

Atmospheric evolution: Oxygen and carbon dioxide concentrations constrained by weathering

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Weathering is an interaction between mineral, water and atmosphere occurring at the Earth's surface. Elements in mineral, water and atmosphere are redistributed by weathering. We have been trying to understand atmospheric evolution through weathering. We will show some examples of the estimation of atmospheric carbon dioxide and oxygen concentrations by using rocks and minerals.

Greenstone at the North Pole, Australia was formed 3.5 Ga by mid-ocean ridge basalt reacted with hydrothermal solution. Mineralogical observations and thermodynamic calculations have revealed that the atmospheric carbon dioxide concentration was 10(3.3) - 10(4.7) PAL, higher than previously estimated.

Rhabdophane, (La,Ce, Nd)PO₄.nH₂O, was formed at the rim of apatite in the 2.5 Ga weathering profile developed on Pronto granite. The Ce(III)-rich rhabdophane indicates that Ce was present at Ce(III) in solution. The thermodynamic calculation for the presence of Ce(III) in solution has revealed that the atmospheric oxygen concentration was less than 10(-13) PAL.