Presence of CO_2 in the uplifted lower-crust below Seismogenic region Latur, India

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The Deccan Volcanic Province, covered by a thick suite of volcanic rocks erupted 65 Ma ago, is one of the largest flood basaltic eruptions on the surface of the earth, covering almost $1/6^{th}$ of Indian land mass. This region has been experiencing moderate seismic activity since historic times. In order to understand the subsurface structure of the basement and the possible reason for the occurrence of Latur earthquake, several boreholes were drilled in the earthquake affected region of Latur. One of them (KLR-1) was 617 m deep and penetrated about 280m of late Archean crystalline basement below a 338 m thick column of Deccan basalts [1]. The borehole is located near Killari village in Deccan Traps (18°03´07´´N, 76°33´ 20´´E). Spectroscopic studies revealed presence of several novel secondary minerals in the upper section of the borehole (upto 330 m) [2, 3, 4]. However, there are no reports on the composition and nature of the 2.5 Ga basement rock of the Killari borehole exists. DTA/TG studies on three basement samples exhibit almost identical thermal behaviour viz, weak endothermic peak near 120°C and a very strong endothermic peak in the temperature range 685±5°C. The weak peak near 120°C, with 0.3 to 0.4 % weight loss is attributed to the dehydration reaction of hydrous minerals like biotite and the water absorbed on the surface of the samples. The strong endothermic peak at about 685±5°C with a weight loss of 1.5 is due to the release of decarbonation reaction. The nature of the fluid composition has also been determined by the mass spectra analyses of the liberated gases, which were identified as CO_2. The present study demonstrate that the basement rock contain 2 wt % of carbon-di-oxide fluid components. The presence of carbon-di-oxide clearly demonstrates the granulitic nature of the basement rock.

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High primary productivity and denitrification after the Paleoproterozoic phosphogenic event in the Aravalli Supergroup, India

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The causes of atmospheric oxygenation in the Paleoproterozoic may be related to increased levels of primary productivity. Environmental consequences of these changes included increased abundance of seawater nitrate, which opened new niches to denitrifying organisms. We report N and C isotope data, trace elements and REE compositions of carbonaceous shales from the Paleoproterozoic Aravalli Supergroup, which occur stratigraphically above the oldest phosphogenic event around 2.0 Ga. Our samples of carbonaceous shales represent various metamorphic grades and were found to have ranges of $\delta^{15}N$ values and C/N ratios between +1‰ (C/N = 6) and +27‰ (C/N > 250). Carbonaceous shales from the Rama and Umra sub-basins have $\delta^{13}C$ values between -13 and -18‰, $\delta^{15}N$ values between +5 and +11‰ and C/N below 56, which suggests high productivity and/or evaporative conditions along with denitrification during deposition. Black shales from Udaipur and Amberi have high C contents up to 8%wt, $\delta^{13}C$ values around -30‰, and large ranges of $\delta^{15}N$ values between +1 and +19‰ and of C/N ratios between 7 and 260. These C-isotope compositions are consistent with other Paleoproterozoic shales and the C/N ratios and N-isotope data indicate a progressive loss of ^{14}N during metamorphism. Another group of shales from Udaipur, Lakarwas and Ghasiar have $\delta^{13}C$ values between -20 to -26‰ and a large range of $\delta^{15}N$ values between +3 and +20‰ (C/N from 3 to 305). Combined with V/(V+Ni) ratios typically above 0.6 and often >0.85, these data suggest redox stratifed seawater with active denitrification during sedimentation. Our interpretation of high primary productivity in these shales is consistent with associated stromatolitic phosphorites that have heavy $\delta^{13}C_{org}$ values and dolomites enriched in ^{13}C.