

A Petrologic and Geochemical Study of Volcanics from the Region of Rye Spur and Mt. Harriman in Southern Oregon

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Introduction

During the summer of 1992, a detailed mapping project was conducted by eleven students from Keck Consortium institutions. The project was conducted in the Oregon Cascade volcanics in the vicinity of Mt. McLoughlin. Located in a region of broad subduction related volcanism, the analysis of these rocks will aid in refining a model for the development of the region.

The field area detailed by this study is located in a seven square mile site near the Fish Lake, Oregon. Eleven distinct units are mapped on the sections 26, 25, 36 of T36S R5E; sections 30,31 of T36S R6E; section 1 of T37S R5E; and section 6 of T37S R6E of the Lake of the Woods North Quadrangle. The study area is bounded on the west by the Rye Spur and Pearce Point highlands and extends south eastward to the northwestern flanks of Mt. Harriman. The northern sections are transected by the steep drainage basin of Seldom Creek.

In the field, units based on mineralogy and texture were described and mapped. New names and boundaries were given to a few of the units following petrographic and geochemical study. The stratigraphic order is determined by observed field relations of the outcrops and K-Ar dates of five units provided by Stan Mertzman.

Petrographic Analysis and Age

The petrographic analyses of the units is based on a thirty thin-sections. The petrography of the samples are very similar, units are distinguished by small differences. The rocks are holocrystalline, with abundant laths of plagioclase, ranging in size from micro-crystals in the groundmass to approximately 3mm in phenocrysts. Glomeroporphyritic clumps of plagioclase, clinopyroxene, orthopyroxene and olivine are frequently found in a variety of combinations. Euhedral phenocrysts are common, with the exception of olivine which is frequently iddingsitized. Apatite, magnetite, and ilmenite may additionally appear in the groundmass. The unit descriptions are listed in decreasing age. The percent total is listed in parentheses after the mineral name.

The Rye Spur Basaltic Andesite, the oldest unit in the sections studied, is found in the northwestern part of the area. The flow corresponds to the unit first defined by chemical data and physical properties by Martha Gilmore (1992) and dated 1.58 +/- 0.03 Ma. Phenocrysts compose 41% of the thin-section, 88% of which are plagioclase. The rock exhibits a seriate texture with the phenocrysts of plagioclase, clinopyroxene, and olivine ranging to a maximum size of 2 mm. Olivine and opaques each comprise approximately 10% of the total mineralogy.

The Lone Hill Basaltic Andesite (1.14 +/- 0.10 Ma) flowed from the only point source within the field area. The unit trends downslope to the north from a scoria cone located near the eastern boundary. Phenocrysts comprise 16% of the sample. Glomeroporphyritic groupings of plagioclase (55%) and olivine (18%) measure from 1 to 2 mm in the hiatally textured rock. The fine grained groundmass exhibits a diktytaxitic texture and contains little orthopyroxene or olivine, while plagioclase, clinopyroxene (14%), and opaques (12%) are abundant.

The Cat-in-the-Bag HAOT (1.02 +/- 0.05 Ma), a high-alumina olivine tholeiite, outcrops in the topographically subdued northern section of the map area. The basalt has a seriate texture with phenocrysts of plagioclase (56%) and olivine (20%) as large as 1.5 mm. The groundmass has a classic diktytaxitic texture. Clinopyroxene (11%) found exclusively in the groundmass.

The Rye Spur Andesite occupies the northwest section of the map, adjacent to the older Rye Spur Basaltic Andesite. The andesite is significantly more siliceous than the previous units described and no olivine is present. Glomeroporphyritic groupings of plagioclase (59%), clinopyroxene (18%), and orthopyroxene (14%) are frequently present. A subtrachytic texture exists in the groundmass plagioclase.

Castle Kipuka Andesite located approximately 800 meters northeast of Pierce Point, is confined to a 30x80 meter area. It is a fine grained andesite with maximum phenocryst size of 1mm. The majority of the

phenocrysts are plagioclase (64%) with clinopyroxene (17%) and orthopyroxene (10%) mostly contained in the groundmass. The microphenocrysts exhibit a slight trachytic texture.

The Sweet Andesite, a platy, sugary textured unit, cross-cuts the Castle Kipuka Andesite and also is limited in extent. Its texture is hiatal, with large (1 to 3mm) glomeroporphyritic groups of plagioclase (60%), orthopyroxene (16%), and clinopyroxene (15%) common. Opaques darken much of the crystalline groundmass.

The Seldom Butte Andesite is an extensive unit which surrounds outcrops of the previous two units and extends eastward to overlie the Rye Spur Andesite. Phenocrysts compose approximately 27% of the rocks. Glomeroporphyritic clumps of plagioclase (61%) and orthopyroxene (16%) often reach 2mm in size. Unique to the andesites of this study, clinopyroxene (13%) is limited to the groundmass.

The Roadcut Basaltic Andesite is found in a band of exposures curving around the northern and western contact of the Lone Hill Basaltic Andesite. Seriate phenocrysts of plagioclase (63%) and olivine (19%) up to 2mm in size, compose 30% of the sample. Clinopyroxene (5%) and orthopyroxene (5%) are a small portion of the total rock and rarely occur as phenocrysts.

The Whistler's Basaltic Andesite outcrops is on all sides of the Roadcut Andesite and continues westward to Seldom Creek. The percentage of phenocrysts increases downslope from 10% to 22%, across a distance of approximately 1.5 miles and a 600 foot elevation drop. Seriate phenocrysts of plagioclase (62%) and olivine (11%) are present up to 2mm. A trachytic texture exists in the groundmass which also contains orthopyroxene (11%) and clinopyroxene (8%).

The Greylock Mountain Andesite, dated 0.92 +/- 0.02 Ma, is exposed in a small area at southwest border of the map. Phenocrysts compose 10% of the sample, with 1.5-3 mm seriate phenocrysts of plagioclase (65%) and orthopyroxene (16%) and little glomeroporphyritic clumping. The other minerals are minor constituents of the groundmass, clinopyroxene (11%), and opaques (8%).

The West Varney Peak 2 Pyroxene Andesite, the youngest unit of the area (0.80 +/- 0.03 and 0.71 +/- 0.06 Ma), extends from the southern boundary of the map, downslope to the Whistler's Basaltic Andesite. Large seriate phenocrysts of plagioclase (65%), clinopyroxene (17%), and orthopyroxene (15%) occur in glomeroporphyritic clumps up to 4mm in size. The groundmass contains the same mineral assemblage, with the addition of opaques (5%).

Geochemical Data

Thirty representative samples were analyzed for major and trace elements using X-ray fluorescence and inductively coupled plasma techniques at Franklin and Marshall College. With the geochemical data, the field names can be further refined. By Gill's criteria (1981) the units are first defined by silica content, "basaltic andesites" 53% to 57% and "hi-silica andesites" 57% to 63%, and basalts less than 53%. The Gill's andesites are further subdivided by a K₂O vs. SiO₂ diagram, all plot as "medium-K andesites." Using Miyashiro's plot (1974) for distinguishing tholeiitic and calcalkaline andesites (FeO/MgO vs. SiO₂), all of the units plot as calcalkaline andesites.

Harker-type plots further subdivide the units into three well defined groups. The MgO vs. SiO₂ diagram clearly plots these groupings, that show a depletion of magnesium with increasing silica content. (Fig 1) The assemblages are **Group A**, including the Greylock Mountain, Seldom Butte, Sweet, Castle Kipuka, and Rye Spur Andesites; the **Group B**, including the Whistler's, and Roadcut Basaltic Andesites; and **Group C**, the Lone Hill Basaltic andesites and the Cat-in-the-Bag HAOT. The Rye Spur Basaltic Andesite plots near the units of Group B, however not close enough to be included in that or any of the other groupings. Other Harker plots that demonstrate the groupings include CaO vs. MgO. (Fig 2)

Discussion

Analysis of Pearce element ratios provides further evidence for three geochemical assemblages. Conserved element plots of all the data clearly show a clustering of the units. However, two anomalous points, the Rye Spur Basaltic Andesite and one sample of the Seldom Butte Andesite, plot over one standard deviation from a grouping. Excluding those two points, the data suggest a separate magma source for each of the groups. In Figure 4, an assemblage test diagram of **Group A** furthers this hypothesis. All of the samples plot under a 1/4 of a standard deviation from a line with a slope of 1. The high correlation of the samples suggests the possible fractionation of plagioclase, augite, and/or olivine. With further investigation of the data, the exact relationship of the three groupings and the two anomalous plots should be better understood.

References

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Units in Field Area

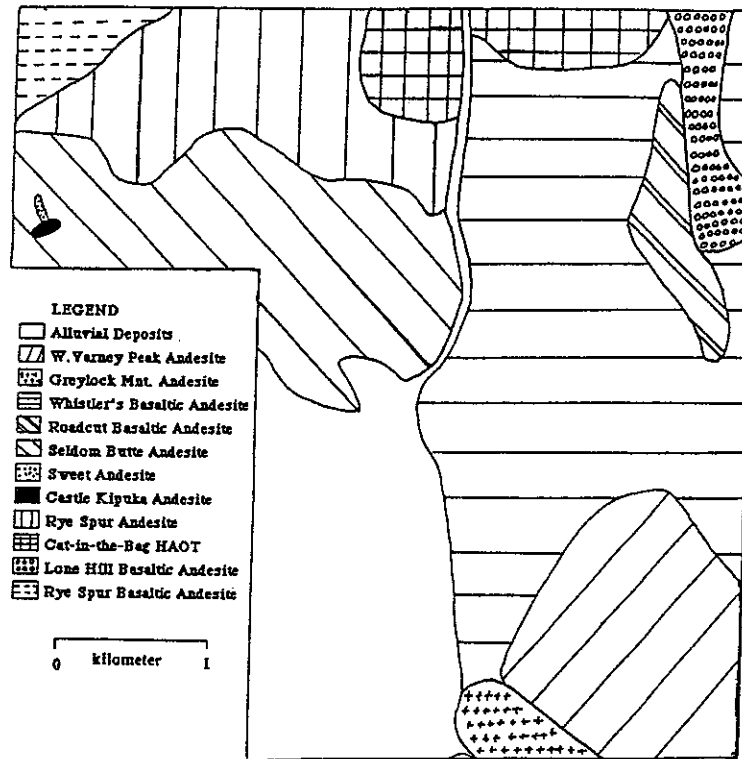
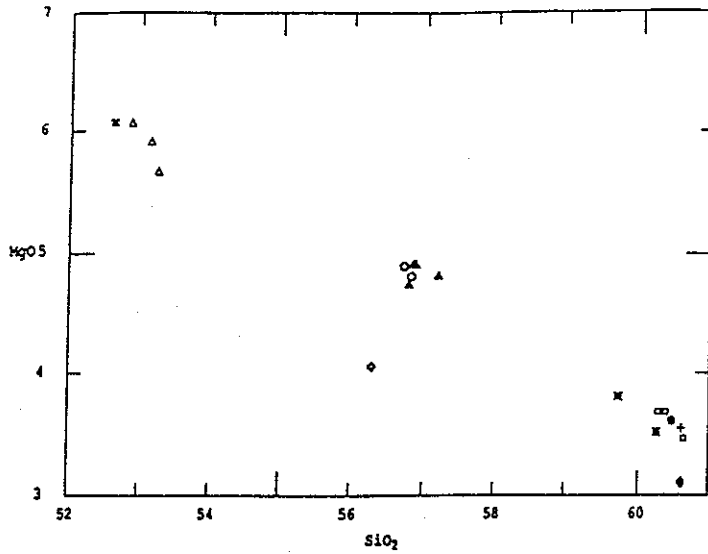


FIGURE 1



Units Plotted in Harker Diagrams

- Group A*
- ◇ W. Varney Andesite
- ◆ Greylock Mt. Andesite
- Seldom Butte Andesite
- Sweet Andesite
- + Castle Kipuka Andesite
- * Rye Spur Andesite
- Group B*
- ▲ Whistler's Basaltic Andesite
- Roadcut Basaltic Andesite
- Group C*
- × Cat-in-the-Bag HAOT
- △ Lone Hill Basaltic Andesite
- Others*
- ⊕ Rye Spur Basaltic Andesite

FIGURE 2

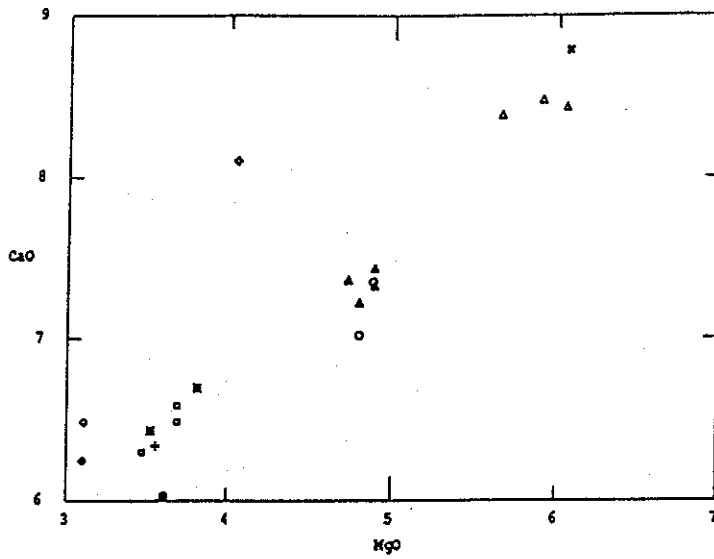


FIGURE 3

