

# Estimating burial rates of organic carbon in terrestrial and marine environments through Phanerozoic time using a geochemical model

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Atmospheric oxygen level on Earth is estimated to have varied and affected evolution of aerobic organisms over Phanerozoic time. Until the early Phanerozoic, primary production and burial of organic carbon occurred only in marine environments. After the emergence of land plants and development of forests, production and burial of organic matter started in terrestrial environments. Since burial of organic carbon is a net supply process of oxygen, variation of burial rates in terrestrial and marine environment should have affected atmospheric oxygen levels. However, isotope-mass-balance models have reconstructed only the global rate of organic carbon burial, not the rates in terrestrial and marine environments separately.

In this study, we estimated burial rates of organic carbon in terrestrial and marine environment, using GEOCARBSULF model [1,2], a geochemical cycle model for carbon and sulfur, with organic carbon and pyrite sulfur (C/S) ratios obtained from sediments deposited in terrestrial freshwater and oxygenated seawater environments [3]. Because it is well known that the C/S ratios in the two environments have a large difference due to the different concentrations of sulfate ions in the two environments, the global rates of organic carbon burial can be divided into the burial rates in the two different environments.

The obtained results are consistent with geological record. Burial of organic carbon in the marine environment mainly contributed to oxygen supply during Cambrian to Devonian when it was before the development of large-scale forests on land. In Carboniferous and Permian, when forests and swamps developed inside the supercontinent and massive coal was produced, burial in the terrestrial environment dominated. In Mesozoic and Cenozoic, burial in the marine environment has dominated again, while burial in the terrestrial environment sometimes occurs, probably reflecting local coal deposits.

## References

[1] Berner (2006), *Geochimica et Cosmochimica Acta* 70, 5653-5664.

[2] Royer, Donnadieu, Park, Kowalczyk & Godderis (2014), *American Journal of Science* 314, 1259-1283.

[3] Berner & Raiswell (1983), *Geochimica et Cosmochimica Acta* 47, 855-862.