**Tectonic vs impact zircon deformation:**

From the Vredefort impact structure to Lunar tectonics: a possible key to distinguish geological processes

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Main problem: How to distinguish tectonic from impact-related pseudotachylites?

- **Pseudotachylites** are dark, cryptocrystalline, *in situ* veins that are found in both shock metamorphic and tectonic settings.
- There are no established criteria to distinguish between impact- and tectonic-related pseudotachylites.

**Scanning electron microscopy:** backscatter electron images

- All pseudotachylites found in the impactites of the Vredefort are considered to be impact-related.
- A sample of basement granite from the Vredefort are undeformed, irregularly-shaped, compositionally zoned, contains abundant clasts.
- Vein 1 is undeformed, folded, recrystallized, foliated and offset, bears only a few clasts.
- Vein 2 is deformed, planar deformation bands (PDBs) and chessboard patterns (Koval'eva et al. 2015).
- Vein 1 follows foliation and is cross-cut by Vein 2, suggesting an age relationship.
- Vein 1 is more coarse crystalline than Vein 2.
- The average grain size in Vein 1 is ~25 µm, biotite grains are oriented roughly parallel to the lineation.
- The average grain size of the groundmass in Vein 2 is ~5-10 µm. Microlites are not preferentially oriented.
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**References:**


**Conclusion:** Vein 1 is of seismic origin, Vein 2 is of impact origin

- Zircon deformation: a solution to the problem of origin! Electron backscatter diffraction

- Deformation patterns in zircon from Vein 1 (left) are similar to seismic deformation: planar deformation bands (PDBs) and chessboard patterns (Koval'eva et al. 2015).
- Deformation patterns in zircon from Vein 2 (below) are shock microtwins: robust evidence of impact-related deformation (Moser et al. 2011).
- EBSD map (Timms et al. 2012) shows that deformation pattern in “The Oldest” zircon is PDBs (left).
- PDBs are consistent with tectonic (seismic) deformation, which may have occurred as the Lunar magma ocean was crystallizing. There is no evidence of shock deformation.
- Younger domains, represented by red and yellow points (left), were interpreted as impact-related plastic deformation (Nemchin et al. 2009).
- “The Oldest” zircon from the Lunar breccia 72215 (Apollo 17) indicates the age of crystallization of the Lunar magma ocean at > 4.40 Ga (left).
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**Implications:** Can we apply this knowledge to zircon removed from its original context?