

## **Description of Additional Supplementary Files:**

**Supplementary Data 1:** Partition Coefficients experimentally derived for this study and those previously published.

**Supplementary Data 2:** LA-ICP-MS measurements of Jack Hills Zircons and Kuehl Lake standard.

**Supplementary Data 3:** SIMS measurements of Jack Hills Zircons and derived delta values

**Supplementary Data 4:** Derived delta values of Jack Hills model parent melts and ODP serpentinites

**Supplementary Data 5:** Experimental details and LA-ICPMS measurements of experimental glass and zircons

**Supplementary Data 6:** Raw geochronology data of zircons measured before Si+O isotopic measurements

**Supplementary Data 7:** Raw geochronology data of zircons measured after Si+O isotopic measurements and reported in this study