Supporting Information

Detailed descriptions for the depth profiling analysis of the laser pit

The laser pit parameters of three minerals samples, such as diameter and depth, were investigated using a white light interferometric microscope (NewView, Zygo Corporation) at Tsinghua University in Beijing. Figure 1s a-c illustrate the craters formed on 10AFK-2 perovskite during a laser ablation of 43 seconds at a spot size of 60 \( \mu m \), a repetition rate of 6 Hz and a fluence of 5 J/cm\(^2\). The depth of acquired laser pit was 27.540 \( \mu m \), which is smaller than the crater diameter of 61.869 \( \mu m \). In the analysis process of OLT-1 titanite, with the purpose of improving the sensitive for the lower U, Pb and Nd content, a laser ablation procedure involved a spot size of 90 \( \mu m \), a repetition rate of 10 Hz and a fluence of 9 J/cm\(^2\). The depth of the crater after 43 seconds of laser ablation was 57.848 \( \mu m \), which smaller than the crater diameter of 96.794 \( \mu m \) (Figure 1s d-f). Considering a higher U, Pb and Nd content of the Namaqualand monazite, the laser ablation system was operated at a smaller spot size of 24 \( \mu m \), a repetition rate of 6 Hz and a fluence of 5 J/cm\(^2\). However, a laser ablation of 43 seconds produced a depth of 32.830 \( \mu m \), which is slightly larger than the crater diameter of 28.021 \( \mu m \) (Figure 1s g-i). Therefore, a further experiment was conducted using a larger spot size of 90 \( \mu m \). The result was represented by Figure 1s j-l with the depth of 30.406 \( \mu m \) comparable to the depth of 24 \( \mu m \) spot size. In view of this, a spot size larger than 33 \( \mu m \), such as 44 \( \mu m \), should be utilized for the measurement of monazite samples to ensure that the spatial resolution is determined by the laser spot size.
Figure 1s. 2D photomicrographs, 3D images and cross-sectional profile of the laser pit characterized by a white light interferometric microscope for (a-c) 10AFK-2 perovskite; (d-f) OLT-1 titanite; (g-i) Namaqualand monazite with spot size of 24μm; (j-l) Namaqualand monazite with spot size of 90μm.