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Plumes with gold and no LIPs: Knowing where the hot spots are

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When plumes pierce the lithosphere, basaltic magmatism, commonly as voluminous outpourings, signals the presence of hot spot activity in the mantle. When the accumulations of mafic rock become large they are referred to as LIPs (Large Igneous Provinces). But how is plume activity recorded in the absence of the familiar mafic volcanism?

Using Re-Os dating of gold-associated arsenopyrite, we investigated the Pular-Parsori Au-Cu deposits in the Sakoli belt of central India. The observed Au mineralization is continuous along strike for more than 3 km. The Sakoli, composed of metasedimentary and metavolcanic rocks, is located along the southern margin of the CITZ (Central Indian Tectonic Zone), just outside a marked boundary known as the Central Indian Shear (CIS). The CITZ is a multiply deformed, continental scale lineament binding amalgamated Archean crustal entities composing the North and South Indian cratons. The Sakoli has been stepped on by deformation associated with the CITZ. Prior to our study, the dynamic-metamorphic crustal history was believed to be Paleoproterozoic. Re-Os dating of Pular-Parsori arsenopyrite, however, clearly indicates that these Au deposits are Mesozoic (160-150 Ma), with a poorly constrained but primitive initial Os ratio. Furthermore, a second less well-constrained group of ages at $\sim$125-110 Ma correlates with hot spot activity (e.g., Kerguelen), and is the same age as the 117 Ma Rajmahal traps in eastern India.

We interpret the older 160-150 Ma event as the Re-Os record of the separation of India-Madagascar from East Africa (i.e., break-up of southeastern Pangea). Before India fast-tracked northward to Asia, the continent moved south and then north, rotating as it separated from Australia at $\sim$120 Ma. In doing so, India may have crossed over the same hot spot(s) more than once. The stretching and ultimate breakaway of India is interpreted to have reactivated the CITZ in Mesozoic time, as recorded by several pulses of Au mineralization. In this case, Au mineralization is not associated with convergent orogenic margins, but deep-seated reactivation of old sutures. Compromised lithospheric strength with extended spheres of thermal influence emanating from shallow mantle plumes may bring Au into shallow crustal structures.