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HUME FORMATION, LOWER MACKENZIE RIVER AREA

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Hume Formation, lower Mackenzie River area

Preamble

The Hume Formation has been described and discussed in numerous publications; to mention only a few: Bassett and Stout (1967), Tassonyi (1969), Gilbert (1973), Kunst (1973), Pugh (1983) and A.W. Norris (1985). The latter reference contains the most complete review of paleontological data. All of the above references contain some discussion on the environment of deposition, correlation and petroleum potential.

The purposes of this report are:

1. to present a convenient, largely graphic summary of the Hume Formation in the subsurface of the lower Mackenzie River drainage basin;
2. to illustrate or discuss some aspects of Hume depositional history that may be pertinent to petroleum exploration in this area.

The two maps (Figs. 2, 3) were compiled from surface geological maps as shown on the index map, Figure 1, and from all available subsurface data. Lithological data are derived from company well reports, lithologs by Canadian Stratigraphic Services Ltd., and my own observations of both surface and subsurface sections.

Some generalities

The Hume Formation consists of limestone and shale. Almost all Hume limestones are argillaceous to some degree; all Hume shales are calcareous. The argillaceous material ranges from clay to fine silt. Some organic matter is almost always present in both limestones and shales; some beds are highly organic.

Fossils are common, often abundant: brachiopods, crinoids, corals, stromatoporoids, ostracods and others. Small biohermal mounds occur, with dimensions of only a few metres. No large bioherms have been reported.

Porosity is rare in Hume limestones. From a petroleum prospector's point of view, the Hume should be regarded as a cap-rock and, possibly, as a potential source-rock; it cannot be regarded as a prime reservoir target.

Nevertheless, the Hume may prove to be important to petroleum prospectors. Because of the abundance of correlatable intra-Hume markers, it is possible to map small-scale growth structures, facies trends, etc. With caution such data can be applied to more prospective Devonian reservoir horizons.

Subdivisions

Possibly no two geologists will agree on how to subdivide the Hume Formation. A twofold division is employed here, based primarily on the character of gamma-sonic logs. Correlation through the lower unit is usually good; where wells are closely spaced (5-10 km) point-for-point correlation is commonplace, with only subtle changes in character and thickness of individual marker beds. The upper Hume section, in contrast, exhibits only a few markers that can be traced with confidence between wells.

Several representative well logs of the Hume Formation are displayed on the maps, Figures 2 and 3. These sample well logs, however, do not adequately demonstrate the validity of the chosen correlation; skeptical readers must resort to a study using all available well logs.

Discussion

The contact between the Landry and Hume formations is gradational but abrupt. The change is from fairly clean, sparsely fossiliferous or unfossiliferous pelletal Landry limestone to richly fossiliferous argillaceous limestone and/or shale. This change clearly reflects a rather sudden, widespread deepening event, or transgression.

Throughout lower Hume time the locus of maximum carbonate deposition lay in the west and northwest. Belt A (Figs. 1, 2) consists entirely of limestone except for the basal few metres of shale. The belt A carbonate bank flanks the Richardson Trough for some 300 km, then apparently trends to the northeast, parallel to the

Eskimo Lakes Arch. However, the northeastern segment is somewhat speculative, only three wells penetrate the Hume Formation in this area. The belt A bank is exposed at the Mackenzie Mountain front, just east of Snake River. Unfortunately, these outcrops are not described in any published reports. From personal observation (Williams, 1969) the Hume limestone in this area is well bedded, argillaceous, micritic; although stromatoporoids and corals are abundant in some layers, the limestone is non-reefal. Because of structural complications, the thickness is unknown.

The belt A bank presumably shales-out rather abruptly westwards. The transitional facies has not yet been drilled (or, if drilled, has not been recognized). In the outcrop belt the westward disappearance of the Hume limestone has usually been ascribed to pre-Canol erosion; however, a transition to shale is a tenable hypothesis, given the paucity of outcrop.

To the east and southeast the belt A bank grades to interbedded limestone and shale. The proportion of shale, both as thin, discrete beds and as a contaminant of the limestone, increases very gradually to the east.

Isopachs of the lower Hume (Fig. 2) probably reflect syndepositional differential subsidence. The locus of maximum subsidence lay in the west, near the south end of the Richardson Trough. One can make no deductions regarding the tectonic behavior along what later became the Eskimo Lakes Arch. The nose of a broad arch is shown southwest of Fort Good Hope (~66°10'N, 128°10'W); this is a somewhat speculative interpretation, given the large area in which no wells have been drilled.

In upper Hume time the belt of maximum carbonate deposition shifted to the east. The insert cross-section on Figures 2 and 3 suggests a fairly dramatic transgressive pulse; facies belt D of upper Hume (belt of maximum limestone) lies some 200 km southeast of lower Hume belt A. Unlike the lower Hume, the upper Hume thins and becomes increasingly shaly to the northwest.

Isopachs of the upper Hume cannot be taken, with assurance, as a measure of differential subsidence. At least two other interpretations are tenable: 1. the northwestward thinning is a depositional phenomena, i.e. carbonate deposition persisted in the southeast after the northwestern part of the Hume platform had drowned; or, 2. the thinning is a pre-Canol erosional phenomena. If pre-Canol erosion is accepted, there are two further possibilities: 2a. subaerial erosion, indicating post-Hume uplift of the Richardson Trough and Eskimo Lakes Arch or 2b. submarine erosion of the drowned Hume platform, which yields no particular tectonic implications.

Based on basinwide considerations (Williams, 1983, 1984) and the physical geometry of the Hume/Hare Indian/Kee Scarp sequence (Williams, 1985) I favor the drowning hypothesis (item 1. above) with local occurrences of pre-Canol submarine erosion. The small area where the Hume Formation is missing near Point Separation, as indicated by the Tree River I-38 well (~67°20N,132°W) may be an example of a local submarine scour (see also cross-section in Figure 4).

As mentioned earlier, there is no known example of a barrier reef facies where the Hume limestone passes westward into shale. Nor has such a facies been seen farther south at the Nahanni limestone front (see Noble and Ferguson, 1973). The Hume-Nahanni carbonate/shale transition would appear to be analogous (in a geometric sense) with that of the Nisku Formation. Given this analogy, one might expect to find reefs or mounds on some of the clinoform beds of the transition belt (e.g. Jean Marie or Pembina-type build-ups).

Only one post-Hume reef is known within the map area. Manitou L-61 (~66°20'N, 128°W) near Fort Good Hope encountered a 225 metre thick build-up (see cross-sections, Williams, 1985). The top of this particular reef is near the surface, and is overlain by Cretaceous sandstone; it is too shallow to have any petroleum potential. However, other such reefs surely exist within the map area, as they do farther south (Rainbow reefs, Horn Plateau reefs as well as within the Utahn Embayment; see

Williams, 1981). At the present time there is no satisfactory concept or set of rules to predict where post-Hume reefs are to be expected.

There are no published studies on the Hume Formation as a potential source-rock; however, its petroliferous nature is often noted in well reports. Preservation of organic material in certain Hume strata may be explained by postulating deposition within a partly silled basin, with cyclic alternations of stagnant and normal-marine conditions. The geometry of the facies belts of lower Hume strata suggest such conditions. The rim-carbonate, belt A, may have restricted access to the western sea.

The Hume Formation of the north correlates with the Nahanni and Headless formations of the south. The logical dividing line between the two nomenclatural systems is just south of Norman Wells. As indicated on the inset cross-section of the maps (Figs. 2, 3), correlation is uncertain. It is possible that the bulk of the Nahanni limestone in the K-03 well is slightly younger than any part of the Hume Formation.

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