The "dolomite problem" is a classic geological enigma: we cannot explain, to the satisfaction of a great number of scientists, many rocks composed dominantly of dolomite. Although numerous Holocene examples, possibly analogous to some ancient deposits, have been described and are still being described, no analog exists to massive stratal dolomites common in the geologic past. Considering the brevity of the shallow water "platform-like" Holocene record, it is unlikely such analogs will ever be found. To compound the problem, dolomite has yet to be synthesized in the laboratory under earth-surface conditions. Practically, this means that we cannot test quantitative measures of dolomite behavior such as trace element distribution coefficients and isotopic fractionation factors.

Another complicating factor, which is also true of virtually all other chemically-generated sedimentary phases, is that the mineral which forms during or immediately following sedimentation is almost never preserved without chemical modification. Limestones provide an excellent parallel. Modern carbonate sediments are composed of the minerals aragonite and Mg-calcite, yet limestones are composed of calcite. The metastable "precursor" phases aragonite and Mg-calcite are transformed stepwise during diagenesis, according to Ostwald's rule, to a more stable configu-
ration. Primary chemical signatures are either irrevocably lost, or modified to the point that we are not yet able to untangle the original from the secondary. Dolomite behaves similarly.

Most Holocene dolomite is Ca-rich, very fine-grained, and is characterized by numerous crystallographic imperfections (e.g., Wenk et al., 1983). Aragonite and Mg-calcite, the precursor phases to limestones, are replaced by calcite as limestones form, and early-formed dolomite is similarly replaced during diagenesis by more stable dolomite phases. Our goal in utilizing isotopic data to understand dolomite (or any other chemically precipitated sedimentary phase) should be not only to characterize the primary sediment, or characterize the water from which it formed, but to understand the history of the sediment, from its chemical inception through its subsequent modification. We should not be surprised or disappointed if we are unable to deduce conditions of genesis, which remains only one (elusive) goal of sedimentology. In the case of dolomite, isotopic data have proven more useful than many other kinds of observations in documenting the geologic history of various kinds of dolomite.

Dolomite, CaMg(CO₃)₂, contains major cations (Ca and Mg), minor cations (e.g., Sr, Fe, Mn, and Rare Earth Elements), major anions (C and O), and possibly minor anions like borate and sulfate, all of which can substitute into the crystal lattice (as opposed to being adsorbed, or trapped in fluid inclusions). The potential number of isotopic systems which bear on the mineral dolomite is clearly very large! Only a few of the potentially useful isotopic systems have been utilized, however. All dolomite crystals are precipitates whether they "replace" other phases or form primary sediment or cements. Solid state reactions are precluded at the temperatures characteristic of sedimentary basins. Because dolomite precipitation from aqueous solution involves vast amounts of oxygen, oxygen isotopes have proven most useful in elucidating dolomite geochemistry. Carbon isotopes, though less useful, have the capacity to document both redox conditions and secular changes in ocean chemistry. One of the most nagging problems of dolomite genesis has been the source of sufficient amounts of Mg to account for large volumes of dolomite.