

Early Dolomitization of the Middle Devonian Ratner Laminates by Diffusion and Recrystallization of Dolomite in the Elk Point Basin of Saskatchewan, Canada

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ABSTRACT

The Ratner carbonate varies from un-dolomitised, partially to completely dolomitised. Stratigraphic, petrographic and geochemical data indicate that the Ratner limestone has undergone early, near-surface dolomitization. Early-formed dolomite is cryptocrystalline to finely crystalline, and occurs more frequently in the upper and middle units than the lower unit of the Ratner laminate. Regionally, the Ratner laminate is thinner and completely dolomitised in the central part of the study area, and is more intensely dolomitised in the southeastern part than in the northern part. The dolomite has $\delta^{13}\text{C}$ values between +1.3 and +3.8‰ PDB (average 2.7‰) and $\delta^{18}\text{O}$ values between -4.9 and -6.4‰ PDB (average -5.6‰) respectively. The $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of early-formed dolostone vary from 0.70793 to 0.70814 (average 0.70802), suggesting the dolostone developed from the Middle Devonian seawater. The Ratner dolomite is interpreted to have formed syn-depositionally by diffusive flux. The diffusion model can satisfactorily explain vertical, lateral and regional variations in the distribution of the Ratner dolostone. Calculation indicates that diffusive flux of Mg^{2+} from overlying seawater is capable of dolomitization of carbonate from 0.4 to 100% volumetrically depending on Mg^{2+} concentration gradient and sedimentation rate. The oxygen isotope compositions, some $^{87}\text{Sr}/^{86}\text{Sr}$ ratios and textures of the early-formed dolomite are not compatible with early stage, near-surface dolomitization. The discrepancy is considered to be the result of recrystallization.