

3-D Computer Based Modeling of Carbonate Platforms

HÜSSNER, HANSMARTIN, JOCHEN ROESSLER, CHRISTIAN BETZLER, and RAINER PETSCHICK, Johann Wolfgang Goethe-University Frankfurt am Main, Senckenberganlage 32, 60054 Frankfurt am Main, Germany

REPRO is a three-dimensional computer simulation program to investigate reef and carbonate platform growth. It produces 3-D block diagrams, fence diagrams and "cores" that can be pulled out at any desired section of the modeling area. In the sections stratal geometries and facies distribution can be studied.

The growth simulation of the model comprises four parts; (1) a reef growth routine, (2) a lagoon growth routine, (3) a fore reef deposit routine, and (4) an identification routine which determines fore reef region, reef region, and lagoon region. Central to part (1) is a FISHER equation which combines logistic growth with spatial diffusion. This partial differential equation is adapted to the marine reef growth conditions: The solution is a time- and space dependent function. It can be approximated by the solution of a system of coupled ordinary differential equations (ODEs), one for each node on the triangular grid and derived from the FISHER equation by finite element methods. This way, the solutions of the ODE system represent approximations to the solution on the nodes. The lagoon growth routine (2) is controlled by the sea level. That is, the growth height of the lagoon follows the sea level about 4m below the level to account for growth prevention due to hydrodynamic ablation mechanism.

Distribution of fore reef deposits and debris (3) is simulated by first identifying the reef crest nodes. For each of them from the 4 nearest neighbor nodes the one with the lowest height value (on the fore reef side) is selected and its height is increased by a user-set amount. Again, from its 4 nearest neighbor nodes the one with the lowest height value is height-increased. Iteration of this procedure simulates the downhill sliding process of reef debris on the fore reef slope.

The identification routine (4) attributes to each node an affiliation either to fore reef, reef, lagoon, or region of favored growth on reef or fore reef. According to this affiliation reef growth, lagoon growth, or fore reef deposit conditions are set for the nodes.

So far the model has been used to test platform growth principles such as ramp/rimmed shelf transitions and platform drowning. Moreover the Miocene Lluçmajor Platform (Mallorca, Spain) has been modeled. A section cut out of the modeling area close to the present coastal cliffs offered the opportunity to compare the modeled reef with the real world. Geometries and facies of the model compare well with the sections from Mallorca published by Pomar et al. (1996).

The next project will be a 3-D modeling of the Permian Capitan Reef (Texas, New Mexico, USA).

Pomar, L., Ward, W.C. & Green, D.G., 1996. Upper Miocene Reef Complex of the Lluçmajor area, Mallorca, Spain. In: Franseen, E., Esteban, M., Ward, W.C. & Rouchy, J.M. (Eds.), Models for carbonate stratigraphy from Miocene reef complexes of the Mediterranean regions. Soc. Econ. Paleont. Mineral., Conc. Sediment. Paleontol. Ser. 5, 191-225.