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Molybdenite tricks with titanite give history of the Central Indian Tectonic Zone

Holly J Stein (1,2), Judith L Hannah (1,2), Manoj K Pandit (3), Saradaprasad Mohanty (4), Fernando Corfu (5,2), and Aaron Zimmerman (1)

(1) AIRIE Program, Colorado State University, Fort Collins, CO 80523, USA (holly.stein@colostate.edu), (2) CEED, University of Oslo, 0316 Oslo, Norway, (3) Deparmtnet of Geology, University of Rajasthan, Jaipur, 302004, India, (4) Department of Applied Geology, Indian School of Mines, Dhanbad, 826004, India, (5) Department of Geology, University of Oslo, 0316 Oslo, Norway

The time that the cratonic blocks joined to form peninsular India creating the E-W-trending Central Indian Tectonic Zone (CITZ) is important for tectonic reconstructions and Paleoproterozoic glaciations, and fundamental to understanding how sutures behave through time. An abundance of recent literature highlights ∼1.0 Ga as the time of suturing. This late 1.0 Ga meeting of the two cratons, however, is increasingly difficult to reconcile.

One of the well-studied and well-mapped terranes in the southern part of the CITZ is the Sausar Belt [1]. The metasedimentary and metavolcanic rocks comprising the extensive Paleoproterozoic Sausar Group are multiply deformed. To examine the history of the Sausar Belt from a new vantage, we employed Re-Os dating of molybdenite, a sulfide that serves faithfully as a single-mineral radiometric clock in both magmatic and metamorphic environments [2]. Molybdenite is rare in the Sausar belt. Samples containing a 1-cm molybdenite patch and coarse-grained, euhedral, clear brown titanite were acquired from two different varieties of calc-silicate rocks near the village of Umri in central India. The molybdenite occurs in a calcite-quartz vein that clearly cross-cuts a strongly deformed calc-silicate host with quartz-biotite and quartz bands at the cm scale. This vein, metamorphic in character, is about 1-cm-wide and slightly deformed. The molybdenite was contained wholly within the vein. To check for possible Re-Os decoupling [2], we split the molybdenite patch into seven subsamples, analyzing each fraction separately; in sum, these seven fractions account for the entire molybdenite crystal. We obtained extremely disparate ages for the individual fractions, ranging from 1.4 to 3.1 Ga. These data were recombined on an atomic basis to calculate the Re-Os age for the entire crystal, a trick we employed after affirming there was no additional sulfide and no additional molybdenite that might compete for Re and Os in our hand-sample of 10 x 15 cm. This circumstance provided us the opportunity to turn Re-Os decoupling to our advantage.

The whole-crystal Re-Os molybdenite age on combining data from individual separates is between 2.41 and 2.45 Ga, depending on estimates of very minor silicate dilution as the crystal was extracted piecemeal from the vein. The U-Pb age for euhedral titanite crystals in a dense massive calc-silicate host, not unexpectedly, is ∼1.0 Ga. The molybdenite and titanite record two different episodes of metamorphism. These results suggest that the Sausar Group calc-silicate rocks we analyzed are earliest Paleoproterozoic, >2.41 Ga. Shortly after deposition these rocks were metamorphosed – the first event in a long history of metamorphism and deformation continually focused along an ancient suture. These results have implications for the CITZ, and are similar to ages found in terranes on either side of this continental scale collisional belt [3,4].

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