

# Sedimentology and Petroleum Source-Rock Potential of Hyperpycnites in the Laberge Group (Jurassic), Whitehorse Trough, Yukon, Canada

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## Abstract

Whitehorse Trough is a frontier basin in south-central Yukon that is thought to contain gas and possibly oil. It consists of up to 7000 m of sedimentary and volcanic rocks referred to as the Lewes River Group (Triassic), Laberge Group (Jurassic), and Tantalus Formation (Jura-Cretaceous) that represent three sedimentary basins partially overlapping in space and time. The Laberge Group was deposited in the Laberge Basin, a collapsing forearc basin in which the arc was undergoing uplift and erosion, and is informally subdivided into the Richthofen, Tanglefoot and Nordenskiöld formations. The Nordenskiöld formation consists of subaerially erupted, resedimented volcanoclastics and has no source rock potential and is not discussed further. The Richthofen formation consists of conglomerate, massive sandstone, sandstone-mudstone couplets and volcanoclastics interpreted as submarine fan systems. The Tanglefoot formation consists of coal-bearing sandstone, mudstone, conglomerate and volcanoclastics interpreted as delta systems and shallow marine deposits. The Richthofen and Tanglefoot formations are the same age, but the Richthofen formation is restricted to the southern half of the basin, whereas the Tanglefoot formation occurs in the northern half. The Richthofen and Tanglefoot formations are separated by a 'transition zone' characterized by very thin- to thin-bedded sandstone/siltstone and mudstone couplets. The couplets are millimeters to centimeters thick and massive to normally graded. They display abrupt to diffuse lower and upper contacts and are sparsely bioturbated (mainly by *Phycosiphon*). The couplets are interpreted as prodelta hyperpycnites and possibly storm-associated hyperpycnites. They formed mainly as prodeltaic hyperpycnal mud plumes derived from the northern (i.e., Tanglefoot) part of the basin that flowed into the deeper water of the southern (i.e., Richthofen) part of the basin. Based on Rock-Eval analyses, thermal alteration indices of palynomorphs, and vitrinite reflectance, the Richthofen formation is a poor source rock that is postmature with minor gas potential, whereas the Tanglefoot formation is a good source rock that is immature to early mature and gas-prone. The Tanglefoot formation also contains petroleum fluid inclusions that indicate several distinct, but minor pulses of oil. The source rock potential of the hyperpycnite transition zone is similar to that of the Richthofen formation (i.e., poor, with minor gas potential).