

Isomer Ratios

Isomers are compounds with the same formula but a different arrangement of atoms in the molecule, which can confer different properties. There are two general types of isomers: (1) Constitutional (or structural) isomers; and (2) Stereoisomers (which include diastereomers and enantiomers). A hallmark of living systems is their selectivity toward specific isomers involved in biochemical roles. This selectivity can lead to some readily identifiable and measurable molecular qualities that can be used as potential biosignatures (Summons et al., 2008). For example, enantiomers are pairs of the same molecule that are mirror images of each other. Life on Earth often displays a preference toward specific enantiomers (e.g., amino acids; sugars) to build functional polymers (e.g., peptides; nucleic acids), which can result in high levels of enantiomeric excesses in a sample, which might serve as signatures of biological activity (Avnir, 2021). Abiotic organic synthesis tends to form equal mixtures of enantiomers in the absence of an asymmetric chiral influence (i.e., a physical or chemical process that favors a specific enantiomer), although abiotic organic mixtures, such as those found in carbonaceous chondrites, sometimes display enantiomeric imbalances, which point to abiotic mechanisms of enantioselectivity (e.g., Glavin et al., 2020).