Geochemistry of metacarbonate rocks from the Highland Complex, Sri Lanka: Apparent depositional ages and tectonic environments

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Sri Lanka forms an integral part of the Latest Proterozoic to Early Cambrian collision zone in the East African-Antractic Orogen (EAAO) that includes Mozambique, Madagascar, southern India and the Dronning Maud Land in East Antarctica. The Mozambique Ocean is supposed to have existed between East- and West-Gondwana, before its final amalgamation to form a single Gondwana supercontinent. The metacarbonate occurrences of these regions are considered to have deposited by chemical precipitation in the Mozambique Ocean. Therefore, these rocks can be ideal for considering the geochemical information of the paleo-ocean that separated continents and cratons that existed prior to the Gondwana amalgamation.

There are four lithotectonic units in Sri Lanka, namely, the Highland Complex (HC), the Wanni Complex (WC), the Vijayan Complex (VC), and the Kadugannawa Complex (KC). The Highland Complex (HC) is the only unit in Sri Lankan basement where meta-carbonate rocks are found. In this study we deal with the meta-carbonate rocks in the Highland Complex, which can help us to estimate the depositional age by using the strontium isotope chemostratigraphy. However, prior to the estimation of the depositional age, it is necessary to consider the influence of metamorphism and alteration in carbonate rocks. For example, the rare earth element + yttrium pattern changes with the mixing of continental rocks during carbonate sedimentation, carbon isotopes alter with lithification, whereas the oxygen isotope composition records fluid-rock interaction during metamorphism. In addition, it is necessary to consider the initial rubidium contents, which can affect the strontium isotopic composition. Thus in this study, taking advantage of the characteristics of metacarbonate rocks, samples that were least influenced by alteration (that consist of calcite/ dolomite mineral or only with minor amounts of calc-silicate minerals) were selected. For this purpose, thin section observation, oxygen and carbon isotopic composition and trace and rare earth element patterns were used. The $\delta^{18}O$ and $\delta^{13}C$ values of meta-carbonate rocks range between 19 to 25 ‰ and -2.0 to 1.5 ‰, respectively, which indicates preservation of possible Neoproterozoic marine carbonate values. However, the Sr initial ratios show regional differences, $^{87}Sr/^{86}Sr$ (850 Ma) values that ranges from 0.70422 to 0.70751. These values when compared with the late Proterozoic Sr isotope chemostratigraphic curve of Halverson et al. (2010) suggest apparent depositional ages between 900 Ma to 660 Ma.

There are many previous studies on detrital zircon ages in the HC; Dharmapriya et al. (2015) has reported youngest detrital ages of 834 ± 12Ma and 722 ± 14Ma, whereas Osanai et al. (2016) has obtained the zircon core ages of 1487± 39Ma on mafic-granulites from the HC. The HC has been considered as the oldest sedimentary units in Sri Lanka, which is supposed to include oldest recycled continental crust from other continents (Takamura et al., 2016). Our estimate of the depositional ages in HC are also comparable with the depositional ages of metacarbonate rocks from the Sør Rondane Mountains (SRM), East Antarctica (880-850Ma and 820-790Ma; Otsuji et al., 2013), and those of Mozambique belt (890-860Ma; Melezhik et al., 2008). In the Madurai Block (MB) in south India, Archean to Paleoproterozoic (ca. 3400-1800Ma) detrital zircon ages are reported with youngest of Neoproterozoic ages (ca. 780-690Ma). Associated with the amalgamation of Gondwana, Otsuji et al. (2016) suggest that the differences in geochemical characteristics, such as Sr and Nd isotope variation and REE+Y patterns, were caused by the variation in depositional setting and environment of metacarbonate rocks. The metacarbonate rocks in the SW terrane in the SRMs are different with those in NE terrane on Balchen region. Also, ƐNd and T_{DM} ages supported detrital zircon in metapelitic rocks from NE terrane. Combining the information obtained from neighboring areas of Gondwana with those from HC, it is possible to infer that the carbonate depositional environments in the HC were associated with possibly with an Island Arc system. Our results also place important constraints on the temporal and spatial extent of the Mozambique Ocean, which may lead to the understanding of the processes and timing of Gondwana formation. Further detailed analytical studies are being carried out, to understand the reliability and regional extent of depositional ages and surrounding marine environments for the metacarbonate rocks in the Highland Complex, Sri Lanka

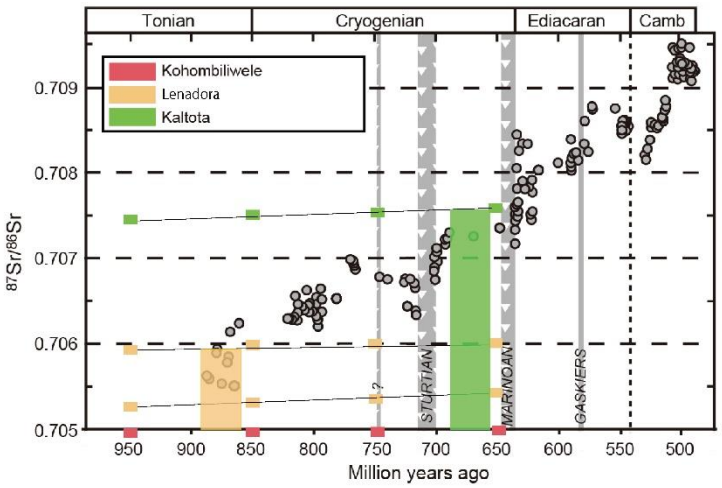

Figure1.Estimation of depositional age from initial Sr isotopic ratio based on the *Sr evolution curve of Halverson et al.(2010).*

References

Dharmapriya et al. (2015), Precam. Res. 271, 311-333; Halverson et al. (2010), Precam. Res.182, 337–350; Melezhik et al. (2008), Precam. Res. 162, 540–558; Osanai et al. (2016), J. Min. Petrol. Sci. 111, 157-169; Otsuji et al. (2013) Precam. Res. 234, 257–278; Otsuji et al. (2016), J. Min. Petrol. Sci. 111, 170-180 Takamura et al. (2016), Precam. Res. 281, 434-452.