A Geochemical Study of Basalts at Nanoose Bay, Vancouver Island, British Columbia

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Introduction

The complex geology of Nanoose Bay has been explored by the BC Geological Survey (BCGS)[1]. Previous data collected from Ainsley Beach, Nanoose reveals a discrepancy in the original mapped basalts. The BCGS mapped the study area as Karmutsen Formation (Fm.) basalt; however, a geochemical analysis undertaken by former VIU Petrology students (2009 and 2015) suggest Sicker Group basalt.

Nanose Bay Geology

Vancouver Island is the major land component of the insular belt within Canada. It is part of the Wrangelian terrane which originated near the equator in the Pacific ocean [2]. About 100 million years ago, Wrangellia collided with North America causing significant deformation of regional rocks [3].

Ainsley Beach, located in Nanoose Bay, contains some of the oldest rocks encountered on Vancouver Island. The area is composed of rock units that represent three major volcanic events which occurred during the development of Wrangellia.

> Sicker Group island-arc volcanism (~370 Ma): A series of subduction-related effusive eruptions composed of mixed volcanic rocks that form the basement of Wrangellia[4].

> Karmutsen Formation ocean-arc volcanism (~230 Ma): Extensive flood lavas that erupted off the Baja California coast, and later migrated towards the Pacific Northwest. This formation is the primary rock type exposed on Vancouver Island[5].

> Bonanza Group island-arc volcanism (~160-200 Ma): A series of volcanic events composed of basaltic to andesitic lavas that erupted on land and intruded older Wrangellian rocks[6].

Field work

A geological map of the study area was developed to provide a better understanding of the distribution of the rock units. Ten representative samples were collected to undergo a geochemical analysis.

Geochemistry

Inductively coupled plasma (ICP-MS) analysis was used to evaluate major and trace element composition of the rock samples. The chemical signatures of basalts were plotted on AFM and PFEs diagrams. Data was compared against published geochronological data[7][8][9][10][11][12] for the Karmutsen Fm., Nitinat/Duke Lake Fms., and Flower Ridge Fm.

Discussion

- Geochronological signatures indicate that the Ainsley Beach data is not closely associated with Karmutsen Fm., nor the Nilanat/Duke Lake Fms. However, the Flower Ridge Fms. displays a strong correlation with basalts from Ainsley Beach.

- Karmutsen Basalts show consistent olivine fractionation, whereas, Ainsley Beach data does not fractionate. This indicates a tectonic environment rather than a ocean-island arc.

- Absence of olivine fractionation suggests either an island-arc, or back-arc tectonic environment. In either case, the mineral assemblage of Ainsley Beach basalt may be correlated to the Flower Ridge Fm.

Further investigation should be conducted in order to confirm if Ainsley Beach rocks are related to the Flower Ridge Fm., and if they formed under similar tectonic environments.

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References