Palynostratigraphy of Campanian Strata, Bonnet Plume Basin, Yukon Territory

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Introduction

Cretaceous stratigraphy in Yukon Territory is in a state of development. Significant coal reserves have been described in the Bonnet Plume Basin of north-eastern Yukon by Mountjoy (1967), Norris and Hopkins, (1977) and Long (1978). These reserves are contained within a series of coal seams up to 11m thick from the upper and lower members of the Bonnet Plume Formation, which consist of poorly consolidated sandstone, shale and conglomerate and conglomerate with minor sandstone and shale, respectively. These coal seams are potentially a viable local source to supply energy for the development and exploitation of copper, uranium and molybdenum found in early Proterozic breccias and iron ore deposits located both south and east of the basin (Sobczak and Long, 1980). Correlation of these coal seams is essential in order to demonstrate continuity and therefore assess the volume of coal present. Forty five core holes, 16 of which have been palynologically examined, and 10 outcrop sections have been collected from the Bonnet Plume Basin. The core holes were drilled by Pan Ocean Oils Ltd. between 1978 and 1980. These lithostratigraphic sections lack good, laterally extensive marker horizons. Therefore, more precise correlations than can be provided by lithostratigraphic techniques are required to determine the areal extent and thickness of the coal seams so that the volume of coal present can be calculated. Palynological techniques which involve the digestion of coal, mudstone and shale samples and identifying the released palynomorphs (fossilized pollen, spores, dinoflagellates etc.) offers a potential solution for correlating the coal seams in the basin as the Campanian strata of the Bonnet Plume basin contains well preserved palynomorphs. Palynology could potentially provide the accuracy required to correlate these coal seams that other methods cannot because of the combination of the cores being spaced widely apart and the laterally discontinuity of the fluvial and floodplain sediments.

Methods and Theory

A detailed study of the palynoflora in three of the cores extracted from the Bonnet Plume Basin (BP-79-17, BP-80-3 and BP-80-15) was conducted by examining available slide mounts of pollen and spores utilizing a light microscope. The three cores are arranged spatially in a narrow triangle with core BP-80-15 forming the most northern point, core BP-80-3 forming the most southern point and core BP-79-17 forming the most eastern point (Figure 1). Based on the distribution of the 108 palynomorph taxa identified from the 99 coal, mudstone and shale samples from within the cores, a detailed zonation and paleoenvironmental interpretation was determined for these cores based on taxon ranges.

Nichols and Sweet (1993) demonstrated that the strata in the northern Cretaceous Basins can be subdivided, based on palynomorph assemblages, into 10 broad zones with zones 1 to 9 identified within the Bonnet Plume Basin. The three cores analyzed in this study had previously been assigned to assemblage zones 6 through 8 (Sweet, pers. comm. May 2009). Core BP-79-17 was determined to contain zones 6 and 7, core BP-80-3 to contain zones 7 and 8 and core BP-80-15 to contain only zone 8 (Sweet, pers. comm. May 2009). Zone 6 is characterized by the presence of *Umbosporites callosus*, *Anacolosidites* sp., *Aquilapollenites clarireticulatus*, *A. parallelus*, *A. quadrilobus, A. rectus, A.* sp. cf. *A. attenuatus*, *Azonia cribrata*, *A.* sp. cf. *A. recta*, *Cranwellia* sp., *Erdtmanipollis procumbentiformis*, *Expressipollis* sp. cf. *E. Barbatus*, *Mancicorpus notabile*, *M. tripodiformis*, *Pulcheripollenite*s sp. cf. *P. narcissus*, *Stelckia vera*, and *Trudopollis sp*. (Nichols and Sweet, 1993). Zone 7 is characterized by the lowest occurrence of *Aquilapollenites senonicus*, *Senipites drumhellerensis*, *Siberiapollis* spp., *Trudopollis meekeri*,

and *Wodehouseia edmontonicola* (Nichols and Sweet, 1993). Zone 8 is characterized by the lowest occurrence of *Aquilapollenites reticulatus*, *Callistopollenites radiatostriatus*, *Kurtzipites trispissatus*, *Mancicorpus rostratus*, *Orbiculapollis lucida*, *Porosipollis porosus*, *Porosipollis* sp., *Pulcheripollenites inrasus*, *Siberiapollis* sp., *Triprojectus magnus* and *T. unicus*. *Singularia aculeata* is restricted to zone 8 (Nichols and Sweet, 1993). The purpose of this study is to develop a more detailed palynostratigraphy that can be applied to the correlation of these sections with high accuracy to other core and outcrop localities in the basin.

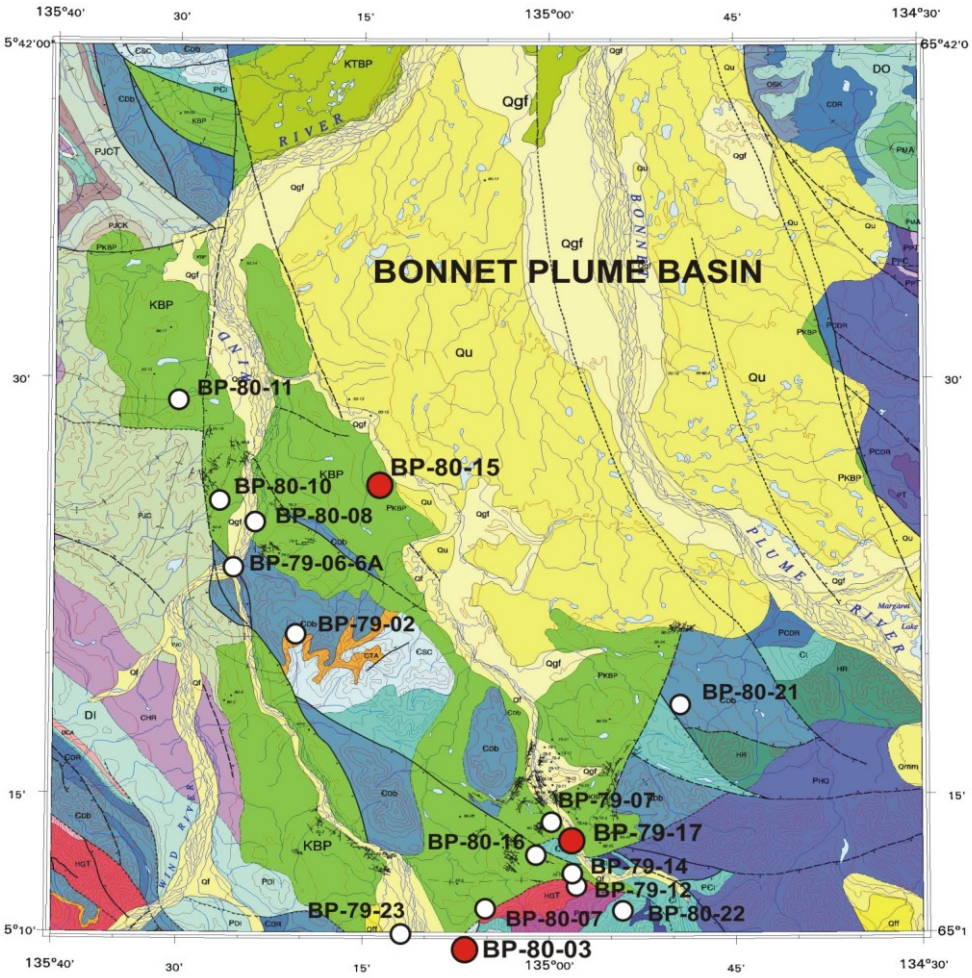

Figure 1. Wind River map sheet showing the Bonnet Plume Basin depicting the location of the 16 palynologically examined cores which were extracted between 1979 and 1980 by Pan Ocean Oils Ltd. at a scale of 1:100 000. The locations of the three cores which are the focus of this study (BP-79-17, BP-80-3 and BP-80-15) are highlighted in red. Geology by D.K Norris, 1979.

Conclusions

After developing more detailed palynostratigraphy of the cores, it was further confirmed that the studied interval corresponds with zones 6, 7 and 8 in ascending order (Nichols and Sweet, 1993), and results indicate that further subdivisions can be made dividing zone 7 into subzones 7a, 7b, and 7c and dividing zone 8 into subzones 8a, 8b and 8c based on the palynomorph distribution within the core.

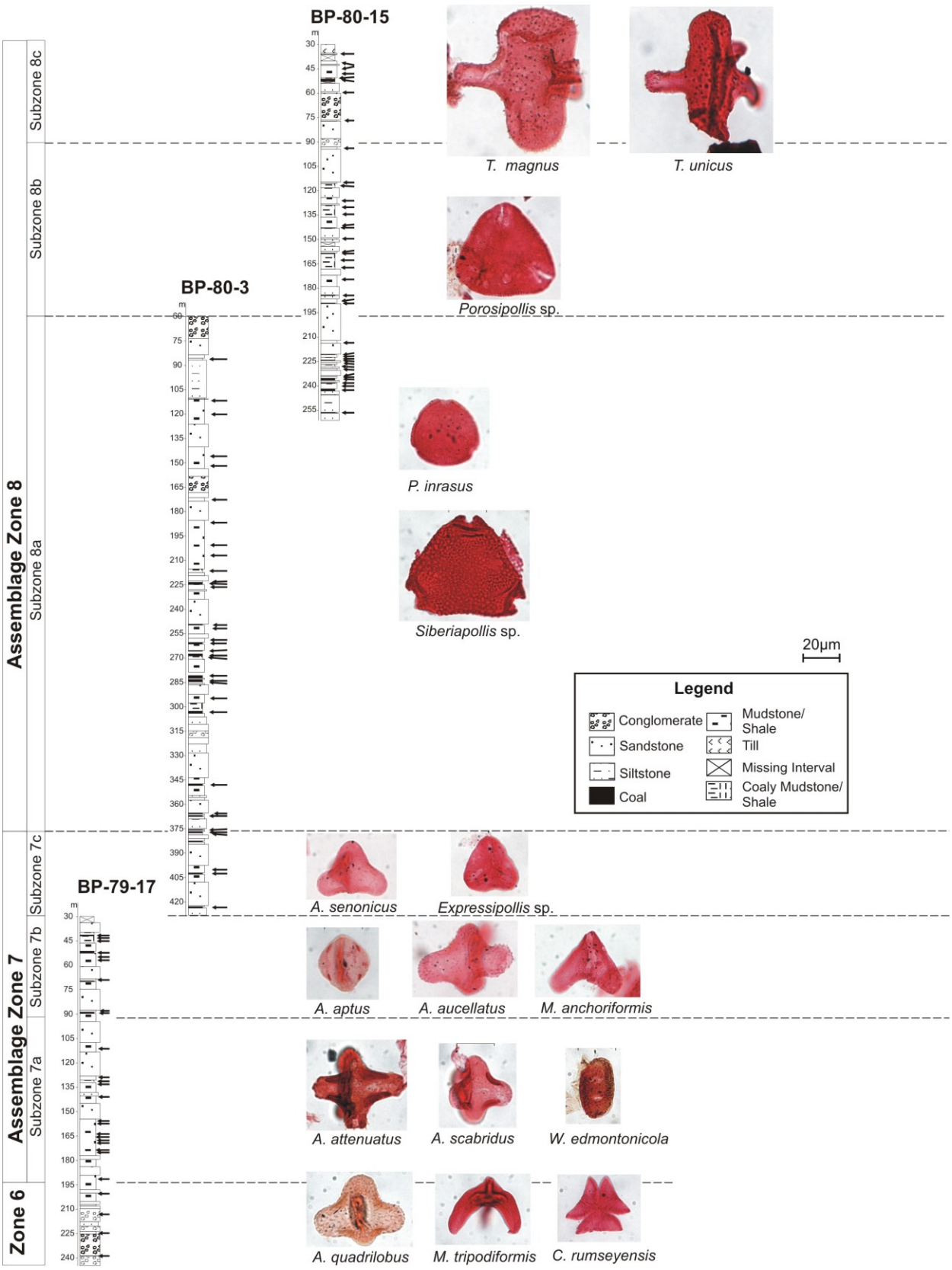

Figure 2. Stratigraphic columns for cores BP-79-17, BP-80-3 and BP-80-15 showing lithologies, sample locations (arrows), and corresponding zones and subzones. The stratigraphic arrangement of the cores in this figure depicts the palynologically derived stratigraphic relationships of the three cores.

The top of zone 6 (bottom of core BP-79-17) is characterized by the presence of *Mancicorpus tripodiformis*, *Aquilapollenites quadrilobus*, and *Cranwellia rumseyensis.* Zone 7 can be divided into subzones 7a, 7b and 7c. Subzone 7a (core BP-79-17) is characterized by the lowest occurrence of *Aquilapollenites scabridus*, *A. attenuatus* and *Wodehouseia edmontonicola*. Subzone 7b (core BP-79-17) is characterized by the above mentioned taxa from subzone 7a as well as the lowest occurrence of *Aquilapollenites aptus*, *A. aucellatus* and *Mancicorpus anchoriformis*. Subzone 7c (core BP-80-3) is characterized by the lowest occurrence of *Expressipollis* sp., and *A. senonicus*. Subzone 8a (core BP-80-3 and BP-80-15) is characterized by the lowest occurrence of *Siberiapollis* sp. and *Pulcheripollenites inrasus*. Subzone 8b (core BP-80-15) is characterized by the species in subzone 8a as well as the first occurrence of *Porosipollis* sp. Finally, subzone 8c (core BP-80-15) is characterized by the first occurrence of *Triprojectus magnus* and *T. unicus*. The palynological zonation presented here provides a method for precise correlation with other cores and outcrops (such as the Wind River outcrop), yielding a better understanding of the subsurface geology in the Bonnet Plume Basin.

Using this newly developed palynostratigraphy and detailed zonation the correlative relationship of the three cores was determined (Figure 2). Core BP-80-15 is the youngest in age and contains strata belonging to subzones 8a, 8b and 8c. The palynoflora assemblage contained in the lower part of this core overlaps with the palynoflora in the upper part of core BP-80-3 (Figure 2). Core BP-80-3 contains subzones 7c and 8a. The palynoflora in the lower part of core BP-80-3 does not appear to overlap with core BP-79-17 and so there is likely strata missing between these two cores (Figure 2). BP-79-17 is the oldest core and contains the top of zone 6 and subzones 7a and 7b.

Examination of the lithologic sequence indicates that the depositional environment of this section of the Bonnet Plume Basin was likely that of a river and floodplain system. This is based on the presence of sandstones and conglomerates, which are interpreted as channel bar deposits, and the progression of siltstone to mudstones and coals, which are interpreted as floodplain deposits. The presence of fern and bryophyte species *Lycopodiumsporites* sp., *Osmundacidites* sp.*,* and *Stereisporites* sp. in this interval supports the interpretation of floodplain deposits as these fern and bryophyte spores are indicative of a wet paleoenvironment.

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