**Supplementary Table S1.** EPMA calibration settings for (a) apatite; (b) monazite; (c) amphibole; (d) columbite and pyrochlore; (e) carbonate. Pulse height analysis mode was integral. cps/nA = counts per second per nanoampere.

**(a)** Calibration setting for apatite. Acceleration voltage 15 KV; beam current 20 nA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Element and Line** | **Crystal** | **Peak Time** | **Background (-ive)** | **Background (+ive)** | **Slope** | **Standard** | **Standard intensity (cps/nA)** |
| F *Ka* | PC0 | 10 | -8500 | 1000 |  | Apatite | 11.1 |
| Na *Ka* | LTAP | 10 |  | 600 | 1.1 | Albite | 119.6 |
| Si *Ka* | LTAP | 10 |  | 600 | 1.1 | Th Glass | 1014.3 |
| Fe *Ka* | LLIF | 10 |  | 500 | 1.1 | Fe2O3 | 388.8 |
| Sr *La* | PET | 20 | -1000 | 1000 |  | SrSO4 | 43.6 |
| P *Ka* | LPET | 10 |  | 500 | 1.1 | Apatite | 135.5 |
| Ca *Ka* | LPET | 10 |  | 500 | 1.1 | Diopside | 323.9 |
| La *La* | LPET | 20 |  | 500 | 1.1 | La Glass | 73.1 |
| Ce *La* | LPET | 20 |  | 500 | 1.1 | Ce Glass | 74.9 |
| Pr *Lb* | LLIF | 20 |  | 6230 | 1.1 | Pr Glass | 3.8 |
| Nd *Lb* | LLIF | 20 |  | 1700 | 1.1 | Nd Glass | 10.6 |

(**b**) Calibration setting for monazite. Acceleration voltage 15 KV; beam current 150 nA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Element and line** | **Crystal** | **Peak Time** | **Background (-ive)** | **Background (+ive)** | **Slope** | **Calibration** | **Standard intensity (cps/nA)** |
| F *Ka* | PC0 | 10 | -8500 | 1000 | - | Apatite | 11.1 |
| Cl *Ka* | LPET | 10 | 400 | 400 | - | NaCl | 171.5 |
| Si *Ka* | LTAP | 10 |  | 600 | 1.1 | Th Glass | 1014.3 |
| P *Ka* | LPET | 10 |  | 500 | 1.1 | Apatite | 135.5 |
| Ca *Ka* | PET | 10 |  | 500 | 1.1 | Diopside | 114.3 |
| Sr *La* | PET | 20 | -1000 | 1000 | - | SrSO4 | 43.6 |
| La *La* | LPET | 20 |  | 500 | 1.1 | La Glass | 73.1 |
| Ce *La* | LPET | 20 |  | 500 | 1.1 | Ce Glass | 74.9 |
| Pr *Lb* | LLIF | 20 |  | 6230 | 1.1 | Pr Glass | 3.8 |
| Nd *Lb* | LLIF | 20 |  | 1700 | 1.1 | Nd Glass | 10.6 |
| Sm *La* | LLIF | 20 |  | 500 | 1.1 | Sm Glass | 6.8 |
| Th *Ma* | LPET | 20 |  | 600 | 1.1 | Th Glass | 7.1 |

1. Calibration setting for amphibole. Acceleration voltage 15 KV; beam current 20 nA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Element and line** | **Crystal** | **Peak Time** | **Background (–ve)** | **Background (+ve)** | **Slope** | **Standard** | **Standard intensity (cps/nA)** |
| F *Ka* | LTAP | 10 | 800 | 800 | – | Apatite | 18.7 |
| Na *Kα* | LTAP | 10 | – | 600 | 1.1 | Albite | 59.7 |
| Mg *Ka* | LTAP | 10 | – | 1200 | 1.16 | Diopside | 359.4 |
| Al *Ka* | TAP | 10 | – | 600 | 1.1 | Al2O3 | 1217.3 |
| Si *Ka* | LTAP | 10 | – | 600 | 1.1 | Th Glass | 1169.4 |
| K *Ka* | PET | 10 | – | 500 | 1.1 | Orthoclase | 73.0 |
| Ca *Ka* | LPET | 10 | – | 500 | 1.1 | Diopside | 335.4 |
| Ti *Ka* | PET | 10 | – | 500 | 1.1 | TiO2 | 467.0 |
| Mn *Ka* | LLIF | 10 | – | 500 | 1.1 | Rhodonite | 163.1 |
| Fe *Ka* | LLIF | 10 | – | 500 | 1.1 | Fe2O3 | 381.9 |

1. Calibration setting for columbite and pyrochlore. Acceleration voltage 15 KV; beam current 20 nA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Element and line** | **Crystal** | **Peak Time** | **Background (–ve)** | **Background (+ve)** | **Slope** | **Standard** | **Standard intensity (cps/nA)** |
| Na *Ka* | LTAP | 10 |  | 600 | 1.1 | Albite | 119.6 |
| Si *Ka* | LTAP | 10 |  | 600 | 1.1 | Th glass | 1014.3 |
| Mg *Ka* | LTAP | 10 |  | 1200 | 1.16 | Diopside | 285.1 |
| Al *Ka* | LTAP | 10 |  | 600 | 1.1 | Al2O3 | 4583.4 |
| K  *Ka* | PET | 10 |  | 500 | 1.1 | Orthoclase | 66.3 |
| Ca *Ka* | PET | 10 |  | 500 | 1.1 | Diopside | 114.3 |
| Ti *Ka* | PET | 10 |  | 500 | 1.1 | TiO2 | 414.7 |
| Fe *Ka* | LLIF | 10 |  | 500 | 1.1 | Fe2O3 | 388.8 |
| Sr *La* | PET | 20 | -1000 | 1000 |  | SrSO4 | 43.6 |
| Y *La* | LTAP | 30 |  | 600 | 1.1 | YAG | 584.8 |
| Nb *La* | LPET | 20 | -1565 | 1900 |  | Nb | 273.3 |
| Ba *La* | LPET | 10 |  | 500 | 1.1 | BaSO4 | 498.9 |
| Ce *La* | LPET | 20 |  | 500 | 1.1 | Ce Glass | 74.9 |
| Pb Ma | LPET | 20 | -1000 | 1000 |  | Crocoite | 104.1 |
| Ta *La* | LLIF | 20 |  | 900 | 1.1 | Ta | 210.1 |
| Pr *Lb* | LLIF | 20 |  | 6230 | 1.1 | REE | 3.8 |
| U *Mb* | LPET | 20 | -996 | 774 |  | U | 305.2 |

1. Calibration setting for carbonates. Acceleration voltage 15 KV; beam current 20 nA

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Element and line** | **Crystal** | **Peak Time** | **Background (–ve)** | **Background (+ve)** | **Slope** | **Standard** | **Standard intensity (cps/nA)** |
| Mg *Ka* | LTAP | 10 |  | 1200 | 1.16 | Diopside | 285.1 |
| Ca *Ka* | PET | 10 |  | 500 | 1.1 | Diopside | 114.3 |
| Mn *Ka* | LLIF | 10 |  | 500 | 1.1 | Rhodonite | 158.8 |
| Fe *Ka* | LLIF | 10 |  | 500 | 1.1 | Fe2O3 | 388.8 |
| Sr *La* | PET | 30 | -1000 | 1000 |  | SrSO4 | 43.6 |