**Table S1.** Element analysis results of the whole rock samples from the Morrenas and Talari Valleys.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample  ID | SiO2  (%) | TiO2  (%) | Al2O3  (%) | Fe2O3  (%) | MnO  (%) | MgO  (%) | CaO  (%) | Na2O  (%) | K2O  (%) | P2O5  (%) | Cl  (ppm) | B  (ppm) | Sm  (ppm) | Gd  (ppm) | U  (ppm) | Th  (ppm) | Cr  (ppm) | Li  (ppm) |
| T-I–2 | 65.4 | 0.65 | 10.10 | 7.25 | 0.10 | 1.96 | 5.24 | 3.00 | 0.69 | 0.01 | 1.4 | 10 | 1.1 | 1.29 | 0.11 | 0.1 | 30 | 10 |
| T-I–3 | 79.2 | 0.43 | 6.29 | 4.37 | 0.02 | 0.27 | 2.21 | 1.20 | 0.74 | 0.01 | 5.1 | 10 | 0.5 | 0.66 | 0.05 | 0.2 | 60 | 10 |
| T-I–4 | 52.5 | 0.78 | 15.00 | 11.10 | 0.12 | 6.52 | 8.37 | 1.49 | 0.26 | 0.04 | 1.1 | 10 | 1.4 | 1.58 | 0.19 | 0.3 | 60 | 10 |
| T-I–6 | 47.4 | 0.93 | 19.30 | 11.40 | 0.14 | 5.49 | 8.79 | 3.14 | 0.38 | 0.06 | 0.3 | 10 | 1.7 | 2.15 | 0.29 | 0.3 | 40 | 10 |
| T-I–7 | 50.3 | 0.92 | 19.20 | 11.20 | 0.13 | 4.84 | 7.85 | 2.78 | 0.31 | 0.05 | 16.1 | 10 | 1.3 | 1.68 | 0.25 | 0.2 | 30 | 10 |
| T-I–8 | 49.8 | 0.83 | 18.20 | 10.70 | 0.19 | 4.10 | 8.08 | 2.68 | 0.67 | 0.09 | 18.1 | 10 | 1.7 | 2.04 | 0.22 | 0.3 | 20 | 10 |
| T-I–9 | 50.3 | 0.74 | 18.90 | 9.12 | 0.16 | 2.86 | 8.29 | 3.49 | 1.24 | 0.16 | 28.2 | 10 | 2.5 | 3.12 | 0.40 | 0.8 | 30 | 10 |
| T-I–10 | 45.6 | 0.91 | 18.70 | 12.20 | 0.16 | 5.91 | 11.80 | 1.95 | 0.18 | 0.10 | 1.3 | 10 | 2.1 | 2.49 | 0.26 | 0.3 | 60 | 10 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| T-II–1 | 49.8 | 0.82 | 18.90 | 10.33 | 0.17 | 4.33 | 9.17 | 2.50 | 0.75 | 0.07 | 17.8 | 10 | 1.8 | 2.15 | 0.23 | 0.3 | 36 | 10 |
| T-II–2 | 47.8 | 0.81 | 17.00 | 11.80 | 0.16 | 6.60 | 10.80 | 2.00 | 0.22 | 0.04 | 8.2 | 10 | 1.7 | 2.1 | 0.20 | 0.2 | 80 | 10 |
| T-II–5 | 49.8 | 0.82 | 18.90 | 10.30 | 0.18 | 4.30 | 9.20 | 2.50 | 0.75 | 0.07 | 2.9 | 10 | 1.8 | 2.2 | 0.20 | 0.3 | 36 | 10 |
| T-II–6 | 50.6 | 0.81 | 19.90 | 9.30 | 0.13 | 3.30 | 8.80 | 2.40 | 0.89 | 0.10 | 2.8 | 10 | 2.2 | 2.5 | 0.30 | 0.5 | 20 | 10 |
| T-II–8 | 52.1 | 0.80 | 17.60 | 10.20 | 0.20 | 4.10 | 7.20 | 3.20 | 0.89 | 0.06 | 8.9 | 10 | 1.4 | 1.8 | 0.20 | 0.2 | 30 | 10 |
| T-II–9 | 48.7 | 0.86 | 20.70 | 10.10 | 0.16 | 3.50 | 9.90 | 2.50 | 0.78 | 0.12 | 4.1 | 10 | 2.1 | 2.6 | 0.30 | 0.5 | 20 | 10 |
| T-II–10 | 50.0 | 0.82 | 19.30 | 10.30 | 0.18 | 4.20 | 9.10 | 2.40 | 0.99 | 0.05 | 2.0 | 10 | 1.4 | 1.7 | 0.20 | 0.2 | 30 | 10 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| M-2–1 | 75.3 | 0.21 | 13.00 | 2.01 | 0.05 | 0.56 | 3.46 | 3.30 | 2.15 | 0.01 | 174.6 | 10 | 1.4 | 1.15 | 1.02 | 2.4 | 110 | 10 |
| M-2–2 | 62.0 | 0.79 | 15.40 | 8.35 | 0.17 | 2.12 | 5.94 | 3.50 | 1.24 | 0.01 | 260.2 | 10 | 2.9 | 2.84 | 1.02 | 2.3 | 80 | 10 |
| M-2–3 | 61.9 | 0.71 | 14.70 | 8.37 | 0.13 | 1.96 | 5.70 | 3.60 | 1.03 | 0.01 | 218.0 | 10 | 2.5 | 2.79 | 0.87 | 1.8 | 130 | 10 |
| M-2–4 | 75.3 | 1.70 | 11.30 | 21.20 | 0.29 | 1.71 | 4.85 | 2.70 | 0.98 | 0.01 | 134.4 | 10 | 2.9 | 3.44 | 1.50 | 2.1 | 120 | 10 |
| M-2–5 | 57.1 | 0.84 | 17.80 | 7.89 | 0.18 | 3.43 | 3.29 | 4.35 | 1.77 | 0.04 | 75.4 | 40 | 3.9 | 4.06 | 2.17 | 3.0 | 80 | 10 |
| M-2–6 | 59.4 | 0.66 | 17.40 | 7.37 | 0.13 | 2.83 | 5.87 | 3.75 | 1.76 | 0.06 | 295.6 | 10 | 3.0 | 2.86 | 1.14 | 2.3 | 70 | 10 |
| M-2–7 | 58.8 | 0.67 | 16.80 | 7.73 | 0.17 | 2.94 | 6.19 | 3.63 | 1.61 | 0.04 | 239.9 | 20 | 2.0 | 2 | 1.05 | 2.0 | 90 | 20 |
| M-2–8 | 61.5 | 0.61 | 16.90 | 6.74 | 0.07 | 2.28 | 5.62 | 3.70 | 2.11 | 0.04 | 347.4 | 20 | 2.5 | 2.38 | 1.08 | 2.0 | 90 | 20 |
| M-2–9 | 61.0 | 0.82 | 15.80 | 7.84 | 0.12 | 3.28 | 1.37 | 4.48 | 1.94 | 0.05 | 76.2 | 10 | 4.0 | 3.94 | 1.95 | 2.7 | 80 | 10 |
| M-2–10 | 58.4 | 0.74 | 17.00 | 7.92 | 0.16 | 3.02 | 6.57 | 3.67 | 1.52 | 0.03 | 405.7 | 10 | 2.5 | 2.55 | 1.20 | 2.6 | 80 | 10 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| M-3–1 | 58.6 | 0.72 | 17.00 | 7.40 | 0.17 | 2.92 | 6.16 | 3.75 | 1.66 | 0.03 | 393.3 | 10 | 2.2 | 2.47 | 1.26 | 2.5 | 60 | 10 |
| M-3–2 | 59.2 | 0.69 | 16.90 | 7.40 | 0.16 | 2.90 | 6.40 | 3.70 | 1.61 | 0.03 | 506.1 | 10 | 2.3 | 2.4 | 1.20 | 2.3 | 70 | 12.5 |
| M-3–3 | 59.4 | 0.66 | 17.00 | 7.14 | 0.14 | 2.69 | 6.58 | 3.69 | 1.55 | 0.02 | 256.2 | 10 | 2.2 | 2.26 | 1.23 | 2.4 | 70 | 10 |
| M-3–5 | 59.0 | 0.72 | 16.90 | 7.39 | 0.16 | 2.84 | 6.49 | 3.80 | 1.60 | 0.03 | 349.8 | 10 | 2.3 | 2.18 | 1.23 | 2.3 | 80 | 10 |
| M-3–6 | 59.7 | 0.63 | 16.80 | 7.44 | 0.15 | 2.74 | 6.30 | 3.68 | 1.59 | 0.04 | 456.7 | 10 | 2.5 | 2.47 | 1.21 | 2.5 | 60 | 10 |
| M-3–7 | 59.4 | 0.72 | 16.90 | 7.32 | 0.17 | 3.02 | 6.42 | 3.77 | 1.60 | 0.03 | 399.1 | 10 | 2.3 | 2.5 | 1.15 | 2.2 | 70 | 10 |
| M-3–8 | 59.1 | 0.69 | 16.50 | 7.51 | 0.17 | 2.99 | 6.14 | 3.63 | 1.65 | 0.03 | 327.3 | 10 | 2.3 | 2.34 | 1.19 | 2.3 | 70 | 20 |
| M-3–9 | 58.1 | 0.69 | 17.40 | 7.72 | 0.15 | 3.00 | 6.69 | 3.70 | 1.45 | 0.03 | 276.7 | 10 | 2.2 | 2.39 | 0.92 | 1.9 | 80 | 10 |
| M-3–10 | 60.1 | 0.71 | 16.60 | 7.15 | 0.15 | 2.74 | 6.07 | 3.81 | 1.77 | 0.02 | 425.5 | 10 | 2.2 | 2.44 | 1.29 | 2.5 | 70 | 10 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| M-4–1 | 60.2 | 0.82 | 14.30 | 9.83 | 0.18 | 2.39 | 5.42 | 3.20 | 1.58 | 0.01 | 321.7 | 10 | 2.4 | 2.53 | 1.03 | 2.0 | 100 | 10 |
| M-4–2 | 62.9 | 1.19 | 12.60 | 12.00 | 0.16 | 1.44 | 5.31 | 3.20 | 1.57 | 0.01 | 339.0 | 10 | 2.2 | 2.31 | 0.97 | 1.5 | 120 | 10 |
| M-4–3 | 60.1 | 0.81 | 12.20 | 11.40 | 0.11 | 3.33 | 4.97 | 3.00 | 1.82 | 0.01 | 367.3 | 10 | 3.5 | 3.63 | 1.09 | 1.4 | 100 | 10 |
| M-4–4 | 57.8 | 0.73 | 16.60 | 8.27 | 0.20 | 3.30 | 6.50 | 3.42 | 1.81 | 0.02 | 397.6 | 10 | 2.6 | 2.65 | 1.13 | 2.0 | 70 | 10 |
| M-4–5 | 61.2 | 0.78 | 15.80 | 7.28 | 0.14 | 2.67 | 5.26 | 3.63 | 2.21 | 0.02 | 284.9 | 10 | 3.2 | 3.28 | 1.66 | 3.0 | 70 | 10 |
| M-4–6 | 60.0 | 0.72 | 15.60 | 8.10 | 0.12 | 3.10 | 5.35 | 3.48 | 2.34 | 0.03 | 268.5 | 40 | 3.2 | 3.29 | 1.36 | 2.8 | 70 | 10 |
| M-4–7 | 58.8 | 0.62 | 16.90 | 7.77 | 0.09 | 3.02 | 6.30 | 3.56 | 1.80 | 0.02 | 348.9 | 10 | 3.1 | 3.08 | 0.96 | 1.7 | 80 | 10 |
| M-4–8 | 58.7 | 0.73 | 16.20 | 7.86 | 0.15 | 3.21 | 5.83 | 3.36 | 1.88 | 0.07 | 194.8 | 10 | 3.2 | 3.28 | 1.21 | 2.4 | 80 | 10 |
| M-4–9 | 59.2 | 0.72 | 16.60 | 8.02 | 0.17 | 3.19 | 6.34 | 3.65 | 1.72 | 0.04 | 123.1 | 10 | 3.1 | 2.98 | 1.29 | 2.6 | 80 | 10 |
| M-4–10 | 58.0 | 0.69 | 16.70 | 8.16 | 0.14 | 3.10 | 6.38 | 3.45 | 1.70 | 0.05 | 196.4 | 10 | 3.2 | 3.26 | 1.10 | 2.3 | 60 | 10 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CS–0 | 58.0 | 0.73 | 17.00 | 8.61 | 0.16 | 3.19 | 6.39 | 3.20 | 1.49 | 0.18 | 64.0 | 11 | 2.0 | 4 | 1.00 | 2.0 | 149 | 10 |
| CS–2 | 58.9 | 0.65 | 16.40 | 7.42 | 0.12 | 2.76 | 6.19 | 3.37 | 1.89 | 0.17 | 382.3 | 9 | 2.0 | 5 | 1.00 | 2.0 | 150 | 10 |
| CS–3 | 57.0 | 0.67 | 16.70 | 8.37 | 0.15 | 3.05 | 7.10 | 3.30 | 1.54 | 0.19 | 78.4 | 17 | 2.0 | 3 | 1.00 | 2.0 | 201 | 10 |
| CS–4 | 58.1 | 0.72 | 16.30 | 8.56 | 0.15 | 3.06 | 6.10 | 3.62 | 1.45 | 0.19 | 89.1 | 7 | 2.0 | 3 | 1.00 | 2.0 | 321 | 10 |
| CS–5 | 56.5 | 0.71 | 16.70 | 8.31 | 0.16 | 3.07 | 6.19 | 3.25 | 1.68 | 0.17 | 123.1 | 10 | 2.0 | 4 | 1.00 | 2.0 | 170 | 10 |