Journal paper isotopic composition as climate proxy

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The increasing use of fossil fuels mainly due to burning of coal and petroleum since the beginning of industrial revolution has caused steady rise in CO_2 concentrations in the atmosphere. CO_2 is well mixed in global atmosphere through general circulation. There is a consistent pattern observed between concentration rise and carbon isotopes in atmospheric CO_2. The isotopic signature seen in CO_2 of atmospheric air is transferred to the biosphere through exchange mechanisms. The $\delta^{13}C$ signature of fossil fuel derived CO_2 being lighter than other natural sources and preferential uptake of $^{12}CO_2$ from atmosphere by plants, provide us an opportunity to understand its fluctuations over time through stable isotopic analyses of plant materials [1]. In the present study we investigated the transfer of $\delta^{13}C$ signal from raw plant material to paper in archives of periodicals and magazines. Study by Yakir (2011) [2] shows a depleting trend in $\delta^{13}C$ of paper cellulose through time and linked it to global-scale increases in plant intrinsic water-use efficiency. In our study we have investigated the $\delta^{13}C$ of paper produced from Europe and America capturing atmospheric CO_2 trends mimicking the rise in global temperature for time period of last 100 years. The representative samples of journal papers are retrieved from the library at four to five year resolutions avoiding any ink contamination. We recorded a sudden drop in $\delta^{13}C$ value (-22.9‰ to -24.39‰) in cellulose composition coinciding with the time period from 1920 to 1925. The global temperature anomalies for the same period ranges from -0.25°C to -0.14°C. Detailed examination of $\delta^{13}C$ variability revealed impacts of historically important events on atmospheric CO_2 via cellulose in paper. Analyses performed on archives of a regionally published journal confirms global patterns and along with the capturing signatures of regional industrial revolution. Analyzes of $\delta^{18}O$ in the cellulose further confirm the signature of global climatic events due to its linkage with the hydrological cycle. The study identified a potential new reliable archive which can supplement proxy records at much higher time resolutions.

[1] Francey and Farquhar(1982) *Nature* **297,** 28–31.[2]Yakir(2011) *Environ. Res. Lett.* 6 034007

Crustal structure beneath the Dharwar craton, India

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We report significant lateral variability in shear wave velocity and Moho depth in the Archean crust beneath the Dharwar craton, India using earthquake waveform data recorded over 50 broadband seismographs (Figure a). The craton is a continuously exposed Archean continental fragement from north to south, and divided into the west Dharwar craton (WDC) of age 2.7-3.36 Ga, and the east Dharwar craton (EDC) of age, dominantly, 2.5 Ga. The craton progressively transition into the Southern Granulite Terrain (SGT) with age of metamorphism around 2.6 Ga.

The inversion of receiver function data reveals significant variation of Moho depth, viz., 38-54 km in the WDC, 40-46 km in SGT, and 32-38 km in the EDC. The average shear wave velocity of crust beneath the WDC is ~3.85 km/s as compared to ~3.60 km/s in the EDC. We infer highly variable thickness (16-30 km) of mafic cumulate (Vs ≥ 4.0 km/s, Vp ≥ 7.0 km/s) beneath the WDC, in contrast with a thin one (<5 km) beneath the late Archean EDC. The 3.36 Ga greenstone belt in WDC has maximum basal layer thickness of ~30 km. The result suggest the mafic crust and exceptional thickness of crust beneath the WDC (>50 km) as compared to felsic to intermediate composition for the EDC crust with almost flat Moho (~36 km) (Figure b). Considering the surface exposure of 15-20 km crust, based on P-T condition, in the southern segment of WDC, we speculate a Himalaya-like crustal thickness (50-70 km) beneath the mid-Archean crust pointing towards a plate-tectonic like scenario at ~3.0 Ga. In contrast, the EDC is possibly evolved as a consequence of subduction and delamination that led to a felsic crust with a nearly flat Moho.

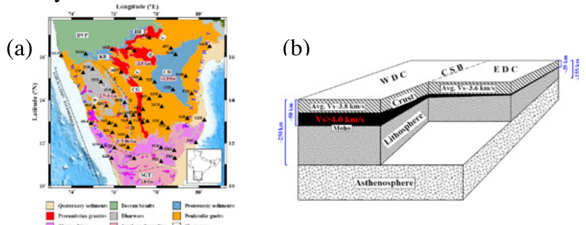

Figure:(a) Tectonic map of Dharwar craton. Seismic stations are shown as black triangles (b) Schematic showing distinct crust-mantle character of the WDC and EDC.

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