channeled estuarine system developed landward of the retrograded shoreline trend. During this tide-dominated aggradational phase, channels migrated over the back-barrier area and produced the relatively coarser sand facies capping the Point Lookout in the study area. After the estuarine system was infilled, coastal plain facies were established in the former back-barrier zone and progradation was renewed. With the repetition of this depositional pattern through time, the coastal plain advanced in a step-wise fashion.

As a consequence of the progradational-transgressive cyclicity, a significant degree of stratigraphic rise was attained during the Point Lookout regression. Each time-stratigraphic coastal sand body acts as a discrete reservoir that interfingers landward with impermeable sediments of the coastal plain facies. Given the necessary present-day structural configuration, major stratigraphic rises corresponding to aggradational phases can act as updip migration boundaries to gas derived from the center of a basin.

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Radiolarian Preservation in Geologic Sequences

The following observations were noted during fieldwork in Tethyan regions.

1. Radiolarians are often preserved where organic matter is abundant, generally in reduced environments or microenvironments resulting from transgression or confined basins. Such an anaerobic environment preserves silica from dissolution.

2. Radiolarian localities are commonly restricted to small basins (e.g., the Gulf of California).

3. In limestones, radiolarians are commonly restricted to small "nests" preserved in pyrite. This restriction may be a result of their sedimentation within fecal pellets, reducing microenvironments.

4. Preservation is generally better in rocks rich in clays (clayey limestones, nonglassy cherts). The clays may produce a double effect: (a) to form protective varnish all around the shell, (b) to slow the opal-A to opal-CT transformation so the structure of the opal-CT is better organized and much less subject to subsequent dissolution.

5. Radiolarians in limestones are generally calcitized. However, in rich limestones where silica is not concentrated in nodules but is "diffuse," radiolarians remain preserved in silica. This results from clays which limit (a) the opal-A to opal-CT transformation which occurs in a fluid state and (b) the migration of the silica fluid.

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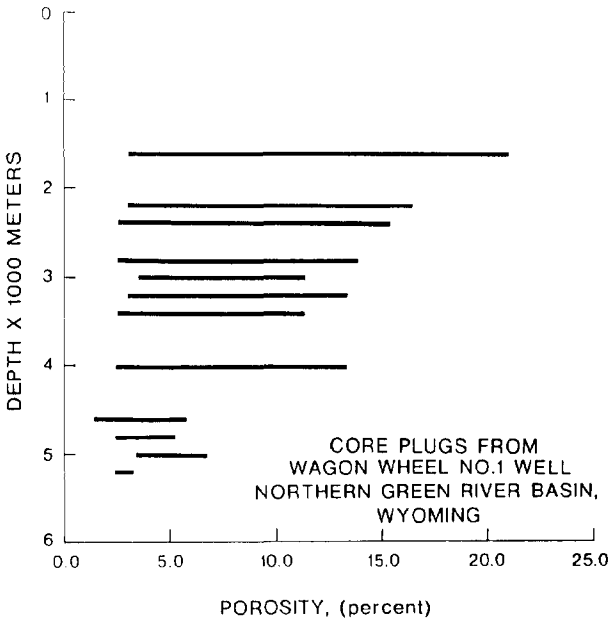
Diagenesis of Nonmarine Rocks and Gas Entrapment in Northern Green River Basin, Wyoming

More than 5,000 m (16,404 ft) of Upper Cretaceous and Tertiary nonmarine rocks have accumulated in the northern Green River basin. At depths below 3,000 m (9,842 ft), they contain large reserves of natural gas in low-permeability, overpressured sandstones and siltstones. Isotopic, petrographic, and mineralogic studies of cores from seven wells reveal that an intricate sequence of diagenetic events has acted upon mineralogically immature sediments to produce the observed low permeabilities. In large portions of the basin, this low permeability impedes the leakage of pore fluids, including gas. Gas accumulates in sandstones because it is generated from humic matter at a rate that exceeds its ability to escape. Gas entrapment due to low permeability is demonstrated by overpressuring. The overpressuring results from a combination of overburden removal and generation of fluids by organic matter maturation.



In the central part of the basin, normal hydrostatic pressures exist down to about 2,500 m (8,200 ft). Sandstone porosities in this zone range from 10 to 15% and permeabilities usually exceed 10 md. Below this depth, sandstones have greatly reduced porosities and permeabilities and become increasingly overpressured. At depths of about 3,500 m (11,483 ft), overpresssuring and gas accumulation are associated with sandstones that have average porosities of about 7% and in-situ permeabilities of approximately 0.005 md. This transition is not marked by a depositional boundary.

Porosity reduction, which is assumed to be paralleled by permeability loss, proceeds by some combination of three principal processes: (1) precipitation of calcite or silica cements early in the burial history; (2) porosity loss through grain deformation and compaction; and (3) the filling and coating of residual and secondary pores by illite, chlorite, microcrystalline quartz, or ferroan carbonates.

A wide range of porosities is present in each depth interval, but maximum sandstone porosity follows a relentless course of destruction with depth. Only locally has the magnitude of grain and cement dissolution been great enough to reverse the porosity-depth trend. Zones of conventional reservoir porosity and permeability have not been recognized in areas of overpressuring and gas accumulation, nor are they to be expected. Because the gas is diagenetically entrapped, the search for economic accumulations should, paradoxically, be limited to sandstones of low porosity and permeability.

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Acritarchs from Ponta Grossa Formation and Their Stratigraphic Significance—Devonian of Parana Basin

The Devonian fossil record in the Parana basin of Brazil is