**Appendix C.1 – Metadata of LA-ICP-MS analysis of biotite, muscovite, chlorite, feldspars, garnet, cordierite and pinite at the Open University.**

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| **Laboratory & Sample Preparation** |  |
| Laboratory name | School of Environment, Earth and Ecosystem Sciences, Open University, UK |
| Sample type/mineral | Pelitic migmatites/biotite, muscovite, feldspars, garnet, cordierite, pinite and chlorite |
| Sample preparation | 40 µm polished thin section |
| **Laser ablation system** |  |
| Make, Model & type | Photon Machines Analyte G2 193 nm excimer laser |
| Ablation cell & volume | HelEx II 2-volume cell |
| Laser wavelength (nm) | 193 nm |
| Pulse width (ns) | 4 ns |
| Fluence (J/cm2) | 3.63 J/cm2 |
| Repetition rate (Hz) | 10 Hz |
| Ablation duration (s) | 30 s |
| Spot diameter (m) | 50 µm |
| Sampling mode / pattern | static spots |
| Carrier gas | 100% He in the cell, Ar make-up gas combined in a mixing bulb down stream. |
| Cell carrier gas flow (l/min) | 0.9 l/min He |
| **ICP-MS Instrument** |  |
| Make, Model & type | Agilent 8800 ICP-QQQ-MS |
| Sample introduction | Ablation aerosol in He & Ar gas mix |
| RF power (W) | 1250 W |
| Ar carrier gas flow (l/min) | ~0.77 l/min |
| Detection system | Dual-mode discrete dynode electron multiplier |
| Masses measured; Integration time per peak/dwell times (ms) | 7Li 0.005; 9Be 0.005; 23Na 0.002; 24Mg 0.005; 27Al 0.002; 29Si 0.002; 31P 0.01; 39K 0.005; 43Ca 0.005; 45Sc 0.005; 49Ti 0.005; 51V 0.005; 53Cr 0.005; 55Mn 0.005; 56Fe 0.005; 59Co 0.005; 60Ni 0.005; 65Cu 0.005; 66Zn 0.005; 71Ga 0.005; 74Ge 0.005; 85Rb 0.005; 88Sr 0.005; 89Y 0.005; 90Zr 0.005; 93Nb 0.01; 95Mo 0.01; 111Cd 0.01; 115In 0.01; 118Sn 0.01; 121Sb 0.02; 133Cs 0.02; 137Ba 0.01; 139La 0.01; 140Ce 0.01; 141Pr 0.01; 146Nd 0.01; 147Sm 0.01; 153Eu 0.01; 157Gd 0.01; 159Tb 0.01; 163Dy 0.01; 165Ho 0.01; 166Er 0.01; 169Tm 0.01; 172Yb 0.01; 175Lu 0.01; 177Hf 0.01; 181Ta 0.01; 182W 0.02; 205Tl 0.02; 208Pb 0.02; 209Bi 0.02; 232Th 0.01; 238U 0.01 |
| Total integration time (s) | 0.6504 |
| Gas blank | 30 seconds |
| Washout | 40 seconds |
| **Data Processing** |  |
| Calibration strategy | SRM-NIST 612 (primary for trace elements), BCR-2G (secondary for traces, primary for majors) every ~20 analyses |
| Reference Material info | SRM-NIST 612 (Jenner and O’Neill, 2012)  BCR-2G (Jenner and O’Neill, 2012 & in house long-term averages) |
| Data processing package used | Iolite v3.71; DRS: X\_Trace\_Elements\_IS; internal standard 29Si |
| Uncertainty level & Quality control / Validation | BCR-2G within 3-10% of the preferred value depending on element concentration and homogeneity of secondary standard.  Major element concentrations obtained by LA-ICP-MS were compared to those measured by EMPA for consistency checks and data defines on a 1:1 line |

**Appendix C.2 – Metadata of LA-ICP-MS analysis of ilmenite and rutile at the Open University.**

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| **Laboratory & Sample Preparation** |  |
| Laboratory name | School of Environment, Earth and Ecosystem Sciences, Open University, UK |
| Sample type/mineral | Pelitic migmatites/Ilmenite and Rutile |
| Sample preparation | 40 µm polished thin section |
| **Laser ablation system** |  |
| Make, Model & type | Photon Machines Analyte G2 193 nm excimer laser |
| Ablation cell & volume | HelEx II 2-volume cell |
| Laser wavelength (nm) | 193 nm |
| Pulse width (ns) | 4 ns |
| Fluence (J/cm2) | 3.63 J/cm2 |
| Repetition rate (Hz) | 5 Hz |
| Ablation duration (s) | 30 s |
| Spot diameter (m) | 20 µm |
| Sampling mode / pattern | Static spot |
| Carrier gas | 100% He in the cell, using a signal smoothing devices before the Ar make-up gas is combined in a mixing bulb down stream. |
| Cell carrier gas flow (l/min) | 0.9 l/min He |
| **ICP-MS Instrument** |  |
| Make, Model & type | Agilent 8800 ICP-QQQ-MS |
| Sample introduction | Ablation aerosol in He & Ar gas mix |
| RF power (W) | 1250 W |
| Ar carrier gas flow (l/min) | ~0.79 l/min |
| Detection system | Dual-mode discrete dynode electron multiplier |
| Masses measured; Integration time per peak/dwell times (ms) | 7Li 0.005; 27Al 0.01; 45Sc 0.005; 49Ti 0.002; 51V 0.005; 53Cr 0.005; 55Mn 0.002; 56Fe 0.002; 59Co 0.005; 65Cu 0.005; 66Zn 0.005; 88Sr 0.005; 89Y 0.005; 90Zr 0.005; 93Nb 0.01; 95Mo 0.01; 118Sn 0.01; 121Sb 0.02; 133Cs 0.02; 137Ba 0.01; 166Er 0.01; 169Tm 0.01; 172Yb 0.01; 175Lu 0.01; 177Hf 0.01; 181Ta 0.01; 182W 0.01; 208Pb 0.01; 232Th 0.01; 238U 0.01 |
| Total integration time (s) | 0.363 |
| Gas blank | 30 seconds |
| Washout | 50 seconds |
| **Data Processing** |  |
| Calibration strategy | SRM-NIST 610 (primary standard) & R10 (secondary standard) |
| Reference Material info | SRM-NIST 610 (Jochum et al., 2011)  R10 (Luvizotto & Zack, 2009) |
| Data processing package used | Iolite v3.71; DRS: X\_Trace\_Elements\_IS; internal standard 49Ti |
| Uncertainty level & Quality control / Validation | R10 within 2-10% of the preferred value, expect of V and Mo which were within 15% of preferred value from Luvizotto & Zack, 2009  Selected trace elements concentrations obtained by LA-ICP-MS were compared to those measured by EMPA for consistency checks. |