Preliminary investigations of the Upper Devonian to Lower Carboniferous Tuttle Formation, east Richardson Mountains, Yukon







Introduction

Field investigations of Upper Paleozoic strata on the eastern flank of the Richardson Mountains during summer 2006 are part of the multi-year "Regional Geoscience Studies and Petroleum Potential, Peel Plateau and Plain, Northwest Territories and Yukon" project. This project, launched in 2005, is informally known as "The Peel Project", and is a working partnership among the Geological Survey of Canada, Northwest Territories Geoscience Office, the Yukon Geological Survey and university and industry affiliates.

The focus of this investigation is the Upper Devonian to Lower Carboniferous Tuttle Formation. This Formation has historically been an exploration target for oil and gas, and gas shows have occurred in the Tuttle in the Peel region and in Eagle Plain. Data collected in this study will be used to enhance future petroleum resource assessments of the Peel region.

Objectives of the 2006 fieldwork were to:

1) locate exposures of the Tuttle Formation and neighbouring units at various localities along the east Richardson Mountains;

2) measure detailed stratigraphic sections of the Tuttle Formation, where accessible;

3) determine the stratigraphic position of the Tuttle Formation; anc

4) sample the Tuttle Formation and neighbouring units for age determination, source rock potential, thin section, porosity, permeability and thermal maturation studies.

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Area of Study



al., 2005.



Above is the stratigraphic column for the Peel Plateau. Phanerozoic geology can be divided into 3 depositional systems. The Upper Devonian to Lower Carboniferous Tuttle Formation forms the top portion of a clastic wedge of rock that includes the underlying Imperial Formation. The Carboniferous Ford Lake Shale is the basinal equivalent to the Tuttle Formation and occurs further south and west of the Peel.



Regional Geoscience Studies & Petroleum Potential, Peel Plateau & Plain

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Map of study area displaying well locations (yellow triangles), summer 2006 camp (red star) and Eagle Plains Hotel (blue diamond). NTS mapsheet 106L is highlighted with a dashed box. The Tuttle type section (F-37 well) represented by an orange triangle. Purple lines denote exploration areas defined by Morrow et

The project area is in the eastern Richardson Mountains, on NTS mapsheet 106L. Although the focus is the hydrocarbon potential of the Peel region, rock exposure in the Peel is very limited. Fortunately, the Phanerozoic succession in the Peel crops out in the Richardson Mountains, allowing for surface investigation of these same rock units.

The base camp for summer 2006 was an exploration camp on Caribou River. The camp was accessed via a 30-minute helicopter ride over the Richardson Mountains from Eagle Plains Hotel.

Type Section

The Type Section for the Tuttle Formation is the Pacific Peel F-37 well, located in the Yukon. The Tuttle Formation occurs between 177 m and 970 m from the surface, and is 874 m thick. It overlies shales of the Upper **Devonian Imperial Formation** and is eroded by the sub-Cretaceous unconformity. This figure displays the Gamma-Ray and Sonic Curve for the Tuttle type section. Coarser-grained (sandstone, conglomerate) intervals are highlighted in yellow.



Distribution



The Tuttle is found at surface on the flanks of the Richardson Mountains and the northern front of the Mackenzie Mountains. It is almost exclusive to the Yukon Territory. On this map, surface expression of the Tuttle is shown in red.

Eagle Plains 2006 Camp

(contours after Pugh, 1983)

The Tuttle Formation in the The Tuttle Formation in the Peel subsurface is encountered in 18 Yukon wells and in 9 NWT wells (red triangles). Contours on this map display the Tuttle thickness in metres. Well H-37 (yellow star) has the thickest Tuttle section in Subsurface distribution of Tuttle. the Peel region at 1200 m.



Sandstone Rib #2 of the Tuttle Formation as observed at Trail River, Yukon (NTS 106L). The top of the section is to the right. Note circled hammer for scale. See measured section below.







Fieldwork

Detailed sections of the Tuttle Formation were measured on the Trail and Road rivers. The Tuttle is recognized in the field by its resistant nature, consisting of predominantly medium- to coarse-grained sandstone with granules. On both rivers, the Tuttle comprises two resistant sandstone packages, up to 54 m thick, separated by a large covered recessive interval. The covered intervals are believed to be siltstone and shale, up to 144 m thick.

A total thickness of 300 m of Tuttle Formation was measured, however, no complete section was observed in the field. Units directly overlying and underlying the Tuttle consist of predominantly shale and siltstone with very thin interbeds of fine-grained sandstone.



Sedimentology

Fining-up sandstone is the most common lithology noted within the sections. The lowermost part of the beds consist of massive or cross-bedded, coarsegrained sandstone with granules. The granules are predominantly chert in a finer grained matrix. The chert weathers chalky white, but may occur as vari-colour The sandstone grades upward into a finer grained sar stone that is massive or parallel laminated.



Thin section of poorly sorted. massive sandstone



Massive, blocky sandstone on Road River

Conglomerate is a subordinate facies in the Tuttle sections that were examined. In the literature, conglomerate is described as one of the more abundant facies within the Tuttle Formation, however, this is not what we observed on Trail and Road rivers. In the measured sections, conglomerate beds observed were generally less than 60 cm thick.



rounded clasts



Note large clasts within

Recessive intervals of **siltstone**, typically less than 50 cm thick, were noted between some fining-up and massive sandstone beds. These intervals, typically poorly exposed, consist of mainly siltstone with thin laminae of very fine-grained, quartz-rich sandstone. The siltstone is laminated, dark grey black with rusty weathering.



beds, Trail River.

The second most common lithology noted in the measured sections is a **massive sandstone**. The sandstone is moderately to poorly sorted, mediumto coarse-grained, quartz- and chert-rich and weathers blocky. Other grains within the sandstone include tripolitic chert granules.



erate on Trail River.

Diamictite was observed in the Road River section only. These beds consist of a mixture of a blocky mudstone, siltstone, or very fine-grained sandstone matrix with clasts of granules, pebbles and cobbles. Clasts are round to subround. Beds have an overall lumpy, massive, structureless appearance.



Interbedded siltstone and sandstone on Trail River.





Energy, Mines and Resources



Fining-up sandstone, Trail River. Note parallel laminae.



of Road River.

sive sandstone beds.

Hydrocarbon Occurrences

The Tuttle Formation has historically been an exploration target in both the Peel region and Eagle Plain. In the Peel, minor gas has been detected in five Yukon wells and in one Northwest Territories well. In Eagle Plain, gas has been detected in the Tuttle Formation in six wells. Four have had minor gas shows, and two wells, the Chance L-08 and Birch B-34, have estimated reserves of 2 BCF and 3 BCF respectively (Osadetz et al., 2005).

Map highlighting wells which have had gas shows in the Tuttle Formation.



▲ Yukon Peel well locations △ other well loca-

Conclusions

The Upper Devonian to Lower Carboniferous Tuttle Formation crops out as resistant sandstone packages on the eastern flank of the Richardson Mountains;

The Tuttle Formation comprises mainly sandstone, with subordinate conglomerate and siltstone;

• Five lithologic units were identified in the sections measured of the Tuttle Formation, including fining-up sandstone, massive sandstone, siltstone, conglomerate and diamictite; and

Gas shows within the Tuttle Formation in Peel Plateau and Eagle Plain, suggest a promising future for the Tuttle as a reservoir unit and warrant further investigation.



Approximate 10 m exposure of Tuttle conglomerate and sandstone on a north-south ridge immediately north of Road River.



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