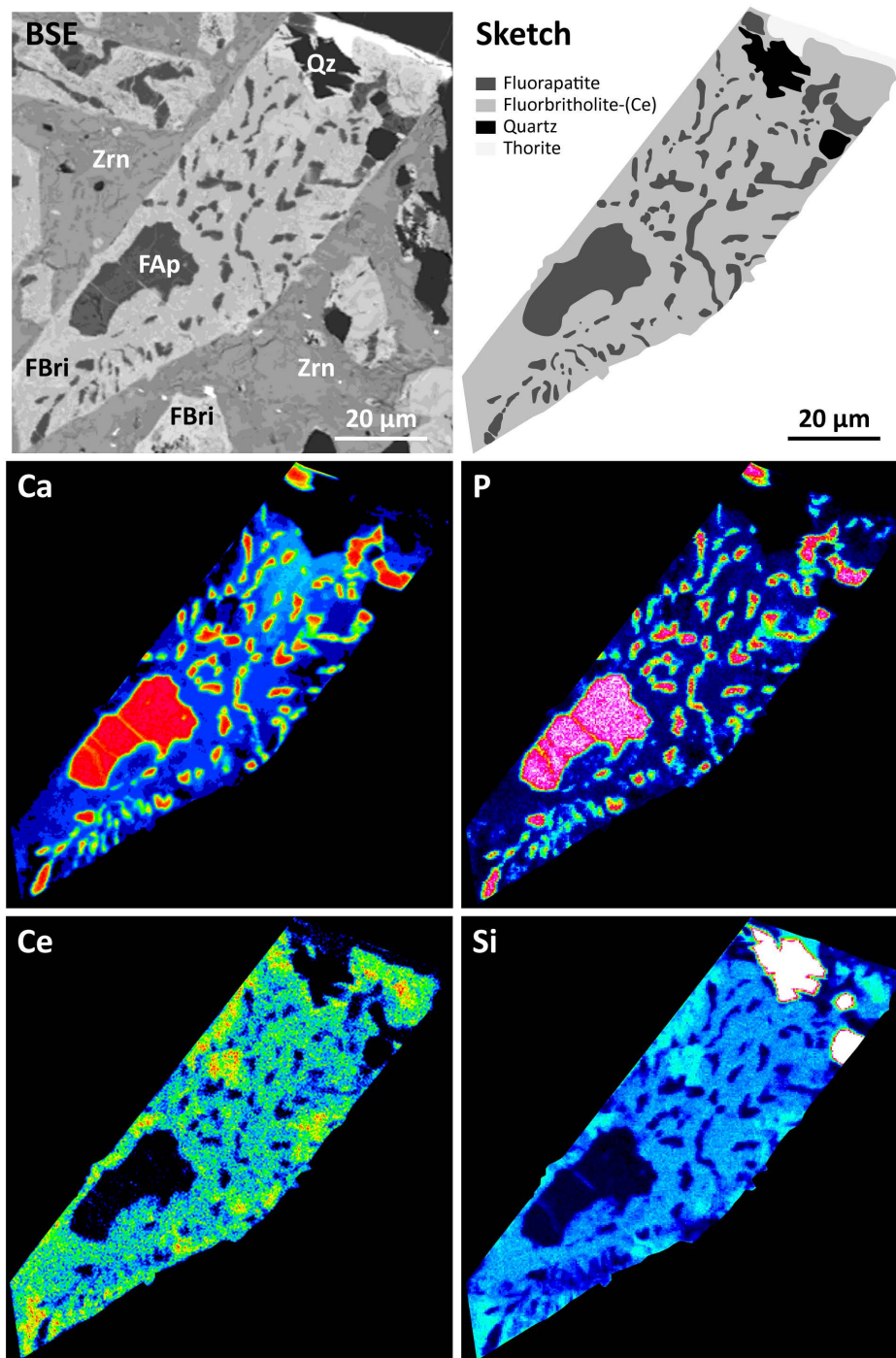


**SUPPLEMENTAL FIGURE S1.** Simplified sketches of intergrowth types 1 and 2, extracted from backscattered electron images of Figure 3. **(A)** Type 1: a euhedral fluorbritholite-(Ce) grain enclosed by titanite (Fig. 3B) and containing variably-oriented vermicular fluorapatite, locally in a parallel arrangement. **(B)** Type 1: a large fluorbritholite-(Ce) aggregate containing vermicular inclusions of fluorapatite in the central part and very small, parallel-oriented blebs of fluorapatite along grain boundaries (upper and left side of the image) within another fluorbritholite-(Ce) grain (see Fig. 3D). Note two orientations of fluorapatite inclusions in the central part, one parallel to the c-axis, the other at a high angle to it. **(C)** Type 2: a fluorapatite host with parallel oriented vermicular inclusions of fluorbritholite-(Ce). **(D)** Type 2: a large fluorapatite grain with variable sizes and arrangements of fluorbritholite-(Ce) inclusions (see Fig. 3C), which are locally parallel oriented (left side of image). Note the very fine-grained cross-cutting fractures that are filled with REE-rich phases.



**SUPPLEMENTAL FIGURE S2.** Backscattered electron image, simplified sketch and microprobe X-ray element maps of a single fluorbritholite-(Ce) grain included in hydrothermal zircon (Type 1 intergrowth, see Fig. 3A). The sketch emphasizes the arrangement and shapes of fluorapatite inclusions. The four lower images show element maps of Ca, P, Ce and Si in the fluorbritholite-(Ce) host and fluorapatite inclusions. Note the positive correlation between Ce + Si and Ca + P within both mineral phases, which supports the interpretation that these are exsolution textures (Fig. 7).