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LIP'S TIMING – WHAT'S NEW

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Keywords: *U-Pb ID-TIMS, zircon, calcic garnets*

Introduction

Timing of the magmatic events is a crucial point in the LIPS study. High precision age data have been published for the numerous mafic LIPS components however the provinces consisting of alkaline and alkaline-ultramafic rock with carbonatites are still deficient of precise duration.

Zircon, the best precise U-Pb geochronometer, is absent in the most of agpaitic and ultrabasic alkaline rocks or susceptible to Pb loss, leading to low precision of isotopic measurements. High content of common, often inherited Pb in zircon from alkaline granitoids whose crystalline structure remains thereby well preserved, and a relatively low U concentration, as well caused significant errors and uncertainties in the U–Pb zircon dates. Our new results demonstrate the annealing and leaching (chemical abrasion) eliminates phases affected by both Pb loss and inheritance in the zircons from high alkaline granites.

Alkaline igneous silicate and carbonate rocks often contain calcic garnets of the andradite-schorlomite-morimotoite-grossular-kimzeyite composition which until recently were not considered as U-Pb geochronometers. We have demonstrated based on the high precision U-Pb ID-TIMS data for numerous alkaline and carbonatitic intrusive rocks that calcic garnets are ideal multi-system geochronological tools. On the example of garnet ages of five massifs from the Kola Alkaline Province we constrained time interval of the main phase of magmatic activity during 1-7 Ma (373±2 Ma to 377±1 Ma) which much less that previously assumed.

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AN UPDATED OVERVIEW ON THE LARGE IGNEOUS PROVINCE (LIP) RECORD OF THE INDIAN SHIELD

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Large Igneous Provinces (LIPs) are significant source of information for constraining paleocontinental reconstructions and providing considerable opportunity to understand the nature, composition and evolution of the underlying subcontinental lithospheric mantle. LIPs (both continental and oceanic) may comprise flood basalts, and a plumbing system of mafic dyke swarms (MDSs), sill complexes, layered intrusions, and crustal magmatic underplating. Most of the Phanerozoic LIPs are usually represented by CFBs (continental flood basalts), however, during the Precambrian, the flood basalts are typically eroded exposing the LIP plumbing system of MDSs which provides a robust record of the rhythm of intraplate mantle melting events (cf. Ernst, 2014).

The different Archean Cratons of the Indian Shield have an extensive record of large magmatic events (i.e. LIPs) throughout Earth's evolution, which range in age from Precambrian to Paleogene, and are an integral part of ancient supercontinents (cf. Ernst, 2014; Samal et al., 2019a,b; Söderlund et al., 2019; Srivastava et al., 2019). Based on available precise geochronological data and the grouping of mafic dykes into swarms (based on their age, trend and chemistry), twelve Precambrian and four Phanerozoic LIP events have been identified in the Indian Shield (see Fig.1).

The 12 Precambrian LIP events comprise 24 dyke swarms, 10 other intrusions and 15 mafic magmatic events bracketed between 2.8 Ga and 0.76 Ga. These are ~2.75-2.80 Ga, ~2.36-2.50 Ga, ~2.25-2.26 Ga, ~2.21-2.22 Ga, ~ 2.18 Ga, ~2.08, ~1.98 Ga, ~1.85-1.90 Ga, ~1.77-1.79 Ga, ~1.42-1.46 Ga, ~1.05-1.12 Ga and ~0.76-0.77 Ga LIP. The four prominent Phanerozoic LIPs are (i) ~290–270 Ma, (ii) ~100-135 Ma, (iii) ~84-94 Ma, and (iv) ~64-69 Ma, which are supposed to be associated with the Crozet, Kerguelen, Marion and Réunion hot spots. These LIP records of the Indian Shield have been correlated with the matching LIPs on other crustal blocks of the globe, which suggest that the Indian Shield was an integral part of almost all the known supercontinents during Earth's history. The improving characterization of the LIP record of the Indian Shield (both their dyke swarms, flows and associated intrusions) is helping to constrain the timing and pattern of the assembly of the various Indian Cratons and any post-assembly rotations between the various Cratons.

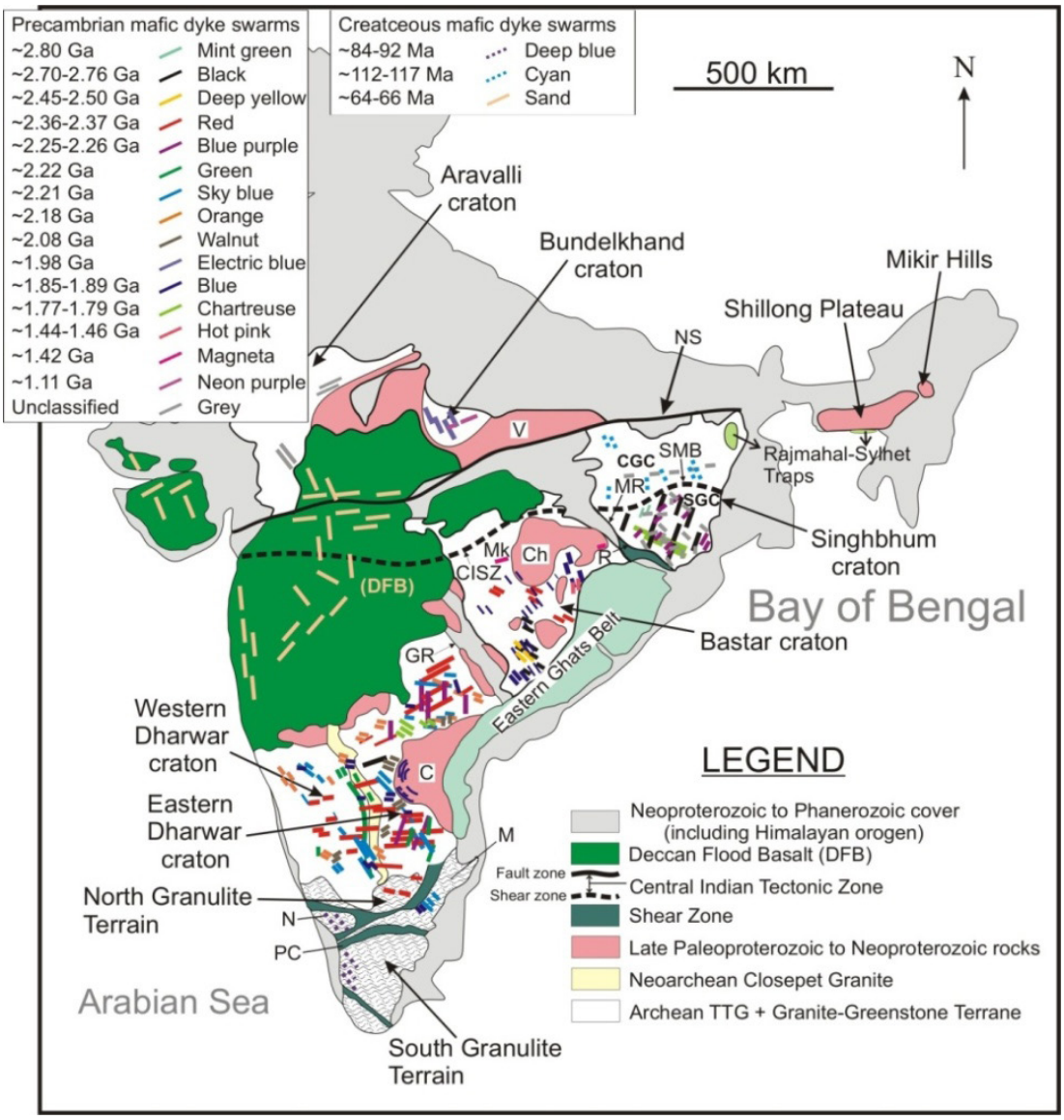

Figure 1: Map showing distinct Precambrian and Cretaceous mafic dyke swarms (MDSs) and Cretaceous continental flood basalts (CFBs) in different Cratons of the Indian Shield (after Samal et al., 2019b; Srivastava et al., 2020).

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