

Supplement to Methods section.

All monazite in a thin section was located using the Oxford Instruments INCA software package. We utilize the INCA routine known as Feature. A Feature run to locate monazite consists of setting up an automated whole-thin section scan consisting of an array of BSE images covering the entire thin section. As each image is acquired, the brightest contiguous pixels, greater than a minimum size, are identified as individual “features.” The brightness threshold is adjusted so that monazite, xenotime and zircon grains are the only features identified. Once the bright features are identified, a 2-second EDS spectrum is collected to determine whether the feature is a phosphate or zircon. Information concerning the shape, size, aspect ratio, orientation and location of each feature is stored in a database. Monazite for further electron microprobe analysis are selected based on textural criteria which provide the greatest constraint on the significance of the ages based on cross-cutting relationships. Such criteria include the occurrence of monazite grains as inclusions in porphyroblasts, within microlithons containing an older fabric, as fabric forming matrix grains, or as matrix grains which are wrapped by a foliation.