Mantle metasomatism in the basement of the Deccan Trap: Stable Carbon and Oxygen isotope compositions of carbonates from the Killari borehole, Maharashtra, India

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The Deccan Volcanic Province, covered by a thick suite of volcanic rocks erupted during the K-T- bounday 65 Ma, is one of the largest flood basaltic eruptions on the surafce of the earth. There are only few reports available on the nature of the crustal structure, tectonism, thermal characteristics, and chemical composition of the basement of the Deccan Trap [1]. The basement rock is identified as an amphibolitic granulite containing 2 wt % of CO_2 [1]. In order to study the origin of CO_2, we have measured stable oxygen and carbon isotope compositions of the two samples KIL-13 and KIL-20 (499.6 meter depth), having 2.28 and 2.18 wt % CO_2. About 50 to 60 μg of powdered carbonates were used for $\delta^{18}O$ and δ^{13} C isotopic measurements, by using a Delta$^+$ Advantage IRMS coupled with Kiel IV automatic carbonate device. The precision was better than 0.10 ‰ for $\delta^{18}O$ and 0.05‰ for δ^{13} C [2]. Triplicate runs were made to check the reproducability. The values of δ^{13} C and $\delta^{18}O$ obtained for the KIL-13 samples are -6.23‰ and 7.94‰ (relative to v- PDB and v-SMOW respectively) and for the KIL-20 sample the values are -6.22‰ and 8.11‰ indicating that the Deccan Trap basement carbonates are derived from deep mantle carbon reservoir, similar to carbonatite magma [3]. In the Deccan region, alkaline and ultra-alkaline rocks such as the carbonatites of the Narmada zone have been attributed to mantle metasomatism and enriched mantle sources. It has also been proposed that in the northern parts of the Deccan Trap, a variety of mineralogical and geochemical features point to mantle metasomatism, probably due to the complex interaction between the Reunion plume and the lithospheric mantle [4]. Our present study provides an additional evidence for the presence of mantle metasomatism in the Killari region of the Deccan Trap.

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$\delta^{13}C$ of *n*-alkanes as a new potential proxy for high atmospheric pCO_2

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Published estimates of Phanerozoic atmospheric pCO_2 levels range from 1–10× today's level, and imply large fluctuations across critical transitions, such as extinction and diversification events. A variety of geochemical proxies have been developed to estimate pCO_2 through geolgical time, however many of these techniques are fraught with limited applicability and/or large uncertainty, particularly under high pCO_2-scenarios. Thus, as part of our ongoing effort to understand the effect of geologic levels of pCO_2 on plant development, we have tested the potential of *n*-alkane biomarkers as a proxy at elevated levels of pCO_2. These biomolecules are targeted for study because terrestrial leaf wax alkanes were a likely prerequisite for the evolution of terrestrial photosynthesis, and they may be isolated with strategic value from Paleozoic rocks, thus providing a window into fluctuating pCO_2 levels during critical periods of land plant evolution. In addition, their lifeform specificity, ease of extraction and routine analysis make these molecules attractive as potential proxy markers. Here we report on growth experiments within which a model angiosperm (*R. sativus*) was grown under systematically increasing pCO_2 levels from ambient to 4200 ppm (RCO_2 = 14). Hydrocarbon fractions were extracted from above ground plant tissue and analysed by gas chromatography-isotope ratio mass spectrometry (GC-IRMS). An excellent correlation is observed between ε_{31} (the stable isotope fractionation between ambient $\delta^{13}CO_2$ and the nC_{31} alkane, $\delta^{13}C_{31}$) and pCO_2 (r^2 = 0.99, hyperbolic regression) being most sensitive up to ~1800 ppm. Interestingly, the fractionation between bulk ($\delta^{13}C_{Plant}$) and $\delta^{13}C_{31}$ decreased as pCO_2 increases (from ε_{31} = 6.1 to 3.9), again up to ~2000 ppm. Carbon isotope analysis of individual lipid fractions (i. e., sterols, fatty acids and phytol) will allow us to determine if the dependence on pCO_2 results from gross metabolic shifts affecting all lipogenesis or from specific alterations to n-alkane biosynthetic pathways. We will also speculate as to why the physiologic response we observe appears to stabilize at ~1800 ppm, within the same range where other plant-based proxies lose precision.