**Supplementary Table 2.** All elemental results of the five different CRT clusters from the Alashan Desert and the average of element content from modern aeolian sand in the Tengger Desert.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Lab.no. | Latitude/ N | longitude/E | 14C yr BP | cal yr BP (2σ) | sample name | CaO/% | SiO2/% | Al2O3/% |
| The first cluster | LUG13-58 | 39°31′21.7″ | 105°42′34.2″ | 6791±71 | 7650 (7513-7786) | W-02 | 15.53 | 61.17 | 5.97 |
| LUG13-57 | 39°30′31.1″ | 105°38′40.4″ | 5731±60 | 6534 (6404-6604) | W-01 | 16.55 | 52.55 | 7.23 |
| LUG13-70 | 39°39′1.80″ | 105°53′17.9″ | 5573±61 | 6382 (6280-6483) | W-13 | 14.95 | 53.70 | 5.35 |
| LUG11-129 | 38°47′2.10″ | 105°01′15.3″ | 5220±58 | 6039 (5895-6183) | T-01 | 25.94 | 46.27 | 6.46 |
| LUG13-60 | 39°34′28.7″ | 105°52′23.3″ | 3328±52 | 3570 (3448-3692) | W-04 | 21.75 | 51.01 | 5.28 |
| LUG13-61 | 39°37′40.3″ | 106°08′54.8″ | 3272±52 | 3498 (3385-3611) | W-05 | 20.93 | 50.48 | 6.66 |
|  |  |  |  |  | average | 19.28 | 52.53 | 6.16 |
| The second cluster | LUG13-69 | 39°59′59.8″ | 106°37′34.5″ | 6198±64 | 7102 (6946-7257) | W-12 | 77.15 | 5.34 | 0.50 |
| LUG13-65 | 40°16′45.3″ | 106°45′44.6″ | 6125±61 | 6986 (6801-7171) | W-09 | 61.17 | 12.12 | 3.59 |
| LUG11-194 | 37°54′59.9″ | 104°52′13.0″ | 4090±60 | 4630 (4438-4821) | T-07 | 63.28 | 11.28 | 2.33 |
| LUG13-62 | 39°41′36.5″ | 106°33′7.1″ | 3755±55 | 4137 (3929-4345) | W-06 | 71.83 | 7.28 | 1.50 |
| LUG13-63 | 39°50′18.5″ | 106°39′14.1″ | 3566±53 | 3879 (3698-4060) | W-07 | 49.51 | 19.00 | 3.59 |
|  |  |  |  |  | average | 64.59 | 11.00 | 2.30 |
| The third cluster | LUG11-174 | 38°48′21.2″ | 105°22′59.9″ | 6382±59 | 7301 (7177-7425) | T-08 | 48.49 | 10.15 | 1.24 |
| LUG11-193 | 38°12′48.4″ | 104°34′50.3″ | 5989±66 | 6829 (6670-6988) | T-06 | 45.38 | 11.81 | 1.10 |
| LUG11-178 | 38°46′33.7″ | 105°05′35.6″ | 5118±59 | 5859 (5727-5990) | T-11 | 36.07 | 19.72 | 2.86 |
| LUG11-188 | 38°55′31.8″ | 104°10′34.7″ | 4891±55 | 5612 (5482-5742) | T-02 | 38.81 | 17.77 | 2.43 |
| LUG11-179 | 38°48′58.9″ | 104°56′43.3″ | 4839±58 | 5523 (5333-5712) | T-12 | 40.45 | 15.82 | 2.54 |
| LUG11-192 | 38°24′1.70″ | 104°34′50.3″ | 4765±54 | 5462 (5326-5597) | T-05 | 38.41 | 17.24 | 2.50 |
| LUG11-181 | 38°44′30.4″ | 105°16′7.4″ | 2970±51 | 3150 (2971-3328) | T-14 | 30.79 | 24.75 | 3.59 |
|  |  |  |  |  | average | 39.77 | 16.75 | 2.32 |
| The forth cluster | LUG11-175 | 38°48′9.50″ | 105°20′30.6″ | 5198±57 | 5969 (5760-6178) | T-9 | 25.66 | 32.89 | 4.82 |
| BA110772 | 39°46′7.90″ | 102°28′34.77″ | 4585±38 | 5259 (5062-5449) | B-03 | 25.24 | 36.77 | 3.50 |
| BA110772 | 39°46′7.90″ | 102°28′34.8″ | 4585±37 | 5258 (5062-5449) | B-02 | 20.53 | 44.09 | 3.81 |
| BA110772 | 39°46′7.90″ | 102°28′34.8″ | 4585±36 | 5257 (5062-5449) | B-01 | 23.34 | 36.69 | 3.51 |
| LUG11-191 | 38°47′14.5″ | 104°17′8.9″ | 3779±59 | 4192 (3980-4404) | T-04 | 24.56 | 33.51 | 4.77 |
| LUG11-176 | 38°46′42.1″ | 105°14′28.9″ | 2262±72 | 2259 (2061-2457) | T-10 | 25.72 | 31.60 | 4.66 |
|  |  |  |  |  |  | 24.18 | 35.93 | 4.18 |
| The fifth cluster | LUG13-67 | 40°10′41.2″ | 106°40′58.4″ | 5649±60 | 6451 (6301-6601) | W-11 | 39.72 | 27.70 | 4.96 |
| LUG11-190 | 38°48′53.5″ | 104°16′24.5″ | 5412±61 | 6154 (6004-6305) | T-03 | 39.76 | 29.61 | 5.08 |
| LUG13-59 | 39°34′40.4″ | 105°50′30.6″ | 4254±55 | 4791 (4617-4964) | W-03 | 35.91 | 33.34 | 5.33 |
| LUG13-66 | 40°17′29.7″ | 106°35′25.7″ | 4094±56 | 4631(4440-4821) | W-10 | 42.06 | 26.20 | 5.36 |
| LUG13-64 | 39°52′51.6″ | 106°32′6.3″ | 4062±56 | 4617 (4420-4813) | W-08 | 29.96 | 35.24 | 6.06 |
| LUG11-180 | 38°45′22.2″ | 105°05′13.1″ | 3339±49 | 3573 (3455-3691) | T-13 | 32.04 | 39.82 | 4.95 |
| LUG13-53 | 39°46′29.41″ | 102°10 ′42.45″ | 3071±51 | 3237(3083-3391) | B-5 | 36.36 | 31.90 | 5.18 |
| LUG13-52 | 39°51′27.13″ | 102°05 ′15.44″ | 2482±50 | 2553(2378-2728) | B-4 | 42.96 | 24.54 | 4.52 |
|  |  |  |  |  |  | 37.35 | 31.04 | 5.18 |
|  |  |  |  |  |  | MAS | 1.90 | 75.90 | 8.60 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | sample  name | MgO /% | Fe2O3 /% | Na2O /% | K2O /% | Sr /ppm | Rb /ppm | Ti /ppm | P /ppm | Ba /ppm | Ce /ppm | Co /ppm | Cr /ppm | Mn /ppm | W /ppm | Zr /ppm |
| The first cluster | W-02 | 4.05 | 1.58 | 1.29 | 3.03 | 741.7 | 59.2 | 1602.3 | 327.2 | 737.0 | 51.0 | 107.7 | 72.9 | 244.8 | 434.8 | 133.3 |
| W-01 | 4.12 | 2.05 | 1.59 | 3.50 | 712.6 | 73.5 | 2190.9 | 389.7 | 791.1 | 44.8 | 41.6 | 81.7 | 311.5 | 108.6 | 144.9 |
| W-13 | 1.59 | 1.02 | 2.19 | 1.77 | 510.1 | 41.8 | 821.5 | 186.3 | 495.6 | 60.1 | 130.1 | 22.2 | 168.5 | 502.6 | 77.4 |
| T-01 | 0.72 | 1.89 | 2.40 | 2.16 | 350.0 | 46.9 | 1701.3 | 218.7 | 644.3 | 67.7 | 200.1 | 72.1 | 274.1 | 515.2 | 105.1 |
| W-04 | 4.55 | 1.50 | 1.34 | 2.55 | 581.6 | 54.1 | 1453.9 | 475.8 | 704.1 | 25.1 | 62.0 | 89.3 | 209.9 | 168.4 | 100.5 |
| W-05 | 0.92 | 1.56 | 2.40 | 2.52 | 436.4 | 53.7 | 1370.1 | 364.9 | 825.0 | 69.8 | 146.9 | 62.9 | 210.0 | 397.6 | 92.6 |
| average | 2.66 | 1.60 | 1.87 | 2.59 | 555.4 | 54.9 | 1523.3 | 327.1 | 699.5 | 53.1 | 114.7 | 66.9 | 236.5 | 354.5 | 109.0 |
| The second cluster | W-12 | 1.82 | 0.27 | 0.31 | 0.21 | 1441.2 | 1.3 | 290.4 | 125.6 | 350.6 | 0.0 | 31.5 | 50.6 | 88.4 | 0.0 | 33.4 |
| W-09 | 1.45 | 1.91 | 1.11 | 0.92 | 1792.4 | 22.1 | 1231.7 | 185.4 | 621.3 | 4.7 | 125.0 | 44.7 | 2163.1 | 0.0 | 89.6 |
| T-07 | 0.88 | 0.79 | 1.02 | 0.73 | 709.5 | 15.0 | 682.7 | 153.3 | 505.8 | 0.0 | 188.6 | 73.8 | 139.6 | 0.0 | 48.8 |
| W-06 | 1.07 | 0.54 | 0.66 | 0.50 | 747.2 | 10.2 | 475.7 | 165.9 | 445.1 | 0.0 | 53.1 | 68.6 | 165.3 | 0.0 | 36.8 |
| W-07 | 0.99 | 1.08 | 1.50 | 1.25 | 637.1 | 33.2 | 897.9 | 350.9 | 569.1 | 15.3 | 112.3 | 83.6 | 200.7 | 54.4 | 65.0 |
| average | 1.24 | 0.92 | 0.92 | 0.72 | 1065.5 | 16.4 | 715.7 | 196.2 | 498.4 | 4.0 | 102.1 | 64.3 | 551.4 | 10.9 | 54.7 |
| The third cluster | T-08 | 1.99 | 0.42 | 0.68 | 0.42 | 918.9 | 5.9 | 388.9 | 386.0 | 262.5 | 5.8 | 31.6 | 59.5 | 87.8 | 8.1 | 46.1 |
| T-06 | 6.01 | 0.58 | 0.58 | 0.38 | 1663.0 | 10.6 | 519.5 | 262.0 | 189.7 | 22.2 | 34.5 | 73.8 | 107.2 | 11.2 | 80.1 |
| T-11 | 0.77 | 0.97 | 1.54 | 0.80 | 507.1 | 27.2 | 701.2 | 308.9 | 382.3 | 30.0 | 62.9 | 58.2 | 143.8 | 62.8 | 55.8 |
| T-02 | 2.22 | 0.80 | 1.27 | 0.69 | 994.2 | 23.0 | 598.9 | 318.5 | 316.4 | 26.6 | 58.7 | 49.1 | 116.7 | 45.9 | 72.7 |
| T-12 | 0.98 | 0.88 | 1.24 | 0.67 | 608.2 | 19.5 | 656.8 | 390.8 | 275.6 | 26.8 | 33.9 | 41.5 | 127.2 | 26.5 | 56.3 |
| T-05 | 0.87 | 0.90 | 1.26 | 0.73 | 510.5 | 25.7 | 708.6 | 289.3 | 368.7 | 19.9 | 49.2 | 37.9 | 128.4 | 41.1 | 69.8 |
| T-14 | 0.86 | 1.07 | 1.84 | 1.15 | 460.7 | 40.1 | 792.4 | 313.8 | 398.5 | 38.5 | 46.6 | 33.5 | 150.1 | 68.6 | 72.7 |
| average | 1.96 | 0.80 | 1.20 | 0.69 | 808.9 | 21.7 | 623.8 | 324.2 | 313.4 | 24.3 | 45.3 | 50.5 | 123.0 | 37.7 | 64.8 |
| The forth cluster | T-9 | 0.75 | 1.12 | 2.34 | 1.55 | 367.0 | 41.4 | 842.9 | 376.1 | 412.3 | 48.8 | 76.4 | 36.0 | 157.3 | 136.0 | 70.4 |
| B-03 | 0.86 | 1.00 | 1.84 | 0.88 | 543.7 | 20.3 | 779.7 | 372.1 | 250.2 | 51.6 | 107.8 | 28.6 | 190.5 | 258.2 | 68.1 |
| B-02 | 0.79 | 1.17 | 1.84 | 0.99 | 498.1 | 27.8 | 895.1 | 309.8 | 322.1 | 81.3 | 161.3 | 69.5 | 175.5 | 507.7 | 90.8 |
| B-01 | 0.80 | 1.40 | 1.77 | 0.89 | 451.0 | 26.4 | 848.2 | 299.9 | 326.9 | 51.6 | 104.7 | 958.5 | 271.4 | 250.6 | 79.9 |
| T-04 | 0.89 | 1.28 | 2.33 | 1.35 | 350.9 | 31.8 | 938.7 | 371.8 | 333.8 | 41.6 | 62.0 | 39.6 | 164.6 | 101.0 | 67.0 |
| T-10 | 0.76 | 1.37 | 2.29 | 1.39 | 418.6 | 53.1 | 1007.9 | 285.4 | 553.1 | 71.3 | 57.5 | 57.4 | 173.0 | 115.4 | 120.4 |
|  | 0.81 | 1.22 | 2.07 | 1.18 | 438.2 | 33.5 | 885.4 | 335.9 | 366.4 | 57.7 | 95.0 | 198.3 | 188.7 | 228.2 | 82.8 |
| The fifth cluster | W-11 | 1.20 | 1.54 | 1.89 | 1.66 | 593.3 | 43.8 | 1396.1 | 434.8 | 667.3 | 28.9 | 113.9 | 106.0 | 242.1 | 124.3 | 79.0 |
| T-03 | 1.29 | 1.18 | 2.23 | 1.71 | 814.2 | 40.5 | 954.2 | 215.0 | 632.5 | 46.4 | 119.3 | 51.1 | 171.3 | 134.7 | 67.6 |
| W-03 | 1.86 | 1.39 | 2.14 | 1.93 | 852.3 | 42.7 | 1186.5 | 308.2 | 645.3 | 28.4 | 171.3 | 56.8 | 218.9 | 265.8 | 81.4 |
| W-10 | 1.35 | 1.89 | 1.83 | 1.72 | 533.8 | 45.4 | 1495.2 | 280.3 | 546.6 | 48.5 | 154.4 | 37.9 | 576.1 | 149.7 | 85.3 |
| W-08 | 1.26 | 1.92 | 2.16 | 2.17 | 445.2 | 56.3 | 1769.0 | 473.1 | 746.7 | 22.9 | 52.0 | 74.2 | 303.6 | 84.7 | 114.5 |
| T-13 | 0.57 | 1.08 | 2.09 | 1.87 | 427.2 | 39.5 | 924.8 | 215.6 | 597.5 | 65.7 | 212.4 | 36.4 | 168.3 | 462.6 | 64.0 |
| B-5 | 1.11 | 1.90 | 2.13 | 1.55 | 619.3 | 36.7 | 1474.6 | 309.9 | 519.8 | 10.2 | 88.9 | 72.0 | 396.3 | 121.9 | 97.2 |
| B-4 | 1.44 | 1.94 | 2.06 | 1.34 | 551.8 | 32.6 | 1558.0 | 449.2 | 432.7 | 29.6 | 113.1 | 122.1 | 350.6 | 96.9 | 105.4 |
|  | 1.26 | 1.61 | 2.07 | 1.74 | 604.6 | 42.2 | 1344.8 | 335.8 | 598.6 | 35.1 | 128.2 | 69.6 | 303.4 | 180.1 | 86.8 |
|  | MAS | 1.00 | 2.00 | 1.90 | 2.60 | 181.6 | 74.7 | 1651.2 | 273.0 | 690.8 | 63.7 | 93.5 | 57.7 | 244.6 | 585.8 | 153.3 |

MAS: modern aeolian sand.