|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Stage | T (°C) | 40Ar/39Ar | 37Ar/39Ar | 36Ar/39Ar | 40Ar\*/39Ark | 40Ar\* (%) | 39Ar (%) | Age (Ma) |
| 1 | 400 | 193.3 | 121.20 | 0.5612 | 27.50 | 14.22 | 0.29 | 190.85± 55.4 |
| 2 | 500 | 47.9 | 19.33 | 0.0419 | 35.54 | 74.15 | 2.07 | 243.04± 6.6 |
| 3 | 600 | 50.8 | 29.32 | 0.0476 | 36.70 | 72.31 | 3.29 | 250.48± 9.3 |
| 4 | 700 | 44.9 | 2.039 | 0.0221 | 38.36 | 85.47 | 19.50 | 261.01± 11.2 |
| 5 | 800 | 41.8 | 2.696 | 0.0132 | 37.93 | 90.66 | 32.72 | 258.32± 2.9 |
| 6 | 900 | 55.3 | 11.85 | 0.0582 | 38.06 | 68.88 | 35.57 | 259.12± 6.6 |
| 7 | 1000 | 40.1 | 1.709 | 0.0060 | 38.34 | 95.55 | 55.95 | 260.90± 3.1 |
| 8 | 1100 | 42.3 | 6.586 | 0.0154 | 37.71 | 89.21 | 61.10 | 256.90± 3.6 |
| 9 | 1200 | 40.5 | 0.905 | 0.0068 | 38.53 | 95.03 | 97.32 | 262.09± 2.6 |
| 10 | 1350 | 40.2 | 13.32 | 0.0059 | 38.47 | 95.68 | 100.00 | 261.74± 4.8 |

Table 1 40Ar/39Ar data of biotite 16HR1-1 sample of the pyrite-quartz veins from the Haoyaoerhudong gold deposit

Table 2 Electro microprobe analysis (EMPA) analytical results (wt.%) of pyrite in Haoyaoerhudong gold deposit

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample No. | Type of ores | Spot No. | As | Hg | S | Fe | Pb | Cu | Sb | Au | Ag | total |
| 16HR01-2 | DP | -1 | - | 0.88 | 52.45 | 47.03 | 0.19 | - | - | 0.01 | - | 100.56 |
| -2 | - | 0.63 | 52.33 | 46.63 | 0.14 | - | - | 0.04 | 0.01 | 99.78 |
| -3 | - | 0.59 | 50.83 | 46.69 | 0.15 | - | - | 0.02 | 0.02 | 98.3 |
| HR02-20 | PY | -1 | 0.03 | 0.14 | 52.18 | 46.24 | 0.03 | - | - | - | - | 98.62 |
| -2 | 0.01 | - | 53.09 | 46.98 | 0.09 | 0.03 | - | - | - | 100.2 |
| -3 | - | 0.25 | 52.83 | 47.2 | 0.28 | - | - | 0.01 | - | 100.57 |
| -4 | - | - | 51.47 | 46.45 | 0.12 | - | 0 | - | 0.05 | 98.09 |
| HR03-5 | -1 | - | - | 52.33 | 46.91 | 0.02 | - | - | 0.03 | - | 99.29 |
| -2 | 0.08 | 1.35 | 52.54 | 46.27 | - | - | - | - | - | 100.24 |
| -3 | 0.03 | - | 52.09 | 46.58 | 0.2 | - | - | - | - | 98.9 |
| -4 | - | - | 52.3 | 46.78 | 0.17 | 0.02 | 0.02 | 0.06 | 0.02 | 99.37 |
| HR02-5 | -1 | 0.1 | 0.97 | 51.02 | 46.39 | 0.21 | - | - | 0.1 | - | 98.79 |
| -2 | 0.04 | - | 52.09 | 46.88 | 0.28 | 0.01 | - | - | - | 99.3 |
| -3 | - | 0.72 | 52.26 | 46.72 | 0.13 | 0 | - | - | 0.02 | 99.85 |
| HR02-19 | -1 | - | 0.39 | 51.51 | 47.01 | 0.08 | - | - | 0.07 | - | 99.06 |
| -2 | - | 0.28 | 52.2 | 46.82 | 0.25 | 0.01 | - | - | - | 99.56 |
| -3 | - | 0.67 | 51.86 | 46.65 | 0.09 | 0 | 0.01 | 0.02 | - | 99.3 |
| -4 | - | 1.33 | 51.86 | 46.68 | 0.33 | - | 0.01 | - | 0.03 | 100.24 |
| HR12-7 | -1 | 0.16 | 0.74 | 52.64 | 45.77 | 0.16 | - | 0.02 | - | - | 99.49 |
| -2 | - | 0.57 | 52.52 | 46.11 | 0.18 | 0 | 0.02 | 0.1 | 0.01 | 99.51 |
| -3 | - | 0.71 | 50.87 | 46.34 | 0.06 | - | 0.01 | 0.08 | - | 98.07 |
| HR04-12 | QV1 | -1 | 0.09 | 0.2 | 51.19 | 46.5 | 0.19 | - | - | - | - | 98.17 |
| -2 | - | - | 52.46 | 47.12 | 0.02 | 0.03 | 0.01 | 0.07 | - | 99.71 |
| -3 | - | 0.1 | 51.6 | 46.81 | 0.04 | 0.02 | - | - | 0.01 | 98.58 |
| -4 | 0.03 | 1.69 | 51.27 | 46.73 | 0.04 | - | 0 | - | - | 99.76 |
| HR06-6 | -1 | - | 0.71 | 51.47 | 47.08 | 0.28 | 0.02 | - | - | 0.01 | 99.57 |
| -2 | - | - | 51.91 | 47.35 | 0.09 | 0.05 | 0.01 | 0.06 | 0.04 | 99.51 |
| HR02-9 | -1 | 0.36 | 1.59 | 50.78 | 46.2 | 0.13 | 0.04 | 0.02 | 0.07 | - | 99.19 |
| -2 | - | 0.04 | 52.08 | 46.7 | 0.24 | - | - | - | - | 99.06 |
| -3 | - | 0.36 | 51.43 | 46.64 | 0.13 | - | 0.03 | 0.02 | - | 98.61 |
| HR02-6 | -1 | - | 1.39 | 51.65 | 46.53 | 0.16 | 0.06 | 0.01 | - | 0.02 | 99.82 |
| -2 | - | 0.08 | 52.07 | 47.04 | 0.12 | - | - | 0.07 | - | 99.38 |
| -3 | 0.01 | 0.65 | 50.83 | 46.71 | 0.1 | - | 0.01 | 0.01 | - | 98.32 |
| HR02-12 | -1 | 0.01 | 1 | 51.1 | 46.44 | 0.12 | 0.05 | 0.02 | 0.01 | 0.02 | 98.77 |
| -2 | - | 0 | 53.13 | 46.72 | 0.16 | - | 0.03 | 0.01 | - | 100.05 |
| -3 | - | - | 51.4 | 46.68 | 0.11 | - | - | 0.01 | - | 98.2 |
| -4 | - | 0.44 | 52.29 | 46.37 | 0.09 | - | - | 0.05 | - | 99.24 |
| HR02-7 | -1 | 0.03 | - | 52.32 | 46.37 | 0.28 | - | 0.03 | 0.02 | - | 99.05 |
| -2 | - | - | 51.62 | 47.02 | 0.27 | - | 0.03 | - | 0.01 | 98.95 |
| -3 | - | - | 51.65 | 46.58 | 0.17 | - | 0 | 0.01 | 0.02 | 98.43 |
| -4 | 0.05 | - | 52.38 | 47.42 | 0.11 | - | - | 0.02 | - | 99.98 |
| HR02-3 | -1 | 0.03 | - | 52.18 | 47.04 | 0.08 | - | - | 0.05 | - | 99.38 |
| -2 | - | - | 51.99 | 47.12 | - | 0 | 0.02 | 0.01 | 0.02 | 99.16 |
| -3 | - | 1.04 | 51.31 | 46.32 | 0.1 | 0.01 | 0 | - | 0.02 | 98.8 |
| -4 | - | - | 51.79 | 46.49 | 0.31 | 0.02 | 0.01 | 0.03 | - | 98.65 |
| HR02-16 | QV2 | -1 | - | 0.69 | 51.42 | 46.7 | 0.22 | 0.05 | - | - | - | 99.08 |
| -2 | 0.1 | - | 52.64 | 47.1 | 0.14 | - | - | - | - | 99.98 |
| -3 | - | - | 51.09 | 47.09 | 0.15 | 0.04 | - | - | - | 98.37 |

Table 3 Sulfur and lead isotopic ratios of sulfides from the Haoyaoerhudong gold deposit

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sample No. | Type of ores | Minerals | δ34S | 206Pb/204Pb | 207Pb/204Pb | 208Pb/204Pb | Reference |
| Sedimentary-diagenesis: | | | | | | | |
| 16HR01-1 | DS | Py | 15.02 | 20.371 | 15.825 | 37.964 | This study |
| 16HR01-2 |  |  | 17.54 | 20.408 | 15.772 | 37.813 |
| 16HR01-3 |  |  | 17.53 | 20.43 | 15.778 | 37.862 |
| 16HR01-4 |  |  | 17.85 | 20.470 | 15.864 | 38.222 |
| 16HR01-5 |  |  | 16.95 | 19.144 | 15.681 | 37.502 |
| 16HR01-6 |  |  | -39.40 | 21.892 | 15.705 | 38.925 |  |
| 16HR01-7 |  |  | -39.26 |  |  |  |  |
| Post-peak metamorphism: | | | | | | | |
| E14 | PoVs | Po | 10.55 |  |  |  | Wang et al., (2014)7 |
| ZK13 |  |  | 12.38 |  |  |  |
| ZK21 |  |  | 13.5 |  |  |  |
| ZK23 |  |  | 14.15 |  |  |  |
| ZK25 |  |  | 14.25 |  |  |  |
| ZK27 |  |  | 14.17 |  |  |  |
| ZK29 |  |  | 14.71 |  |  |  |
| ZK31 |  |  | 13.9 |  |  |  |
| ZK33 |  |  | 13.41 |  |  |  |
| E42 | PQVs1 | Py | 12.06 |  |  |  | Wang et al., (2014)7 |
| W7 |  | 11.65 |  |  |  |
| 16HR02-2 | PQVs2 |  | 14.3 | 18.790 | 15.684 | 38.983 | This study |
| 16HR02-3 |  | 12.2 | 18.794 | 15.674 | 38.924 |
| 06SCH-1 |  |  | 18.566 | 15.645 | 38.961 | Zhao et al., (2011)33 |
| 06SCH-2 | Asp |  | 18.922 | 15.674 | 38.979 |
| E12 | Py | 10.53 |  |  |  | Wang et al., (2014)7 |
| W12 |  | 13.4 |  |  |  |
| ZK5 |  | 12.49 |  |  |  |
| ZK7 |  | 14.08 |  |  |  |
| ZK15 |  | 14.26 |  |  |  |
| ZK17 |  | 14.45 |  |  |  |
| ZK19 |  | 14.77 |  |  |  |
| ZK35 |  | 13.83 |  |  |  |
| SCH-B3 |  | 6.8 |  |  |  | Liu et al., (2016)17 |
| SCH-B5 |  | 13.2 |  |  |  |  |
| SCH-B7 |  | 13.4 |  |  |  |  |
| SCH-B8 |  | 11.5 |  |  |  |  |
| W23 | PVs |  | 16.47 |  |  |  | Wang et al., (2014)7 |
| W25 |  | 10.15 |  |  |  |
| ZK9 |  | 13.48 |  |  |  |
| ZK11 |  | 12.66 |  |  |  |
| SCH-A1 |  | 12.4 |  |  |  | Liu et al., (2016)17 |
| SCH-A2 |  | 13.1 |  |  |  |
| SCH-A4 | 10.8 |  |  |  |

DS-Disseminated pyrite; PoVs-Pyrrhotite veins; PVs-Pyrite veins; PQVs1=Pyrite-quartz veins; PQVs2-Pyrite-bearing quartz veins