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Neoproterozoic-Palaeoproterozoic Mafic Dyke Swarms from the Singhbhum Granite Complex, Singhbhum Craton, Eastern India: Implications for Identification of Large Igneous Provinces and Their Possible Continuation on Other Formerly Adjacent Crustal Blocks

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The Singhbhum craton of the eastern India consists of the Singhbhum Granite Complex (SGC) and the Chotanagpur Gneissic Complex (CGC) separated by the Singhbhum Mobile Belt (SMB). The CGC is intruded by Mesoproterozoic as well as Cretaceous mafic dykes; in contrast, the SGC is transacted by Neoproterozoic-Palaeoproterozoic mafic dyke swarms, collectively known as 'Newer Dolerite Swarms' in the literature. Mafic volcanic rocks are also associated with these mafic dyke swarms. There are no Phanerozoic mafic dyke swarms reported from the SGC. Here, we present a precise and robust U-Pb baddeleyite age for a NE-SW mafic dyke from Kaptipada located in the eastern part of the SGC. In order to increase the chance of finding baddeleyite, the dyke was sampled at two sites approximately 100 m across. In total, six fractions of dark brown baddeleyite were analyzed, three from each sample site (sites KTPD-09-01 and KTPD-09-07). Each site gives identical ²⁰⁷Pb/²⁰⁶Pb dates of 2251.7±1.9 Ma and 2248.8±7.8 Ma, and a combination of which yields a result of 2251.7±1.8 Ma. The latter is calculated as the weighted ²⁰⁷Pb/²⁰⁶Pb mean and this is the preferred age of this dyke. On the basis of available ages, including the here reported new age of the Kaptipada dyke, four major mafic dyke swarms can now be identified. These include – (i) 1.76-1.77 Ga NW-SE to WNW-ESE trending (Ravi Shankar et al., 2014) Pipilia swarm, (ii) 2.25 Ga NE-SW to ENE-WSW trending Kaptipada swarm (this study), (iii) early Paleoproterozoic N-S to NNW-SSW trending Gobardhana-Sankiri swarm, and (iv) ~2.6-2.7 Ga NNE-

SSW trending (Roy et al., 2004) Keshargaria swarm. Although available radiometric ages of mafic volcanic rocks are not very precise (Misra and Johnson, 2005), these ages indicate that the Dhanjori and the Dalma mafic volcanic rocks are probably associated with the 2.7 Ga Keshargaria swarm, whereas the Jagannathpur and Malangtoli mafic volcanic rocks are probably part of the Kaptipada swarm. A map of mafic dykes and associated volcanic rocks for the SGC has been prepared with help of Google™ Earth images and ArcGIS™. This mapping also reveals cross-cutting relationships of distinct Neoproterozoic-Palaeoproterozoic mafic dykes and thus establishes their relative emplacement ages.

Each of these swarms (and associated volcanic rocks) is interpreted to represent the erosional remnant of a Large Igneous Province (LIP), and each is likely to continue on other formerly adjacent crustal blocks. For instance, the 1.76-1.77 Ga Pipilia dyke swarm is similar in age to LIP remnants reported from the North China craton (China), Rio de Plata Craton (Uruguay), Sarmatia (part of Baltica), Kimberley (Australia), and Roraima (Brazil); most of these shield areas are supposed to be part of the assembly of a supercontinent Columbia/Nuna, and the possibility of a widespread c. 1.76-1.77 Ga LIP in this supercontinent needs to be considered. The 2.25 Ga Kaptipada swarm does not have any known age matches on other crustal blocks except in the eastern Dharwar craton, which also is intruded by ~1.79 Ga dykes (Demirer, 2012; Bleeker et al. 2016, abstract for IDC-7 in preparation). These two age matches suggest juxtaposition of the Singhbhum and Dharwar

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cratons prior to 2.25 Ga. Ages for the two other identified swarms (Gobardhana-Sankiri and Keshargaria) are currently too imprecise to test for correlations with LIP remnants on other crustal blocks.

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