

Figure B1. Scatterplot matrix of magmatic titanite compositions from the three localities. The ovals represent a 90% probability contour of primary titanite data. The Little Cottonwood stock and its enclaves are relatively similar, but the spread is smaller for the enclaves. Titanite in the more evolved Notch Peak granite has higher Nb, Mn, Fe and less Ti.

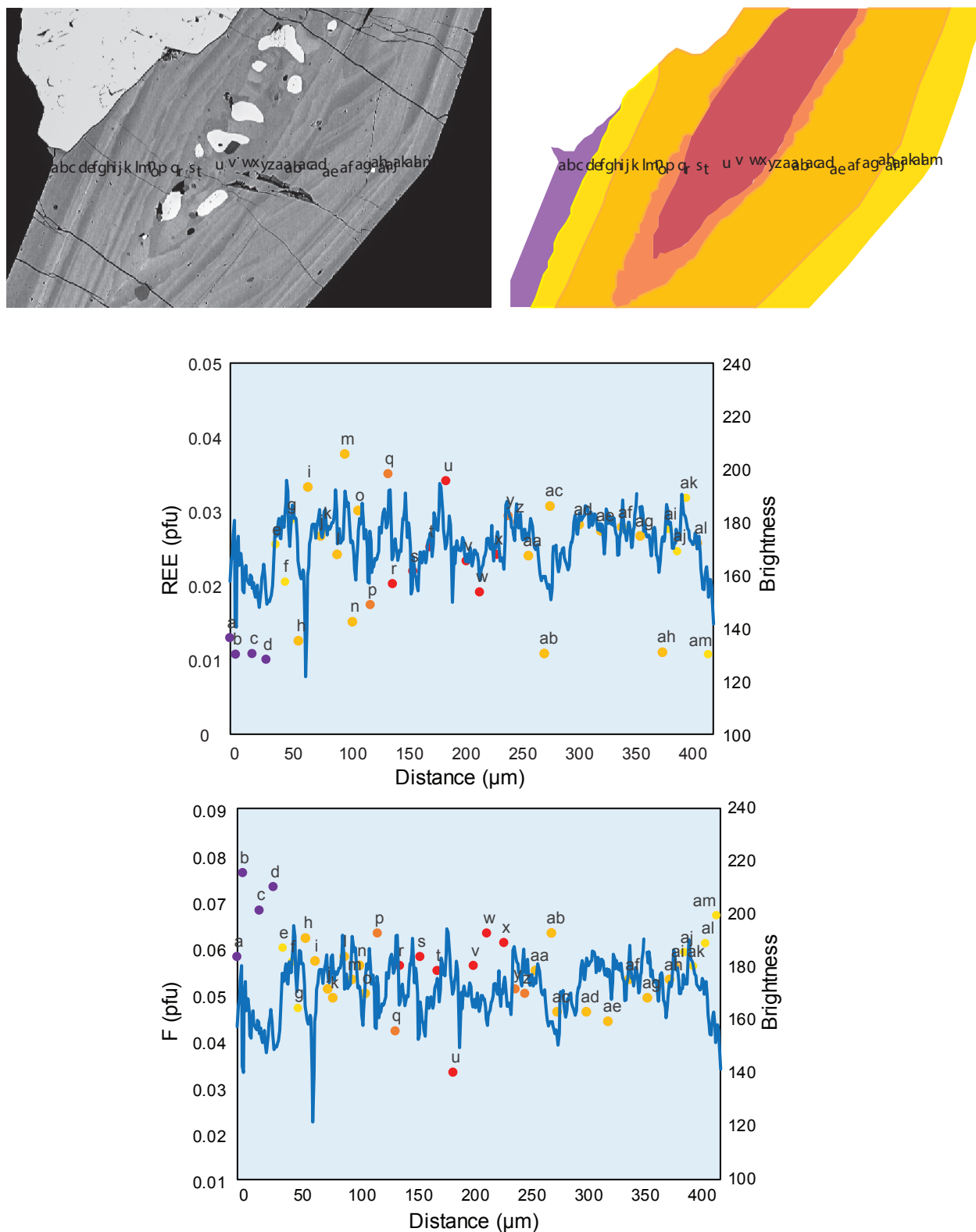


Figure B2. Diagrams for brightness-REE-distance of LC-HFT-1-3. A line of microprobe points was divided into growth zones and plotted against brightness. REE correlate positively with brightness and F correlates negatively. Compositions are shown in figure B3.

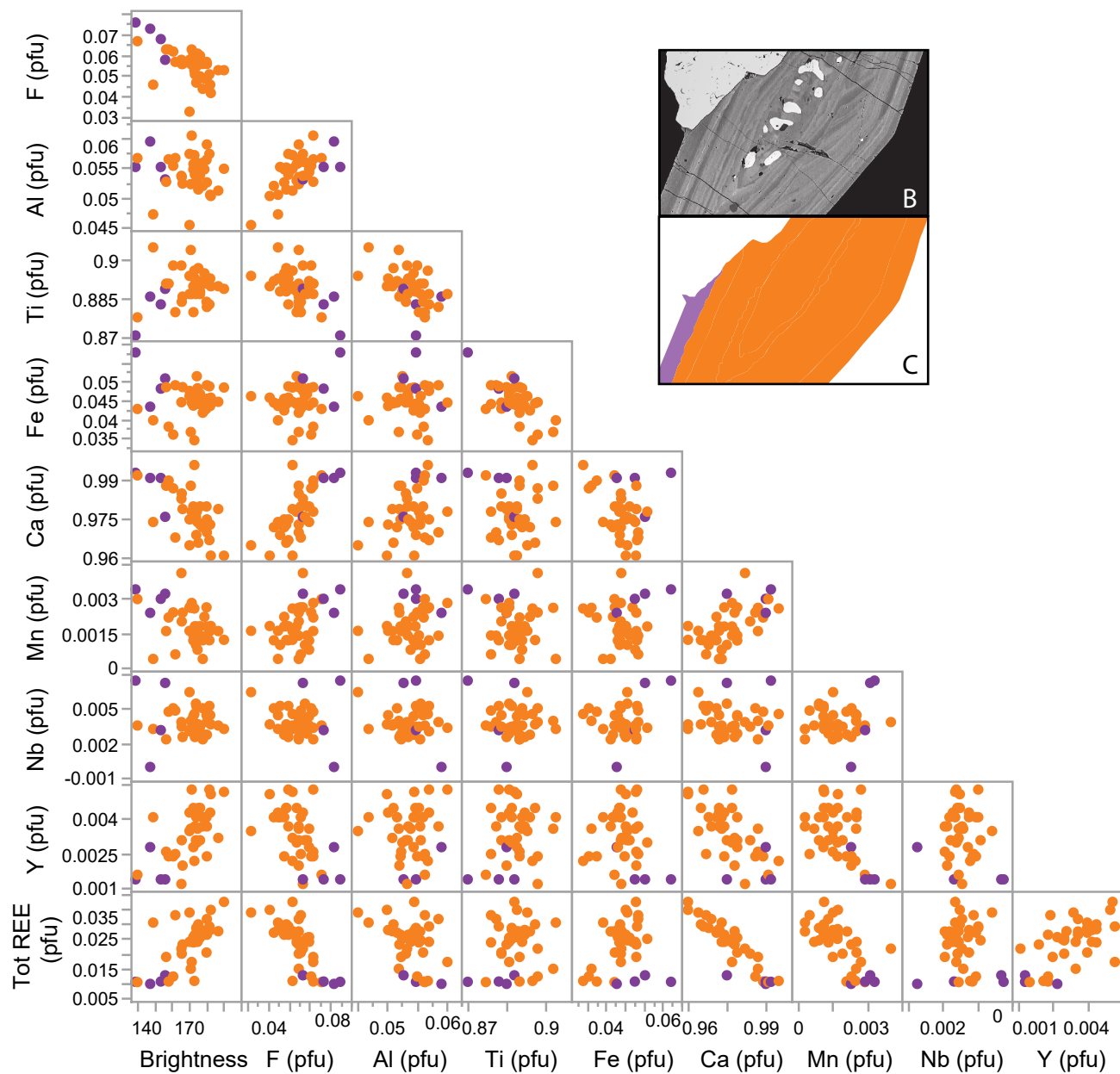


Figure B3. A scatter plot matrix of a line of microprobe points from LC-HFT-1-3 and classified in figure 20. Tot REE and Y have a positive correlation with Brightness. F, Al, Ca have a negative correlation. A reference BSE (B) and growth zone (B) map has been provided.

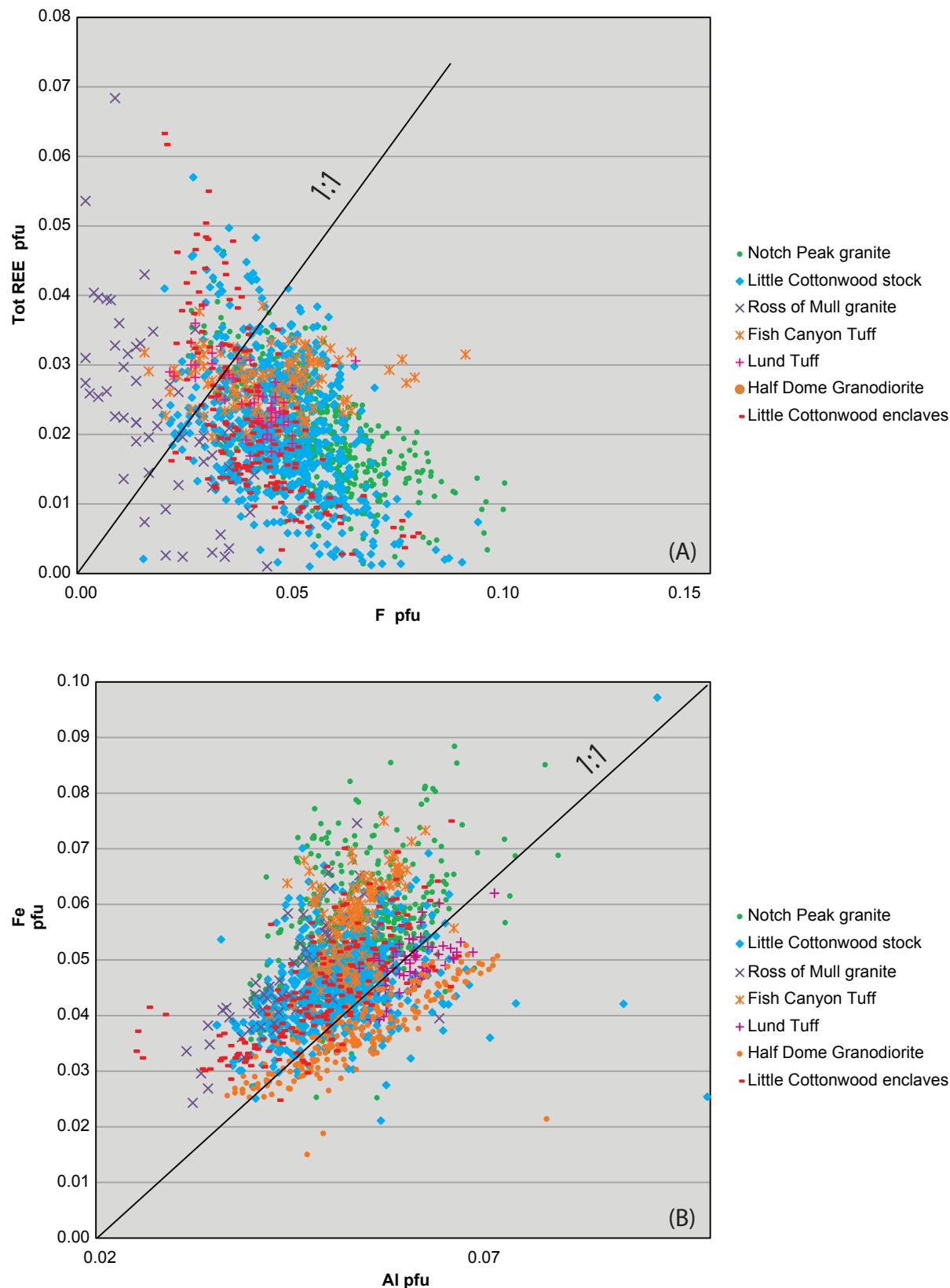


Figure B4. Compositions of titanite are compared in this plot of total REE vs F and Fe vs Al concentration. Data for the Ross of Mull granite are from McLeod et al. (2011) and for the Half Dome Granodiorite from Bauer (2011). The rest of the data are from our own research.

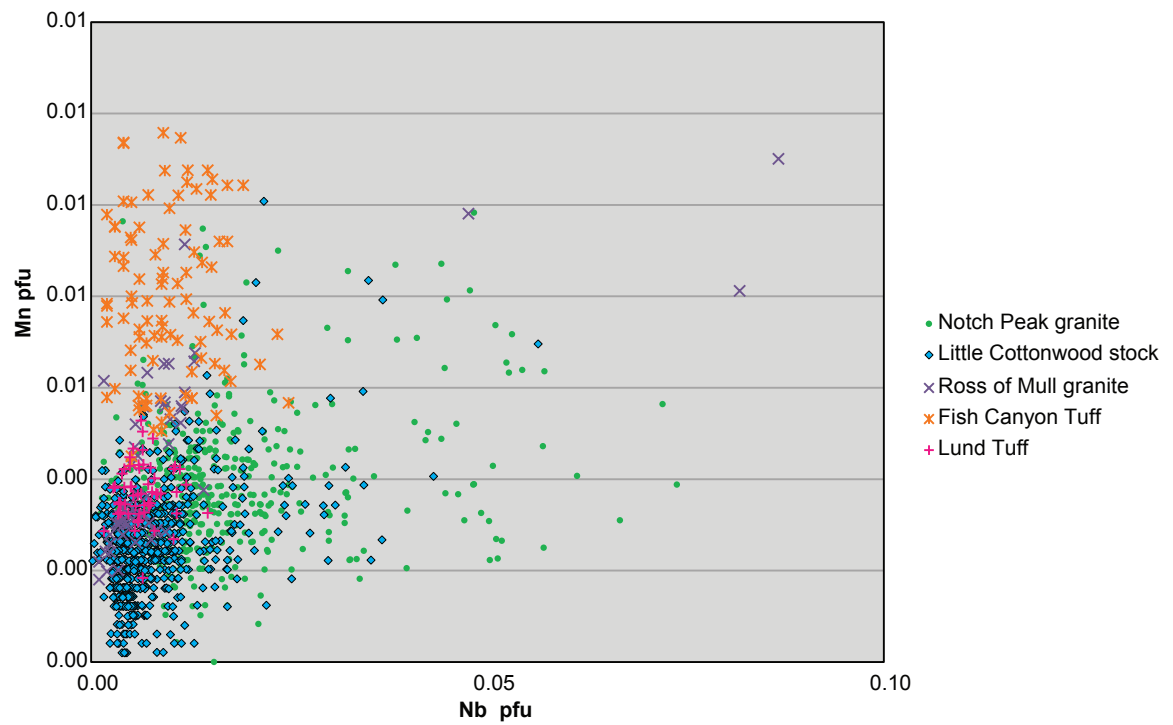


Figure B5. Nb vs Mn concentrations in titanite compared. Data for the Ross of Mull granite are from McLeod et al. (2011) and for the Half Dome Granodiorite from Bauer (2011). The rest of the data are from our own research.

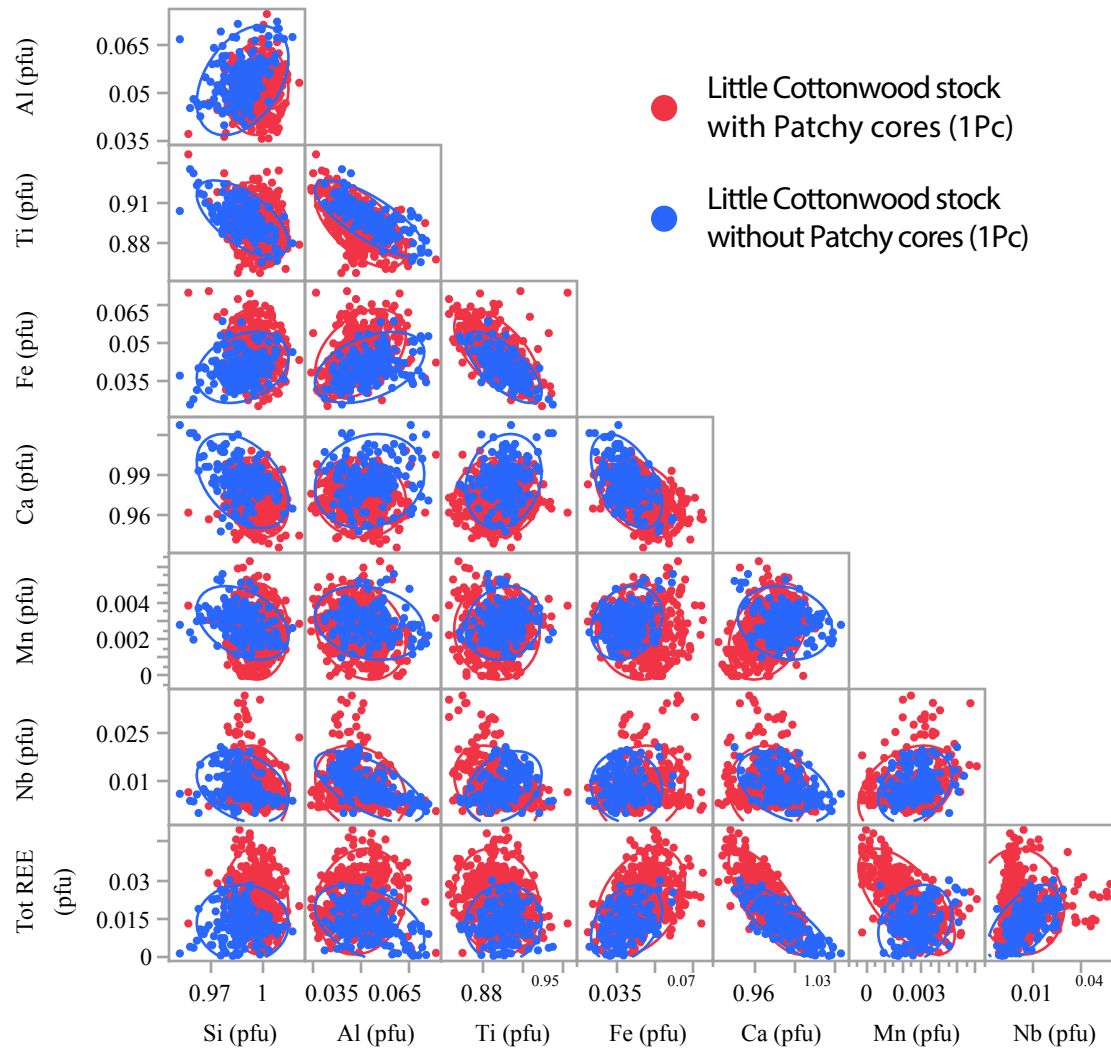


Figure B6. Scatterplot matrix of EMP data for patchy cores (1pc) in titanite vs other types of titanite in the Little Cottonwood stock. Patchy cores (1Pc) tend to have lower Total REE and Si, but higher Ca. The ovals are 90% confidence intervals.

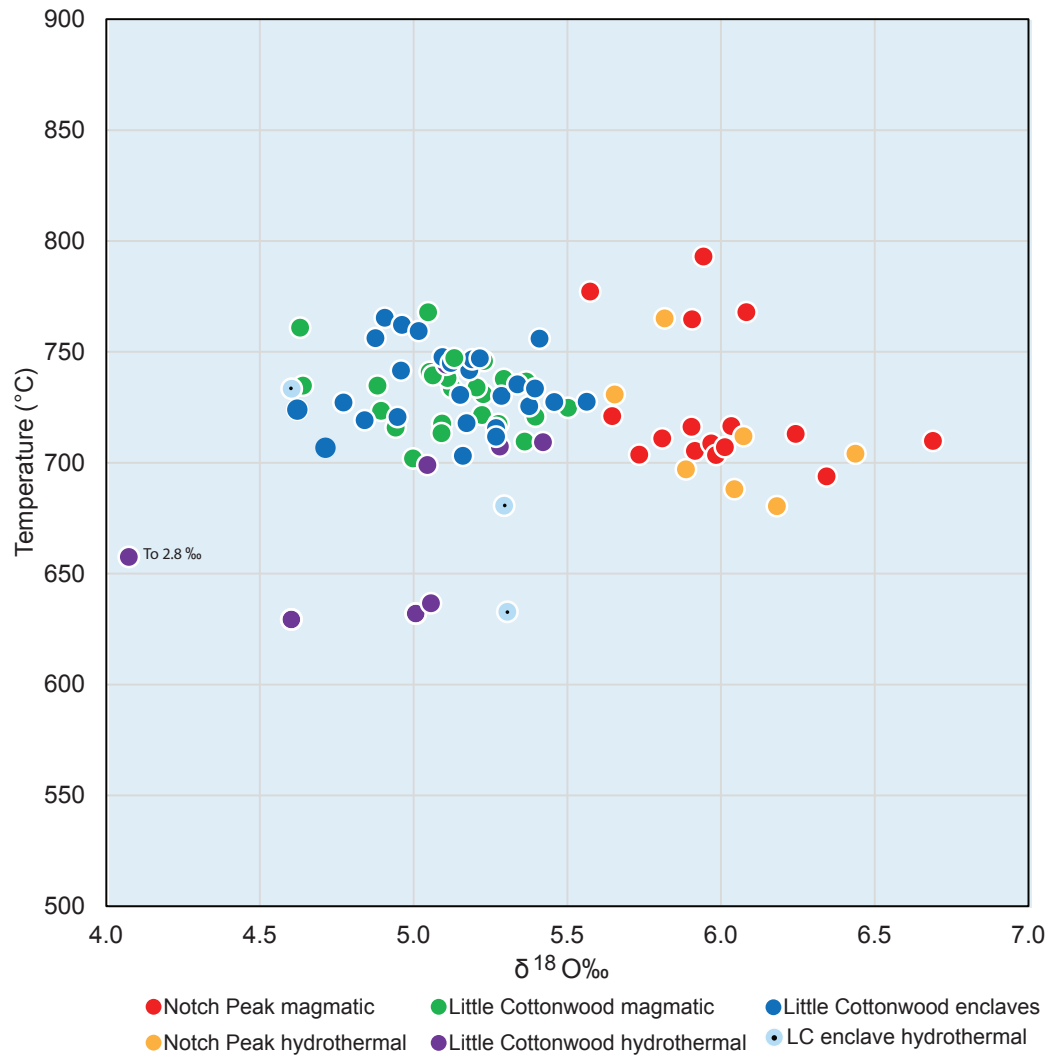


Figure B7. Zr-in-titanite temperatures vs $\delta^{18}\text{O}$ for titanite in this study. In most cases, $\delta^{18}\text{O}$ values in secondary hydrothermal titanite is lower than that of magmatic titanite.

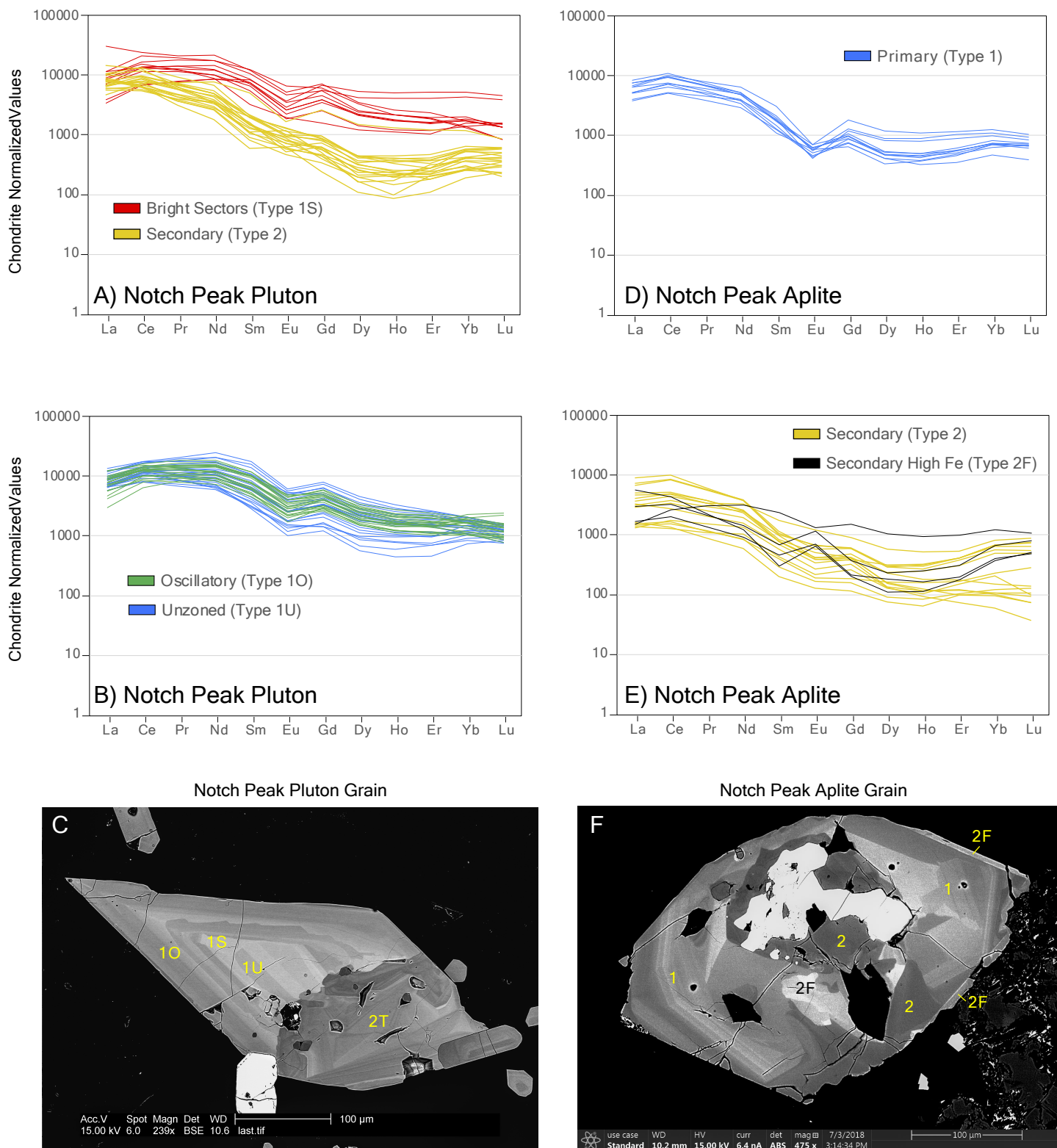


Figure B8. Titanite from the Notch Peak pluton. (A & B) Chondrite-normalized REE patterns for different textural types of titanite in the granite. (C) BSE image of titanite grain in sample NP-6. (D & E) REE patterns from titanite in the aplite. (F) BSE image of titanite from aplite sample NP-18-2a. Note the secondary overgrowth of high-Fe titanite (type 2F) on the aplite grain and a patch of the same in the interior that is probably an artifact of the cut through the grain. Other types shown are: unzoned (1U), oscillatory (1O), bright sectors (1S), and replacement (2T).

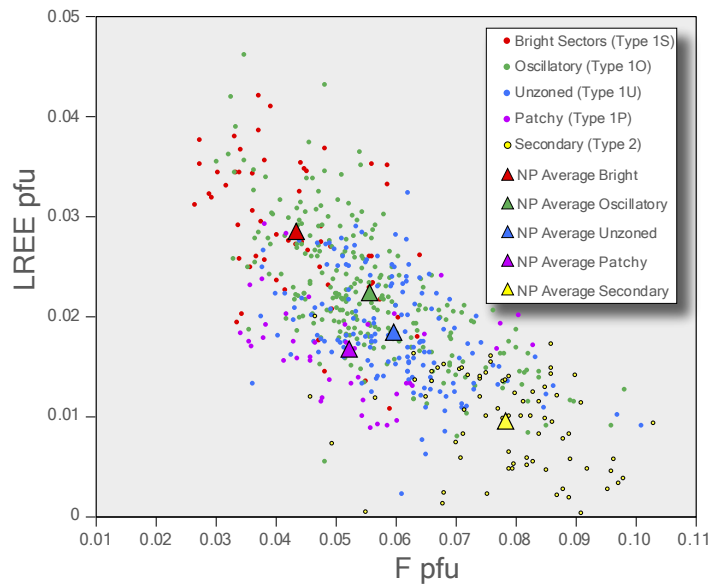


Figure B9. F vs LREE (La+Ce+Sm+Nd), both from EMPA, from titanite in the Notch Peak granite. Dots are individual analyses and larger triangles are averages for each textural type.

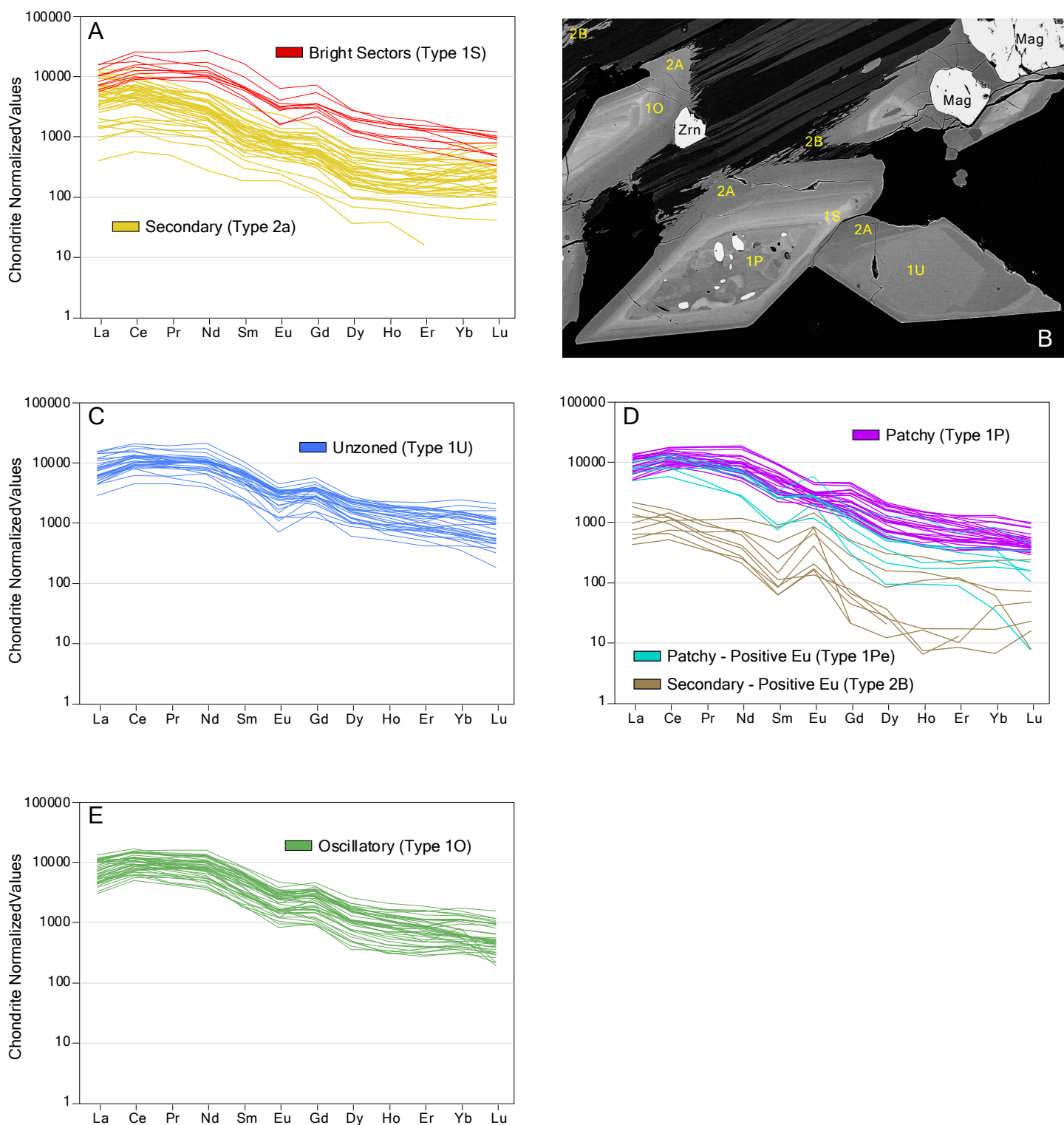


Figure B10. Titanite from the Little Cottonwood stock. (A, C, D, E) Chondrite-normalized REE plots for different types of titanite in Little Cottonwood stock. Bright sectors (1S), unzoned (1U), oscillatory (1O), and patchy core (1Pc) types have similar REE patterns, although the patchy cores tend to have smaller Eu anomalies. Secondary titanite grains have lower REE contents and lack Eu anomalies, except for type 2B which has strong positive Eu anomalies. Several analyses in patchy zones also have strong positive Eu anomalies (1Pe) and may be evidence of for a secondary origin. (B) BSE image of a cluster of titanite grains with different types labeled as well as magnetite (Mag) and zircon (Zrn) grains. Photo is about 400 μ wide.

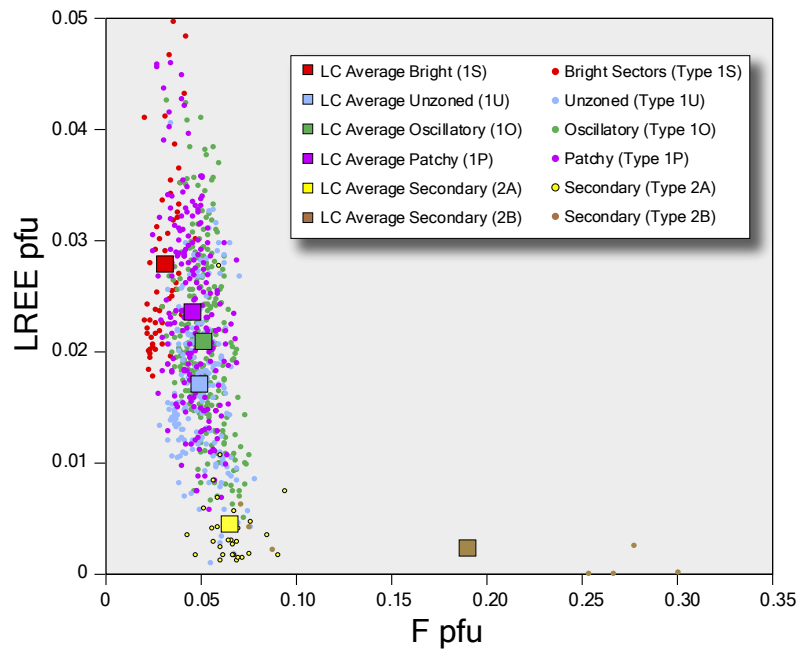


Figure B11. F vs LREE (electron microprobe data) from titanite in the Little Cottonwood stock. Both types of secondary titanite (2T and 2B) are LREE-poor, but type 2B is very F-rich.

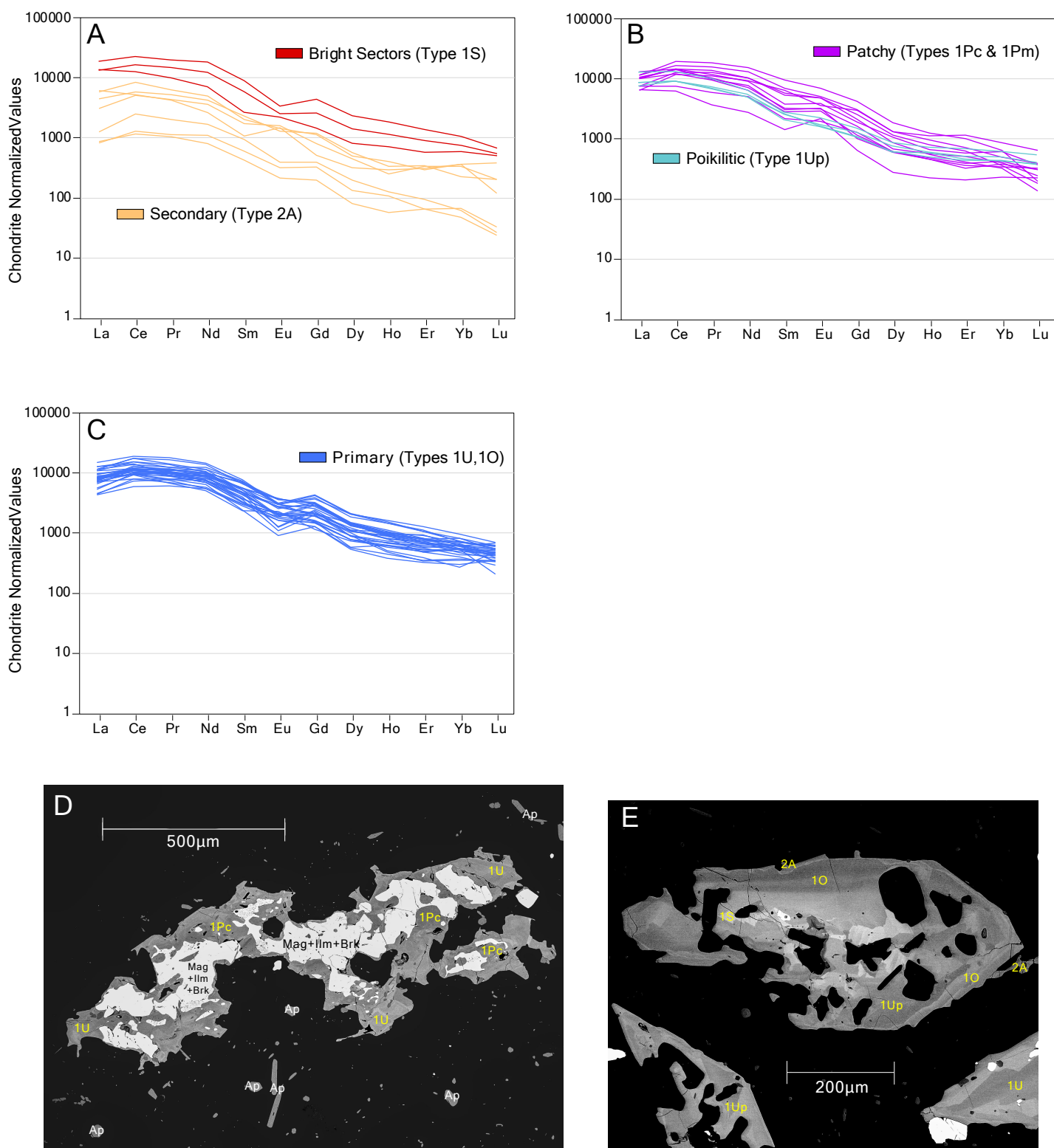


Figure B12. Titanite in mafic enclaves from the Little Cottonwood stock. (A-C) Chondrite-normalized REE diagrams for the different types of titanite. (D) Large irregular mass of patchy titanite (LC-SB-18-5-1) rimming grains of magnetite and resorbed ilmenite showing the poikilitic nature of some of the titanite in the enclaves, perhaps representing an early stage of resorption of ilmenite and its replacement by titanite; (E) LC-HFT-18-6-3, a poikilitic group of grains with titanite surrounding earlier formed silicates.

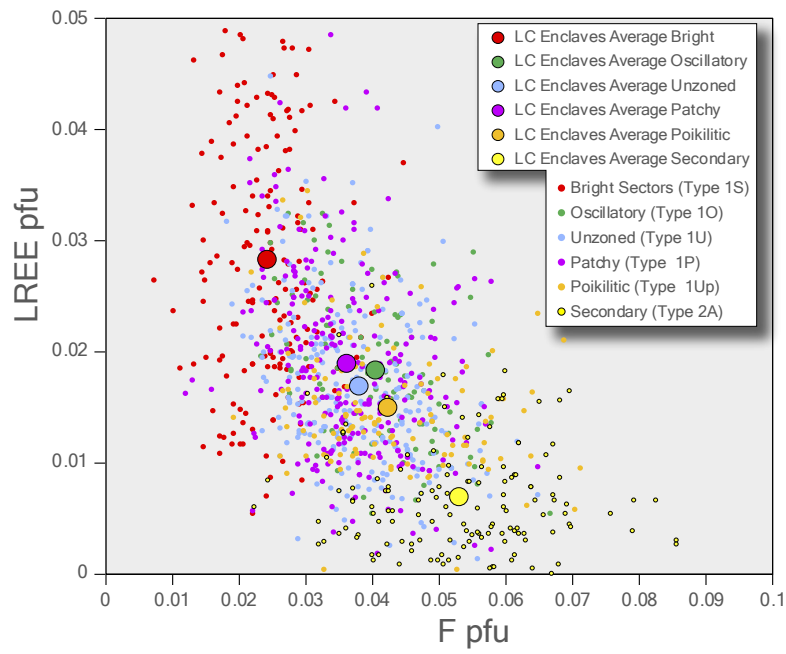


Figure B13. F vs. LREE for titanite in enclaves in the Little Cottonwood stock. Small circles are individual electron microprobe data points, and large circles are averages.

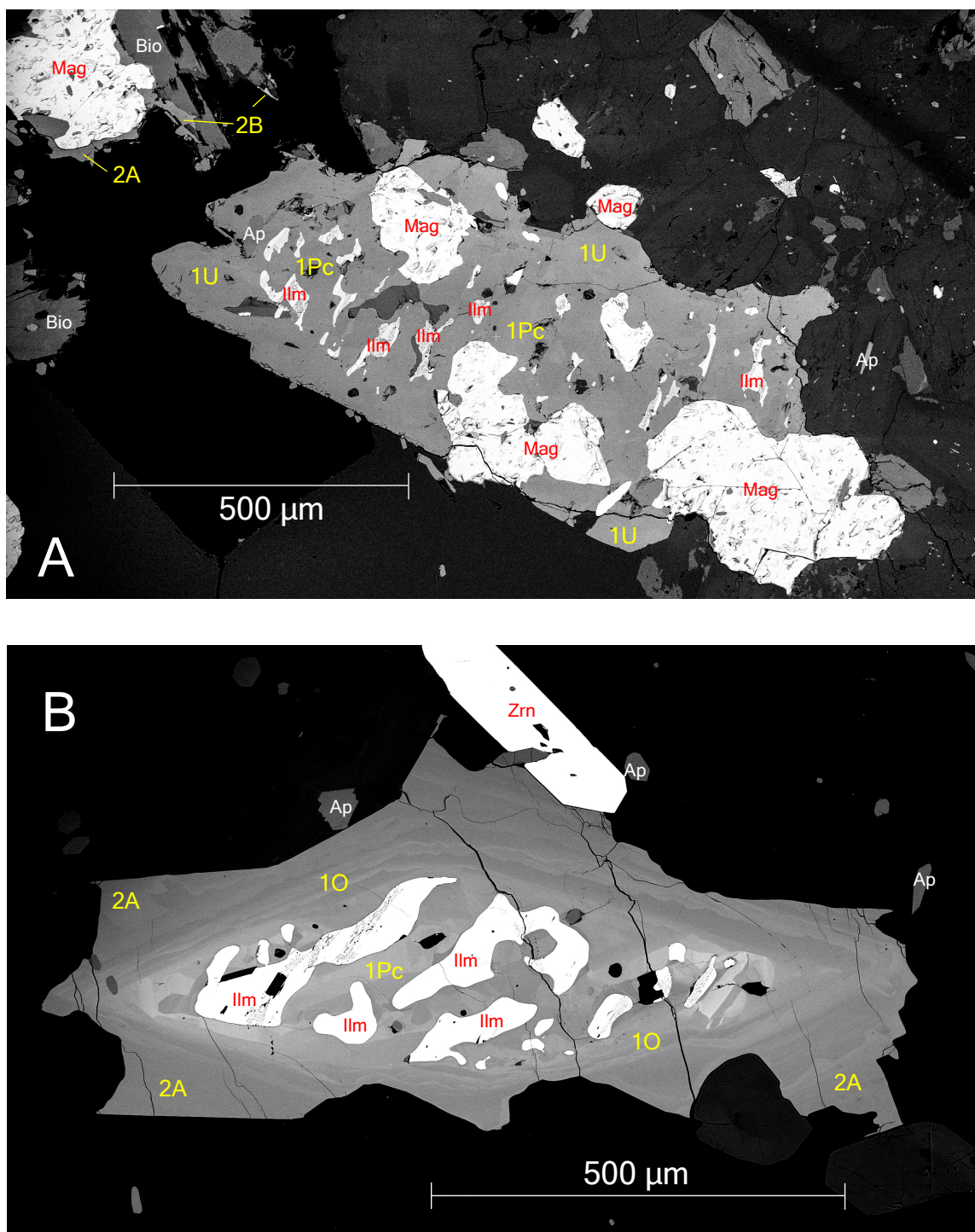
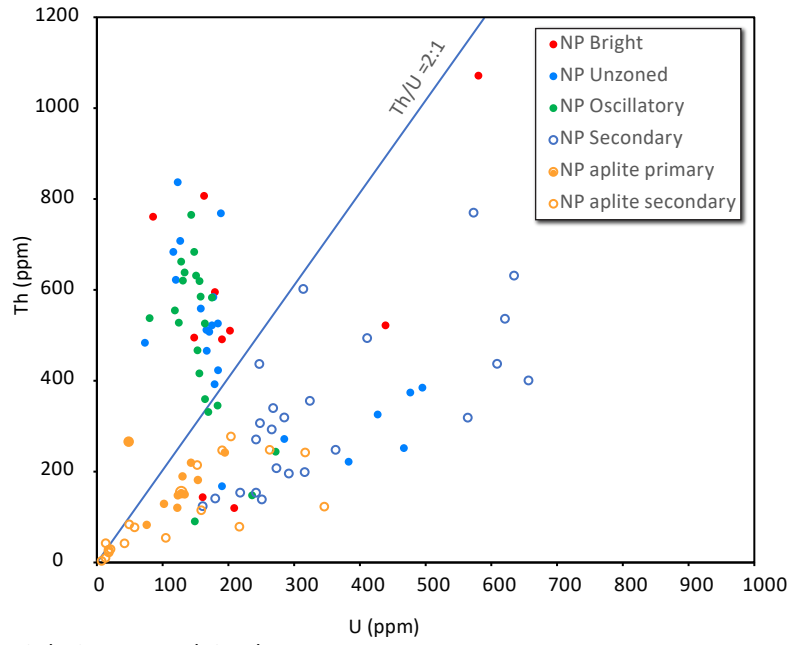


Figure B14. Common titanite textures from the Little Cottonwood stock enclaves in BSE images. (A) Large anhedral mass of titanite (SB-18-5-12) with a patchy core (1Pc) and large magnetite (Mag) grains on the margin. Secondary titanite (2A) formed on the magnetite grain to the left and in altered biotite (2B). (B) Large euhedral titanite grain (HTF-18-1-1) with a patchy core (1Pc) and oscillatory rim (1O) was overgrown by secondary titanite (2A). Resorbed ilmenites (Ilm) in both grains are now composed of intergrown ilmenite + magnetite + brookite.

A. Notch Peak Granite



B. Little Cottonwood Stock

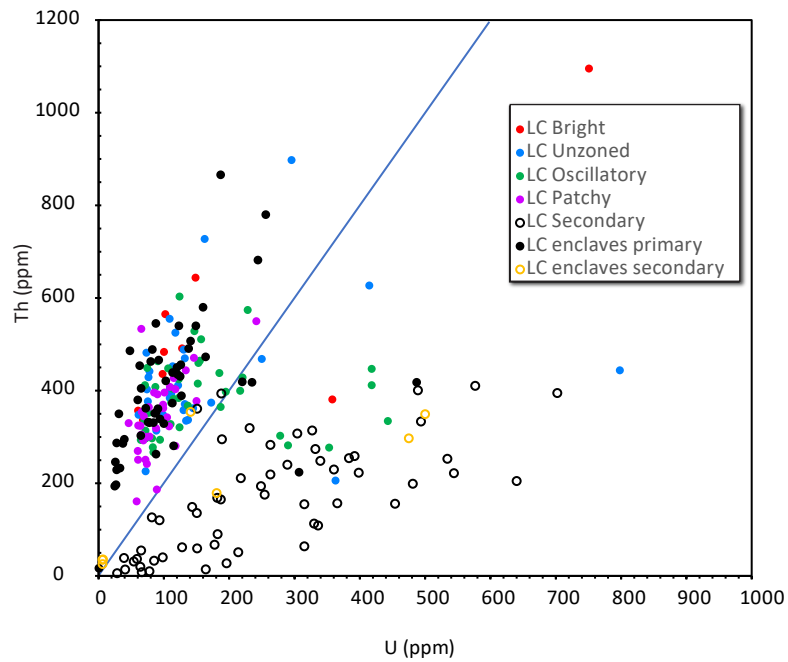


Figure B15. These U versus Th graphs show that nonmagmatic hydrothermal titanite is enriched in U and commonly depleted in Th compared to magmatic titanite in both (A) the Notch Peak granite and in (B) the Little Cottonwood granodiorite.