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Paleoproterozoic (1.65 Ga) juvenile magmatism in the Chhotanagpur Granitic Gneiss Complex (CGGC), eastern India: link to the assembly of the Columbia supercontinent

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Juvenile crust with radiogenic Hf isotope composition is typically found in I-type granites [1] produced primarily in arc-type tectonic settings, i.e., during subduction rather than during collision. A global compilation of the Hf isotope composition of zircon [2] shows a distinct excursion to positive εHf values at ca. 1.6 – 1.7 Ga, suggestive of extensive juvenile magmatism in arc setting, which may be related to the assembly of the Paleoproterozoic-Mesoproterozoic supercontinent Columbia. In this study, we analyzed the whole rock chemistry and the U-Pb-Hf isotope composition of zircon from Paleoproterozoic granites/gneisses of the Chhotanagpur Granitic Gneiss Complex (CGGC) in eastern India. The CGGC represents the eastern extension of the Central India Tectonic Zone (CITZ), which marks the accretion zone along which the Northern and Southern blocks of the Indian shield amalgamated in the Proterozoic to form the Greater Indian Landmass. The CITZ is proposed as a transcontinental suture continuous with either the Trans North China Orogen or the Capricorn Orogen of Western Australia in palaeogeographic reconstructions of the Columbia supercontinent.

The major and trace element chemistry suggests that the Paleoproterozoic granites/gneisses are I-type and were emplaced in an arc setting. Igneous oscillatory-zoned domains of zircon provide concordia age of 1.65 Ga. Xenocrystic cores that appear darker in cathodoluminescence images furnish concordant ages of 1.75 Ga. The $\varepsilon_{Hf}(t)$ values of the xenocrystic domains vary between – 2.0 and – 5.9, implying contribution from crustal sources. The igneous domains have $\varepsilon_{Hf}(t)$ between - 0.4 and 9.0, suggestive of the involvement of a juvenile source. The positive $\varepsilon_{Hf}(t)$ of the 1.65 Ga granitoids of the CGGC mirror the world-wide excursion to positive ε_{Hf} values at ca. 1.6–1.7 Ga, and support the involvement of the CITZ as a transcontinental zone of convergence/suture in the Columbia supercontinent.

[1] Dhuime et al. (2012), Science 335, 1334-1336. [2] Cawood et al. (2013), Bulletin 125, 14-32.