RESERVOIR QUALITY OF THE VIKING FORMATION, DODSLAND AREA, SASKATCHEWAN

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ABSTRACT

Cores of the Viking Formation from seven wells in the Dodsland Field and surrounding area were examined in detail to provide petrologic data to aid in selection of efficient exploitation methods. Study techniques included core examination, X-ray diffraction, scanning electron microscopy and thin section petrography.

Viking sediments are Upper Albian marine deposits which have been shown to be linear offshore sand bodies enclosed in shale. The sandstones are commonly parallel to paleoshorelines in Alberta and have been recently interpreted to be barrier island (Tizzard and Lerbekmo, 1975) or shelf (Beaumont, 1984) sandstones. In the Dodsland area of Saskatchewan, sandstones appear to occur at high angles to the paleoshoreline and have been interpreted to be tidal sand ridge deposits (Evans, 1970). Both storm-generated shelf sandstones and tidal ridge sandstones may coarsen upwards and are thus not easily differentiated. The linear sandstone bodies may all represent storm-generated shelf deposits.

Cores from the study wells consist of interlaminated shales, siltstones, and sandstones. Black shale containing sand lenses grades into black carbonaceous shale above and below. Porosity and permeability are highest in the sands, with communication between sandstone lenses via very low porosity and permeability siltstones or shales. Porosity types within the sandstones include intergranular porosity and significant amounts of microporosity associated with clay mineral assemblages.

Sandstones in all the cores examined are typically subtharenites which locally grade into siltstones of similar composition. The sandstones are poorly cemented by quartz, siderite, pyrite, and kaolinite. Detrital and authigenic clay minerals play a significant role in porosity and permeability reduction. These clays include smectite, illite (often with smectite interlayers), and trace to minor amounts of kaolinite and chlorite.

INTRODUCTION

The Viking Formation in southwest Saskatchewan, in particular the Dodsland area, has been subject to extensive exploration. In contrast to the Viking Formation of Alberta, little recent work has been done on the petrology of the Saskatchewan oil bearing sequence. The subject of this paper is a petrologic appraisal of the Viking Formation to provide a better understanding of the desirable and undesirable features which characterise this often marginal reservoir. Examination and detailed petrographic studies on cores of producing Viking strata from seven wells provide the basis for the study and its application to the surrounding potentially productive Viking Formation. Four cores studied are from wells at the following locations: 2-32-26-19W3; 7-17-30-20W3; 12-24-31-20W3; and 16-16-30-21W3. Three of the cores studied are confidential.

STRATIGRAPHY

The first reference to the Viking Formation was by Slipper (1918) in which he refers to the Viking gas sand, a producing horizon of the Colorado Group near the town of Viking in east central Alberta. The Viking Formation is now recognized to be Upper Albian in age and is underlain by the Joli Fou shale and overlain by the Colorado shale (Fig. 1). The overlying Colorado shale is conformable with the Viking Formation but the underlying Joli Fou may be unconformable. This unconformity is indicated by westward thinning of the Joli Fou and a sand-filled desiccation crack in the Joli Fou about 3m below the Viking contact (Jones, 1961).

The Viking Formation in the study area consists of very fine to coarse sand, silt, and silty shale. Chert pebbles and glauconite are common. The Formation is about 20 m thick near Viking, Alberta. It thickens to more than 75 m to the west and south and "shales out" to the east and north (Norgaard, 1954).

GEOLOGICAL SETTING AND DEPOSITIONAL ENVIRONMENT

Viking sediments make up part of Sloss's (1963) Zuni Sequence; they were deposited in a shallow epeiric sea which covered much of the North American craton during the Cretaceous. This sea was bounded by the cordilleran orogen to the west and the emergent centre of the craton to the east. The paleogeographically high cordilleran region supplied most of the sediment to the basin at this time. The Viking Formation thickens towards this westerly source (Beaumont, 1984).

Environmental interpretation of the Viking Formation has been the subject of some controversy. Viking sediments have been interpreted to be deep water turbidites (Beach, 1955) and barrier island deposits (Tizzard and Lerbekmo, 1975). Deposition on a shallow marine shelf, dominated by either tidal (Evans, 1970; Simpson, 1975) or storm-generated currents (Beaumont, 1984) is more probable.

Recent research on continental shelf sands along the east coast of the United States (e.g., Duane et al., 1972; Swift et al., 1972) has provided a modern analogue for some marine sandstone sequences. Viking sandstones are enclosed in marine shales and were probably formed into linear ridges by storm activity. Since these sand ridges are enclosed in marine shales it is probable that they were at a moderate distance from the shoreline. The emplacement of sands and gravels tens of kilometres offshore onto the shaly shelf is problematic. Linear sand ridges may be formed subparallel to the shoreline during a transgressive period as suggested by Duane et al. (1972) or the may form by the storm reworking of turbidite or stream deposits. The modification of turbidite deposits by storm processes is suggested by Walker (1983) for the Cardium Formation in Alberta. Beaumont (1984) suggests that pebbles in the