**附表1 茂名盆地茂页1井油柑窝组油页岩主微量元素特征及部分古环境参数**

**Table 1 Main and trace elements and partial paleoenvironmental parameters of Youganwo Formation oil shale in MY1 well**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 样品编号 | 深度  (m) | Al2O3 | CaO | Fe2O3 | K2O | MgO | MnO | Ba | Cu | Ga | Rb | Ni | Sr | V | Th | U | Babio | Ba/Al | V/(V+Ni) | Th/U | Sr/Cu | Rb/Sr | Sr/Ba | Ba/Ga |
| (%) | | | | | | (μg/g) | | | | | | | | |
| MY-1 | 815 | 17.91 | 0.39 | 3.39 | 1.84 | 0.62 | 0.043 | 520.53 | 37.73 | 25.54 | 141.80 | 36.44 | 100.41 | 82.44 | 33.37 | 6.89 | 164.03 | 0.0069 | 0.69 | 4.84 | 2.66 | 1.41 | 0.19 | 20.38 |
| MY-2 | 816 | 19.26 | 0.34 | 6.35 | 1.93 | 0.85 | 0.046 | 510.4 | 32.58 | 26.06 | 163.04 | 30.67 | 101.39 | 85.67 | 36.91 | 6.80 | 127.44 | 0.0050 | 0.74 | 5.43 | 3.11 | 1.61 | 0.20 | 19.58 |
| MY-3 | 818.4 | 14.59 | 0.26 | 4.55 | 1.70 | 0.68 | 0.031 | 496.14 | 28.25 | 20.35 | 134.40 | 23.98 | 83.81 | 74.43 | 29.23 | 6.13 | 200.5 | 0.0064 | 0.76 | 4.77 | 2.97 | 1.60 | 0.17 | 24.39 |
| MY-4 | 819.6 | 16.36 | 0.31 | 4.98 | 1.83 | 0.71 | 0.047 | 511.98 | 27.01 | 22.73 | 146.63 | 23.22 | 93.6 | 75.14 | 30.61 | 5.84 | 174.82 | 0.0059 | 0.76 | 5.25 | 3.47 | 1.57 | 0.18 | 22.53 |
| MY-5 | 821 | 21.30 | 0.51 | 5.03 | 1.92 | 0.80 | 0.020 | 534.93 | 37.90 | 30.90 | 165.96 | 31.93 | 118.47 | 91.00 | 45.31 | 8.37 | 107.31 | 0.0047 | 0.74 | 5.42 | 3.13 | 1.40 | 0.22 | 17.31 |
| MY-6 | 823 | 20.17 | 0.34 | 5.26 | 1.81 | 0.79 | 0.047 | 506.94 | 36.00 | 27.95 | 156.64 | 28.59 | 101.87 | 88.26 | 40.70 | 8.95 | 99.63 | 0.0047 | 0.76 | 4.55 | 2.83 | 1.54 | 0.20 | 18.14 |
| MY-7 | 824.6 | 20.41 | 0.29 | 4.61 | 1.80 | 0.81 | 0.021 | 521.94 | 34.89 | 27.99 | 154.51 | 28.78 | 110.87 | 91.47 | 42.60 | 9.26 | 127.73 | 0.0048 | 0.76 | 4.60 | 3.18 | 1.39 | 0.21 | 18.64 |
| MY-8 | 826.8 | 17.62 | 0.38 | 5.35 | 1.80 | 0.80 | 0.035 | 538.31 | 30.93 | 24.12 | 154.93 | 32.56 | 115.12 | 77.60 | 40.38 | 7.70 | 185.86 | 0.0058 | 0.70 | 5.25 | 3.72 | 1.35 | 0.21 | 22.32 |
| MY-9 | 827.5 | 19.93 | 0.36 | 4.90 | 1.57 | 0.78 | 0.045 | 486.35 | 33.90 | 27.06 | 147.81 | 28.11 | 110.81 | 77.99 | 41.72 | 7.79 | 121.63 | 0.0046 | 0.74 | 5.36 | 3.27 | 1.33 | 0.23 | 17.98 |
| MY-10 | 830.8 | 18.20 | 0.70 | 5.62 | 2.29 | 0.91 | 0.091 | 603.06 | 27.23 | 26.20 | 193.33 | 26.55 | 145.42 | 82.77 | 32.19 | 4.76 | 210.59 | 0.0063 | 0.76 | 6.76 | 5.34 | 1.33 | 0.24 | 23.02 |
| MY-11 | 833.1 | 19.79 | 0.44 | 5.57 | 1.66 | 0.90 | 0.058 | 552.02 | 34.97 | 27.21 | 150.69 | 29.75 | 143.21 | 88.99 | 41.95 | 7.88 | 185.82 | 0.0053 | 0.75 | 5.32 | 4.10 | 1.05 | 0.26 | 20.29 |
| MY-12 | 833.7 | 20.32 | 0.89 | 10.57 | 1.74 | 0.92 | 0.209 | 588.30 | 31.68 | 28.22 | 159.49 | 26.75 | 143.92 | 95.53 | 38.95 | 7.12 | 205.67 | 0.0055 | 0.78 | 5.47 | 4.54 | 1.11 | 0.24 | 20.85 |
| MY-13 | 834.5 | 16.20 | 0.69 | 4.21 | 1.71 | 0.80 | 0.026 | 590.23 | 32.99 | 22.91 | 137.17 | 31.11 | 155.66 | 77.82 | 33.12 | 7.11 | 276.24 | 0.0069 | 0.71 | 4.66 | 4.72 | 0.88 | 0.26 | 25.77 |
| MY-14 | 836.5 | 20.48 | 0.40 | 4.90 | 1.92 | 0.99 | 0.019 | 582.35 | 38.67 | 27.88 | 171.05 | 33.78 | 160.48 | 89.07 | 46.42 | 8.78 | 195.55 | 0.0054 | 0.73 | 5.29 | 4.15 | 1.07 | 0.28 | 20.89 |
| MY-15 | 839.1 | 14.93 | 0.51 | 5.90 | 1.68 | 0.82 | 0.088 | 542.02 | 33.06 | 20.54 | 134.03 | 33.42 | 142.74 | 71.62 | 34.41 | 7.17 | 261.07 | 0.0069 | 0.68 | 4.80 | 4.32 | 0.94 | 0.26 | 26.39 |
| MY-16 | 840.7 | 19.69 | 0.37 | 4.74 | 1.78 | 0.91 | 0.018 | 552.32 | 44.01 | 27.49 | 154.67 | 31.96 | 154.87 | 100.04 | 88.99 | 10.49 | 183.03 | 0.0053 | 0.76 | 3.75 | 3.52 | 1.00 | 0.28 | 20.09 |
| MY-17 | 842.1 | 15.19 | 0.46 | 4.79 | 1.72 | 0.90 | 0.016 | 529.55 | 38.36 | 20.23 | 136.61 | 34.00 | 157.58 | 76.32 | 95.53 | 6.68 | 228.27 | 0.0066 | 0.69 | 4.50 | 4.11 | 0.87 | 0.30 | 26.18 |
| MY-18 | 844.2 | 16.60 | 0.65 | 7.58 | 1.48 | 0.83 | 0.182 | 514.67 | 36.88 | 22.85 | 131.22 | 34.15 | 155.62 | 75.64 | 77.82 | 6.93 | 224.97 | 0.0059 | 0.69 | 6.50 | 4.22 | 0.84 | 0.30 | 22.52 |
| MY-19 | 846.5 | 20.14 | 0.31 | 4.47 | 1.70 | 0.89 | 0.014 | 431.02 | 44.46 | 27.37 | 155.64 | 39.19 | 143.64 | 87.58 | 46.55 | 8.63 | 80 | 0.0040 | 0.69 | 5.39 | 3.23 | 1.08 | 0.33 | 15.75 |
| MY-20 | 849.6 | 21.28 | 0.31 | 4.83 | 2.03 | 0.99 | 0.015 | 467.40 | 54.73 | 28.93 | 173.30 | 45.21 | 147.56 | 91.44 | 40.75 | 7.44 | 97.13 | 0.0041 | 0.67 | 5.48 | 2.70 | 1.17 | 0.32 | 16.16 |
| MY-21 | 851.9 | 12.39 | 0.32 | 3.60 | 1.43 | 0.60 | 0.030 | 344.22 | 21.75 | 17.54 | 101.47 | 25.85 | 126.82 | 68.17 | 27.75 | 4.39 | 98.77 | 0.0052 | 0.73 | 6.32 | 5.83 | 0.80 | 0.37 | 19.63 |
| MY-22 | 853.1 | 21.48 | 0.31 | 4.35 | 2.66 | 1.21 | 0.019 | 456.29 | 39.61 | 27.69 | 202.48 | 40.69 | 159.45 | 83.94 | 35.87 | 5.74 | 49.87 | 0.0040 | 0.67 | 6.25 | 4.03 | 1.27 | 0.35 | 16.48 |
| MY-23 | 854.5 | 21.77 | 0.29 | 3.98 | 3.06 | 1.36 | 0.024 | 482.80 | 33.39 | 27.63 | 205.37 | 28.11 | 169.61 | 80.69 | 29.01 | 6.28 | 57.41 | 0.0042 | 0.74 | 4.62 | 5.08 | 1.21 | 0.35 | 17.47 |
| MY-24 | 856.8 | 18.88 | 0.26 | 3.19 | 2.88 | 1.12 | 0.021 | 432.05 | 29.55 | 25.25 | 203.96 | 29.11 | 150.9 | 71.11 | 28.58 | 4.57 | 16.75 | 0.0043 | 0.71 | 6.25 | 5.11 | 1.35 | 0.35 | 17.11 |
| 均值 |  | 18.54 | 0.42 | 5.11 | 1.91 | 0.88 | 0.05 | 512.33 | 35.02 | 25.44 | 157.34 | 31.41 | 133.07 | 82.70 | 37.12 | 7.15 | 153.34 | 0.0054 | 0.73 | 5.28 | 3.89 | 1.18 | 0.26 | 20.14 |
| PAAS |  | 18.88 | 1.29 | 7.18 | 3.68 | 2.19 | 0.11 | 650.00 | 50.00 | 20.00 | 160.00 | 55.00 | 200.00 | 150 | 14.60 | 3.10 |  |  |  |  |  |  |  |  |
| 富集系数 |  | 1.00 | 0.33 | 0.73 | 0.53 | 0.41 | 0.45 | 0.803 | 0.713 | 1.295 | 1.001 | 0.582 | 0.678 | 0.56 | 2.589 | 2.35 |  |  |  |  |  |  |  |  |

**附表2 茂名盆地茂页1井油柑窝组油页岩稀土元素特征及部分地质参数**

**Table 2 Rare earth elements and partial geological parameters of Youganwo Formation oil shale in MY1 well**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 样品编号 | 深度  (m) | La | Ce | Pr | Nd | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu | (La/Yb)N | (La/Sm)N | (Gd/Yb)N | δCe | Ceanom |
| (μg/g) | | | | | | | | | | | | | |
| MY-1 | 815 | 496.05 | 304.82 | 219.06 | 162.42 | 94.42 | 52.45 | 86.90 | 61.51 | 48.64 | 42.43 | 42.95 | 38.81 | 36.36 | 36.49 | 13.64 | 5.25 | 2.39 | 0.92 | -0.10 |
| MY-2 | 816 | 213.72 | 158.24 | 118.17 | 86.38 | 49.62 | 27.64 | 42.24 | 28.69 | 22.14 | 19.35 | 19.59 | 18.45 | 17.73 | 17.75 | 12.06 | 4.31 | 2.38 | 1.00 | -0.03 |
| MY-3 | 818.4 | 168.72 | 128.37 | 94.50 | 70.13 | 40.73 | 23.15 | 35.32 | 23.99 | 18.46 | 16.09 | 16.43 | 14.84 | 14.43 | 14.27 | 11.69 | 4.14 | 2.45 | 1.02 | -0.02 |
| MY-4 | 819.6 | 167.10 | 125.84 | 90.83 | 66.16 | 36.89 | 20.30 | 32.37 | 20.91 | 16.09 | 14.03 | 14.21 | 13.15 | 12.58 | 12.48 | 13.29 | 4.53 | 2.57 | 1.02 | -0.03 |
| MY-5 | 821 | 251.72 | 188.75 | 143.03 | 108.84 | 67.60 | 38.15 | 58.95 | 43.43 | 35.72 | 31.99 | 32.15 | 29.81 | 28.15 | 28.17 | 8.94 | 3.72 | 2.09 | 0.99 | -0.03 |
| MY-6 | 823 | 197.51 | 147.65 | 107.64 | 78.51 | 45.12 | 25.46 | 39.37 | 26.80 | 21.15 | 18.43 | 19.02 | 17.94 | 17.60 | 18.22 | 11.23 | 4.38 | 2.24 | 1.01 | -0.03 |
| MY-7 | 824.6 | 197.46 | 150.38 | 107.12 | 78.57 | 45.76 | 25.50 | 39.42 | 27.26 | 21.40 | 18.76 | 19.10 | 18.04 | 17.64 | 17.24 | 11.19 | 4.32 | 2.23 | 1.03 | -0.02 |
| MY-8 | 826.8 | 199.38 | 148.55 | 109.88 | 79.75 | 44.71 | 23.64 | 37.24 | 25.67 | 19.91 | 17.25 | 17.92 | 17.20 | 16.63 | 16.92 | 11.99 | 4.46 | 2.24 | 1.00 | -0.03 |
| MY-9 | 827.5 | 211.26 | 160.95 | 118.21 | 86.22 | 49.42 | 27.58 | 41.28 | 28.87 | 22.28 | 19.55 | 19.77 | 18.39 | 17.97 | 17.94 | 11.76 | 4.28 | 2.30 | 1.02 | -0.02 |
| MY-10 | 830.8 | 186.66 | 136.57 | 96.22 | 69.38 | 37.95 | 20.70 | 32.77 | 22.02 | 16.87 | 14.85 | 14.99 | 13.87 | 13.10 | 13.39 | 14.25 | 4.92 | 2.50 | 1.02 | -0.03 |
| MY-11 | 833.1 | 229.17 | 175.76 | 127.54 | 93.53 | 53.27 | 29.30 | 44.47 | 30.62 | 23.81 | 21.24 | 21.71 | 20.53 | 19.59 | 20.19 | 11.70 | 4.30 | 2.27 | 1.03 | -0.02 |
| MY-12 | 833.7 | 242.66 | 185.63 | 134.76 | 99.17 | 56.78 | 31.75 | 48.17 | 33.40 | 26.31 | 24.18 | 25.32 | 24.38 | 24.18 | 26.51 | 10.03 | 4.27 | 1.99 | 1.03 | -0.02 |
| MY-13 | 834.5 | 224.55 | 178.01 | 124.69 | 95.96 | 57.68 | 33.72 | 50.46 | 37.36 | 30.81 | 28.65 | 29.00 | 27.04 | 25.25 | 26.24 | 8.89 | 3.89 | 2.00 | 1.06 | -0.01 |
| MY-14 | 836.5 | 245.68 | 175.57 | 136.71 | 99.28 | 55.65 | 29.94 | 46.01 | 31.26 | 23.90 | 20.80 | 20.90 | 19.26 | 18.62 | 18.56 | 13.20 | 4.41 | 2.47 | 0.96 | -0.05 |
| MY-15 | 839.1 | 165.39 | 127.33 | 91.92 | 67.85 | 38.88 | 22.42 | 33.28 | 23.43 | 18.61 | 16.67 | 17.09 | 16.13 | 16.00 | 16.06 | 10.34 | 4.25 | 2.08 | 1.03 | -0.02 |
| MY-16 | 840.7 | 205.31 | 155.11 | 111.05 | 81.20 | 46.57 | 26.73 | 39.70 | 28.30 | 22.55 | 19.78 | 19.89 | 18.41 | 17.40 | 17.76 | 11.80 | 4.41 | 2.28 | 1.03 | -0.02 |
| MY-17 | 842.1 | 141.76 | 110.69 | 78.86 | 58.36 | 32.83 | 19.50 | 28.15 | 19.35 | 15.17 | 13.56 | 13.74 | 12.94 | 12.49 | 12.83 | 11.35 | 4.32 | 2.25 | 1.05 | -0.01 |
| MY-18 | 844.2 | 232.69 | 188.35 | 133.61 | 98.88 | 57.11 | 30.51 | 47.85 | 34.47 | 27.67 | 25.73 | 27.04 | 26.15 | 25.72 | 27.33 | 9.05 | 4.07 | 1.86 | 1.07 | 0.00 |
| MY-19 | 846.5 | 236.51 | 188.36 | 137.25 | 101.37 | 57.67 | 31.00 | 47.21 | 32.61 | 24.94 | 21.61 | 21.92 | 20.36 | 19.76 | 20.06 | 11.97 | 4.10 | 2.39 | 1.05 | -0.01 |
| MY-20 | 849.6 | 206.87 | 166.44 | 120.64 | 89.61 | 50.98 | 28.81 | 41.79 | 29.34 | 22.44 | 19.89 | 20.34 | 18.89 | 18.44 | 18.95 | 11.22 | 4.06 | 2.27 | 1.05 | 0.00 |
| MY-21 | 851.9 | 146.48 | 117.74 | 80.99 | 60.42 | 33.53 | 17.77 | 27.39 | 18.91 | 15.08 | 13.16 | 13.86 | 13.18 | 12.69 | 13.66 | 11.55 | 4.37 | 2.16 | 1.08 | 0.00 |
| MY-22 | 853.1 | 166.48 | 128.41 | 93.76 | 70.23 | 39.96 | 23.17 | 30.29 | 21.96 | 17.19 | 14.91 | 15.14 | 14.26 | 14.08 | 14.15 | 11.82 | 4.17 | 2.15 | 1.03 | -0.02 |
| MY-23 | 854.5 | 179.34 | 137.98 | 98.02 | 70.94 | 38.06 | 21.56 | 29.39 | 19.81 | 14.43 | 12.53 | 12.97 | 12.26 | 11.76 | 11.80 | 15.25 | 4.71 | 2.50 | 1.04 | -0.02 |
| MY-24 | 856.8 | 147.81 | 114.92 | 82.50 | 59.98 | 32.74 | 17.90 | 25.48 | 18.42 | 15.02 | 14.02 | 14.90 | 14.51 | 14.06 | 14.88 | 10.51 | 4.51 | 1.81 | 1.04 | -0.01 |
| 北美页岩 | | 32.00 | 73.00 | 7.90 | 33.00 | 5.7 | 1.24 | 5.2 | 0.85 | 5.80 | 1.04 | 3.40 | 0.50 | 3.10 | 0.48 |  |  |  |  |  |
| 球粒陨石 | | 0.31 | 0.81 | 0.12 | 0.60 | 0.20 | 0.07 | 0.26 | 0.05 | 0.32 | 0.07 | 0.21 | 0.03 | 0.21 | 0.03 |  |  |  |  |  |