

# Organic and inorganic compounds, and biogenic and non-biogenic materials

|  | <b>Biogenic materials</b>  | <b>Transformed biogenic materials</b>  | <b>Non-biogenic natural materials</b>  |                                       |
|--|--|--|--|---------------------------------------|
| <b>Organic compounds</b><br>(Compounds with at least one C-H bond) | Carbohydrates, fats, and proteins of living organisms, and their remains   | Humins, humic acids, and fulvic acids (collectively "humic substances")<br>Coal<br>Organic matter (largely kerogen) in sediments<br>Petroleum (asphalt, oil, & natural gas)                                    | Methane in or from mantle<br>Hydrocarbons and hetero-compounds in volcanic gases<br>(Capaccioni et al. 2005; Teague et al. 2005)<br>C-bearing molecules, including amino acids, in meteorites (in carbonaceous chondrites)   | <b>Carbon-bearing compounds</b>       |
|  | Tests, shells, or skeletons of calcite (CaCO <sub>3</sub> ) (e.g., foraminiferal tests, brachiopod shells, and skeletons of bryozoa and Paleozoic corals)<br>Tests, shells, or skeletons of aragonite (CaCO <sub>3</sub> ) (e.g., pteropod tests, many mollusc shells, and skeletons of modern corals) | Atmospheric carbon dioxide (CO <sub>2</sub> ) from fossil fuels<br>Marine bicarbonate (HCO <sub>3</sub> <sup>-</sup> ) from CO <sub>2</sub> from fossil fuels<br>Calcitized aragonite<br>Limestones<br>Marbles | Atmospheric carbon dioxide (CO <sub>2</sub> )<br>Bicarbonate (HCO <sub>3</sub> <sup>-</sup> ) in groundwater, riverwater, and seawater, generated in weathering of rocks<br>Calcite (CaCO <sub>3</sub> ) cements in sandstones and limestones<br>Calcite in carbonatites<br>Diamond and graphite (C)<br>Moissanite (SiC) |                                       |
| <b>Inorganic compounds</b><br>(Compounds with no C-H bonds)        | Tests or skeletons of opalline silica (e.g., tests of diatoms and radiolarians, and skeletons of many sponges)<br>Phosphatic shells or skeletons   | Sedimentary Chert (finely crystalline quartz formed from opalline silica)<br>Phosphorite sediments   | Silicate minerals of igneous and metamorphic rocks<br>Most silicate minerals in sandstones<br>Most other minerals (sulfates, halides, sulfides, etc.)  | <b>Compounds containing no carbon</b> |

Organic chemistry is sometimes haphazardly defined as the chemistry of carbon-bearing compounds, and from its name one might assume that it is the chemistry of compounds made by organisms. One point of this page is to make clear that neither of those thoughts is correct. First, there are many carbon-bearing compounds that we designate as inorganic (shown in

the cells between the red lines, and most notably including carbonate materials). Furthermore, there are both organic compounds not formed by organisms (the upper right cell of the matrix) and inorganic compounds formed by organisms (the lower left cell of the matrix).