

Ceramah Teknik (Technical Talks)

C. Prasada Rao: Dolomitization in peritidal Ordovician carbonates, Tasmania, Australia.

Laporan (Report)

The talk by Dr. Prasada Rao (Department of Geology, University of Tasmania, G.P.O. Box 252C, Hobart, Tasmania, Australia) was held on 11 March 1991 at 5.00 pm at the Geology Department, University of Malaya, and it attracted about 30 members.

Abstrak (Abstract)

Dolomite, a common mineral in most of the stratigraphic sequences in the Gordon Group, is abundant in intertidal and supratidal carbonates and extends into some subtidal carbonates. Three major types of dolomitization are common, namely a) dolomitized burrows; b) mottled or dispersed dolomite; and c) laminar dolomite. Dolomite is predominantly subhedral, equigranular, fine-grained (submicron to 150 microns) and coarser than associated micrite. It is randomly distributed and replaces micrite extensively, and some oolites, peloids, intraclasts and rarely fossils. Sparry calcite cement and spar in veins are not replaced by dolomite. These features confirm that dolomite formed mainly during early diagenesis before and during spar cementation but prior to development of spar in veins. The former presence of evaporites is indicated in a few samples. Where dolomite is abundant, evidence of former evaporites is lacking, indicating that dolomites formed in normal marine to mixed-marine waters.

The ranges of Sr and Na concentrations are similar to those of marine to mixing zone dolomites. The Mn and Fe concentrations in the dolomite indicate oxidizing to reducing conditions and influence of continental water during dolomitization. The decrease of Sr and increase of Mn with increasingly lighter values of both $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ in dolomite and associated micrite indicate meteoric diagenesis during their formation.

Mole Creek dolomites are enriched in both $\delta^{18}\text{O}$ ($\pm 2\text{‰}$) and $\delta^{13}\text{C}$ ($\pm 0.5\text{‰}$) relative to co-existing calcites. The $\delta^{13}\text{C}$ values of dolomites and micrites are mostly parallel to each other in the stratigraphic sequence as a result of inheritance of $\delta^{13}\text{C}$ from the micrite replacement. The $\delta^{18}\text{O}$ values of dolomites and micrites are generally opposed to each other because $\delta^{18}\text{O}$ of dolomite is derived mainly from the dolomitizing fluids.

The Mole Creek dolomite isotopic field falls at the edge of the mixing zone dolomite isotope fields and overlaps that of the Ordovician-Silurian dolomite of Nevada because of the light $\delta^{18}\text{O}$ of seawater and related meteoric water. The dolomitization is characterized by variable isotopic composition of marine and meteorically altered sediment and variable water composition. For this reason the dolomite isotopic field ranging from marine to mixing zone,

overlaps marine calcite fields, extends toward meteoric calcite fields and is far removed from the burial calcite field. Dolomitization occurred simultaneously with or slightly after the transformation of metastable CaCO_3 to calcite during early diagenesis. The major mechanisms of dolomitization are tidal pumping of seawater mixing with continental waters and mixing of seawater by torrential rains, reflux and capillary movements.

Similar slopes of lines connecting $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ plots between co-existing micrite and dolomite pairs are due to small inheritance effects on $\delta^{13}\text{C}$ from dissolution of CaCO_3 and large variations in $\delta^{18}\text{O}$ in dolomite due to marine to mixing zone dolomitizing fluids. The $\delta^{13}\text{C}$ values of replaced precursor CaCO_3 were variable due to early meteoric diagenesis. Dolomites are in equilibrium with marine, mixed-marine and meteoric CaCO_3 because dolomitization occurred when CaCO_3 was metastable, simultaneously with or slightly after the transformation of metastable CaCO_3 to calcite during early diagenesis. Recrystallization of dolomite involved the renewed growth of dolomite on early-formed dolomite and replaced co-existing CaCO_3 . This involved negligible depletion in $\delta^{13}\text{C}$ and a small negative shift in $\delta^{18}\text{O}$.

Three conceptual temperature models are proposed to show that similar original isotopic slopes of calcite-dolomite pairs will be retained with little or no modification in $\Delta(\text{dolomite-calcite}) \delta^{18}\text{O}$ and $\delta^{13}\text{C}$ values with increasing temperature. The trend of depletion of both $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ due to diagenesis of organic matter with increasing temperatures is partly applicable to the calcite-dolomite pairs studied.

The Δ values of $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ are related to fluid composition, water/rock interaction, recrystallization of dolomite and some dedolomitization. Most of the $\Delta\delta^{13}\text{C}$ and $\Delta\delta^{18}\text{O}$ ratios are between 1:3 and 1:>10 indicating less ^{13}C relative to ^{18}O in fluid, due to low to moderate water/rock interaction and slight influx of meteoric and/or continental water into surface to shallowly buried marine sediments that caused most of the dolomitization.



C. Prasada Rao