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# Insights from olivine into the origin of the Deccan LIP

**AZHAR MOHAMMED SHAIKH**[1], PROF. SEBASTIAN TAPPE, PHD[2], MR. JYOTI PRAKASH NAYAK[3], PAYEL DEY[1], FANUS VILJOEN[4], MARLINA A. ELBURG[5] AND RAYMOND DURAISWAMI[6]

[1]Indian Institute of Science Education and Research Berhampur
[2]Technical University Bergakademie Freiberg
[3]Indian Insitution of Science Education and Research Berhampur
[4]University of Johannesburg
[5]Department of Geology, University of Johannesburg, P.O. Box 524, Auckland Park, 2006 Johannesburg, South Africa
[6]Department of Geology, Savitribai Phule Pune University

Olivine is the most common mineral phase in the Earth's upper mantle and is the first mineral to crystallize in most mantle-derived magmas. Therefore, an olivine-focused study can improve our understanding of mantle-derived magmatism including LIPs. Unfortunately, such study has been lacking for the Deccan LIP, possibly due to difficulty in finding fresh olivine owing to its rare occurrence and rapid alteration.

Our quest for olivine in the Deccan LIP started with the compilation of sporadic data scattered in the literature, followed by major and trace elemental analyses of selected olivine-phyric dykes from the Bombay Volcanic Complex (BVC). The compiled olivine data show a wide range of forsterite contents (11–92 mol%), with a peak distribution at 75–85 mol%. They show typical fractionation trends marked by decreasing forsterite and NiO contents (<0.4 wt%) with an increase in MnO. The variations in NiO/MnO and maximum forsterite values not exceeding 92 are similar to those of other CFBs worldwide, whose magma sources likely equilibrated at moderate pressures (~2–3 GPa).

Our meticulous investigation on two picrite (~65 Ma) and two ankaramite dykes (~62 Ma) from the BVC revealed a substantial quantity of pristine olivine with considerable core-to-rim zoning. There is a systematic lowering of forsterite and NiO contents from picrite (Fo 55–88 mol%, NiO 0.15–0.45 wt.%) to ankaramite (Fo 42–76 mol%, NiO 0.23–0.06 wt.%). Picritic olivine exhibits lower MnO (0.15–0.43 wt.%) than ankaramite (0.25–0.62 wt.% MnO). Trace elements mimic the major elemental variations, with picritic olivine having elevated concentrations of Cr, Ni and Al, but lower Ti, Zn, Mn, Li and Co than olivine in ankaramite. The temperatures recorded by olivine-spinel pairs in picrite range between 1190–1350 °C, which are higher than those for olivine in MORB (~1200 °C). Mn/Zn, Ca/Fe, Mn/Fe and Ni/Mg ratios suggest an olivine-poor mantle source for the picrites and ankaramites. The systematic shift in forsterite and NiO contents and trace elements concentrations in olivine from picrite to ankaramite plus the absence of high-forsterite olivine (>88) can be attributed either to fractionation or change in the melting regime over time.