DOLOMITIZATION OF RECENT AND PLIO-PLEISTOCENE SEDIMENTS BY MARINE EVAPORITE WATERS ON BONAIRE, NETHERLANDS ANTILLES

The carbonate rocks and sediments on the island of Bonaire in the Netherlands Antilles contain interesting examples of early dolomitization. A large flat area of Recent supratidal sedimentation exists on the south end of Bonaire, and in this area evaporation of sea water is depositing calcium carbonate and gypsum, which produces dense brines having large Mg/Ca ratios. Dolomite is found in most of the Recent supratidal sediments, and carbon-14 dates on the dolomite establish that the time since dolomitization has been less than 2,200 years. Textural evidence indicates that some of the dolomite was formed by replacing lime sediments.

The dense brines produced by evaporation tend to flow downwards into the permeable sediments, and an analysis of the chemistry and hydrology of a hypersaline lake chosen for detailed study shows that downward drainage of brine having a Mg/Ca ratio of about 30 must be happening today. Examination of marine Plio-Pleistocene rocks on the north end of Bonaire shows large areas of dolomitization whose boundaries cut across the bedding. The field evidence is consistent with the hypothesis that this dolomite has been produced by the flow of dense brines from a supratidal area. The time required to produce the estimated volume of dolomite found in the Plio-Pleistocene rocks would be of the order of 10^5 years.

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PETROGRAPHY OF THE SOUTHESK-CAIRN CARBONATE COMPLEX, WESTERN ALBERTA, CANADA

Regional and petrographic studies suggest that a specialized reef association was responsible for the build-up of the carbonate mass. Although dolomitization has preferentially affected certain formational members, some original textures and rock constituents may be recognized.

At the Mount Dalhousie type section, the complex has divided into lower Cairn and overlying Southesk formations. The coarsely crystalline, light gray dolomites of the Peechee member, Southesk formation, were originally medium and coarse calcarenites with some areas of algal-stabilized sediment. The whole is suggestive of a depositional environment with strong currents and local sheltered areas. Where dolomitization is incomplete, there is a preference for replacement of integranular sparry calcite. It is suggested that this is an early diagenetic event that took place prior to complete infilling of porosity by calcite precipitation.

The Arcs member, in contrast, consists dominantly of microcrystalline calcite with eyes of clear sparry calcite (dismicrite and birdseye limestone), with sporadically distributed areas of calcarenite and layered algal limestone. Comminuted skeletal remains are abundant, although locally, delicate undamaged ostracod shells occur; the latter partly infilled with microcrystalline calcite constitute geopetal fabrics and indicate quiet microenvironments where the fine calcite or aragonite particles settled out. A relatively quiet environment is postulated during deposition of most of this member, with algal-stabilized areas building up locally to further restrict circulation. The algal material was in turn frequently torn up, presumably during storms, and incorporated as intercalated calcarenites in the predominantly microcrystalline rock sequence of the Arcs member.

The overlying Ronde member, composed of calcarenite, microcrystalline limestone, silty limestone, silty dolomite and siltstone, probably accumulated under unsettled conditions. Globular stromatoporoids appear to have been characteristic of turbulent reef-margin areas and colonial corals of rather deeper and turbid environments. The sedimentary record terminates at an unconformity beneath the overlying Sassenach formation.

Viewed as a whole, the carbonate complex has been extensively dolomitized. Various types of dolostone have been mapped and studied with a view to equating them with limestone facies, establishing a reef model and interpreting the dolomitized sequence.

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CRITICAL ANALYSIS OF THE GLADSTONE-DALE RULE AND ITS CONSTANTS

The Gladstone-Dale rule, which is an empirical attempt to relate chemical composition, refractive indices, and density, was applied to minerals by Larsen in 1934. In 1956, Jaffe offered some corrections and additions to Larsen's original constants.

While applying the Gladstone-Dale relationship to some tellurites and selenites this writer found that Larsen's constants for TeO_2 and SeO_2 required revision. Furthermore, the value of these constants, as well as those for many other oxide components, varied widely, depending on the particular compounds used to calculate them.

Values of k for various oxide components are given here, using Larsen's form of the Gladstone-Dale equation:

$$\frac{n-1}{d} = k_1 \frac{p_1}{100} + k_2 \frac{p_2}{100} + \cdots k_n \frac{p_n}{100}.$$

In this equation, n is the average index of refraction, d is the density, k is the specific refractive energy for a particular oxide component, and p is the weight percentage of the component.

Oxide	*Larsen's k*	*Aver.*	*k—This Study Range*	*No. of Compounds*
Cs_2O	.124	.120	.116–.122	3
CaO	.225	.225	.213–.239	7
CoO	.184	.182	.167–.206	4
CuO	.191	.182	.173–.201	8
ZnO	.153	.160	.139–.179	4
BaO	.127	.128	.123–.132	6
PbO	.137	.144	.125–.169	7
SeO_2	.147	.196	——	1
TeO_2	.200	.193	.181–.206	4

Users of the Gladstone-Dale relationship should realize that wide differences between calculated and observed refractive indices and densities may be caused by the variation in k values.

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TECHNIQUES OF EXPLORATION FOR BURIED LANDSCAPES

Hydrocarbon traps are customarily subdivided into two main classes: structural and stratigraphic. A third important class, hitherto not considered separately, includes hydrocarbons trapped in buried hills, ancient valleys, fossil reefs, and other primarily geomorphological phenomena. These are referred to as paleogeomorphic traps. The analysis of and prospecting for this type of trap must proceed along purely geomorphological lines of reasoning.

Paleogeomorphology covers all geomorphic phenomena recognized in subsurface geology; i.e., all