CHAPTER 4

Some of the material in the following chapters is dealt with in more detail in Read and Horbury (1993).

RESERVOIRS ON PLATFORMS DEVELOPED UNDER SMALL, HIGH FREQUENCY SEA LEVEL OSCILLATIONS (GREENHOUSE CONDITIONS)

Greenhouse cycles may include, the Cambro-Ordovician of the U.S. Appalachians (Koerschner and Read, 1989; Demicco, 1985), Late Silurian and Early Devonian of New York (Goodwin and Anderson, 1985), many Mid to early Late Devonian platforms in Australia and North America (Read, 1973; Wendte and Stoakes, 1982; Elrick, pers. comm., 1992), the Late Permian of the Permian Basin, U.S.A. (HovORKa, NANCE and Kerans, 1992; Borer and Harris, 1991) the Mid to Late Triassic (Fischer, 1964; Schwarzacher and Haas, 1986; Goldhammer et al., 1990), the Early Jurassic, Morocco (Crevello, 1991) and the Late Jurassic (Mitchell et al., 1988) and Cretaceous (Strasser, 1988).

Key Features

During greenhouse times there is little or no polar ice, thus:

1. Cycle stratigraphy will be dominated by high frequency carbonate cycles, commonly less than 20 k.y. duration, that formed under low amplitude precessional driven sea level changes, perhaps with superimposed small 100 k.y. and 400 k.y. sea level fluctuations

2. Carbonate platforms typically are aggraded and flat-topped to gently sloping.

3. Sub-seismic scale peritidal meter scale cycles or parasequences commonly have regionally extensive tidal flat caps

4. High relief buildups such as pinnacle reefs are absent from parasequences on the shallow platform top

5. Parasequences tend to have "layer cake" stacking patterns, arranged into large scale transgressive onlap and regressive offlap patterns within 3rd order depositional sequences

6. Marginal reef/grainstone facies show limited lateral migration from cycle to cycle; may be thick and poorly partitioned, or highly compartmentalized

7. Cycle capping disconformities are relatively poorly developed.

8. Small sea level changes limit vertical migration of ground water tables relative to the platform surface. Arid zone flats generally associated with pervasive early dolomitization of inner platform as brine systems migrate seaward during progradation. Humid settings may develop limited meteoric/mixed lenses beneath exposure surfaces.

Fourth and Fifth Order Sea Level Changes, Greenhouse Times:

Sea level changes during greenhouse times appear to be driven by precession (Fig. 1-5), which today is 19 to 23 k.y. but in the past may have been less than this, and perhaps as little as 15 to 17 k.y. in the Early Paleozoic (Berger et al., 1989). However, it is possible that 10 k.y. and higher frequency cycles also are important. The magnitude of the sea level changes forming precessional greenhouse cycles probably were small, and less than 10 m (Goldhammer et al., 1990; Koerschner and Read, 1989; Wright, 1992) although facies within contemporaneous intrashelf basins suggest somewhat larger sea level changes. Cycles may be bundled into what have been interpreted as eccentricity cycles composed of 5 precessional cycles, which may be observed on Fischer plots as in the Middle Triassic Latemar platform