0.34 | 25.48 |
| ZZ-9 | 37.48 | 7.75 | 2.76 | 1.53 | 6.19 | 0.06 | 0.26 | 0.51 | 1.05 | 42.18 |
| ZZ-10 | 50.22 | 4.14 | 1.29 | 0.55 | 1.04 | 0.08 | 0.10 | 0.20 | 0.58 | 41.37 |
| Avg. | 49.82 | 6.08 | 1.02 | 0.41 | 1.48 | 0.06 | 0.07 | 0.17 | 0.39 | 40.20 |
| ZZ-11 | *L*5 | 53.46 | 0.72 | 1.03 | 0.30 | 0.75 | 0.04 | 0.03 | 0.04 | 0.16 | 43.23 |
| ZZ-12 | 51.81 | 1.79 | 1.83 | 0.51 | 0.77 | 0.09 | 0.07 | 0.05 | 0.45 | 42.27 |
| Avg. | 52.64 | 1.26 | 1.43 | 0.41 | 0.76 | 0.07 | 0.05 | 0.05 | 0.31 | 42.75 |
| PAAS |  | 1.29 | 62.40 | 7.18 | 18.88 | 2.19 | 0.11 | 3.68 | 0.16 | - | - |

Abbreviations: Avg., Average value; PAAS, post-Archean Australian shale.

Supplementary Table 2. Trace elements contents of the Taiyuan Formation samples (μg/g)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | V | Cr | Co | Ni | Sr | Zr | Mo | Cd | Ba | Hf | Pb | Th | U | Na | Ti |
| T2-1 | 17.44 | 74.17 | 9.19 | 53.18 | 1011.6 | 18.27 | 1.17 | 0.62 | 168.57 | 0.47 | 5.49 | 2.31 | 0.33 | 716.52 | 313.79 |
| T2-2 | 22.35 | 81.25 | 6.50 | 36.58 | 983.5 | 21.36 | 1.21 | 0.57 | 272.07 | 0.55 | 5.19 | 2.42 | 0.36 | 742.52 | 394.20 |
| T2-3 | 34.69 | 110.02 | 5.78 | 44.39 | 1176.0 | 26.21 | 2.72 | 1.23 | 437.59 | 0.64 | 8.43 | 3.75 | 6.48 | 901.50 | 478.48 |
| Y2-1 | 5.91 | 78.79 | 2.31 | 19.56 | 1267.5 | 6.68 | 0.71 | 0.48 | 181.90 | 0.17 | 2.43 | 0.75 | 0.23 | 818.63 | 110.49 |
| Y2-2 | 9.16 | 71.02 | 1.56 | 13.13 | 1363.5 | 6.79 | 0.75 | 0.47 | 136.93 | 0.17 | 2.83 | 0.71 | 0.34 | 764.23 | 85.22 |
| Y2-3 | 12.84 | 83.39 | 1.68 | 12.97 | 1169.5 | 12.63 | 0.80 | 0.48 | 127.14 | 0.29 | 2.76 | 1.07 | 0.22 | 879.32 | 195.31 |
| ZZ-1 | 4.10 | 58.52 | 1.01 | 9.06 | 989.7 | 4.33 | 0.50 | 0.38 | 115.79 | 0.09 | 1.85 | 0.48 | 0.13 | 445.54 | 55.18 |
| ZZ-2 | 11.04 | 62.05 | 1.75 | 16.64 | 918.5 | 6.91 | 0.68 | 0.40 | 133.40 | 0.18 | 3.90 | 0.58 | 1.38 | 456.80 | 121.14 |
| ZZ-3 | 4.44 | 56.82 | 1.11 | 9.67 | 844.8 | 6.58 | 0.58 | 0.38 | 103.61 | 0.14 | 2.11 | 0.50 | 0.21 | 497.08 | 109.58 |
| T7-1 | 18.92 | 85.94 | 4.09 | 14.35 | 1394.8 | 26.60 | 0.84 | 0.60 | 218.11 | 0.67 | 6.30 | 2.34 | 1.69 | 1684.10 | 518.34 |
| T7-2 | 61.80 | 111.72 | 6.48 | 31.10 | 1362.1 | 80.22 | 1.60 | 1.15 | 372.41 | 1.65 | 13.16 | 5.89 | 7.20 | 2096.95 | 1499.80 |
| T5-1 | 21.39 | 67.75 | 2.69 | 13.09 | 892.5 | 37.91 | 1.53 | 0.44 | 156.43 | 0.89 | 4.54 | 2.08 | 2.24 | 708.24 | 518.28 |
| T5-2 | 21.84 | 72.48 | 3.11 | 19.18 | 725.1 | 42.32 | 1.19 | 0.54 | 195.54 | 1.01 | 5.69 | 2.69 | 2.55 | 781.18 | 640.72 |
| Y1-1 | 16.08 | 62.82 | 2.52 | 25.61 | 829.1 | 21.88 | 0.69 | 0.47 | 100.99 | 0.53 | 4.89 | 1.97 | 0.60 | 565.30 | 358.72 |
| Y1-2 | 13.82 | 64.81 | 3.25 | 13.96 | 728.1 | 39.35 | 0.92 | 0.56 | 185.75 | 0.86 | 5.59 | 2.30 | 1.24 | 573.68 | 405.00 |
| T2-4 | 4.01 | 77.12 | 1.37 | 9.91 | 1007.2 | 6.05 | 0.73 | 0.56 | 133.88 | 0.13 | 1.95 | 0.60 | 0.34 | 612.14 | 61.28 |
| T2-5 | 4.48 | 49.55 | 0.88 | 9.02 | 611.2 | 5.53 | 0.79 | 0.58 | 59.28 | 0.12 | 1.30 | 0.26 | 1.83 | 298.86 | 41.68 |
| T2-6 | 11.08 | 83.62 | 1.53 | 21.28 | 1418.1 | 9.99 | 2.38 | 0.31 | 173.48 | 0.21 | 2.95 | 0.58 | 4.61 | 693.13 | 151.87 |
| Y2-4 | 11.30 | 92.80 | 1.72 | 17.43 | 996.7 | 8.51 | 1.41 | 1.00 | 134.95 | 0.15 | 2.54 | 0.49 | 5.84 | 740.00 | 59.83 |
| Y2-5 | 7.18 | 76.18 | 1.19 | 10.41 | 1075.4 | 5.61 | 1.22 | 0.42 | 99.80 | 0.10 | 1.44 | 0.14 | 2.34 | 691.25 | 35.77 |
| Y2-6 | 24.16 | 97.10 | 3.06 | 35.32 | 2327.5 | 12.38 | 7.71 | 0.94 | 166.77 | 0.32 | 7.85 | 1.27 | 7.94 | 838.45 | 260.92 |
| ZZ-4 | 11.97 | 60.09 | 1.11 | 13.71 | 1157.6 | 6.47 | 1.03 | 0.92 | 141.86 | 0.11 | 2.71 | 0.27 | 5.81 | 456.13 | 60.76 |
| ZZ-5 | 4.57 | 53.78 | 0.80 | 13.10 | 923.3 | 3.39 | 0.96 | 0.15 | 104.39 | 0.06 | 1.42 | 0.15 | 2.28 | 392.45 | 39.33 |
| Y3-3 | 12.64 | 64.33 | 3.18 | 25.89 | 878.7 | 11.55 | 2.15 | 0.42 | 120.85 | 0.36 | 3.98 | 1.24 | 0.74 | 657.83 | 267.43 |
| Y3-4 | 6.05 | 58.65 | 1.90 | 16.17 | 938.5 | 6.62 | 1.43 | 0.26 | 94.38 | 0.14 | 2.23 | 0.49 | 0.49 | 524.64 | 72.00 |
| T7-3 | 28.70 | 88.84 | 4.68 | 21.20 | 666.4 | 61.56 | 1.80 | 0.62 | 165.99 | 1.43 | 8.02 | 4.67 | 2.91 | 1961.69 | 912.43 |
| T7-4 | 22.86 | 94.68 | 3.62 | 19.80 | 962.1 | 45.94 | 2.37 | 0.72 | 168.57 | 1.03 | 6.39 | 2.95 | 4.96 | 1644.37 | 667.74 |
| T7-5 | 30.02 | 90.60 | 3.86 | 17.76 | 848.8 | 51.28 | 1.99 | 0.61 | 158.36 | 1.18 | 6.69 | 3.52 | 4.16 | 1792.56 | 841.40 |
| T5-3 | 20.99 | 69.46 | 3.33 | 12.97 | 689.4 | 44.21 | 1.22 | 0.96 | 174.17 | 1.07 | 5.35 | 3.01 | 1.35 | 1160.10 | 715.06 |
| T5-4 | 12.50 | 59.84 | 2.14 | 8.89 | 753.7 | 27.33 | 0.91 | 0.33 | 126.54 | 0.70 | 3.55 | 1.80 | 1.20 | 770.22 | 415.64 |
| T5-5 | 9.98 | 63.51 | 2.24 | 8.53 | 774.7 | 21.42 | 1.01 | 0.44 | 126.95 | 0.54 | 3.30 | 1.40 | 1.18 | 840.20 | 333.99 |
| Y1-3 | 23.19 | 69.63 | 2.58 | 11.69 | 972.4 | 30.69 | 1.34 | 0.51 | 126.67 | 0.77 | 5.16 | 2.44 | 2.06 | 583.84 | 479.89 |
| Y1-4 | 7.33 | 64.64 | 1.48 | 8.73 | 1011.6 | 11.87 | 1.04 | 0.40 | 78.00 | 0.30 | 2.33 | 0.80 | 1.52 | 518.12 | 162.11 |
| Y1-5 | 6.05 | 63.11 | 1.58 | 9.12 | 852.2 | 9.90 | 1.09 | 0.32 | 144.07 | 0.23 | 2.59 | 0.73 | 0.86 | 497.80 | 155.38 |
| T2-7 | 4.00 | 74.10 | 1.23 | 6.60 | 884.3 | 4.05 | 0.62 | 0.27 | 77.55 | 0.08 | 1.15 | 0.18 | 0.93 | 493.34 | 54.69 |
| T2-8 | 7.98 | 78.26 | 1.03 | 8.04 | 1048.2 | 5.57 | 0.75 | 0.13 | 78.86 | 0.09 | 1.22 | 0.15 | 1.04 | 604.03 | 37.40 |
| T2-9 | 12.48 | 74.67 | 0.98 | 8.36 | 956.6 | 7.35 | 0.71 | 0.21 | 70.14 | 0.17 | 0.91 | 0.29 | 1.10 | 448.77 | 27.56 |
| Y2-7 | 10.41 | 83.22 | 1.38 | 9.05 | 1629.5 | 11.33 | 0.76 | 0.35 | 85.06 | 0.26 | 2.05 | 0.72 | 1.91 | 638.18 | 154.76 |
| Y2-8 | 3.27 | 45.30 | 0.76 | 6.69 | 643.2 | 2.91 | 0.47 | 0.46 | 73.08 | 0.06 | 0.95 | 0.15 | 0.73 | 281.75 | 27.43 |
| Y2-9 | 7.78 | 137.42 | 1.63 | 11.31 | 1306.1 | 6.09 | 1.50 | 0.33 | 108.73 | 0.15 | 1.70 | 0.24 | 1.06 | 942.56 | 74.40 |
| Y2-10 | 5.78 | 67.72 | 2.36 | 14.35 | 792.2 | 6.39 | 1.15 | 0.62 | 165.17 | 0.18 | 2.48 | 0.42 | 1.54 | 572.77 | 105.62 |
| ZZ-6 | 4.98 | 56.93 | 0.90 | 6.72 | 717.0 | 4.56 | 0.57 | 0.19 | 64.35 | 0.09 | 1.33 | 0.23 | 0.88 | 356.20 | 53.98 |
| ZZ-7 | 4.94 | 55.23 | 1.14 | 7.63 | 706.7 | 5.56 | 0.49 | 0.37 | 75.60 | 0.15 | 1.49 | 0.52 | 0.57 | 533.33 | 107.86 |
| Y3-1 | 3.71 | 78.75 | 1.54 | 9.38 | 1094.7 | 5.96 | 0.93 | 0.48 | 35.37 | 0.15 | 1.78 | 0.25 | 1.08 | 720.15 | 81.66 |
| Y3-2 | 6.60 | 89.84 | 2.00 | 12.96 | 641.1 | 7.36 | 1.34 | 1.51 | 43.47 | 0.17 | 2.02 | 0.21 | 1.92 | 817.78 | 81.69 |
| T7-6 | 26.30 | 95.67 | 4.18 | 17.18 | 968.7 | 52.87 | 1.59 | 0.64 | 391.60 | 1.17 | 6.43 | 3.42 | 2.71 | 1211.14 | 728.36 |
| T7-7 | 12.64 | 104.10 | 2.75 | 15.62 | 1136.4 | 20.73 | 1.97 | 0.73 | 144.22 | 0.49 | 3.56 | 1.29 | 2.52 | 1232.16 | 303.74 |
| T7-8 | 15.36 | 86.49 | 2.61 | 12.29 | 897.4 | 22.74 | 1.42 | 0.54 | 155.96 | 0.54 | 3.69 | 1.65 | 2.05 | 1071.93 | 388.67 |
| T5-6 | 14.69 | 69.43 | 2.12 | 15.64 | 550.5 | 18.53 | 2.28 | 0.55 | 86.07 | 0.47 | 2.89 | 1.27 | 2.49 | 518.52 | 347.38 |
| T5-7 | 12.58 | 64.98 | 1.94 | 17.43 | 673.9 | 13.95 | 1.54 | 0.42 | 83.66 | 0.34 | 2.57 | 0.91 | 2.21 | 466.88 | 250.85 |
| T2-10 | 6.27 | 62.52 | 0.94 | 12.81 | 708.0 | 3.01 | 1.58 | 0.45 | 55.06 | 0.05 | 1.11 | 0.08 | 2.92 | 374.11 | 15.25 |
| T2-11 | 4.79 | 58.75 | 0.80 | 9.11 | 707.6 | 2.28 | 0.98 | 0.27 | 59.59 | 0.04 | 0.87 | 0.04 | 2.41 | 382.77 | 8.50 |
| Y2-11 | 3.55 | 84.15 | 1.19 | 9.06 | 1202.0 | 9.91 | 0.94 | 0.19 | 76.79 | 0.13 | 1.24 | 0.11 | 1.73 | 651.67 | 28.32 |
| Y2-12 | 8.87 | 4.80 | 0.31 | 2.92 | 1730.4 | 2.40 | 1.29 | 0.35 | 113.39 | 0.06 | 1.54 | 0.12 | 5.41 | 552.72 | 35.72 |
| ZZ-8 | 2.79 | 52.77 | 0.80 | 6.40 | 454.9 | 3.63 | 0.73 | 0.17 | 62.14 | 0.05 | 0.88 | 0.08 | 0.82 | 357.93 | 21.82 |
| ZZ-9 | 10.73 | 61.63 | 1.49 | 18.94 | 649.2 | 6.90 | 3.06 | 0.26 | 65.99 | 0.16 | 3.27 | 0.58 | 3.70 | 403.36 | 143.92 |
| ZZ-10 | 7.04 | 66.49 | 0.84 | 9.57 | 1149.2 | 13.54 | 1.18 | 1.12 | 98.64 | 0.15 | 2.36 | 0.30 | 5.02 | 406.74 | 63.17 |
| ZZ-11 | 6.32 | 59.13 | 0.86 | 22.74 | 695.7 | 2.98 | 0.95 | 0.20 | 53.87 | 0.06 | 0.97 | 0.14 | 0.96 | 311.36 | 28.07 |
| ZZ-12 | 13.51 | 56.77 | 0.90 | 9.24 | 971.2 | 4.22 | 1.12 | 0.34 | 57.37 | 0.08 | 1.28 | 0.23 | 1.18 | 312.50 | 48.40 |
| UCC(a) | 60 | 35 | 10 | 20 | 350 | 240 | 1.5 | - | 700 | 5.8 | 15 | 10.5 | 2.5 | 28200 | 3600 |

Abbreviations: UCC, upper continental crust. Note: (a) data comes from Taylor *et al*. (1981); Taylor & McLennan (1985)

Supplementary Table 3. REEs contents (μg/g) and relevant ratios of the Taiyuan Formation samples

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NO. | *L*1 | | | | | | | | | | | | | | | *L*2 | | | | |
| T2-1 | T2-2 | T2-3 | Y2-1 | Y2-2 | Y2-3 | ZZ-1 | ZZ-2 | ZZ-3 | T7-1 | T7-2 | T5-1 | T5-2 | Y1-1 | Y1-2 | T2-4 | T2-5 | T2-6 | Y2-4 | Y2-5 |
| Y | 18.1 | 16.6 | 17.6 | 3.6 | 18.5 | 8.3 | 11.7 | 21.6 | 11.8 | 12.0 | 19.9 | 10.6 | 13.4 | 17.3 | 17.4 | 12.5 | 7.2 | 16.6 | 7.8 | 2.6 |
| La | 15.2 | 14.1 | 13.1 | 2.0 | 9.2 | 6.2 | 6.4 | 9.5 | 6.7 | 9.1 | 16.7 | 10.9 | 14.4 | 12.2 | 15.0 | 6.4 | 5.6 | 6.3 | 4.4 | 1.6 |
| Ce | 18.9 | 17.7 | 15.5 | 2.0 | 6.4 | 6.9 | 5.6 | 10.7 | 6.9 | 12.0 | 23.0 | 18.2 | 23.7 | 16.4 | 21.5 | 4.4 | 5.3 | 6.4 | 3.3 | 1.4 |
| Pr | 3.30 | 3.03 | 2.37 | 0.39 | 1.67 | 1.21 | 1.22 | 1.80 | 1.31 | 1.83 | 3.30 | 2.30 | 3.01 | 2.50 | 3.04 | 1.20 | 0.91 | 1.02 | 0.75 | 0.27 |
| Nd | 13.63 | 12.53 | 9.45 | 1.66 | 6.91 | 5.06 | 5.24 | 7.84 | 5.55 | 7.43 | 13.2 | 9.09 | 11.8 | 10.4 | 12.1 | 5.16 | 3.73 | 4.36 | 3.27 | 1.11 |
| Sm | 2.80 | 2.60 | 1.93 | 0.35 | 1.57 | 1.03 | 1.14 | 1.81 | 1.25 | 1.52 | 2.65 | 1.78 | 2.26 | 2.17 | 2.39 | 1.18 | 0.73 | 0.94 | 0.69 | 0.23 |
| Eu | 0.72 | 0.70 | 0.67 | 0.12 | 0.41 | 0.31 | 0.36 | 0.70 | 0.40 | 0.49 | 0.80 | 0.50 | 0.64 | 0.57 | 0.58 | 0.37 | 0.23 | 0.34 | 0.24 | 0.10 |
| Gd | 3.42 | 3.12 | 2.60 | 0.48 | 1.99 | 1.36 | 1.52 | 2.66 | 1.73 | 2.06 | 3.56 | 2.21 | 2.85 | 2.90 | 3.11 | 1.58 | 0.98 | 1.48 | 0.95 | 0.30 |
| Tb | 0.48 | 0.42 | 0.38 | 0.11 | 0.33 | 0.19 | 0.22 | 0.40 | 0.24 | 0.28 | 0.48 | 0.28 | 0.36 | 0.40 | 0.42 | 0.26 | 0.15 | 0.22 | 0.14 | 0.06 |
| Dy | 2.55 | 2.41 | 2.17 | 0.41 | 1.75 | 1.02 | 1.31 | 2.49 | 1.41 | 1.49 | 2.61 | 1.57 | 2.01 | 2.30 | 2.40 | 1.42 | 0.79 | 1.44 | 0.81 | 0.25 |
| Ho | 0.51 | 0.48 | 0.45 | 0.09 | 0.38 | 0.21 | 0.28 | 0.55 | 0.29 | 0.31 | 0.54 | 0.32 | 0.41 | 0.47 | 0.50 | 0.29 | 0.16 | 0.34 | 0.17 | 0.05 |
| Er | 1.42 | 1.37 | 1.32 | 0.26 | 1.06 | 0.60 | 0.82 | 1.61 | 0.82 | 0.90 | 1.58 | 0.93 | 1.20 | 1.36 | 1.47 | 0.84 | 0.48 | 1.07 | 0.49 | 0.17 |
| Tm | 0.19 | 0.17 | 0.17 | 0.03 | 0.14 | 0.08 | 0.11 | 0.21 | 0.11 | 0.12 | 0.21 | 0.13 | 0.17 | 0.18 | 0.20 | 0.11 | 0.06 | 0.14 | 0.06 | 0.02 |
| Yb | 1.15 | 1.13 | 1.07 | 0.21 | 0.83 | 0.50 | 0.68 | 1.32 | 0.68 | 0.75 | 1.34 | 0.84 | 1.09 | 1.14 | 1.26 | 0.65 | 0.39 | 0.94 | 0.38 | 0.13 |
| Lu | 0.18 | 0.16 | 0.17 | 0.07 | 0.15 | 0.08 | 0.10 | 0.20 | 0.10 | 0.12 | 0.21 | 0.12 | 0.15 | 0.17 | 0.19 | 0.12 | 0.07 | 0.14 | 0.06 | 0.03 |
| LREE | 54.5 | 50.7 | 43.0 | 6.5 | 26.1 | 20.7 | 19.9 | 32.3 | 22.1 | 32.4 | 59.6 | 42.8 | 55.8 | 44.2 | 54.6 | 18.7 | 16.5 | 19.3 | 12.7 | 4.7 |
| HREE | 28.0 | 25.8 | 25.9 | 5.2 | 25.1 | 12.4 | 16.7 | 31.1 | 17.2 | 18.0 | 30.4 | 17.0 | 21.6 | 26.3 | 27.0 | 17.8 | 10.3 | 22.4 | 10.9 | 3.6 |
| ∑REY | 82.5 | 76.5 | 68.9 | 11.8 | 51.3 | 33.0 | 36.6 | 63.4 | 39.3 | 50.5 | 90.1 | 59.8 | 77.4 | 70.5 | 81.6 | 36.5 | 26.8 | 41.7 | 23.5 | 8.4 |
| (Nd/Yb)SN | 0.98 | 0.93 | 0.73 | 0.67 | 0.69 | 0.83 | 0.64 | 0.49 | 0.68 | 0.83 | 0.82 | 0.90 | 0.90 | 0.76 | 0.80 | 0.66 | 0.79 | 0.39 | 0.71 | 0.69 |
| Ce/Ce\* | 0.61 | 0.63 | 0.64 | 0.51 | 0.38 | 0.58 | 0.46 | 0.60 | 0.53 | 0.68 | 0.71 | 0.84 | 0.83 | 0.69 | 0.73 | 0.37 | 0.55 | 0.58 | 0.42 | 0.51 |
| Eu/Eu\* | 1.09 | 1.16 | 1.41 | 1.42 | 1.10 | 1.24 | 1.28 | 1.50 | 1.28 | 1.31 | 1.23 | 1.19 | 1.19 | 1.07 | 1.01 | 1.28 | 1.29 | 1.36 | 1.40 | 1.83 |
| Y/Ho | 35.5 | 34.7 | 38.8 | 41.2 | 49.3 | 39.5 | 41.8 | 39.3 | 40.4 | 38.6 | 36.6 | 33.1 | 32.3 | 37.0 | 34.8 | 42.9 | 43.6 | 48.5 | 45.4 | 49.3 |
| Pr/Pr\* | 1.21 | 1.20 | 1.15 | 1.27 | 1.47 | 1.21 | 1.33 | 1.16 | 1.25 | 1.14 | 1.11 | 1.05 | 1.06 | 1.13 | 1.11 | 1.48 | 1.20 | 1.14 | 1.34 | 1.24 |
| Gd/Gd\* | 1.15 | 1.13 | 1.01 | 0.82 | 1.06 | 1.09 | 1.06 | 0.99 | 1.09 | 1.09 | 1.13 | 1.16 | 1.17 | 1.19 | 1.23 | 0.99 | 1.03 | 1.06 | 1.02 | 0.79 |
| Y/Y\* | 1.27 | 1.23 | 1.41 | 1.52 | 1.82 | 1.43 | 1.54 | 1.47 | 1.47 | 1.41 | 1.33 | 1.19 | 1.17 | 1.33 | 1.27 | 1.55 | 1.58 | 1.89 | 1.67 | 1.79 |
| (Pr/Yb)SN | 0.92 | 0.86 | 0.71 | 0.60 | 0.64 | 0.77 | 0.57 | 0.44 | 0.61 | 0.78 | 0.79 | 0.88 | 0.88 | 0.70 | 0.77 | 0.59 | 0.74 | 0.35 | 0.63 | 0.64 |
| (Pr/Sm)SN | 0.74 | 0.73 | 0.77 | 0.69 | 0.67 | 0.74 | 0.67 | 0.63 | 0.66 | 0.76 | 0.78 | 0.81 | 0.84 | 0.72 | 0.80 | 0.64 | 0.78 | 0.69 | 0.69 | 0.74 |
| NO. | *L*2 | | | | | | | | | | | | | | *L*3 | | | | | |
| Y2-6 | ZZ-4 | ZZ-5 | Y3-3 | Y3-4 | T7-3 | T7-4 | T7-5 | T5-3 | T5-4 | T5-5 | Y1-3 | Y1-4 | Y1-5 | T2-7 | T2-8 | T2-9 | Y2-7 | Y2-8 | Y2-9 |
| Y | 18.6 | 13.8 | 5.2 | 17.2 | 12.4 | 10.0 | 9.4 | 10.3 | 9.6 | 7.6 | 8.1 | 8.4 | 5.3 | 5.1 | 2.0 | 1.9 | 3.8 | 4.2 | 3.8 | 2.6 |
| La | 9.5 | 7.6 | 2.2 | 15.0 | 8.4 | 12.2 | 9.1 | 10.4 | 12.3 | 8.1 | 7.3 | 10.3 | 4.4 | 4.3 | 1.5 | 0.9 | 3.5 | 2.8 | 2.1 | 1.5 |
| Ce | 10.5 | 6.2 | 2.1 | 17.0 | 8.9 | 21.0 | 14.6 | 17.8 | 23.3 | 14.7 | 12.4 | 19.8 | 6.9 | 7.0 | 2.0 | 1.2 | 6.7 | 3.9 | 2.4 | 1.9 |
| Pr | 1.73 | 1.21 | 0.37 | 2.90 | 1.73 | 2.59 | 1.92 | 2.24 | 2.65 | 1.76 | 1.50 | 2.34 | 0.94 | 0.93 | 0.28 | 0.18 | 0.83 | 0.52 | 0.41 | 0.33 |
| Nd | 7.40 | 5.10 | 1.63 | 11.88 | 7.28 | 9.97 | 7.56 | 8.80 | 10.2 | 6.81 | 5.87 | 9.02 | 3.72 | 3.61 | 1.13 | 0.76 | 3.19 | 2.05 | 1.69 | 1.38 |
| Sm | 1.62 | 1.06 | 0.35 | 2.41 | 1.56 | 1.87 | 1.45 | 1.67 | 1.87 | 1.29 | 1.12 | 1.71 | 0.71 | 0.68 | 0.21 | 0.14 | 0.67 | 0.39 | 0.35 | 0.30 |
| Eu | 0.50 | 0.40 | 0.19 | 0.67 | 0.45 | 0.50 | 0.40 | 0.46 | 0.52 | 0.36 | 0.34 | 0.41 | 0.19 | 0.20 | 0.09 | 0.07 | 0.09 | 0.13 | 0.14 | 0.12 |
| Gd | 2.39 | 1.56 | 0.52 | 2.99 | 1.97 | 2.46 | 1.96 | 2.25 | 2.32 | 1.58 | 1.45 | 2.04 | 0.89 | 0.87 | 0.27 | 0.21 | 0.82 | 0.54 | 0.46 | 0.36 |
| Tb | 0.37 | 0.22 | 0.07 | 0.39 | 0.27 | 0.30 | 0.25 | 0.28 | 0.29 | 0.19 | 0.18 | 0.26 | 0.12 | 0.11 | 0.03 | 0.02 | 0.11 | 0.08 | 0.07 | 0.06 |
| Dy | 2.18 | 1.36 | 0.49 | 2.20 | 1.55 | 1.55 | 1.33 | 1.51 | 1.58 | 1.13 | 1.10 | 1.40 | 0.68 | 0.66 | 0.21 | 0.18 | 0.62 | 0.44 | 0.38 | 0.30 |
| Ho | 0.48 | 0.29 | 0.11 | 0.45 | 0.31 | 0.31 | 0.27 | 0.30 | 0.32 | 0.23 | 0.23 | 0.28 | 0.15 | 0.14 | 0.04 | 0.04 | 0.12 | 0.10 | 0.08 | 0.06 |
| Er | 1.45 | 0.86 | 0.33 | 1.26 | 0.89 | 0.90 | 0.78 | 0.90 | 0.95 | 0.69 | 0.70 | 0.81 | 0.43 | 0.42 | 0.14 | 0.13 | 0.36 | 0.32 | 0.26 | 0.19 |
| Tm | 0.20 | 0.11 | 0.04 | 0.17 | 0.12 | 0.12 | 0.11 | 0.12 | 0.14 | 0.10 | 0.09 | 0.11 | 0.06 | 0.06 | 0.02 | 0.02 | 0.05 | 0.04 | 0.03 | 0.02 |
| Yb | 1.29 | 0.67 | 0.25 | 1.04 | 0.72 | 0.81 | 0.67 | 0.81 | 0.90 | 0.65 | 0.64 | 0.73 | 0.40 | 0.39 | 0.13 | 0.13 | 0.32 | 0.31 | 0.23 | 0.18 |
| Lu | 0.20 | 0.10 | 0.04 | 0.16 | 0.11 | 0.13 | 0.11 | 0.12 | 0.13 | 0.09 | 0.09 | 0.11 | 0.06 | 0.06 | 0.02 | 0.02 | 0.04 | 0.05 | 0.04 | 0.03 |
| LREE | 31.2 | 21.6 | 6.8 | 49.8 | 28.3 | 48.1 | 35.0 | 41.4 | 50.8 | 33.1 | 28.5 | 43.5 | 16.9 | 16.8 | 5.1 | 3.3 | 14.9 | 9.8 | 7.1 | 5.6 |
| HREE | 27.1 | 18.9 | 7.0 | 25.9 | 18.4 | 16.6 | 14.9 | 16.6 | 16.2 | 12.3 | 12.6 | 14.1 | 8.1 | 7.8 | 2.8 | 2.7 | 6.2 | 6.1 | 5.4 | 3.9 |
| ∑REE | 58.4 | 40.6 | 13.8 | 75.7 | 46.7 | 64.7 | 49.9 | 58.0 | 67.0 | 45.3 | 41.1 | 57.7 | 25.0 | 24.5 | 8.0 | 6.0 | 21.1 | 15.9 | 12.4 | 9.5 |
| (Nd/Yb)SN | 0.48 | 0.64 | 0.55 | 0.95 | 0.83 | 1.02 | 0.94 | 0.90 | 0.95 | 0.87 | 0.77 | 1.02 | 0.78 | 0.77 | 0.73 | 0.49 | 0.83 | 0.56 | 0.61 | 0.64 |
| Ce/Ce\* | 0.60 | 0.47 | 0.54 | 0.59 | 0.54 | 0.86 | 0.80 | 0.85 | 0.94 | 0.90 | 0.87 | 0.93 | 0.79 | 0.81 | 0.70 | 0.66 | 0.91 | 0.76 | 0.61 | 0.63 |
| Eu/Eu\* | 1.20 | 1.46 | 2.04 | 1.17 | 1.22 | 1.09 | 1.13 | 1.11 | 1.17 | 1.19 | 1.24 | 1.03 | 1.13 | 1.25 | 1.73 | 1.99 | 0.58 | 1.31 | 1.67 | 1.70 |
| Y/Ho | 38.5 | 47.0 | 49.2 | 38.6 | 39.7 | 32.4 | 34.9 | 33.7 | 30.1 | 33.1 | 35.6 | 29.8 | 36.5 | 36.2 | 46.8 | 50.5 | 30.9 | 42.2 | 45.2 | 42.1 |
| Pr/Pr\* | 1.15 | 1.26 | 1.17 | 1.20 | 1.26 | 1.05 | 1.07 | 1.05 | 1.01 | 1.03 | 1.03 | 1.03 | 1.09 | 1.08 | 1.13 | 1.11 | 1.05 | 1.07 | 1.18 | 1.17 |
| Gd/Gd\* | 1.09 | 1.04 | 0.89 | 1.14 | 1.10 | 1.24 | 1.20 | 1.22 | 1.18 | 1.17 | 1.14 | 1.23 | 1.17 | 1.12 | 0.97 | 0.96 | 1.61 | 1.06 | 0.89 | 0.85 |
| Y/Y\* | 1.44 | 1.74 | 1.82 | 1.39 | 1.42 | 1.15 | 1.25 | 1.21 | 1.08 | 1.19 | 1.30 | 1.06 | 1.34 | 1.33 | 1.70 | 1.85 | 1.10 | 1.59 | 1.70 | 1.54 |
| (Pr/Yb)SN | 0.43 | 0.58 | 0.47 | 0.89 | 0.76 | 1.02 | 0.91 | 0.88 | 0.94 | 0.86 | 0.75 | 1.02 | 0.75 | 0.76 | 0.70 | 0.44 | 0.82 | 0.54 | 0.56 | 0.58 |
| (Pr/Sm)SN | 0.67 | 0.72 | 0.65 | 0.76 | 0.70 | 0.87 | 0.83 | 0.84 | 0.89 | 0.86 | 0.84 | 0.86 | 0.83 | 0.85 | 0.87 | 0.79 | 0.78 | 0.84 | 0.73 | 0.69 |
| NO. | *L*3 | | | | | | | | | | *L*4 | | | | | | | *L*5 | | PAAS |
| Y2-10 | ZZ-6 | ZZ-7 | Y3-1 | Y3-2 | T7-6 | T7-7 | T7-8 | T5-6 | T5-7 | T2-10 | T2-11 | Y2-11 | Y2-12 | ZZ-8 | ZZ-9 | ZZ-10 | ZZ-11 | ZZ-12 |
| Y | 6.1 | 3.2 | 10.2 | 4.7 | 3.6 | 13.0 | 5.2 | 6.5 | 9.7 | 8.1 | 5.4 | 5.7 | 6.2 | 2.5 | 2.6 | 9.1 | 10.4 | 2.0 | 3.1 | 27 |
| La | 4.6 | 2.0 | 4.6 | 2.6 | 2.2 | 12.3 | 3.9 | 5.6 | 7.1 | 5.4 | 2.1 | 2.1 | 5.7 | 1.4 | 1.8 | 5.8 | 4.1 | 1.3 | 1.8 | 38.2 |
| Ce | 6.6 | 2.5 | 5.9 | 3.5 | 2.6 | 21.7 | 6.3 | 9.5 | 10.3 | 7.5 | 1.2 | 1.2 | 7.8 | 1.3 | 1.3 | 5.7 | 4.6 | 1.8 | 2.8 | 79.6 |
| Pr | 0.94 | 0.37 | 0.78 | 0.52 | 0.43 | 2.84 | 0.88 | 1.23 | 1.43 | 1.07 | 0.34 | 0.34 | 1.07 | 0.23 | 0.30 | 1.09 | 0.61 | 0.25 | 0.35 | 8.83 |
| Nd | 3.76 | 1.55 | 3.17 | 2.14 | 1.77 | 11.5 | 3.54 | 4.88 | 5.85 | 4.38 | 1.54 | 1.50 | 4.13 | 0.92 | 1.26 | 4.65 | 2.51 | 1.01 | 1.45 | 33.9 |
| Sm | 0.74 | 0.30 | 0.66 | 0.42 | 0.37 | 2.31 | 0.72 | 0.97 | 1.16 | 0.90 | 0.33 | 0.34 | 0.77 | 0.19 | 0.24 | 0.95 | 0.52 | 0.20 | 0.28 | 5.55 |
| Eu | 0.32 | 0.12 | 0.25 | 0.13 | 0.11 | 0.70 | 0.21 | 0.29 | 0.33 | 0.27 | 0.11 | 0.13 | 0.15 | 0.16 | 0.10 | 0.29 | 0.22 | 0.08 | 0.11 | 1.08 |
| Gd | 0.92 | 0.42 | 1.05 | 0.55 | 0.47 | 3.02 | 0.94 | 1.32 | 1.51 | 1.16 | 0.49 | 0.50 | 1.01 | 0.29 | 0.31 | 1.33 | 0.88 | 0.27 | 0.37 | 4.66 |
| Tb | 0.11 | 0.05 | 0.15 | 0.08 | 0.07 | 0.39 | 0.13 | 0.17 | 0.20 | 0.15 | 0.08 | 0.07 | 0.15 | 0.09 | 0.04 | 0.18 | 0.13 | 0.03 | 0.04 | 0.77 |
| Dy | 0.67 | 0.34 | 1.06 | 0.41 | 0.37 | 2.09 | 0.70 | 0.93 | 1.20 | 0.94 | 0.47 | 0.48 | 0.76 | 0.23 | 0.26 | 1.10 | 0.91 | 0.21 | 0.29 | 4.68 |
| Ho | 0.14 | 0.08 | 0.25 | 0.09 | 0.08 | 0.41 | 0.14 | 0.19 | 0.25 | 0.20 | 0.11 | 0.10 | 0.16 | 0.05 | 0.06 | 0.23 | 0.22 | 0.04 | 0.06 | 0.99 |
| Er | 0.42 | 0.22 | 0.80 | 0.29 | 0.24 | 1.19 | 0.43 | 0.57 | 0.74 | 0.60 | 0.31 | 0.32 | 0.48 | 0.15 | 0.18 | 0.64 | 0.72 | 0.13 | 0.19 | 2.85 |
| Tm | 0.05 | 0.03 | 0.12 | 0.04 | 0.03 | 0.16 | 0.06 | 0.08 | 0.10 | 0.08 | 0.04 | 0.04 | 0.07 | 0.02 | 0.02 | 0.08 | 0.10 | 0.02 | 0.03 | 0.40 |
| Yb | 0.36 | 0.19 | 0.75 | 0.26 | 0.21 | 1.08 | 0.39 | 0.53 | 0.65 | 0.52 | 0.24 | 0.25 | 0.43 | 0.13 | 0.15 | 0.47 | 0.65 | 0.11 | 0.17 | 2.82 |
| Lu | 0.05 | 0.03 | 0.11 | 0.05 | 0.03 | 0.16 | 0.06 | 0.08 | 0.09 | 0.07 | 0.04 | 0.04 | 0.07 | 0.06 | 0.02 | 0.07 | 0.10 | 0.02 | 0.02 | 0.43 |
| LREE | 17.0 | 6.9 | 15.4 | 9.3 | 7.5 | 51.4 | 15.5 | 22.5 | 26.2 | 19.4 | 5.6 | 5.6 | 19.6 | 4.2 | 5.0 | 18.5 | 12.6 | 4.6 | 6.8 | 167 |
| HREE | 8.8 | 4.6 | 14.5 | 6.4 | 5.1 | 21.5 | 8.1 | 10.4 | 14.5 | 11.9 | 7.1 | 7.5 | 9.3 | 3.5 | 3.6 | 13.2 | 14.1 | 2.8 | 4.2 | 44.6 |
| ∑REY | 25.8 | 11.4 | 29.9 | 15.8 | 12.6 | 72.9 | 23.6 | 32.9 | 40.7 | 31.3 | 12.8 | 13.1 | 28.9 | 7.7 | 8.6 | 31.7 | 26.7 | 7.4 | 11.1 | 211.8 |
| (Nd/Yb)SN | 0.86 | 0.68 | 0.35 | 0.68 | 0.70 | 0.89 | 0.75 | 0.77 | 0.75 | 0.70 | 0.53 | 0.49 | 0.80 | 0.59 | 0.68 | 0.82 | 0.32 | 0.74 | 0.70 | 1.00 |
| Ce/Ce\* | 0.73 | 0.67 | 0.72 | 0.69 | 0.60 | 0.85 | 0.78 | 0.84 | 0.75 | 0.72 | 0.32 | 0.32 | 0.73 | 0.55 | 0.39 | 0.52 | 0.66 | 0.73 | 0.82 | 1.00 |
| Eu/Eu\* | 1.81 | 1.61 | 1.43 | 1.28 | 1.28 | 1.26 | 1.22 | 1.22 | 1.18 | 1.23 | 1.27 | 1.46 | 0.83 | 3.14 | 1.81 | 1.20 | 1.54 | 1.61 | 1.59 | 1.00 |
| Y/Ho | 44.3 | 42.7 | 40.6 | 50.7 | 45.3 | 31.9 | 36.6 | 33.8 | 39.5 | 41.4 | 50.7 | 54.4 | 38.9 | 50.1 | 45.7 | 40.2 | 47.8 | 47.0 | 50.0 | 34.5 |
| Pr/Pr\* | 1.12 | 1.12 | 1.05 | 1.13 | 1.19 | 1.06 | 1.10 | 1.06 | 1.08 | 1.10 | 1.47 | 1.50 | 1.11 | 1.23 | 1.39 | 1.25 | 1.06 | 1.10 | 1.03 | 1.00 |
| Gd/Gd\* | 0.95 | 1.01 | 1.04 | 1.06 | 1.07 | 1.13 | 1.12 | 1.15 | 1.15 | 1.12 | 1.03 | 1.00 | 1.32 | 0.47 | 0.95 | 1.15 | 1.02 | 1.09 | 1.05 | 1.00 |
| Y/Y\* | 1.60 | 1.61 | 1.58 | 1.92 | 1.67 | 1.13 | 1.31 | 1.23 | 1.43 | 1.51 | 1.91 | 2.02 | 1.42 | 1.85 | 1.71 | 1.46 | 1.87 | 1.69 | 1.82 | 1.00 |
| (Pr/Yb)SN | 0.83 | 0.63 | 0.33 | 0.64 | 0.65 | 0.84 | 0.71 | 0.74 | 0.70 | 0.66 | 0.45 | 0.43 | 0.80 | 0.57 | 0.62 | 0.74 | 0.30 | 0.71 | 0.65 | 1.00 |
| (Pr/Sm)SN | 0.80 | 0.78 | 0.74 | 0.79 | 0.74 | 0.77 | 0.76 | 0.79 | 0.77 | 0.75 | 0.64 | 0.63 | 0.88 | 0.76 | 0.80 | 0.72 | 0.73 | 0.80 | 0.79 | 1.00 |

Abbreviations: HREE, the total content of heavy rare earth elements; LREE, the total content of light rare earth elements; REEs, rare earth elements and Y.

Note: Ce/Ce\*=CeSN/SQRT(LaSN×PrSN), Eu/Eu\*=EuSN/SQRT(SmSN×GdSN), Pr/Pr\*=PrSN/SQRT(CeSN×NdSN), Gd/Gd\*= GdSN/SQRT(EuSN×TbSN); Y/Y\*=YSN/SQRT(DySN×HoSN); SN represents standardized with PAAS (Taylor & McLennan, 1985).