The rise of oxygen in the Earth surface at 3.5–3.4 Ga and 2.7–2.2 Ga

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Great oxidation event (GOE) on Earth occurred approximately 2.3 billion years ago (Ga) based on iron redox state and sulfur isotopes. However, the age of first oxidation of the Earth's surface is controversial. Presence of small amount of O_2 in the environment at 2.5 Ga has been suggested by redox sensitive elements and sulfur isotopes and at 2.7 Ga by nitrogen isotopes. We analyzed hydrocarbon-derived geochemical parameters diagnostic for sedimentary redox conditions, i.e., the pristane/phytane ratio (Pr/Ph), from shallow marine sedimentary rocks in Labrador, Canada, Western Australia, and South Africa. Here, we show that anoxic shallow sea at >3.95 Ga was followed by intermediate conditions at 3.5–2.9 Ga, local oxic conditions at 2.7 Ga, and subsequently global oxidation at 2.6–2.2 Ga. These results indicate that the rise of oxygen in the Earth surface occurred at 3.5–3.4 Ga and 2.7–2.2 Ga.

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