ANALYSIS OF THE INTERMEDIATE ROCKS OF THE PIKES PEAK AREA, SOUTHERN FRONT RANGE, COLORADO

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Introduction

The Pikes Peak Batholith is located in the Southern Front range of Colorado. Unique in it's size, the batholith consists of 2800 km^2 of 1050 m.y. old anorogenic granite (A-type). The batholith consists mainly of classic, pink, Pikes Peak granite, however, within the batholith there are seven late-stage sodic and potassic intrusive centers. As a result, wide variety of rock types are represented within the Pikes Peak batholith suite. Up to this point little geochemical analysis has been completed in explaining petrologic origins of the batholith.

Purpose

This study focuses on some of the the granitic rocks of the Pikes Peak Batholith,(other than the main Pikes Peak granite), and characterizes them geochemically and petrogra ghically. With further analysis using the data compiled by all the students participating in the project, I plan to outline what role these A-type granites play in the petrogenetic evolution of the batholith.

Field description

The rocks analyzed in this study come from four geographically distinct areas limited to the northern half of the batholith, as mapped by Bryant and Wobus (1975) . There were no such intermediate rocks present in the southern half of the batholith. The main area where my samples come from is in the Pine and Green Mountain quadrangles, representing about a seven sq. mile area. Other samples represent the Cheesman Lake area, the Hackett Mountain area, as well as the Wellington lake area in the Green Mountain Quadrangle, (see map, Noblett et al.,this volume). There was one other area containing intermediate rocks that was inaccessible and as a result is not represented in this study. Field relationships show that the intermediate rocks are older than the Pikes Peak granite. In the field, the intermediate rocks were not always easy to find because they did not form large cliffs, but weathered down to form relative lows with respect to the Pikes Peak granite that surrounds it. Although my rocks prove to be granites through modal analysis, the rocks I am studying are very different in appearance when compared to the classic Pikes Peak granite. In outcrop, the rock weathers to a buff pink-grey color. It is a dark gray , medium-grained rock when looking at a fresh surface. Classic Pikes Peak granite on the other hand, forms large cliffs, and the rock is pink to red when fresh. The rocks are 1050 m.y. old, and obtaining fresh samples was difficult, so it became important to remove the outer weathering surfaces before taking a sample.

Petrography

In hand specimen, these syeno- and monzo-granites of the Pikes Peak area are medium grained, with crystals that range from a few mm. to roughly 5 cm. Also notable in the field are the presence of plagioclase 'mega-crysts'. These crystals are exclusive to the intermediate rocks, however, I only found two locations where the crystals occured. The majority of the granites did not have the crystals present. The crystals are considerably larger, (2-5 cm in length), than the surrounding crystals. The plagioclase crystals are generally euhedral, and sometimes exhibit zoning. Some of the samples brought back from the field were coarse enough to stain and use for modal analysis, however thin section study provided most of the data used in classifying the rocks. I preformed a petrographic study of the thinsections in order to describe the mineralogy and textures of the minerals making up the granites.

Point counting show that the rocks range from syeno-granite to monzo-granite. (fig.1) These granites fit in well with the modal composition of Proterozoic anorogenic granites as described by Anderson (1983), with average Quartz = 25.48%, Alk. feldspar = 40.06%, and Plagioclase = 24.02%. Values for the aluminous index, (mol $Al_2O_3/Ca+Na_2o+K_2$) fall on the borderline between peraluminous and metaluminous rocks. (range= .78-1.05) This also meshes well with the data provided by Anderson for other A-type suites. Feldspar, quartz, plagiocase, microcline, biotite, and hornblende are the main constituents of the rock. Thin section work shows that the feldspars are sericitically altered, and chloritization of the biotite is also common. The plagioclase is subhedral and oftentimes zoned. Accessory minerals include allanite, apatite and zircon. The apatite is the most abundant of the three, commonly forming euhedral needles and/or prisms. Opaque minerals, illmanite or magnitite, occur in both euhedral and anhedral form. In thin section, the alkaline feldspar is dominantly micro-perthitic, as well as antiperthitic. Seritic alteration has affected a majority of the crystals.Thinsection study indicates that the K-feldspar, microcline and plagioclase all crystalized somewhat simultaneously. Some of the opaque minerals as well as zircon and apatite seem to have crystallized early as euhedral grains are present. At the same time, however, there are anhedral grains of apatite, zircon, as well as opaque minerals. Quartz consistently represents the later stages of crystallization as it fills in the spaces between the other grains

Geochemistry

I prepared and chemically analyzed twelve samples. I obtained trace element values by using ICP analysis at Beloit College. Commercial INAA analysis also contributed additional trace element data. XRF analysis at Carlton College provided major element data. Isotope analysis supplied Nd and Sr values. Using EDS analysis on the SEM at Beloit College, I studied possible compositional variance from core to rim within the crystals of the plagioclase 'mega-crysts.

The granites I am studying fit the characteristics of A-type, within plate granites. The rocks represent a within plate granite as seen in fig. 2. I plotted Ta vs Yb and used a discrimination diagram as proposed by Pearce et al. (1984). Whalen, Currie and Chappel (1987) define chemical parameters for A-type granites based off the accumulation of chemical analysis of A-type granites from around the world. Eby, (1990) also puts forth chemical parameters for A-type granites. Comparing my geochemical data with the data and parameters set forth in both papers, it is clear that my samples fit within the label of A-type granite. Analysis of my samples show relatively low values of CaO, Al_2O_3, Sc, Cr, Ni, Ba, and Sr, relatively high values of Fe0, MgO, K_2O, Na_2, Zr, Nb, Ta, Y, as well as enrichment of LREE values. I plotted average values of both major and trace element for all my samples with thee major and trace element averages as calculated by Whalen et al. (1987). (fig. 3) My values plotted on almost the same points as the values of Whalen, Currie and Chappel's. One exception in the data lies in the Ba values, which, compared to Whalen's values, appears to be significantly high. However, when compared to the values presented by Anderson (1983), it is clear that such Ba values are not uncommon in A-type rocks. The analysis of the plagioclase megacrysts so far has shown no significant variations within the large plagioclase crystals.

Discussion and future work

So far the chemical data I have accumulated has raised many questions. Harker diagrams show that the magma source of these granites may have involved fractional crystallization, possible contamination and/or magma mixing. As these rocks are older than the main pike peak granite I plan to investigate the relationship between the samples I have accumulated and data on the Pikes Peak granite to see if the granite is a possible derivation of the rocks I am presently studying.

References

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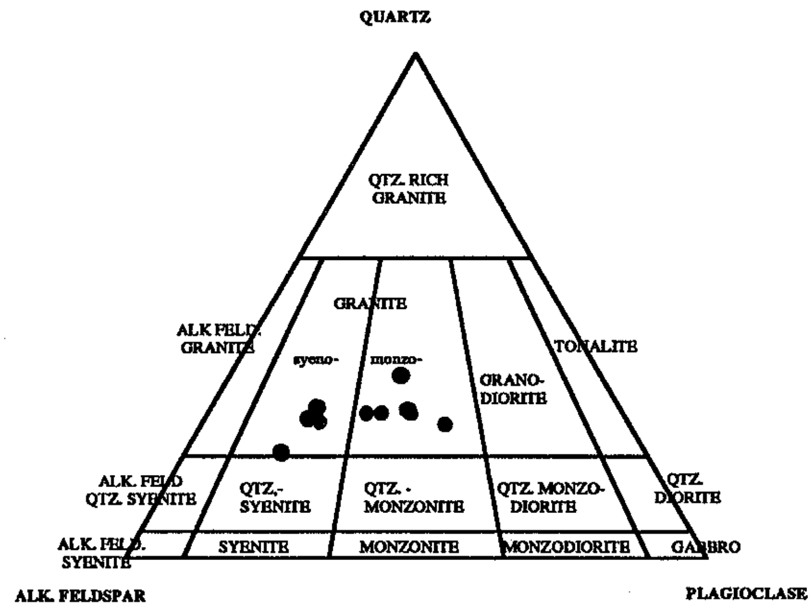

Fig. 1 Streckeisen diagram showing the classification of 10 samples from the areas studied.

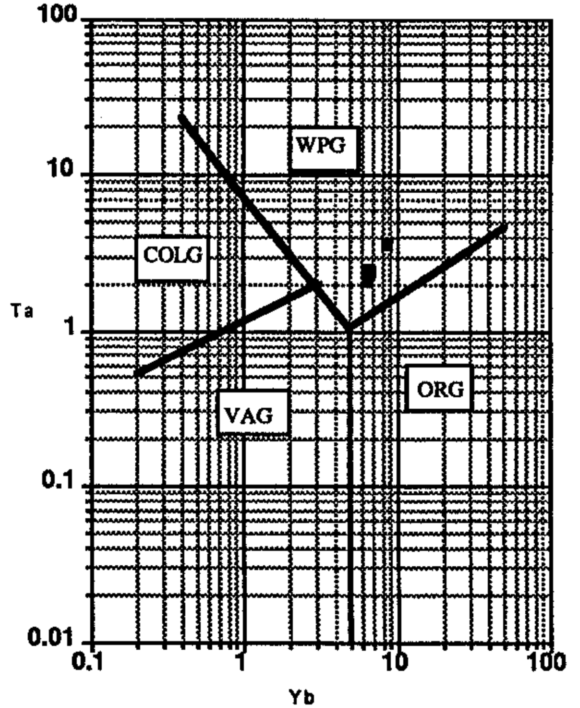

Fig. 2 Pikes Peak data points fit in the within plate granite (WPG) field from Pearce et al. (1984)

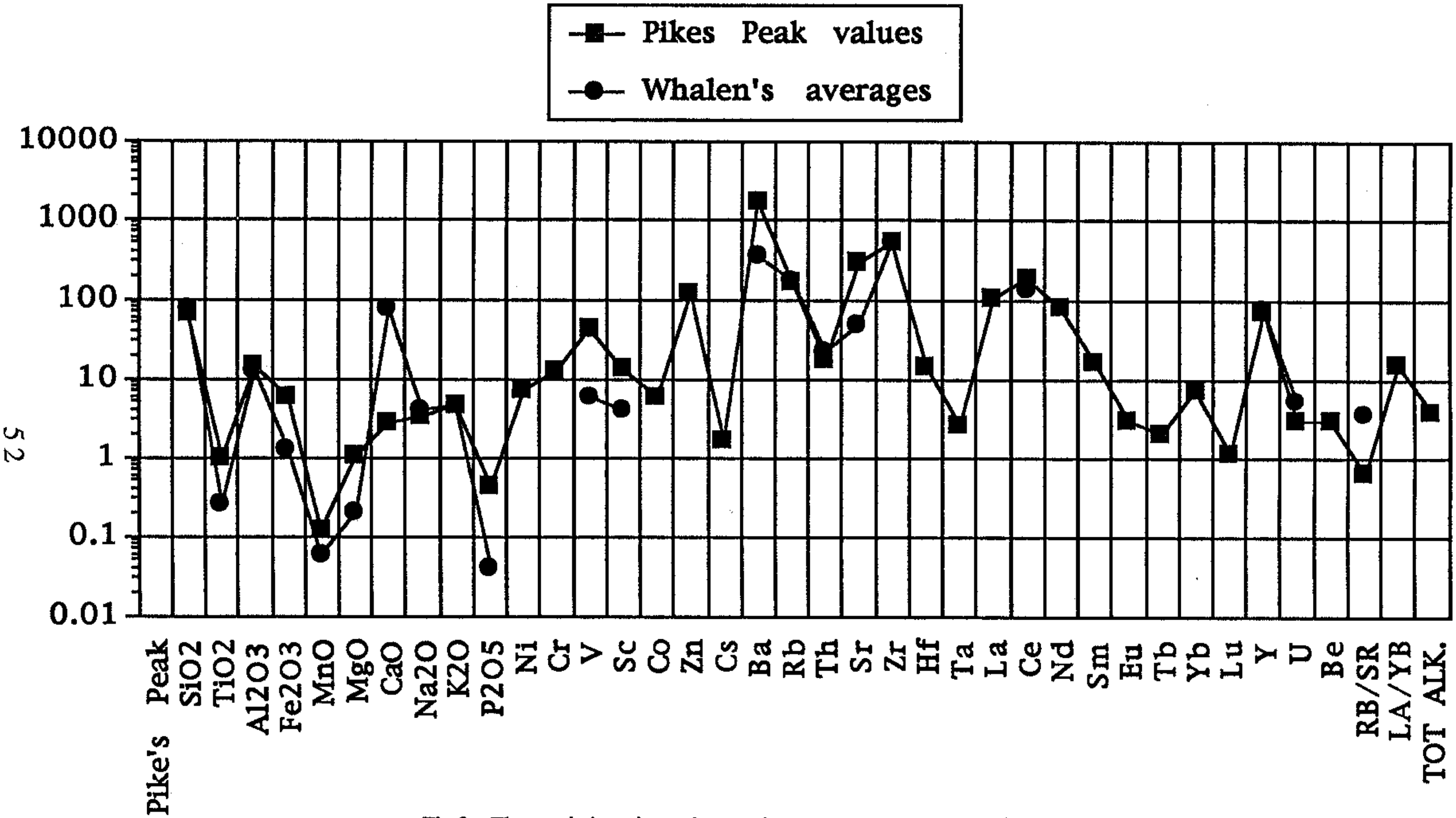

Fig.3 The granite's major and trace element average values as plotted with the average values given in Whalen et al. (1984). The values of the Pikes Peak rocks match the values given for A-type rocks in general..