**Talk:** Using garnet and monazite compositions to constrain the P-T path and exhumation rate in a deep crustal shear zone

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**Abstract:**

Deep crustal, intracontinental shear zones commonly host granulite facies metamorphic rocks. Granulites are metamorphosed under high geothermal gradients, and because of equilibration at high temperatures, their prograde signatures are largely obliterated. As a result, valuable information about their early tectonic setting is lost. In this regard, stable accessory minerals such as monazite [(Ce,La,Nd)PO$_4$ with Y, Th and U substitutions] have the potential for accurate characterization of the pressure-temperature (P-T) conditions of the last and previous metamorphic events because the closure temperatures for intra-crystalline diffusion of trace elements such as U, Th, Pb and Y are high (>1000 °C) in these minerals and consequently, their compositions are not easily altered. Monazite incorporates U and Th, but not Pb during formation. Because all Pb is of radiogenic origin, monazite is commonly used as a geochronometer based on the U-Th-Pb chemical dating technique. The dual use of monazite as a chronometer and a thermobarometer can potentially yield a complete P-T-time path. Garnet compositional zoning patterns are traditionally used to determine the P-T path. This path can be more accurately constrained with monazite compositions through P-T pseudosection modeling in the MnO-CaO-Na$_2$O-K$_2$O-FeO-MgO-Al$_2$O$_3$-SiO$_2$-H$_2$O-P$_2$O$_5$-Y$_2$O$_3$-Ce$_2$O$_3$ (MnCNKFMSH-PYCe) system with major minerals as well as apatite and monazite.

The N-S trending Eastern Indian Tectonic Zone (EITZ) is a major Neoproterozoic intracontinental belt of tightly folded and sheared high-grade, anatectic metapelites along the eastern margins of several Archean/Proterozoic terranes with different fabric orientations. Garnet zoning and pseudosection modeling indicate isothermal burial to >11 kbar (perhaps up to 15 kbar) and exhumation to 7 kb within a narrow temperature interval of 750-800 °C. Furthermore, diffusion modeling of the compositional profiles in different zones of garnet indicate time intervals of ~35 million year for burial (0.05 mm/yr) and ~1.3 million year for exhumation (8.1 mm/yr) in the lower crust. The EITZ arguably passes through Elan Bank in the Kerguelen Plateau, where metapelitic clasts recording similar age and P-T conditions occur in conglomerate, and perhaps through the Rayner Complex of East Antarctica where rocks with similar age have been found. The P-T conditions and exhumation rate for the EITZ compare favorably with different parts of the well-studied Snowbird Tectonic Zone, a long intracontinental Paleoproterozoic belt in the Canadian Shield.