Characterization of Eocene Volcanic Sequences in the Nechako Region, Central British Columbia

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Abstract

The Nechako region of central British Columbia is partially underlain by Jura-Cretaceous successor basin clastic sedimentary rocks with petroleum potential. However, Mesozoic stratigraphy and structures which potentially host hydrocarbons have been subjected to widespread Eocene magmatic, thermal and structural overprinting. Variable thicknesses of Eocene volcanic strata now cover potentially hydrocarbon-bearing host rocks. Masking of the hydrocarbon prospective strata is further exacerbated by the extensive cover of Late Cenozoic subaerial Chilcotin flood basalts and extensive glacial sediments. In this project, characterization of the nature, thickness and structural framework of Eocene volcanic rocks will lead to increased understanding of the area's Cenozoic history, contribute to improved interpretations and add value to existing seismic and magnetotelluric data sets.

During the 2010 field season, the nature, structure and extent of the different packages of volcanic sequences currently inferred to be Eocene in age were documented, as well as their relationships with underlying and overlying rocks. Data collection was emphasized along existing seismic, gravity and magnetotelluric surveys. Preliminary results show that the Nechako region of central British Columbia is covered by a range of coherent magmatic and volcaniclastic rocks of various ages, compositions and textures, reflecting a long-lived and complex history of tectonomagmatic events. Integration of field observations with existing datasets and maps of physical properties, magnetic susceptibilities, radiometric ages and structural measurements will provide the framework for future regional scale understanding of the structure and tectonic evolution of the Nechako region. In turn, this will facilitate oil and gas, mineral and geothermal resource exploration efforts through this part of central British Columbia.

Geological Setting

The Nechako region is bounded to the east by the Fraser fault, to the west by the Coast Mountains and Yalakom fault, by the Skeena arch to the north and the Tyaughton Basin to the south (Figure 1; Ferri and Riddell, 2006). It is underlain by portions of the accreted Paleozoic and Mesozoic terranes of the western Canadian Cordillera including the Stikine (island arc), Cache Creek (accretionary-complex) and Quesnel (island arc) terranes (Figure 1; Gabrielse and Yorath, 1991; Monger and Price, 2002).

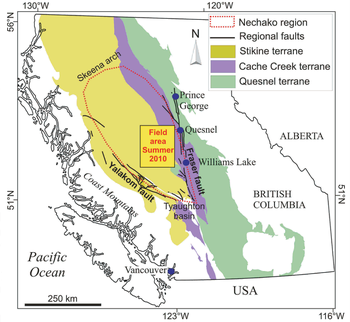


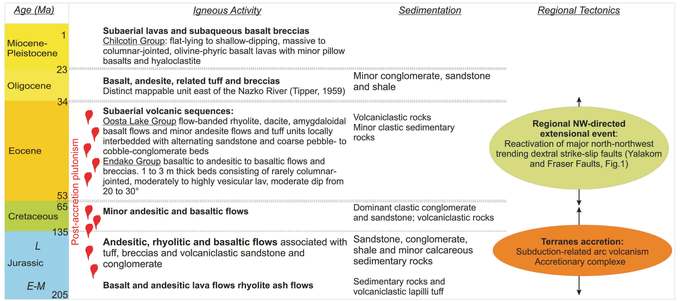
Figure 1. Location of the Nechako region in central British Columbia and position relative to the accreted terranes and regional structures (simplified from Massey et al., 2005). Outline of the summer 2010 field area is indicated.

Regional Structural Framework

Three major fault systems are recognized (Struik, 1993):

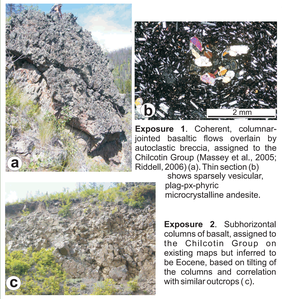
- Early Eocene northwest-trending faults (Yalakom and Casey faults): attributed to extension and dextral-translation processes; have accompanied the development of Early Cenozoic pull-apart basins.
- Late Cretaceous, Paleocene or Early Eocene normal or strike-slip northeast-trending faults locally associated with northwest-trending faults.
- Late Eocene to Early Oligocene en échelon north-trending dextral faults (Pinchi and Fraser faults): coeval with northwest-directed extension that exposed the Vanderhoof Metamorphic Complex between 55–45 Ma.

Stratigraphy



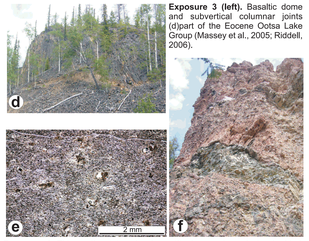
Nazko-Clisbako Traverse

Deformed Cretaceous clastic sedimentary rocks are exposed along the Nazko River valley (Figure 2), and tilting of these strata may be syn- or post-Cretaceous. They are unconformably overlain by coherent, massive to columnar-jointed, vesicular basaltic to andesitic lava flows inferred to be part of the Ootsa Lake, Endako or Chicotin groups (Figure 3; Tipper, 1959; Massey et al., 2005).



Exposure 1. Coherent, columnar-jointed basaltic flows overlain by autoclastic breccia, assigned to the Chilcotin Group (Massey et al., 2005; Riddell, 2006) (a). Thin section (b) shows sparsely vesicular, plag-px-phyric microcrystalline andesite.

Exposure 2. Subhorizontal columns of basalt, assigned to the Chilcotin Group on existing maps but inferred to be Eocene, based on tilting of the columns and correlation with similar outcrops (c).



Exposure 3 (left). Basaltic dome and subvertical columnar joints (d)part of the Eocene Ootsa Lake Group (Massey et al., 2005; Riddell, 2006).

Exposure 4. Thin section (e) and outcrop (f) of sparsely vesicular, bedded, plagioclase-rich microcrystalline intermediate volcanic rock part of the Endako Group (Massey et al., 2005; Riddell, 2006).

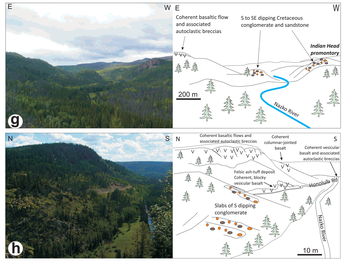
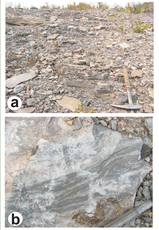


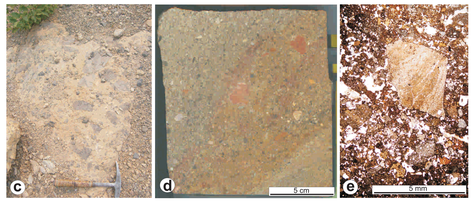
Figure 3. Structural relationships between Cretaceous sedimentary rocks and Eocene volcanic rocks in the Nazko River Valley (g-h).

Tibbles Road Traverse

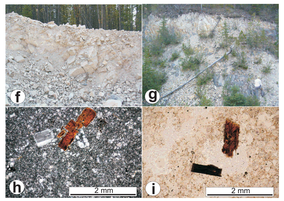
Along Tibbles Road, a widespread unit of biotite-rich rhyolite was mapped (Figure 2). It is spatially associated with coherent mafic units and fragmental volcanic deposits. All outcrops are inferred to be Eocene and/or Oligocene by Tipper (1959), and are included with the Endako Group on compilations by Massey et al. (2005) and Riddell (2006).



Exposure 5. Bedded, slightly tilted layers of rhyodacite (a) overlie more massive, locally flow-banded rock of the same composition (b).



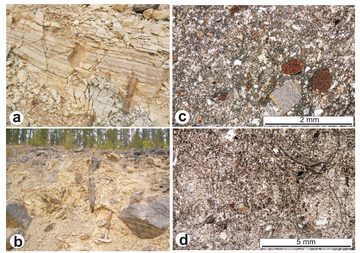
Exposure 6. A volcanic breccia made of angular to subangular blocks of dark grey-red highly vesicular basalts supported by a soft-weathered, light pink vesicular matrix (c) is in contact with a layered, poorly sorted, polymictic fragmental unit displaying angular to subangular ash- and lapilli- size felsic and mafic clasts (Hand sample (d) and thin section under plain polarized light(e)).



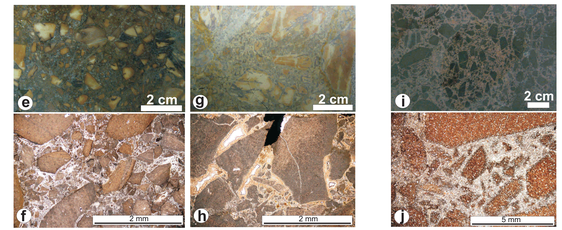
Exposures 7 and 8 represent a widespread mappable unit of rhyolite previously assigned to the Endako Group (Massey et al. 2005) and dated at 49.8 Ma (K/Ar: outcrop g). New geochron dating is in progress as part of this project. Outcrops (f-g) and thin sections (h: cross nicols; i: plane polarized light) of sparsely vesicular, pale grey-pink biotite-Kpar-plag-quartz bearing rhyolite.

Baezaeko Traverse

This traverse (Figure 2) displays a wide variety of fragmental volcanic rocks, ranging from block and ash-fall deposits to volcaniclastic debris flows, and possibly includes some products of hyaloclastic brecciation. A number of coherent lava exposures ascribed to the Chilcotin Group are also described.



Exposure 9. Roadside quarry displaying a sequence of volcaniclastic rocks, possibly a block and ash-fall deposit. A banded lapilli-tuff deposit (a) is overlain by a 3 m thick very chaotic, non sorted fragmental unit comprising vesicular and nonvesicular basaltic blocks in a lapilli-tuff matrix (b). Thin sections of the lapilli-tuff unit (c-d) display plagioclase phenocrysts and microcrysts, andesite and glass rich lithic volcanic rounded fragments; perlitic fractures indicate devitrification of the matrix.



Exposure 10. Hand sample (e) and thin section (f; PPL) of a monomictic silicified bedded breccia: banded, angular clasts of homogeneous composition are contained in a very fine grained quartz-plag-rich matrix. Rotation of clasts suggests autobrecciation and quench fragmentation. Hand sample (g) and thin section (h; PPL) of a similar silicified bedded breccia: textures suggest that fragmentation results from a mechanical process, later modified by infiltration of a secondary fluid. Secondary porosity results from precipitation/dissolution.

Exposure 11. Hand sample (i) and thin section (j; PPL) of a monomictic volcanic intermediate breccia. Clasts are intermediate angular, plag-cpx phyric, flow banded, and show variable crystal alignement. The microcrystalline crystal-rich matrix could result from clast reduction during brecciation.

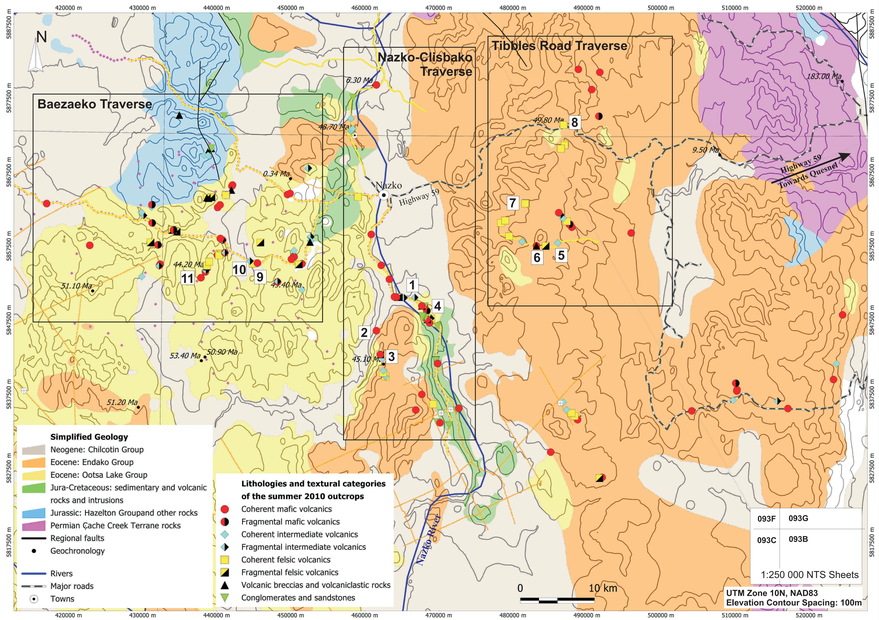


Figure 2. Distribution of documented outcrops in the Nechako region, central British Columbia, during the Summer 2010. Textural categories (coherent versus volcaniclastic) and rock types are indicated. Existing geochronology dates (Breitsprecher and Mortensen, 2004) are also displayed. Lithologies and textures encountered along the Baezaeko, Nazko-Clisbako and Tibbles Road traverses are documented in more detail in subsequent figures. Numbers refer to exposures illustrated in photographs. Bedrock geology from Massey et al. (2005).

Summary of Field Observations

The Nechako region of central British Columbia is covered with a range of coherent magmatic and volcaniclastic rocks of various ages, compositions and textures, reflecting a long-lived and complex history of tectonomagmatic events. Eocene coherent and volcaniclastic sequences are distinguished from the Chilcotin basalt outcrops which normally show thick, flat beds of massive to blocky or columnar jointed, vesicular to non vesicular basalts.

- Along the Nazko and Clisbako valleys, coherent Eocene Ootsa Lake and Endako basalt and andesite flows showing typical autoclastic top- and front-flow textures were mapped, as well as minor felsic ash deposits. They overlie the deformed Cretaceous clastic rocks, which have also been intersected by two oil exploration wells.
- In the Tibbles Road area, a broad rhyolitic unit previously dated at 49.8 Ma and assigned to the Endako Group was mapped. Based on field observations, this unit is assumed to be continuous for up to 20 km, but it is locally interbedded with coherent mafic and intermediate lava and breccias.
- In the Baezaeko area, a variety of volcaniclastic units are associated with coherent basaltic, andesitic and felsic volcanic rocks. There is a wide variation of textures and compositions within the volcaniclastic facies, and more work is required to fully understand the different processes taking place, as well as the events and timescales with which they are associated. In this area, some of the outcrops mapped during summer 2010 have been previously dated, providing a framework for future interpretation of thermal events.

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Acknowledgements

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