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Observation of alpha recoil tracks in zircon: An attempt

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The decay of heavy nuclrei leaves damage in crystal; fission tracks (FT) or alpha recoil tracks (ART). ART is smaller in size compare to FT, thus only applied to layered silicates. If ART can be ovserved in zircon, which in general has higher uranium concentration than layered silicate, we can date samples whose ages are in order of thousand years old or older.

When zircon with high track density (e.g., $>$30 tracks/10^{-6}cm^2) was observed, many small pits with the depth less than 20 nm were found together with fission tracks. Fission tracks show deeper depths of ˜50nm when the sample was readily etched and can be reasonably distinguished from other topographic lows. In the observation of young zircons collected from modern volcanic product, dynamic range of surface topography is less than 5 nm after the etching of 10 hrs. Many surface shallow etch pits with the depth of ˜20 nm found in old zircons do not exit. Occasionally a hole with the depth of ca. 10 nm was found on the smooth surface. Because these zircons are from modern volcano and existence of a fission track is less plausible, these countable holes may be alpha recoil tracks. The depth of these holes is concordant with the shallow pits found in old zircon. Therefore, these shallow pits may also be alpha recoil tracks.

To see the behavior of shallow pits in old zircon, zircon was annealed at 600 degrees C or 1000 degrees C and observed. The surface topography have not changed much and 10˜15nm pits were still preserved in the sample after 600 degrees C annealing. After 1000 degrees C annealing, the surface topography become a little flat, and as smooth as modern zircon.

Keywords: radiation damage, atomic force microscope, alpha recoil track, fission track, zircon