Petrology of the Volcanic Rocks south of Cox Butte, Southern Cascade Range, Oregon

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Introduction

Volcanisim in the southern Cascades is a result of the subduction of the Juan de Fuca plate beneath the North American plate and of the crustal extension in the Basin and Range (Guffanti and Weaver, 1988). The tectonic complexities of this region are responisible for the compositional variations in lesser known eruptive vents. The third Keck Consortium research project to Oregon focused on the small volcanic vents south of Mt. McLoughlin in an attempt to differentiate subduction volcanism from extensional volcanism. Each student researcher was responsible for a seven square mile study area in which the field relationships and geochemical analyses were used to distinguish units from one another and to determine the magamtic source of each unit. The goal of my research is to study the petrology of the volcanic rocks that lie south of Cox Butte.

Field Observations

The study area is located within the Brown Mountain quadrangle in R4E T37S sections 33 - 36 and R4E T38S sections 2 - 4 (see figure 1). Outcrops were scarce and the contacts between flows were usually obscured. Determining unit boundaries was aided by lobate topographic lines and by stream valleys. Most units were intensely weathered and difficult to distinguish without a fresh sample. The rock samples brought back for petrography, ICP, and XRF anayses were taken from the freshest possible outcrops.

Lithology

During the four week study, eight different volcanic units were identified. Five of the units could be traced back to a volcanic vents, all of which were outside the study area. The units range in composition from basalt to basaltic andesite and range in age from late Miocene to middle Pleistocene. Unit descriptions are based on field and petrographic observation. All of the K-Ar dates were obtained from personal communication with Stan Mertzman (1994). The units are listed from oldest to youngest.

Lithic tuff is an unwelded tuff with numerous lithic fragments of varying compositions. There are no fragments within the rock that relate to any of the other units in the study area. It is possible that the unit is from the Western Cascade province and was extruded between late Eocene and Miocene time.
5385 T (Grungy Green) basalt (5.82 +/- 0.09 Ma) is porphyritic with a plagioclase microlites showing flow alignment. There are phenocrysts of olivine (10%), clinopyroxene (5%), and orthopyroxene (2%). This unit is highly weathered and has a greenish color.
Daley Creek basaltic andesite (5.09 +/- 0.13 Ma) is porphyritic with phenocrysts: 2 - 4 mm plagioclase (45%), 1 mm olivine (10%), and 1 - 2 mm clinopyroxene (10%). The clinopyroxene is usually elongate and the plagioclase shows resorbtion.
Big Draw Creek basalt (2.96 +/- 0.06) is porphyritic with plagioclase microlites. The units contains 15% olivine and 10% clinopyroxene phenocrysts. There is a sugary texture, but it is not diktytaxitic.
Cox Butte basalt (2.96 +/- 0.06 Ma) has an aphanitic groundmass with phenocrysts of <1mm plagioclase (40%), 2 - 4mm olivine (10%), 1mm clinopyroxene (10%), and <1mm orthopyroxene (4%). Glomeroporphyritic clumps and a sugary texture are characteristic features. The outcrop is commonly platy.
Cinder Pit olivine basalt (2.77 +/- 0.05 Ma) is porphyritic with phenocrysts of olivine 2 - 3 mm (15%). There is plagioclase in the groundmass. The unit has a sugary texture and is platy in outcrop form.
Four Corners olivine basalt (2.63 +/- 0.08 Ma) is porphyritic with phenocrysts 1 - 2 mm long of olivine (10%). Iddingsitized rims are common around olivine phenocrysts. There is some plagioclase in the groundmass.
Burton Butte basalt (0.82 +/- 0.08 Ma) is porphyritic with phenocrysts of clinopyroxene (5%), olivine (15%), and plagioclase (30%). Glomeroporphyritic clumps, diktytaxitic texture, and vesicles are distinctive characteristics of this unit.
Quaternary alluvium deposits are found in swamps in the low lying areas near Beaver Dam Creek. The area is completely vegatated.

Conclusions

An Interesting Detail

Examine the Ba/Zr versus Nb/Zr diagram (See Figure 2) for one petrogenetic "snapshot" into possible magma origins for the mafic rocks in this area. Ba and Nb contents have been normalized to Zr, a slightly more compatible trace element, in order to minimize as much as possible scatter which relates to variations in degree of crystallization or partial melting. Two distinct trends have been noted by vectors in Figure 2. One, the gently sloped vector, delineates the fairly typical behavior of increasing concentrations of both Ba and Nb; geochemists often refer to this vector as representing the "mantle array". The nearly vertically oriented vector is the one which causes a petrologist to pause; it trends toward a high Ba/Zr component. Ba enrichment in arc magmas commonly has been attributed to subduction of Ba-rich pelagic sediments (Hole and other, 1984). Another interpretation suggests these high LILE/HFSE ratios might reflect source enrichment by LILE-rich "emanations" released at depth by the subducted slab through dehydration-decarbonation chemical reactions. To date only three lavas with Ba/Zr >10 have been delineated, suggesting the last hypothesis might not be appropriate since it is rather difficult to imagine how such a large-scale process (at least as envisioned by me!) could selectively enrich the source regions, only three magma batches without similarly affecting rather enormous volumes of the hangingwall-forming upper mantle peridotite. Clearly Sr, Pb, Nd, and O isotopic data will help better constrain the nature of the source for these rather unusual Cascade arc basalts.

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The area south of Cox Butte consists of basaltic units that all contain olivine. The timing of extrusion varies throughout the area. There is one extremely young flow, Burton Butte basalt. There are four flows that are dated to about 3 Ma: Big Draw Creek, Cox Butte, Cinder Pit, and Four Corners. And finally, there are two flows older than 5 Ma: 5385 T and Daley Creek. The consistently mafic nature of the units may reflect the source of the units. And the clumping of four olivine phyric units near 3 Ma may suggest that those units are related. However, it is difficult to corrolate composition, time of extrusion, and magmatic source.

Future Research

Presently, x-ray fluorescence analysis is in progress to determine major element and trace element compositions with . Iductively coupled plasma, loss of ignition and iron titration analyses are also in progress in order ascertain geochemical comopositions. With the addition of the geochemical analyses, it will be possible to make conclusions as to the source of the volcanic units.

Works Cited

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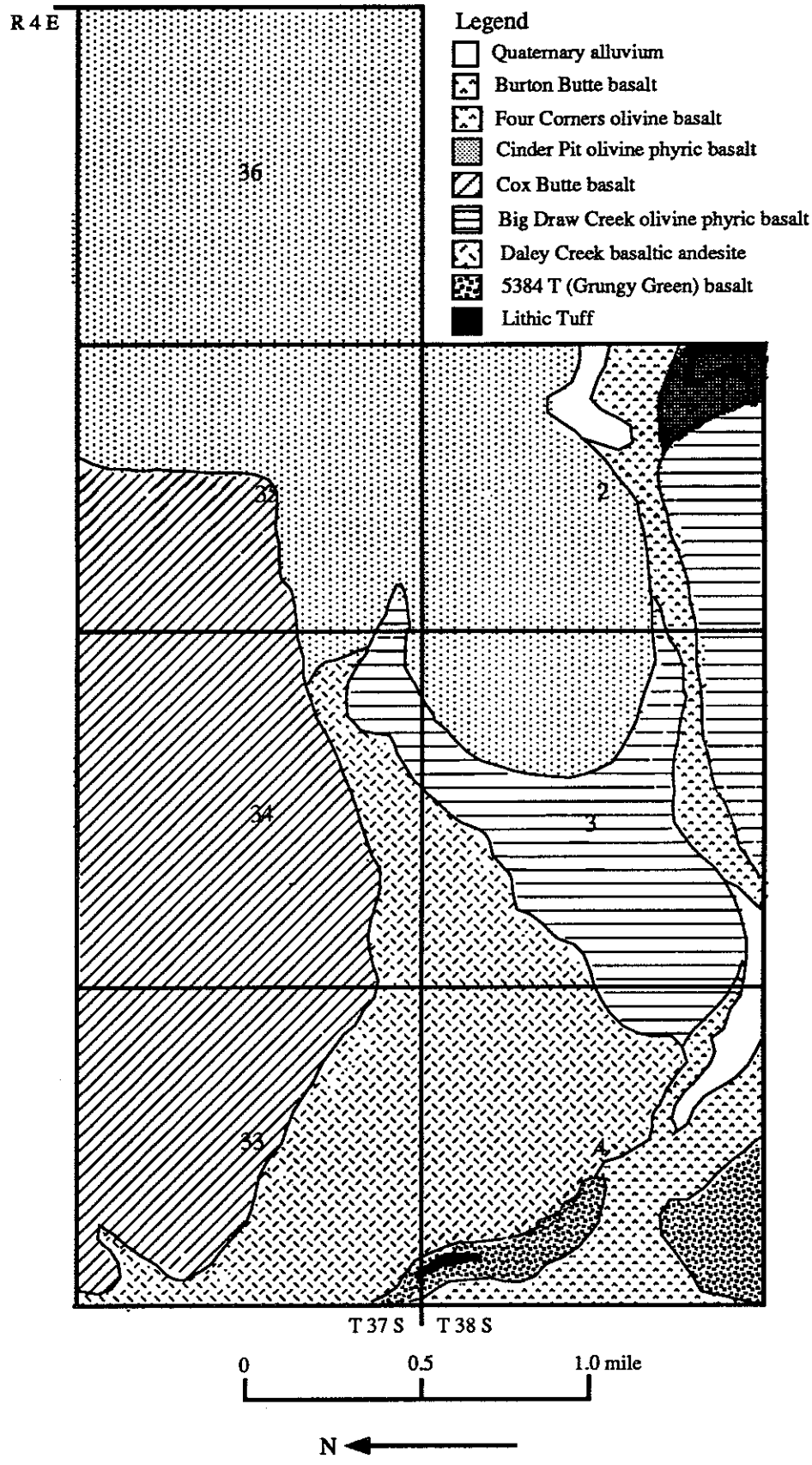

Figure 1. Geologic map of study area located south of Cox Butte with township and range numbers.