**Supplementary Table S6.** Thermo-mechanical properties of the rock phase. (1) The pre-exponential factor of the diffusion creep (Pa-1·s-1) has a different unit of measure of the dislocation one (Pa-n·s-1) (2) The activation volume of the lithosphere has been fairly increased to simulate a dehydration (10·10-6) (3) These two phases are only for visualization, so they have the same properties of upper/lower mantle and plume (as a function of their depth). a) From82 b) From83.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Phase** | **ρ**  *kg/m3* | **Viscosity Creep law** | **B(1)**  *(Pa·s)-1/(Pan·s)-1* | **n** | **Ea**  *J/mol* | **Va**  *m3/mol* | **α**  *K-1* | **k**  *W/m/K* | **Cp**  *J/kg/K* |
| **Lithosphere(2)** | 3300 |  |  |  |  |  |  |  |  |
| **Upper mantle** | 3300 | **Diffusion Creep :** *Dry Diffusion Olivine(a)*  **Dislocation Creep :** *Dry Dislocation Olivine(a)* | 1.5·10-9  6.22·10-16 | -  3.5 | 375·103  530·103 | 8·10-6  15·10-6 | 3·10-5 | 3 | 1050 |
| **Lower mantle** | 3600 |
| **Upper M. Plume** | 3300 |
| **Lower M. Plume** | 3600 |
| **Mantle Zircon(3)** | - |
| **Plume Zircon(3)** | - |
| **Oceanic Crust** | 3000 | **Diffusion Creep :** *Wet Plagioclase (b)*  **Dislocation Creep:** *Wet Plagioclase (b)* | 4.74·10-11  1.13·10-15 | -  3.0 | 159·103  345·103 | 38·10-6  38·10-6 |

**Supplementary Table S7.** List of the numerical experiments. (1) Each timestep we collect all the eruption events, however not all the mantle involved into this eruption events retains the geochronological information. Therefore, to produce the histograms showed in Fig.3, Fig.S5, Fig. S6, we choose the eruption events that are representative of a mantle that has never cross the Reidite-Zircon phase transition. Here we list the total number of eruption event and the total amount of eruption event (Total Eruption Event) that effectively preserve the geochronological information (Total Preserved Zircon). (2) These experiments have been run for a considerable long timescale (i.e. 400 Myrs) to reach the state-state condition. The initial plume has not been prescribed and the plume spontaneously emerges due to the thermal boundary condition.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test Name** | **T Mantle**  **°C** | **T Plume**  **°C** | **Thermal Age**  **Myrs** | **Plate Velocity**  **cm/yrs** | **Total Eruption Event(1)** | **Total Preserved Zircon Erupted(1)** |
| **Reference** | **1350** | **1650** | **30** | **5** | **2896** | **2614** |
| **Test\_15M** | **15** | **5** | **4584** | **4251** |
| **Test\_40M** | **40** | **5** | **1126** | **1110** |
| **Test\_1\_15M** | **15** | **1** | **5030** | **4944** |
| **Reference\_1** | **30** | **1** | **2689** | **2514** |
| **Test\_1\_40M** | **40** | **1** | **2167** | **1544** |
| **Test\_10\_15M** | **15** | **10** | **4949** | **4949** |
| **Reference\_10** | **30** | **10** | **1647** | **1647** |
| **Test\_10\_40M** | **40** | **10** | **1045** | **1045** |
| **Reference\_0d** | **30** | **5** | **2228** | **2206** |
| **Reference\_150d** | **30** | **5** | **2150** | **1963** |
| **Ref\_no\_Pl(2)** | **30** | **5** | **454** | **454** |
| **Test\_15M\_noPl(2)** | **15** | **5** | **1818** | **1818** |
| **Test\_40M\_noPl(2)** | **40** | **5** | **444** | **444** |