

## Shale gas potential of Besa River Formation in Liard Basin, southeast Yukon: report on 2012 field activities

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### Summary

The Yukon Geological Survey, British Columbia Ministry of Energy, Mines and Natural Gas, Northwest Territories Geoscience Office, and Geological Survey of Canada are collaborating to provide geoscience information on the petroleum potential of Devonian-Mississippian shale units in Liard basin. Reconnaissance fieldwork based out of Fort Liard, Northwest Territories in July 2012 involved measuring and sampling of a shale outcrops in each jurisdiction to evaluate shale gas potential. This poster presents preliminary geological observations on a 187-metre outcrop of Besa River Formation section in the Yukon part of Liard basin (NTS 95C/11).

### Introduction

The most prospective shale gas exploration targets in western Canada are the widespread organic-rich, Devonian – Mississippian, black shale and mudstone formations of the Western Canadian Sedimentary Basin (Ross and Bustin, 2008). In an effort to improve our understanding of this potential resource in Yukon, the Yukon Geological Survey initiated a shale gas study of Devonian - Carboniferous strata in Liard basin. In July 2012, geologists from the Yukon Geological Survey, Northwest Territories Geoscience Office and British Columbia Ministry of Energy, Mines and Natural Gas visited outcrops of Besa River (Yukon and BC) and Golata Formation (NWT) in Liard basin to evaluate shale gas potential. Detailed sampling and section descriptions were accomplished in the first field season of a proposed multi-year project. Laboratory results and further fieldwork are anticipated in 2013.

### Background

Liard Basin is a relatively underexplored region straddling the boundaries of Yukon and Northwest Territories and the province of British Columbia. Historically, exploration and production in the region have focused on conventional targets, specifically Lower-Middle Devonian carbonate and Cretaceous siliciclastic reservoirs. Portions of three conventional gas fields extend into the Yukon including Kotaneelee, Beaver River and La Biche. The first well drilled in the Liard area of Yukon was in 1963 on the Beaver River anticline. Since then, 12 additional wells were drilled, the most recent of which was in Kotaneelee in 2005. In addition, over 500 km of 2D-seismic data have been acquired in the Yukon portion of the basin (Energy, Mines and Resources, 2011). The main exploration target to date has been the Manetoe hydrothermal dolomite facies in the Middle Devonian Nahanni Formation (Dunedin

Formation equivalent). Current Yukon land dispositions in the region include eight production licenses in Kotaneelee and two special discovery licenses in La Biche. The most recent activity in the basin in Yukon is the 2012 EFL Overseas Inc. acquisition of assets in the Kotaneelee gas field, with estimates of 7.23- 12.96 TCF original raw gas in place in shale, corresponding to a company share of 3.9-7.0 TCF (EFL Overseas Inc., 2013).

The unconventional hydrocarbon potential of the basin has not yet been assessed, however, a 2009 well drilled by Apache in the BC part of the basin completed a well test of 21 MMcf per day believed to be “the most prolific shale gas resources test in the world” (Apache Corp., 2013). A 2012 scoping study of unconventional oil and gas potential in Yukon (Hayes and Archibald, 2012), which used existing geological data to evaluate Yukon’s sedimentary basins for unconventional oil and gas potential, identified good shale gas prospectivity in the Upper Devonian through Carboniferous Besa River/Muskwa/Exshaw formations and in the Cretaceous Fort St. John Group. Moderate (?) prospectivity was identified for the Devonian Funeral/Headless Formation.

## Field Observations

One hundred and eighty seven metres of Besa River Formation shale and mudstone was measured, described and sampled in the Yukon part of Liard basin on a tributary of Whitefish River (NTS 95C/11; Fraser *et al.*, in press). The section comprises three lithofacies: 1) mudstone and shale; 2) silty mudstone and shale; and 3) interbedded mudstone/shale and silty mudstone and shale. Shale is generally black on fresh surfaces, recessive, fissile, carbonaceous, and very thinly laminated (<1 cm). Mudstone is medium to dark grey on fresh surfaces, competent, platy, thin- to medium-bedded (1-5 cm) and has variable silt and silica components based on hand sample observation. Fossils in the section are rare and include cephalopod impressions and unidentified microfossil fragments. The sampling program involved spectral gamma-radiation readings at one-metre intervals, and collection of chip samples through two metre intervals for source rock and thermal maturity analyses (Rock-Eval/total organic carbon and vitrinite reflectance), mineralogical determination (X-ray diffraction), lithogeochemistry (ICP-ES and MS) and age dating (microfossil biostratigraphy). Laboratory results and further fieldwork are anticipated in 2013.

## Future Studies

Additional fieldwork is planned for summer 2013. Identifying new Besa River Formation outcrop sections will be critical in moving this project forward. In addition, correlating outcrop sections to subsurface wells logs will define the regional distribution of Devonian shale in Liard basin area.

Corresponding research in BC and NWT is ongoing with a BC publication in press (Ferri *et al.*, in press). Comments or suggestions on this or future research in this region are encouraged.

## References

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