THE CHARACTER OF THE BLUESKY FORMATION IN THE FOOTHILLS OF NORTHEASTERN BRITISH COLUMBIA (93O, P, I)

By W. E. Kilby

The Bluesky Formation has been extensively studied and mapped in the subsurface of northeastern British Columbia and Alberta (Alberta Study Group, 1954; Pugh, 1960; Karst, 1981; and White, 1982). There it reaches a thickness of 25 metres and is an oil and gas producer. In the adjacent foothills equivalent strata are encountered in the course of coal exploration. The unit is situated between the marine Moosebar and the coal-bearing Gething Formations; it is important as a marker horizon over much of the Northeastern British Columbia Coalfield. The unit may also be important in controlling the pyrite content in some underlying Gething coals. Widely spaced sections show that the Bluesky varies considerably in thickness and lithological composition (Figs. 41 and 42). Taken in conjunction with tonstein/bentonite 'time lines' it becomes apparent that the erosional base of the unit is regionally irregular. Previous work showed that what has traditionally been referred to as Bluesky equivalent strata north and south of the Sukunka River are at two different stratigraphic positions (Duff and Gilchrist, 1982). In this paper these two stratigraphically different occurrences will be informally referred to as Bluesky-N and Bluesky-S. Bluesky-N is found north of the Sukunka River and is stratigraphically below Bluesky-S.

In beds known as Bluesky, as in the coal-bearing Gething and Gates Formations, there appears to be a major change in character between the Sukunka and Wolverine Rivers. North of this area the Gates is dominantly marine and lacks major coal seams; the Gething is the major coal-bearing sequence. To the south the Gates contains economically important seams; the Gething is less important. Throughout Cretaceous time the Peace River Arch affected sedimentation patterns in this area (Stott, 1975; Stelk, 1975).

In the Sukunka-Wolverine area what is known as the Bluesky-S is usually about 1 metre thick, is glauconitic throughout, and may contain some sand or floating pebbles (Fig. 42, stratigraphic columns 12 to 14). Two prominent bentonite bands (Twin Bentonites) lie 4 to 6 metres above the Bluesky-S horizon in this area. To the north rocks equivalent to the Bluesky-N can be broken into three units: basal conglomerate, middle silty mudstone, and upper glauconitic unit (Fig. 42, stratigraphic columns 2 to 11).

The basal conglomeratic unit can vary from coarse sand to cobble-sized material; thicknesses vary from negligible to more than 10 metres. Angular chert pebbles less than 1 centimetre in diameter are common but occasionally well-rounded cobbles are up to 4 to 5 centimetres in diameter. The middle unit consists of pyritic, bioturbated, and turbiditic silty mudstone; it varies from tens of centimetres to several metres in thickness. The turbidites are thin (3 to 5 centimetres) and probably storm generated. This middle unit commonly displays a coarsening upward trace on geophysical logs. There are varying degrees of bioturbation, usually consisting of small (2 to 3-millimetre) black burrows that are spherical in cross section; they may represent *chondrites* or a similar type of trace fossil. Pyrite is usually present in the form of nodules up to 1 centimetre in length. The upper glauconitic unit can vary in thickness from several cenimetres to several metres. With the exception of number 12, glauconite occurs in all sections examined. Number 12 is the most westerly location examined (Fig. 42). Glauconite content varies from a few scattered grains to about 80 per cent where it forms glauconite sand. Glauconite identification referenced is based on hand sample examination and is not yet verified by thin section or X-ray work. These three units in the Bluesky-N are believed to represent a two-phase transgression.

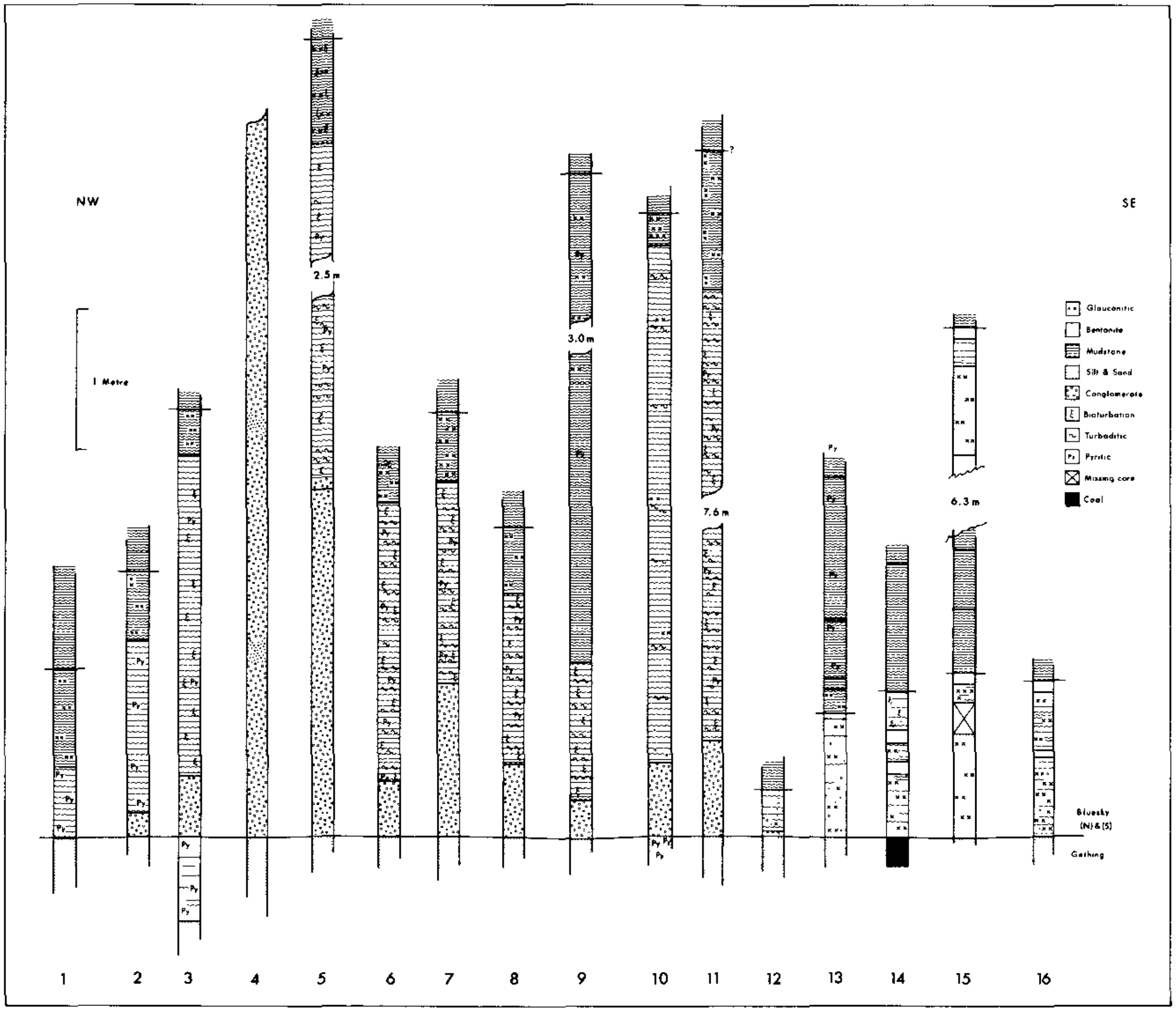

Figure 42. Detailed sections of the Bluesky equivalent strata from coal exploration drill cores.

Variable Bluesky-N thicknesses and thickness changes in the Gething Formation between the Fisher Creek Tonstein zone and the Bluesky-N suggest an irregular and possibly channelled erosional surface (Kilby, this volume, Fig. 37).

In areas where coals are present at the top of the Gething Formation, the thickness of the Bluesky was thought to be related to the quality of the coal. When peat swamps are subjected to marine influence, they usually show an increase in pyrite content. It was thought that when the Bluesky was less than a critical thickness the sulphur content of the underlying coal seam became greater than 1 per cent (Gilchrist, 1978). Shielding of coal seams from marine influence is well known and documented in other areas (Stack, 1982 and Horne, 1978). However, in this case the Bluesky itself is marine, therefore the sulphur content of the underlying seams should be high. Perhaps the strata between the seam and the Moosebar are not all marine perhaps non-marine Gething sediments were deposited over the peat swamp prior to the marine incursion. This type of occurrence is well documented in the eastern United States (Horne, 1978). Often medium to coarse sands lie between the Bluesky and the uppermost coal. For convenience the top of the Gething has generally been positioned at the top of the uppermost coal seam; in reality some of the overlying sands may also be non-marine Gething. It appears that the sulphur shielding is actually dependent on the thickness of the coal-to-Bluesky interval not on the thickness of the Bluesky. A more detailed investigation of stratigraphic relationships and the type and distribution of pyrite in the seams is required to solve this problem.

Glauconite can form in a wide variety of low-energy environments, both marine and lacustrine. It is often associated with transgressions, which is true in the case of the Bluesky; it marks the southerly transgression of the Moosebar-Clearwater Sea over the coal-bearing Gething-Gladstone Formations. The glauconitic portion of the Bluesky-N is in gradational contact with the lowermost part of the Moosebar Lower Silty Member; the glauconite occurs in a mudstone matrix. This setting is consistent with authigenic formation of glauconite (McRae, 1972). Glauconite formation is considered possible only in non-turbulent waters, that is, below wave base (30 to 50 metres).

Duff and Gilchrist (1982) showed that what has traditionally been referred to as Bluesky equivalent strata over the length of the coalfield occurs in two different stratigraphic intervals. North of Sukunka River the distinctive three-unit Bluesky-N lies between the Moosebar Lower Silty Member and the Gething Formation. The Bluesky-S lies between the Moosebar Mudstone Member and the Gething Formation; which of these units is actually correlative to the type Bluesky of the plains is unclear at present. The positions of the Twin Bentonites over both these glauconitic transgressive deposits over the length of the coalfield support the interpretation that they occur at two stratigraphic levels. Detailed examination of these bentonites and several others lower in the section may help in pin-pointing the stratigraphic position of the Bluesky-S in the Peace River area.

A staggered transgressive history for the Moosebar-Clearwater Sea is implied by the interpretation that there are two 'Bluesky Formations'. The initial transgression of this boreal sea formed the conglomerate unit of Bluesky-N. A minor regression occurred during deposition of the middle unit, witnessed by its coarsening upward character. Then a major transgression occurred in the northern area which resulted in flooding southward to the approximate position of the Peace River Arch. The resultant deep, tranquil water favoured glauconite formation at the top of the Bluesky-N sequence. Following this inundation a slow regression was occurring, resulting in the deposition of the coarsening-up Moosebar Lower Silty Member in the north. During this period, in the area of the Sukunka River, deltas and coal swamps were migrating northward over the lowest Lower Silty Member. Following this regression a major transgression occurred flooding virtually all of the Northeastern British Columbia Coalfield and resulting in the formation of the Bluesky-S unit south of the Sukunka River; mudstone deposition continued to the north. A short while after this incursion the Twin Bentonites were deposited. At present the bentonites can be traced about 170 kilometres in a northwest-southeast direction and provide an approximate time marker of this last major Moosebar transgression. Carmichael (1983) tentatively correlated these bentonites with similar rocks in the Torrens Member of the Gates Formation in the Dumb Goat Mountain area, suggesting the major regression had already started at the time of their deposition. He also points out that what has been referred to as the Torrens Member north of the Wapiti River is actually a higher stratigraphic unit, his Sheriff Member. Obviously the history of the Moosebar-Gething contact (Bluesky) has yet to be fully understood.

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