THE PETROLOGY AND GEOCHEMISTRY OF EXTRUSIVES OF THE FISH LAKE AREA, FISH LAKE, OREGON.

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INTRODUCTION

Fish Lake is located in the Rogue River National Forest, at the base of Mt. McLoughlin, approximately 45 km east from Medford, Oregon. Much of the surrounding area is covered by relatively fresh lava flows from Mt. McLoughlin and other nearby volcanoes, such as Brown Mountain and Robinson Butte. This study covers the units found in a seven square mile field area located T36S R4E, sections 19, 20, and 29-33 (Figure 1). Seventy samples were collected from this field area, of which twenty-nine were studied in thin section and twenty were studied geochemically. This study is one part of an ongoing petrographic and geochemical transect across the Cascade Arc. It is hoped that results from such a transect will help in better understanding the evolution of the High Cascades.

FIELD DESCRIPTION AND AGES

Basaltic andesite flows are by far the most widely distributed rocks in the area. Seven distinct, mappable units are found in sections 19, 20, and 29-33: the Mt. McLoughlin II 2-pyroxene basaltic andesite, the Mt. McLoughlin I olivine-phyric basaltic andesite, the Willow Quarry hornblende-olivine-pyroxene basaltic andesite, the Rye Spring pyroxene-olivine basalt, the Rye Spring' pyroxene-olivine basaltic andesite, the Willow Prairie basalt, and the Shake Camp pyroxene-olivine basaltic andesite (Figure 1). Of these units, the last five are the most important to this particular study: Rye Spring and Rye Spring' due to their abundance, and the others due to the fact that they are only found in this area. The Mt. McLoughlin units are not included in this study due to their abundance in other nearby areas.

K-Ar ages for Rye Spring (6.06 ± 0.10 my), Rye Spring' (6.43 ± 0.10 my), and Willow Quarry (5.62 ± 0.09 my) were provided by Stan Mertzman at Franklin and Marshall College (Mertzman, unpublished data). From the stratigraphy it can be determined that Willow Prairie and Shake Camp are older units than Rye Spring, however it is impossible to determine how much older. The name Rye Spring' is a misnomer applied to the unit before the stratigraphic relationship with Rye Spring had been determined; in actuality, Rye Spring' is older and has a different source location.

PETROGRAPHY

The Rye Spring basalt is holocrystalline and generally equigranular, with 3-7 modal percent olivine phenocrysts up to 4mm in length; these phenocrysts have been extensively iddingsitized. The groundmass consists of about 75-80% trachytic plagioclase, 10-15% pyroxene, 7-10% olivine, and occasional small spinels.

The Rye Spring' basaltic andesite appears very similar to the Rye Spring basalt in thin section. It is distinguished by a greater degree of inequigranularity, and a less fresh groundmass consisting of 80% plagioclase, roughly equal amounts of pyroxene and olivine, and occasional spinels.

The Willow Quarry basaltic andesite is also very similar to the Rye Spring basalt. Its most distinguishing characteristic is the presence of 1-2 modal percent phenocrystic hornblende, up to 3mm in length. This hornblende

is in disequilibrium with the surrounding rock and has been largely replaced with pyroxene, olivine, and spinels. Aside from the hornblende, this unit is virtually indistinguishable from the Rye Spring basalt in thin section.

The Willow Prairie basalt is holocrystalline and inequigranular, with roughly 40 modal percent phenocrystic plagioclase, up to 1cm in length. The groundmass consists of about 60% pyroxene, 35% plagioclase, and 5% olivine, with rare spinels.

The Shake Camp basalt is holocrystalline and inequigranular, with roughly 25 modal percent phenocrystic plagioclase up to 5mm in length, and 15 modal percent phenocrystic olivine up to 4mm in length. The groundmass consists of about 85% plagioclase and 15% pyroxene, with rare spinels.

GEOCHEMISTRY

Major element analysis was performed on twenty samples using x-ray fluorescence spectrometry (XRF) at Carleton College and Franklin and Marshall College, and trace element analysis was performed on nineteen samples using inductively coupled plasma spectrometry (ICP) at Beloit College.

Total alkali vs. silica results were plotted according to the LeBas, et al. (1986) TAS diagram (Figure 2). The Rye Spring and Willow Prairie units plot in the high SiO_2, high alkali corner of the basalt field, while Rye Spring', Willow Quarry, and Shake Camp all plot in the basaltic andesite field. Harker-type plots were used to determine possible genetic relationships between the units. Both Rye Spring and Rye Spring' exhibit very high P_2O_5 levels (>0.4%) relative to the other units.

CONCLUSIONS

Based on Harker-type plots of SiO_2, CaO, K_2O (Figures 3-5), P, Ni, Co, and Cr vs. Mg (Figures 3-9), the Rye Spring' and Willow Quarry basaltic andesites may be genetically related to the Willow Prairie basalt, resulting from fractional crystallization of olivine, clinopyroxene, and/or spinel, although with only one sample for Willow Prairie these conclusions may not be valid. It also appears that the Willow Quarry basaltic andesite may be related to the Rye Spring basalt. However, these trends are not supported by the observed concentrations of LIL elements (Ba, Ce, La, Sr, and Zr) in these units, which generally decrease from the older units to the younger units.

Due to their similarity in hand sample and thin section, one would expect a genetic relationship between the Rye Spring' basaltic andesite and the Rye Spring basalt. The geochemical data supports a rock of Rye Spring' composition (the older unit) being derived from a magma of Rye Spring composition (the younger unit). There are three hypotheses for the genetic relationship between Rye Spring and Rye Spring':

1) There is no genetic relationship between the two units.
2) Both units were derived from a stratified magma chamber, with the more felsic material erupting first; however, it is unlikely that such a magma chamber would persist for the 3-400,000 years separating Rye Spring and Rye Spring Prime'.
3) A primitive magma fractionated to produce magma of the composition of Rye Spring', which then erupted; later, more of the primitive magma was injected into the magma chamber and Rye Spring was erupted.

There is insufficient data at this point to determine which of these hypotheses is correct.

REFERENCES

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, v. 27, p. 745-750.

Mertzman, S.A., unpublished data.

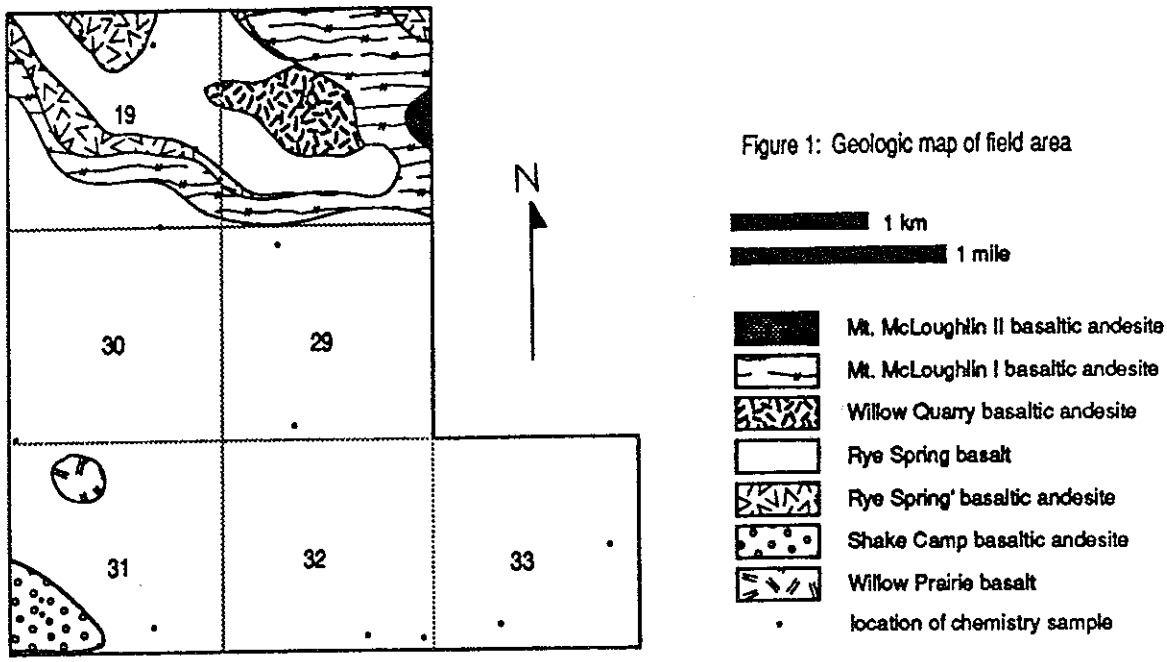
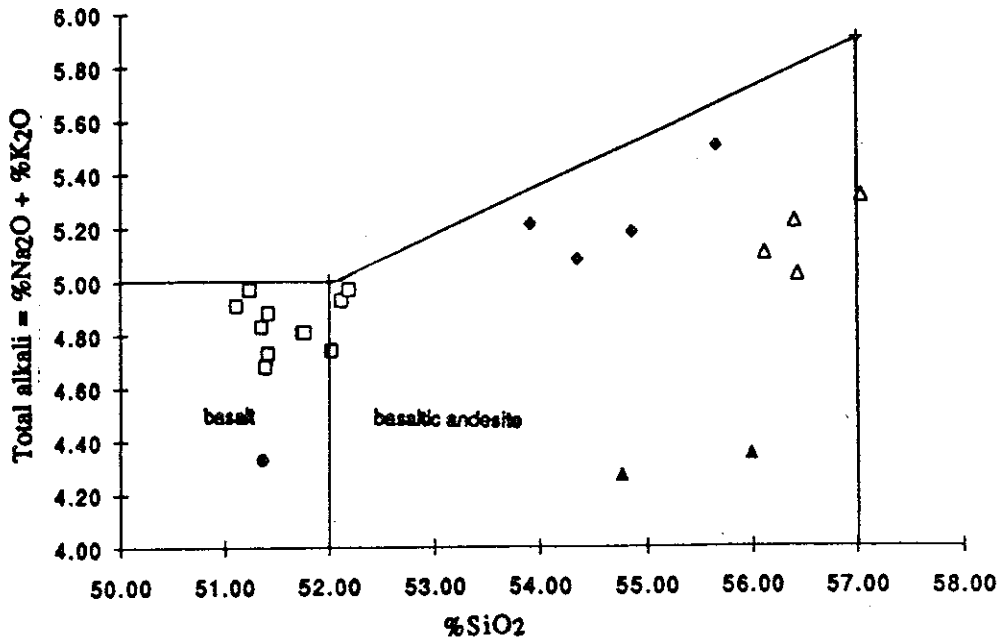


Figure 1: Geologic map of field area

Figure 2: Total alkali vs. silica after LeBas, et al. (1986). □ =Rye Spring, ◆ =Rye Spring', △ =Willow Quarry, ● =Willow Prairie, and ▲ =Shake Camp.



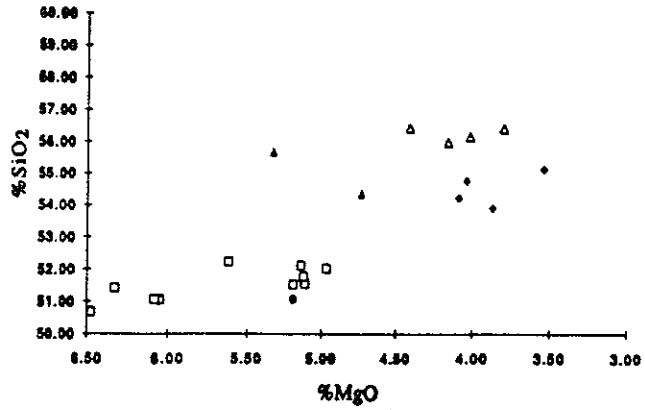


Figure 3: %SiO_2 vs. %MgO, showing enrichment of silica and depletion of magnesium from Willow Prairie to Rye Spring' and Willow Quarry, suggestive of olivine and pyroxene fractionation.

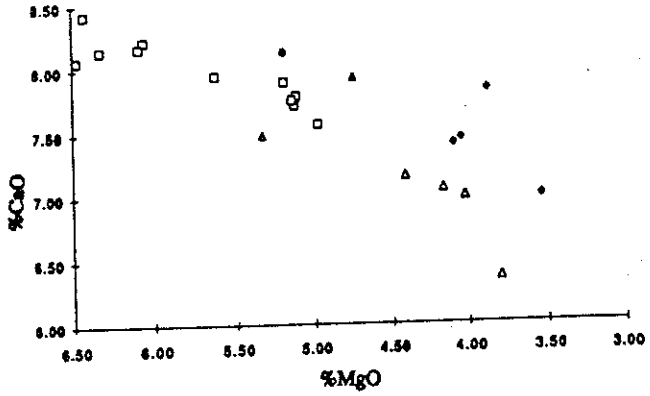


Figure 4: %CaO vs. %MgO, showing depletion of calcium from Willow Prairie to Rye Spring' and Willow Quarry, suggestive of pyroxene fractionation.

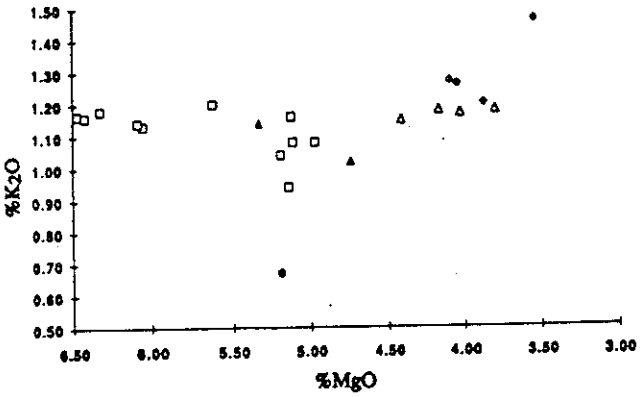


Figure 5: %K2O vs. %MgO, showing enrichment of potassium from Willow Prairie to Rye Spring' and Willow Quarry, suggestive of olivine and pyroxene fractionation.