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Sr isotopes and trace elements in melt inclusions from ~260 Ma Song Da komatiites, northern Vietnam, reveal evidence of component mixing and water excess in their parental melt

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Studies of melt inclusions in Phanerozoic komatiites are crucial for understanding the evolution of mantle composition, as well as the rates of crustal production and recycling through time. The Permian (~260) Ma Song Da komatiites in Vietnam are among the few known occurrences of well-preserved Phanerozoic komatiites. Hanski et al. (2004) proposed that the Song Da lavas were derived from komatiitic primary magmas based on their bulk-rock composition, assuming that water content in these rocks was <0.03 wt.%. Despite continuous efforts to unravel their primary melt composition, concentrations of the volatile and mobile elements in the primary Song Da melt are still poorly constrained due to the widespread alteration and low-grade metamorphism of these rocks.

This study reports high precision EPMA, SIMS, and LA-ICP-MS melt inclusion data, suggesting that the primary melt of Song Da komatiites contained up to 0.9 wt.% H_2O. Their original δD values were lower than -66‰, and the H_2O/K_2O ratio was ~37. Despite the elevated water content, we contend that these rocks were indeed derived from a komatiitic melt. Moreover, this study reports for the first time Sr isotope data for komatiite melt inclusions, recording a large range of $^{87}Sr/^{86}Sr$ from 0.7025± 0.0006 to 0.7047 ± 0.0006 (2SE). Along with the trace element abundances, these data indicate the presence of two different components in melt inclusions. The first component is depleted in $^{87}Sr/^{86}Sr$ compared to the Bulk Silicate Earth (BSE), whereas the second component is relatively enriched and contains higher concentrations of Rb, Sr, Yb, and Zr. The uniformly high H_2O/K_2O ratios indicate a vast excess of water in both components and their sources compared to the BSE.

We propose that the trace-element depleted melt parental to the Song Da komatiites was derived from a mantle plume thatpassed through the partially molten mantle transition zone located between depths of 410 and 660 km. This plume entrained H_2O from the hydrated transition zone, likely through the interstitial melt. This explains the high water content and depletion in deuterium recorded in the melt inclusions. The origin of the enriched component will be discussed here also.