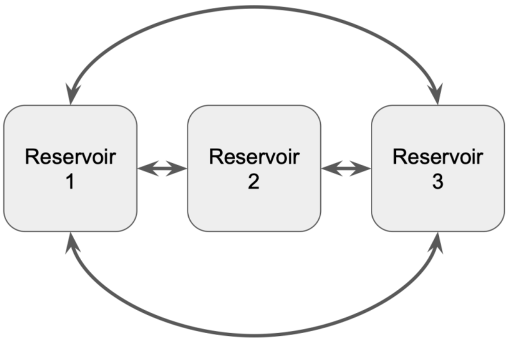
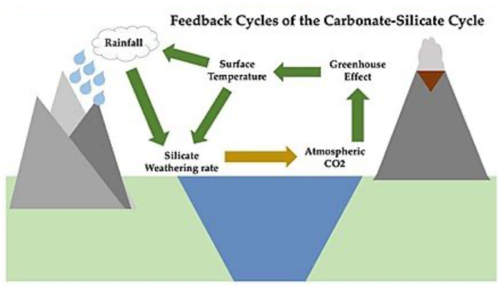
Carbon Reservoirs

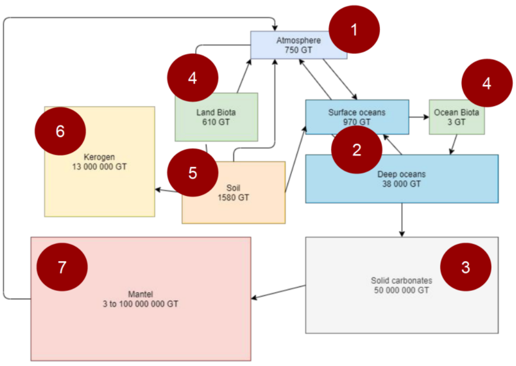
1. The concept of reservoir





source : Wikipedia

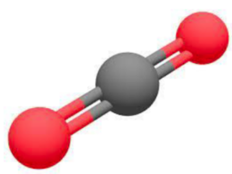
2. Carbon reservoirs



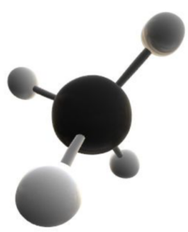
The global carbon-cycle showing the different reservoirs for carbon and the exchanges between reservoirs in GT (109) . The arrows represent natural processes of carbon transfer between atmosphere and earth.

Reservoir 1 : Atmosphere

- CO_2



- CH_4



Reservoir 2 : Ocean

- ⅔ of the Earth's surface.
- store and transporte heat.
- making the atmosphere warm and moist.
- enable life to flourish in the sea and on land.

Table 1.1 Properties of water and their implications for the ocean.

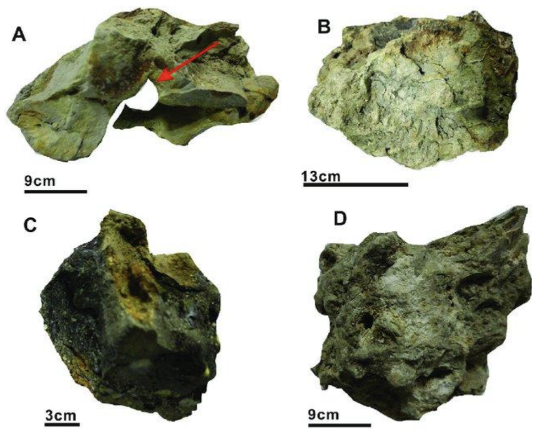
Property	Definition	How water compares with other substances	Implications for the ocean and climate system
Specific heat capacity	Heat required to raise temperature of a unit mass by 1 K.	Highest for all liquids and solids (except NH_3).	Limits temperature range over the Earth.
Latent heat of evaporation	Heat required to evaporate a unit mass.	Highest.	Phase changes are important for the storage and release of heat.
Solvent power	Ability to dissolve substances.	Highest.	Ocean has a high storage of dissolved elements, including nutrients.
Surface tension	Attraction of liquid surface to itself.	Highest.	Bubbles and drops form, which enhance the air–sea transfer of water and gases.
Conduction of heat	Transfer of heat between molecules.	Highest of all liquids.	Heat easily transferred, although turbulence usually dominates.
Molecular viscosity	Resistance to flow.	Less than most liquids.	Ocean easily circulates over the Earth.

- CO_2 (aqueous),
- H_2CO_3 (carbonic acid),
- HCO_3^- (bicarbonate ion),
- CO_3^{2-} (carbonate ion).

$DIC = [CO_2(aq)] + [H_2CO_3] + [HCO_3^-] + [CO_3^{2-}]$

Reservoir 3: Solid carbonates or carbonates rock

Calcite or calcium carbonate, $CaCO_3$

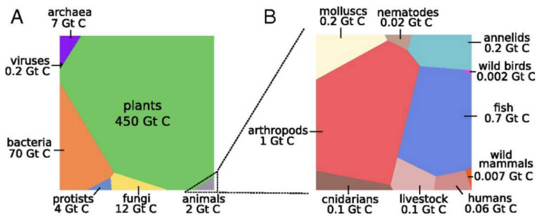


Photographs of typical seep carbonate rocks.

Layers of sedimentary rock in Makhtesh Ramon

Xi, Shichuan, Xin Zhang, Zengfeng Du, Lianfu Li, Bing Wang, Zhendong Luan, Chao Lian, et Jun Yan. 2018. « Laser Raman Detection of Authigenic Carbonates from Cold Seeps at the Formosa Ridge and East of the Pear River Mouth Basin in the South China Sea ». Journal of Asian Earth Sciences 168 (décembre) : 207-24. https://doi.org/10.1016/j.jseaes.2018.01.023

Reservoir 4: Biomass (oceanic and continental)



- Polysaccharides
- Protein
- Lipids

Graphical representation of the global biomass distribution by taxa.

Bar-On, Yinon M., Rob Phillips, et Ron Milo. 2018. « The Biomass Distribution on Earth ». Proceedings of the National Academy of Sciences 115 (25): 6506-11. https://doi.org/10.1073/pnas.1711842115.

Reservoir 5 : Soil

950 GtC is inorganic carbon.

Credit: Antonio Jordán (distributed via imaggeo.egu.eu)

1500 Gt is organic carbon.

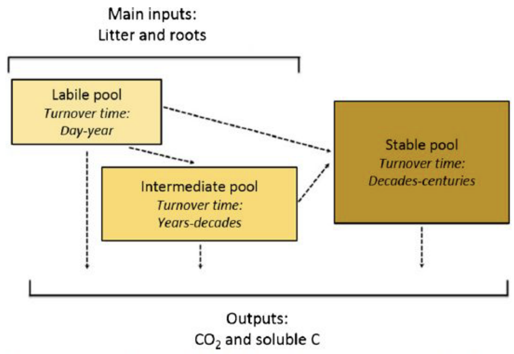
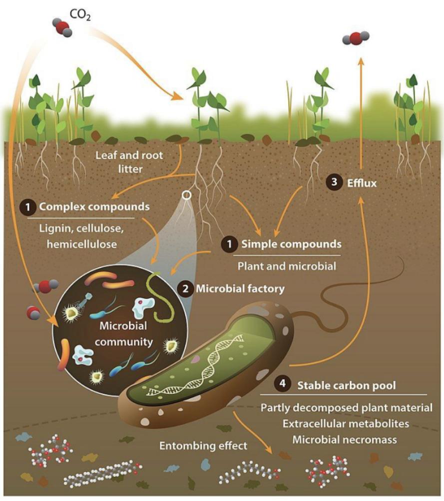


Fig. 1 Conceptual pools of soil C depending on its turnover time: labile, intermediate and stable pools

Dignac, Marie-France, Delphine Derrien, Pierre Barr , S bastien Barot, Lauric C cillon, Claire Chenu, Tiphaine Chevallier, et al. 2017. Increasing Soil Carbon Storage: Mechanisms, Effects of Agricultural Practices and Proxies. A Review . Agronomy for Sustainable Development 37 (2) : 14. https://doi.org/10.1007/s13593-017-0421-2.

Organic matter turnover (EN) = renouvellement de la matière organique (FR)

shoots (EN) = pousses (FR)



Naylor D, et al. 2020.
Annu. Rev. Environ. Resour. 45:29–59

Figure : Soil carbon (C) cycle through the microbial loop. Carbon dioxide (CO2) in the atmosphere is fixed by plants (or autotrophic microorganisms) and added to soil through processes such as ❶ root exudation of low-molecular weight simple carbon compounds, or deposition of leaf and root litter leading to accumulation of complex plant polysaccharides. ❷ Through these processes, carbon is made bioavailable to the microbial metabolic “factory” and subsequently is either ❸ respired to the atmosphere or ❹ enters the stable carbon pool as microbial necromass. The exact balance of carbon efflux versus persistence is a function of several factors, including aboveground plant community composition and root exudate profiles, environmental variables, and collective microbial phenotypes [i.e., the metaphenome (19)].

Naylor, Dan, Natalie Sadler, Arunima Bhattacharjee, Emily B. Graham, Christopher R. Anderton, Ryan McClure, Mary Lipton, Kirsten S. Hofmockel, et Janet K. Jansson. 2020. « Soil Microbiomes Under Climate Change and Implications for Carbon Cycling ». Annual Review of Environment and Resources 45 (1): 29-59. https://doi.org/10.1146/annurev-environ-012320-082720.

Reservoir 6 : Kerogen

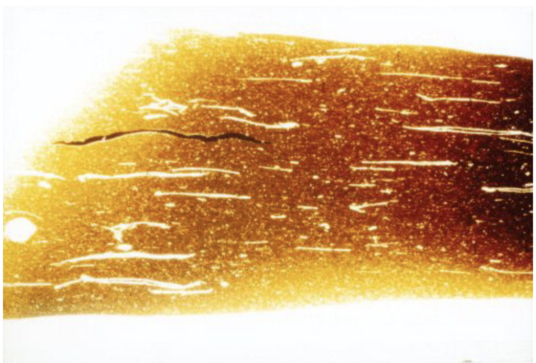
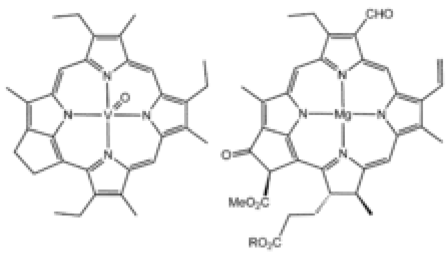


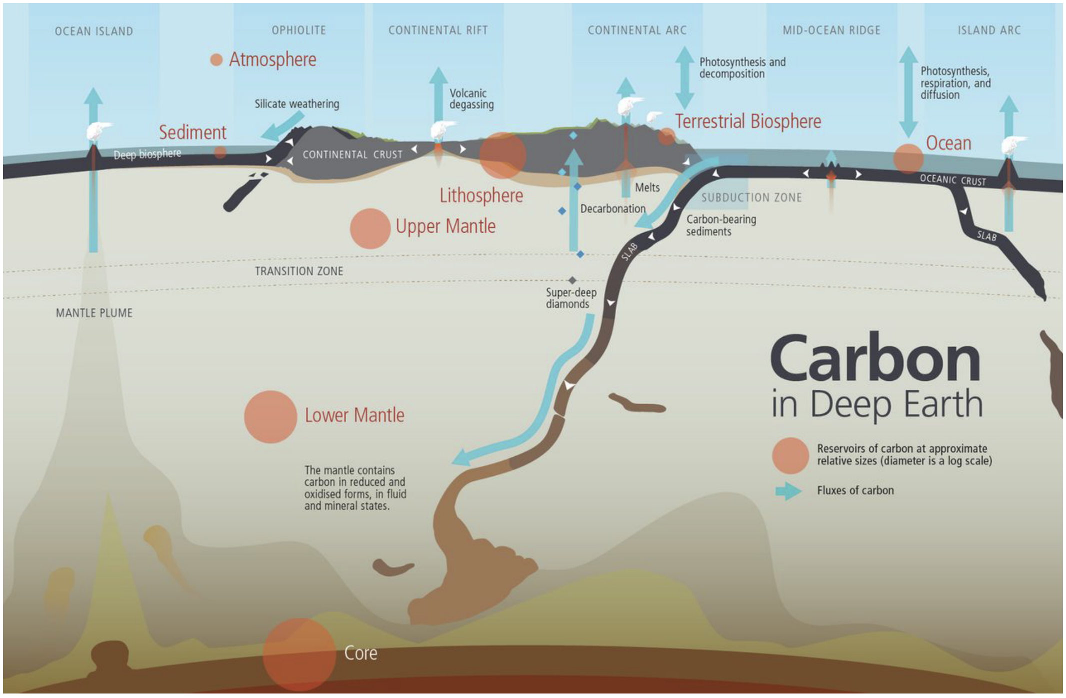
Figure. Photomicrograph of kerogen. This is the sapropelic Kimmeridge Coal (Upper Jurassic) from Dorset, UK. Cross-sections of bivalves are ubiquitous, and carbonized plant detritus is also visible. Reproduced with permission from Selley RC (2000) Applied Sedimentology, 2nd edn. London: Academic Press.



Structure of a vanadium porphyrin compound (left) extracted from petroleum by Alfred E. Treibs, father of organic geochemistry. The close structural similarity of this molecule and chlorophyll a (right) helped establish that petroleum was derived from plants

Kvenvolden, Keith A. 2006. « Organic Geochemistry – A Retrospective of Its First 70 Years ». *Organic Geochemistry* 37 (1): 1-11. https://doi.org/10.1016/j.orggeochem.2005.09.001.

Reservoir 7 : Mantle



3. Media

https://pod.utt.fr/video/4141-carboncycle-video2mov/