Abstract: Clumped isotopes are a recently developed suite of isotopic measurements that can, in principle, be used to identify equilibrium mineral precipitation in natural systems, and to trace the origins of kinetic disequilibria. Minerals that form in equilibrium can be used to reconstruct climates, and form the basis for the clumped isotope paleothermometer that is invaluable for reconstructing temperature conditions and is based on studying the distribution of heavy isotopes in CaCO3. By exploiting the thermodynamically-favored aggregation, or “clumping”, of heavy isotopes, a relationship between relevant earth temperatures and clumping frequency can be drawn. However, as with all proxies, there are caveats associated which limit their universal application. The clumped isotope paleothermometer requires isotopic equilibration of dissolved inorganic carbon (DIC) prior to mineral precipitation. This condition is violated on many accounts and leads to isotopic disequilibria that cause deviations from the established temperature and clumping correlation. Herein I use measurements of dual clumped isotopic species in CaCO3 to study two different types of natural systems. I demonstrate cases where there is equilibrium precipitation that in turn imply the mineral samples can be used to study past climates. In cases where there are kinetic isotope effects expressed, I examine mechanisms of disequilibria associated with CaCO3 mineral precipitation. The results demonstrate how dual clumped isotope data can be compared to theoretical predictions and lab experiments to study the transformation of DIC in different naturally occurring systems.