A GEOCHEMICAL AND PETROGRAPHIC ANALYSIS OF VOLCANICS IN COON POINT AND VICINITY, SOUTHERN OREGON CASCADES

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Introduction

The Cascade Range is a chain of composite volcanos that extend from northern California to British Columbia. It is an active volcanic arc centered approximately 250 km east of the boundary between the north-eastwardly subduction Juan de Fuca plate and the North American plate (Catchings and Mooney, 1988). The past and present volcanic and tectonic characteristics of the northwestern region of the U.S. is generally believed to be due to the plates changing nature and orientation in relation to each other (Hart and Carlson, 1987).

The Cascade Range is divided into two sup-provinces, the older Western Cascades and the younger High Cascades. Rocks of the Western Cascades range in age from Eocene to late Miocene. Rocks of the High Cascades generally range in age from the present to 5 million years and the majority of the volcanoes are basaltic shield volcanoes, although the larger composite volcanoes are mainly andesite (Catchings and Mooney, 1988).

This study concentrates on the many Miocene to Holocene in age smaller volcanic units near Mount McLoughlin in south-central Oregon. The specific goal of this project is to analyze the petrographic and geochemical trends of the volcanics in one seven square mile field area, Coon Point and vicinity. The data obtained is important for the understanding of how the northwest United States evolved volcanically and is crucial for the determination of the origin and evolution of the magma supplying Coon Point and vicinity.

The general area of research was near Fish Lake and Mount McLoughlin in the south-central portion of Oregon state. Specifically, research was concentrated in the most eastern seven square miles studied: T36S R6E, sections 23-26, 35-36 and T36S R7E, section 19. (figure 1). Karyn Powers and Andrew Gavin researched the two adjacent seven square mile areas directly west of this study area.

Methods

Eighteen days were spent in the field mapping, establishing stratigraphic relationships based on contact relationships and relative weathering observed, and collecting samples from a seven square mile area. Samples were selected to represent each of the 9 volcanic units that were distinguished and named in the field. Thin sections of 30 rock samples representing the 9 rock units were then studied using a petrographic microscope.

Other lab work included preparation and the analysis of 19 samples for X-ray fluorescence (XRF), Inductively Coupled Plasma Spectrometry (ICP), loss on ignition and iron titration; the major and trace element concentrations were measured by XRF, and additional trace elements and rare earth elements were measured by ICP.

Petrography and Stratigraphy

Coon Point and vicinity has 9 distinct volcanic units. These units are named, from youngest to oldest: Knobbly Basaltic Andesite, Tomahawk Ridge Basaltic Andesite, Long Rite Cinder Pit II, Long Rite Cinder Pit I, Coon Point Aphyric, Odessa Campground, Orthopyroxene-rich, Coon Point Phyric, and Mt. Harriman olivine bearing, 2-pyroxene Andesite.

Definite contacts or other features that indicate the age relationships of most of the units are elusive in most of the study area. The stratigraphy is based mostly on the similarity or dissimilarity of each unit's characteristic thin section and hand sample to those characteristic of Tomahawk Ridge and Mt. Harriman. The Tomahawk Ridge basaltic andesite flow is younger than the Mt. Harriman olivine-bearing, 2-pyroxene andesite flow as indicated by K/Ar dating done by Stan Mertzman (unpublished data). The respective dates are 1.13±0.09 Ma and 1.36±0.04 Ma. These are the two volcanic flows that are used to constrain the stratigraphy of Coon Point and vicinity.

The Mount Harriman flow is an olivine-bearing, 2-pyroxene andesite and its flow is characterized in the field as being massive, with no platy features. The modal composition of this unit is as follows: 10-30% plagioclase phenocrysts, <1-2% olivine phenocrysts, 1-4% orthopyroxene phenocrysts, 1% clinopyroxene phenocrysts, and 65-85% groundmass. Glomeroporphyritic clots of plagioclase and orthopyroxene ± clinopyroxene ± olivine are abundant within this flow.

The units similar in hand sample and thin section to the Mount Harriman flow include the Odessa Campground, the Orthopyroxene-rich, and the Coon Point Phyric flows. Similarities include glomeroporphyritic clots of plagioclase and olivine ± orthopyroxene ± clinopyroxene and/or larger phenocrysts with a more equigranular appearance.

The flows of Tomahawk Ridge are basaltic andesite in composition. These flows are characterized in the study area as being platy. Glomeroporphyritic clots of plagioclase and olivine are present. This unit is trachytic with an average of 45-50% plagioclase microphenocrysts surrounded by groundmass. Percentages of phenocrysts include <1-5% plagioclase, 1-3% olivine with some samples having 3-5% olivine microphenocrysts, and 0-<1% of orthopyroxene as well as clinopyroxene. Some samples have pyroxene microphenocrysts.

Similar units to the Tomahawk Ridge flows include the Long Rite Cinder Pit II, the Long Rite Cinder Pit I, and the Coon Point Aphyric flows. The similarities include that these units tend to have less large phenocrysts and instead have higher percentages of microphenocrysts and/or glassy groundmass.

Geochemistry

Chemical analysis on 19 samples that represent the 9 units mapped in the field establish that the volcanics in the study area are calc-alkaline. In the LaBas classification diagram (1986) 8 of the units plot as basaltic andesite and the Mount Harriman flow plots as an andesite. SiO_2 ranges from 52.82% (Odessa Campground) to 62.17% (Mount Harriman). Harker variation diagrams were used to relate various weight percents of major element oxides to 1) each other and 2) to trace and rare element abundances (ppm). Negative correlations exist for Na_2O and K_2O with MgO and TiO_2, P_2O_5, MnO, MgO, FeO, Fe_2O_3, and CaO with SiO_2. Positive correlations are shown by various graphs such as Na_2O and K_2O with SiO_2 and CaO, MnO, P_2O_5, TiO_2 with MgO. Particular trends that are unique include graphs of Al_2O_3 versus CaO, Sc versus CaO, and Ni versus MgO (figure 3). The Sc and CaO and the Ni and MgO graphs both show a definite positive correlation but the Al_2O_3 and CaO graph shows only a slight positive correlation.

Conclusions

Analysis of the geochemical data suggests that all of the units are genetically related and that crystal fractionation seems to account for most of the trends in magma evolution. Positive correlations in the Ni and MgO (figure 3), Ba and Sr (figure 2), and MgO and SiO_2 graphs suggest olivine fractionation. The negative correlations in the CaO, TiO_2, FeO, and Fe_2O_3 with SiO_2 possibly show plagioclase and magnetite as fractionating phases. Both the Al_2O_3 and CaO graph and the Ba and Sr graph show a strong plagioclase fractionation trend (figure 3). The Sc and CaO graph suggests that clinopyroxene is also a fractionating phase (figure 3).

Until K/Ar dating is able to be done on the other volcanic units in the study area, the exact trends that are functions of age will not be able to be determined.

References cited

Catchings, R.D., Mooney, W.D. 1988. Crustal structure of East Central Oregon: relation between Newberry Volcano and regional crustal structure. Journal of Geophysical Research 93(B9): 10,081-10,094.

Hart, W.K., R.W. Carlson. 1987. Tectonic controls on magma genesis and evolution in the northwestern United States. Journal of Volcanology and Geothermal Research 32: 119-135.

LeBas, M.J., Le Maitre, R. W., Streckeisen, A., and Zanettin, B. 1986. A chemical classification of volcanic rocks based on the total alkali-silica diagram. Journal of Petrology 27: 754-750.

Mertzman, S.A., unpublished data.

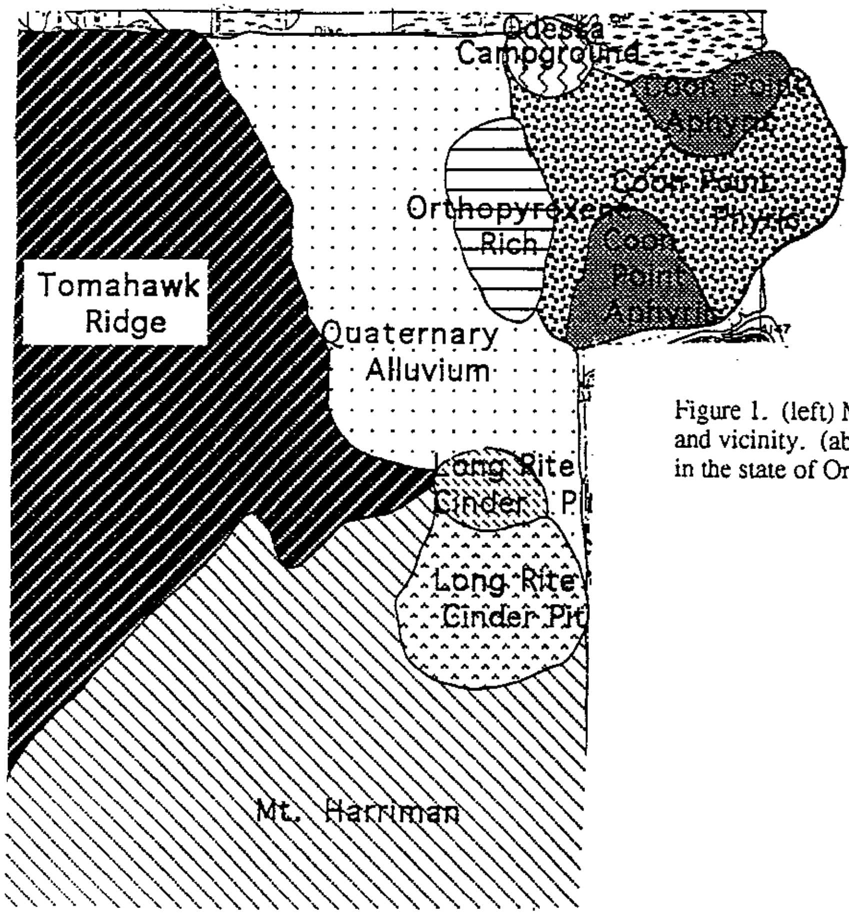

Figure 1. (left) Map of volcanics in Coon Point and vicinity. (above) Exact location of the study area in the state of Oregon.

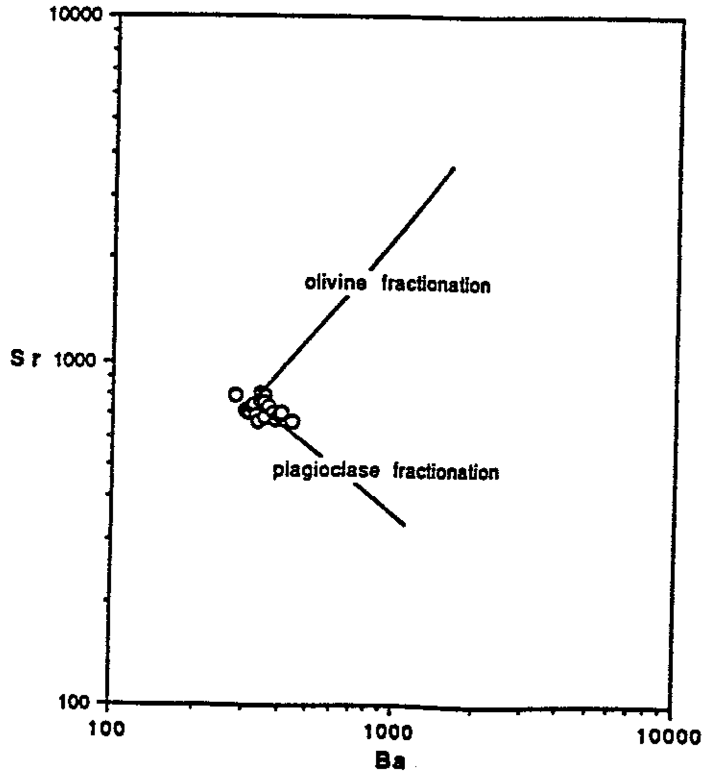

Figure 2. Variation diagram of Ba versus Sr. Fractionation trends show olivine and plagioclase as being the main fractionating assemblages in the study area though the clinopyroxene and orthopyroxe fractionation trends plot almost exactly in the olivine trend.

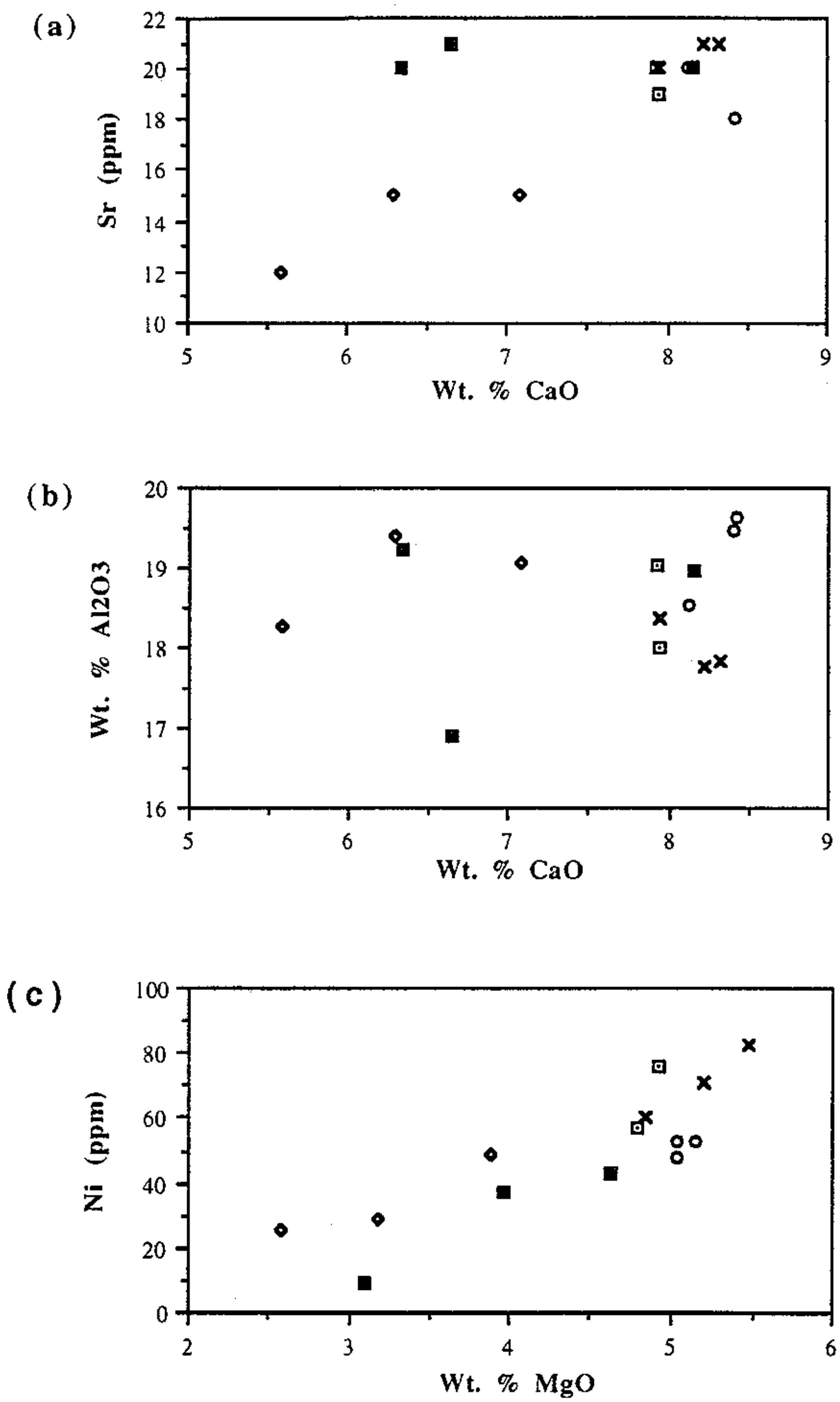

Figure 3. Variation diagrams showing fractionation trends:
(a) The positive correlation between Sc and CaO suggests that clinopyroxene was a major fractionating phase,
(b) the %Al2O3 vs. %CaO flat trend suggests that plagioclase was a major fractionating phase and the
(c) positive correlation between Ni and MgO suggests that olivine was a major fractionating phase in the study ar

- ▫ Coon Point Phyric
- × Coon Point Aphyric
- o Odessa Campground
- ◆ Mount Harriman
- ■ Tomahawk Ridge