MISSISSIPPIAN OIL FIELDS OF NORTHEASTERN WILLISTON BASIN

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ABSTRACT

Anhydrite seems to be the most important factor in forming the seals for Mississippian reservoirs in the northeastern portion of the Williston Basin. There are at least three methods by which anhydrite helps to seal the reservoirs of this area.

First, secondary anhydrite along the unconformity at the top of the Madison forms an impervious zone of variable thickness by filling the fractures and pores of associated rocks.

A second type of seal is created by primary anhydrites interbedded with porous, often vuggy, fragmental limestones. The angle between the unconformity and bedding is small so the primary anhydrites often help to form the seal along the weathered area.

A regional facies change, in which porous reservoir beds grade to dense anhydrites in an easterly direction as the basin edge is approached, is a third type of seal.

This paper, covering a small portion of the Williston Basin, is confined to a series of relatively new fields discovered in southeastern Saskatchewan, extreme southwestern Manitoba and north central North Dakota. All produce from the Madison limestone of Mississippian age and all have one or more of the sealing factors.

Normally, the Madison limestone is divided into Lodgepole, Mission Canyon and Charles. The Charles represents an evaporitic stage at the end of Madison deposition. Mission Canyon and Charles both represent a cyclic deposition referred to in other published papers on the Madison limestones. The oil fields mentioned in this paper produce from the Mission Canyon and Charles sections. By detailed analysis, it can be shown that individual beds of limestones on the basinward side completely change laterally first to fragmental limestone with algal pisolites, then finally to dense anhydrites near the edge of the basin. If the term Charles is used, it represents much older beds on the basin edge than are found farther into the basin. This condition is very easily demonstrated in an east-west direction. In a northerly direction, the condition does not exist to such a degree because the unconformity truncates the section at a rate faster than the facies change so the evidence is lost. Since Charles-Mission Canyon terminology is not suitable here, the subdivisions proposed by the Saskatchewan Geological Society, MC 1, 2, 3, 4 and 5 and C-1, C-2 will be used.

Oil fields, to date, have been confined to structural noses with little or no reversal, but having the anhydritic weathered zone or facies change as an updip seal.