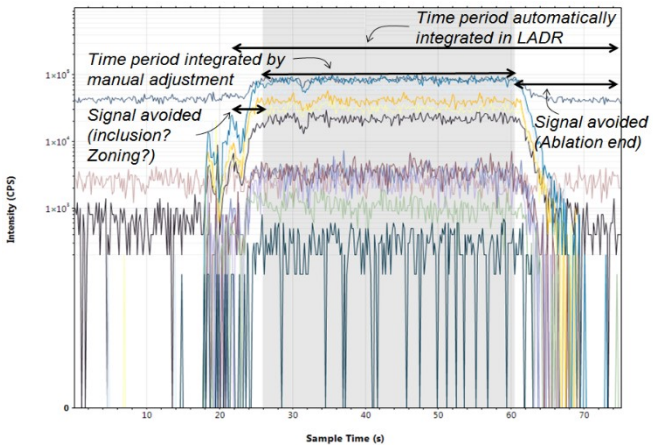
1 Supplementary information

2 Time period adjustment

3 The time periods can be adjusted or fragmented in order to avoid undesired zones like the apparent signal of ablated epoxy resin, grain defects (inclusions, zoning, etc.) and/or the remnant signal acquired by MassHunter when the ablation time was shorter than the acquisition time, as it is illustrated in Figure S. Note that the acquisition time has to be the same for each ICP-MS acquisition.



4

5 Figure S: Time period automatically integrated in LADR and its *manual adjusting.*

6 Calculation of Uranium Concentration

7 By EDM

8 Calculation of the uranium concentration for individual mineral grains is accomplished through reference to a dosimeter glass of known uranium concentration. We used IRMM-540R reference material certified by the Institute for Reference Materials and Measurements of the European Commission. The uranium concentration of grains was calculated from Equation 1:

9
$$U_{unk} = \frac{\rho_i}{\rho_d} U_{std} \qquad (1)$$

10 where U_{unk} and U_{std} are the uranium concentration of unknown mineral grain and the IRMM-540R reference material, respectively, ρ_i and ρ_d are the induced track density over the grain and the induced track density of the external detector over the IRMM-540R reference material, respectively.

11 The uncertainties were estimated as the sum of the squares of the relative error of each contribution.

12 The uncertainties were estimated as the sum of the squares of the relative error of each contribution.

13

14 By LA-ICP-MS

15 Calculation of the uranium concentration for individual mineral grains is accomplished through reference to a reference material of known uranium concentration. We used NIST610 as primary reference material and NIST 612 as secondary reference material. The uranium concentration of grains was calculated using LADR Software from Equation 2:

16

17
$$U_{unk} = IS_{unk} \times \frac{I_{U-unk}}{I_{IS-unk}} \times \frac{I_{IS-CAL}}{I_{U-CAL}} \times \frac{U_{CAL}}{IS_{CAL}} \qquad (2)$$

18 where U_{unk} and U_{CAL} are the uranium concentration of unknown mineral grain and the calibration material reference, respectively; $I_{U\text{-}unk}$ and $I_{U\text{-}CAL}$ are the uranium signal intensity of unknown mineral grain and the calibration material reference, respectively; $I_{IS\text{-}unk}$ and $I_{IS\text{-}CAL}$ are the internal standard signal intensity of unknown mineral grain and the calibration material reference, respectively; and IS_{CAL} is the internal standard concentration in the calibration material reference.

19 The uncertainties were estimated as the sum of the squares of the relative error of each contribution.

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