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# Gross primary productivity variability in a tectonic hotspot revealed by coral carbon isotopes and solar-induced fluorescence.

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Gross primary productivity (GPP) exerts a fundamental control on regional carbon cycling and isotopic fractionation, as it integrates photosynthetic carbon fixation and respiration [1]. In tectonically active regions such as the Andaman–Nicobar archipelago, vertical land-level changes associated with megathrust earthquakes can significantly modify coral platform depth, thereby altering light availability, photosynthetic efficiency, and ultimately reef productivity. Because light attenuation in shallow marine systems is highly sensitive to small elevation shifts, earthquake-induced uplift or subsidence can influence carbon fluxes and the isotopic composition of biogenic carbonates.

Here, we investigate the role of Solar-Induced Fluorescence (SIF) as a proxy for earthquake-driven elevation change and associated shifts in GPP. We focus on Porites corals from Chidiya Tapu (South Andaman), which experienced ~1 m of coseismic subsidence during the 2004 Sumatra–Andaman megathrust earthquake [2]. We compare mean terrestrial SIF derived from the GOSIF dataset [3] with high-resolution $\delta^{13}C$ measurements from annual coral growth bands. Assuming no major coeval shift in nutrient supply, we attribute productivity changes primarily to variations in coral platform depth and associated light attenuation [4].

Our results reveal a pronounced decline of 148 mW $m^{-2}$ $sr^{-1}$ $nm^{-1}$ in SIF following the earthquake, accompanied by a ~0.4‰ decrease in coral skeletal $\delta^{13}C$. Additionally, analysis of earthquake magnitudes within a 50–200 km radius of Chidiya Tapu [5] demonstrates a systematic dependence of both SIF and $\delta^{13}C$ signals on seismic intensity. These findings establish SIF as a sensitive remote-sensing indicator of earthquake-induced elevation shifts and provide the first evidence that GPP variations linked to tectonic subsidence can directly regulate $\delta^{13}C$ signatures in marine corals.

This study highlights a previously unrecognised coupling between seismic processes, reef productivity, and coral carbon isotopes, offering a novel framework for tracing tectonic elevation changes through integrated satellite and geochemical observations.

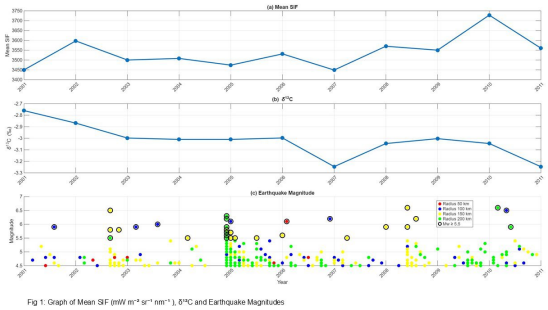


Fig 1: Graph of Mean SIF (mW m⁻² sr⁻¹ nm⁻¹), δ¹³C and Earthquake Magnitudes

References

[1] Miao et al. (2018), Journal of Geophysical Research: Biogeosciences 123, 610–623

[2] Meltzner et al. (2006), J. Geophys. Res. 111, B02407

[3] Li & Xiao (2019), Remote Sensing 11, 517

[4] Gagan et al. (2015), Earth and Planetary Science Letters 432, 461–471

[5] U.S. Geological Survey (n.d.), ISC-GEM 910494 Region Information, USGS Earthquake Hazards Program