Provenance of the Paleocene-Eocene Oyster Bay Formation, British Columbia

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ABSTRACT

The Oyster Bay Formation is a recessive, thin-bedded, fine-grained succession that disconformably overlies the Upper Cretaceous Nanaimo Group in isolated exposures along the eastern coast of Vancouver Island, British Columbia. The Formation consists of thin-bedded siltstone and sandy siltstone intercalated with lesser medium bedded feldspathic sandstone. Large calcareous concretions occur at three distinct stratigraphic intervals, and contain permineralized fossil plants, gastropods, decapods, corals, echinoderms, bivalves, and foraminifera. These fossils, coupled with fossilized crab burrows, suggest a shallow marine depositional setting. Paleontology and palynology suggest a Paleocene to Eocene age.

Petrographically, the unit contains primarily of fine-grained micaceous feldspathic arenite to wacke, dominated by very angular clasts of plagioclase, quartz, biotite, and potassium feldspar. Locally, fossil fragments of brachiopod shells and bryzoans, organic material, and volcanic lithic fragments are evident. Detrital zircon provenance analysis suggests the Formation is dominated by Jurassic to Cretaceous detritus derived from the Coast Plutonic Complex to the east. This detrital zircon signature is strikingly similar to the subjacent Nanaimo Group, suggesting derivation of sediment due to erosion of the underlying strata. However, the unit is dominated by fine-grained, very angular mineral fragments indicative of a first-cycle, texturally immature sediment, not a second cycle sediment.

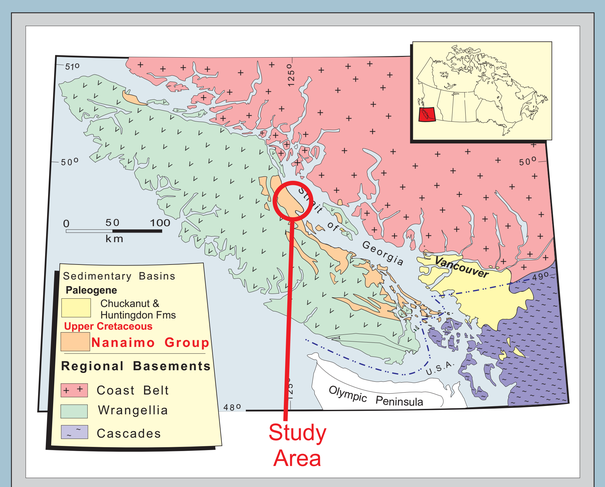

Figure 1: Geologic setting of study area. The Oyster Bay Formation unconformably overlies the Nanaimo Group on the eastern edge of Vancouver Island.

Figure 2: Regional geographic map of the study area. Note the formation is primarily exposed along the coast in Oyster Bay, but is also exposed in river exposures along Oyster River, suggesting the original extent of the formation is much larger than current exposures indicate.

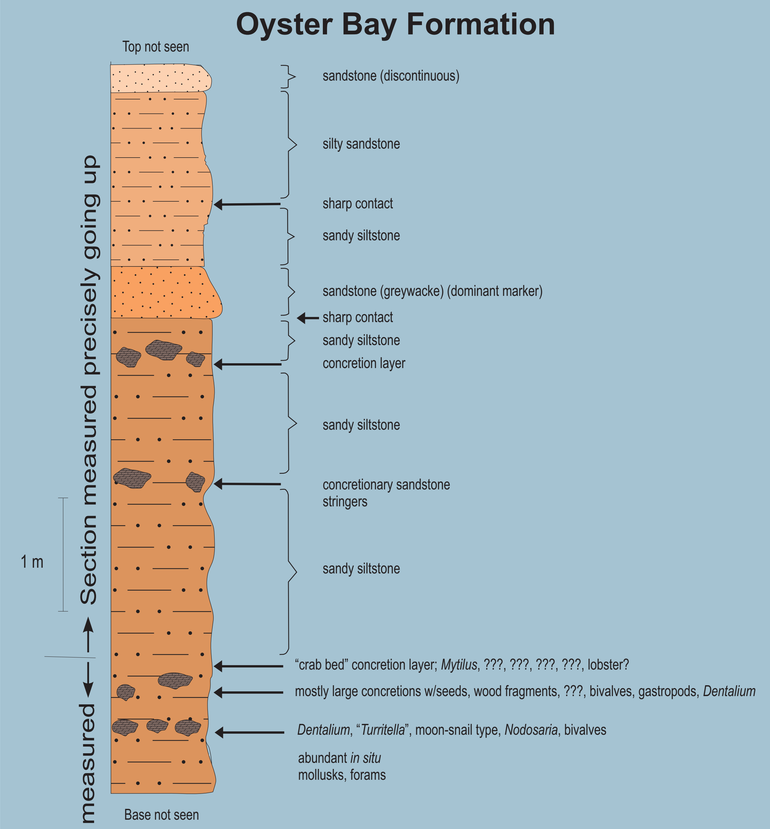

Figure 3: Measured stratigraphic section of the Oyster Bay Formation from coastal exposures in Oyster Bay. Note the formation is primarily fine-grained sandy siltstone, with lesser fine to medium grained sandstone. Note location of fossilerous zones within the unit.

The Oyster Bay Formation contains a diverse assemblage of invertebrate fauna indicative of a shallow marine depositional setting. Calcareous concretions occur at three distinct stratigraphic intervals (Fig. 3), and contain permineralized fossil plants, gastropods, decapods, corals, echinoderms, bivalves, and foraminifera. These fossils, coupled with fossilized crab burrows, suggest a near shore, probably tidal to estuarine environment. Paleontology and palynology suggest a Paleocene to Eocene age.

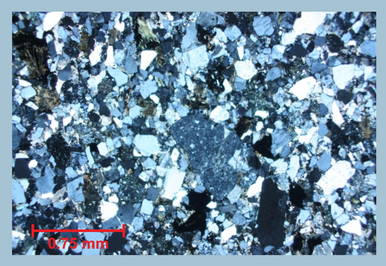

Figure 5a: Medium grained moderately sorted feldspathic arenite of the Oyster Bay Formation. Texture and composition is characteristic of the sand-dominated lithofacies.

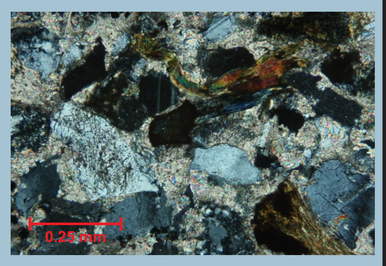

Figure 5b: Medium to coarse grained feldspathic arenite. Note angularity of mineral grains and calcite cement

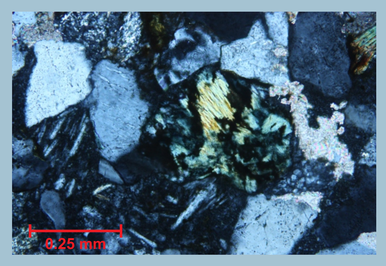

Figure 5c: Fine to medium grained angular grains, including volcanic lithic fragments and chloritized mafic volcanic(?) grain

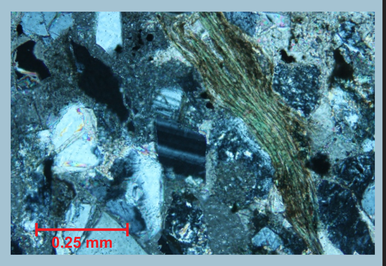

Figure 5d: Coarse, fresh biotite grain within finer grained plagioclase and lithic fragments, set in calcite matrix.

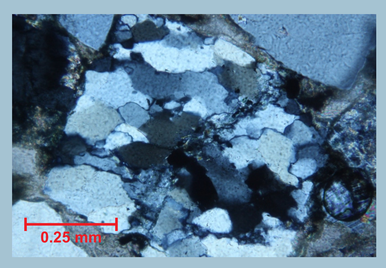

Figure 5e: Polymineralic quartz grain within medium grained lithic arenite. Note crude alignment of individual quartz grains, suggesting a metamorphic origin.

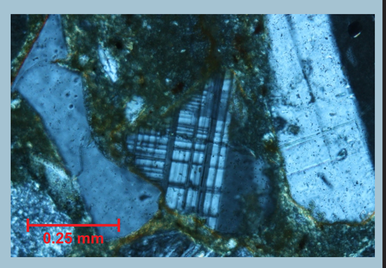

Figure 5f: Angular grains of microcline, plagioclase and quartz within a calcite+clay matrix. Angularity of grains suggests a first-cycle plutonic origin.

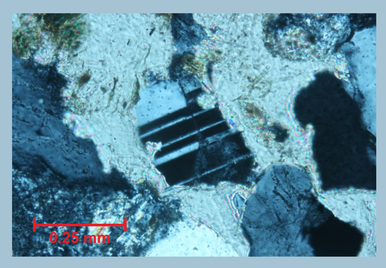

Figure 5g: Plagioclase grain 'floating' in coarse crystalline calcite. Calcite cementation requires enhanced porosity and permeability, indicating a lack of diagenetic clay development. This relationship supports rapid deposition and cementation, which precludes breakdown of feldspathic grains.

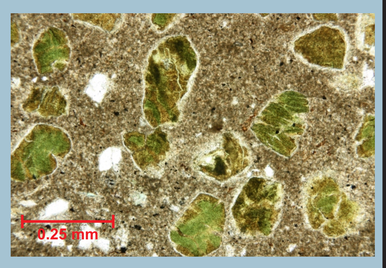

Figure 5f: Pyroxene and plagioclase phenocrysts in an aphantic matrix. Sample represents a cross-cutting sill within the Oyster Bay Formation.

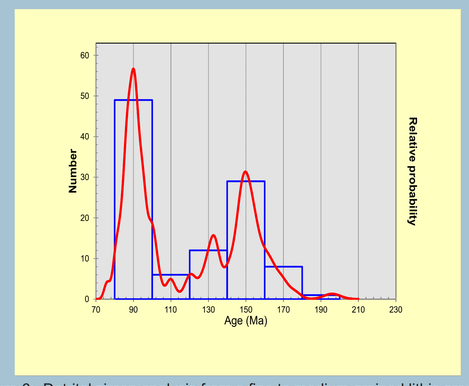

Figure 6: Detrital zircon analysis from a fine to medium grained lithic arenite within the Oyster Bay Formation. The age spectra is strikingly similar to the bimodal age spectra documented in the underlying Nanaimo Group, which records derivation primarily from the Coast Plutonic Complex to the east. Importantly, the lack of syndepositional Paleocene to Eocene zircon indicates a lack of volcanism during deposition of the Oyster Bay Formation.

CONCLUSIONS

Stratigraphic, sedimentologic, paleontologic and detrital zircon studies within the Oyster Bay Formation demonstrate:

- the formation was deposited in a near shore, shallow marine environment
- abundant gastropod, brachiopod and other fauna, including burrowing crab ichnofauna suggest a tidal or estuarine depositional setting
- framework mineralogy and texture suggests a first-cycle continental arc source region, and does not support a second-cycle derivation from subjacent Nanaimo Group strata
- abundant coarse calcite cement suggests high porosity and permeability with a minimal production of clay through chemical weathering, supporting rapid deposition and burial without prolonged surficial weathering
- detrital zircon age spectra mimic the bimodal pattern of the underlying Nanaimo Group and the Coast Plutonic Complex to the east. Extraregional detritus is absent, supporting first-cycle derivation from the Coast Plutonic Complex.

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