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PROGRESS ON THE ORIGIN OF PEGMA TITE DIKES AND PODS IN THE MOUNT SHERIDAN GABBRO, OKLAHOMA

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ABSTRACT

The Mount Sheridan Gabbro of the Wichita Mountains of south western Oklahoma contains dikes and pods of a coarse grained pegmatite. Initial field work was carried out and samples collected. All samples have been slabbed with a rock saw and described. These samples reveal spectacular examples of the minerals amphibole, feldspar, quartz, and apatite and zircon. The minerals apatite and zircon were investigated using the SEM as part of a class. From these slabs, representative examples have been selected for making thin sections. These are prepared by a commercial lab and I am awaiting their return. I can then complete my descriptions with a petrographic microscope. Rock powders have been prepared for geochemical analyses pending installation of the LAICPMS at UMR. I will also complete geochemical analyses of individual minerals using this equipment and the thin sections.

INTRODUCTION

The Mount Sheridan Gabbro of the Wichita Mountains of south western Oklahoma contains dikes and pods of a coarse grained pegmatite (Fig. 1). Dikes of the material can be found throughout the body of rock, but with greater abundance of large dikes in the middle parts of the pluton with some over one meter in thickness. The dikes exhibit clear cross-cutting relationships with the gabbro. Pods of the material are common in the lower and middle areas of the pluton and are commonly intimately associated with the gabbro.

These initial observations suggest two possible hypotheses for the origin of the pegmatite. Are these pegmatites derived from Gabbro by extreme fractional crystallization? In this model the pegmatites from by the coalescence of pods of felsic material into dikes due to filter pressing of the gabbro. Are the pegmatites the result of a separate intrusive event? There is a large amount of granite which was emplaced around the gabbro. The pegmatite magma may have had its source from one of these granites and intruded into the gabbro. By establishing a crystallization age on these dikes, the minimum age of the gabbro's crystallization can be constrained.

The goal of this project is to test these hypotheses. To do this, the distribution of pegmatite in the Mount Sheridan Gabbro was mapped. I have completed one field season, and based upon my initial result I am planning on a second field season this summer. Samples have been collected for petrographic and chemical analysis. Unfortunately, due to delays with an outside company and delays in installation of the LAICPMS several portions of the project are still needed to test the hypotheses. Although I have described in detail hand samples and sawed slabs, a complete mineralogical description of the pegmatite using thin sections and a petrographic microscope must still be done. Interpretation of whole rock chemical analyses done by a commercial lab cannot be done yet. Once thin sections are returned from the commercial lab, a visit to use the electron microprobe facilities at the University of Oklahoma for compositional characterization of minerals will hopefully be made. When the new LAICPMS instrument at UMR is installed, an attempt to determine the age of crystallization for these dikes will be made.

FIELD WORK

During the first to forth of June 2004 field work for this project was conducted in the Wichita Mountains of Oklahoma. During this excursion, Dr. Hogan, Daniel Lasco and I made several trips to the mountain to collect data and samples for Daniel Lasco's masters research and this OURE from the Mt Sheridan Gabbro and its associated pegmatites. On the mountain, each outcrop was recorded was recorded using GPS. All pegmatite dikes were measured using a Brunton compass to obtain their orientation of each dike present. In addition, the thickness of each dike was recorded. Dikes and pods were classified based on amphibole characteristics and rock texture; small amphibole pegmatite dikes (SAPD) (Fig. 1), combed small amphibole pegmatite dikes (SACP) (Fig. 2), large amphibole pegmatite dikes (BAPT) (Fig. 3), combed large amphibole pegmatite dikes (BAPC) (Fig. 4), hair line dikes (HLD) (Fig. 5), and granitic dikes. Samples were taken of any dike which had little weathering, had good exposure, and were representative of an outcrop. In addition some samples were taken of dikes which appeared to have unusual compositions or positions in the pluton.

Image1: SAPD dike, this material is commonly found in the smaller dikes (3-20cm) and pods and is typified by a relatively even distribution of blocky amphibole crystals

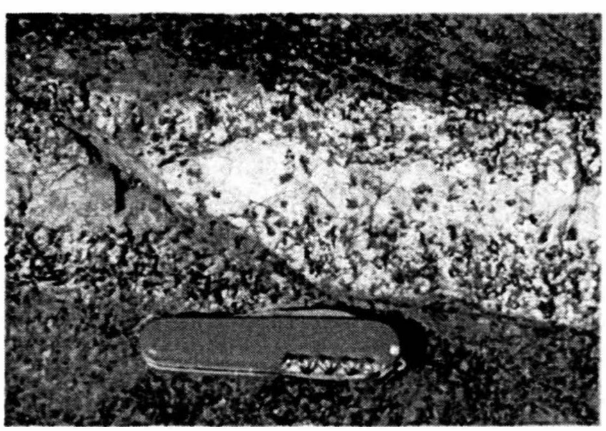

Image 2: SACP dike, composed of a pegmatite which that is enriched in amphibole near the contact with the Gabbro, while the inner portion of the dike is filled with a more felsic or SAPD material. Like the SAPD type dikes and pods, all amphiboles in these dikes are of the small blocky variety.

Image 3: BAPT dike, composed of a pegmatite characterized by large, hollow, tabular amphiboles with little or no comb of large tabular or small blocky amphibole crystals on the walls of the dike.

Image 4: BAPC dike, dikes containing large, hollow, tabular amphibole crystals with a comb of small blocky and tabular crystals protruding into the dike from the walls.

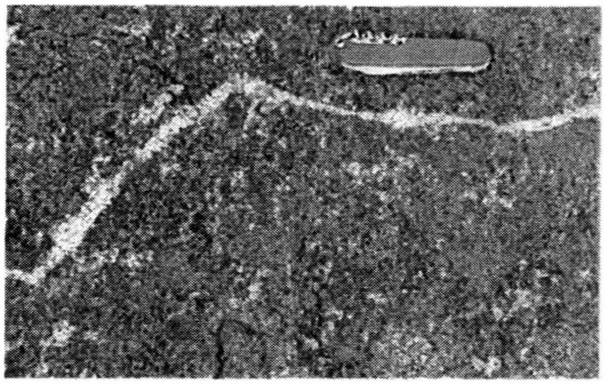

Image 5: HLD type dikes are small, filled fractures. These dikes are characterized by small width and lack of amphiboles.

Sample Preparation

Once the samples were returned to the lab they underwent preparation for analysis. Each sample was cut into slabs approximately one centimeter thick using a Hillquist slab saw. The slabs were then examined and the most representative and unusual areas were cut into thin section blanks; matchbook sized pieces of stone, using a Felker cutoff saw. The remaining slabs were polished using five stages of grinding on a lap in order to remove saw marks.

Two of the samples were large enough for whole rock chemical analysis. The original samples were cut into slabs, and blanks for thin sections were extracted and a set of representative slabs were set aside. For chemical analysis, the rock must first be reduced to a powder form. In order to reduce a sample to the desired grain size, several steps are taken. First the sample is broken by hammer into pieces half the size of a fist or smaller. In addition, the weathered material on the samples was removed using the hammer to prevent contamination from recent chemical changes in the sample. The broken fragments are then placed into a Bico Inc. jaw rock crusher to reduce the size of fragments to less than ½ centimeter on an edge. At this point the material is small enough that it can be introduced into a tungsten carbide shatter box. After several minutes in the grinder the material is a rock flour of the proper size for chemical analysis. The thin section blanks and whole rock chemical samples were sent off to a company in December.

Analysis

Until thin sections and chemical samples are returned, little more can be done to analyze the samples at this point in time. Some analysis was done using the JEOL T330 on samples collected and made into polished sections by Dr. Hogan several years ago. Standardless EDS x-ray spectra were taken for several accessory minerals. In addition, several EDS maps were produced of pegmatite samples (Fig. 6).

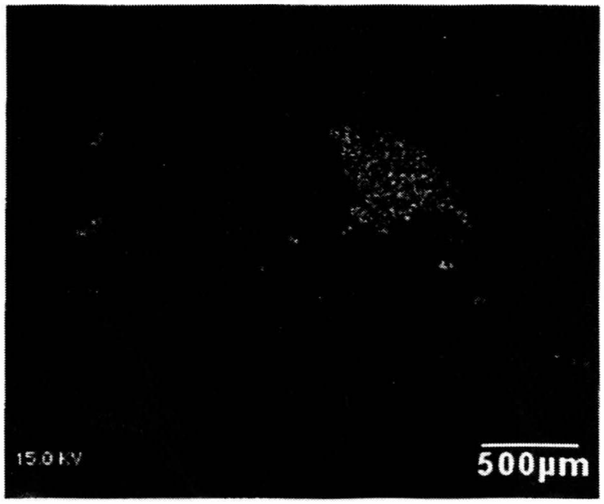

Image 6: Compositional false color eds map of pegmatite polished section.

Once the thin sections returned by the outside company, more analysis will be done to complete this project. The thin sections must be polished before they can be analyzed using transmission light microscopes and before they can be analyzed for compositional variation with the electron microprobe facilities at the University of Oklahoma. The new LAICPMS instrument at UMR will be used for an attempt to determine the age of crystallization of these dikes.

Observations

Visual analyses of slabs taken from samples collected for this project suggest that the majority of pegmatites are genetically related. There is a smooth transition in the groundmass texture as well as amphibole types and quantities between each type of pegmatite, ranging from SAPD type to BAPC dikes. The granitic type dikes are variable in texture and amphibole types, with some appearing to be related to pegmatites, while others do not. Dikes have a preferred orientation in the gabbro, indicating a uniform stress regime at the time of emplacement. The distribution of dikes is more complete than first suspected; nearly all outcrops in the gabbro had some pegmatites in them. The pegmatites appeared to have a decrease in amphibole concentrations, and increase in amphibole crystal size with increased elevation in the Gabbro.

Conclusions

Preliminary field observations and description of hand samples and sawed rock slabs has been used to recognize and describe distinct types of pegmatite in this gabbro. Several of these pegmatite occurrences appear to be texturally related. This suggests that the different types of pegmatite represent sequential stages in the segregation of felsic magma to form first pods and then eventually dikes. In order to more fully develop my model for pegmatite formation I would like to make additional field observations and analyze thin sections and rock powders.

NOMENCLATURE

Dike: Tabular body of igneous rock that cuts across a structure of massive rocks.
Pod: Small body of pegmatite, usually between 45cm and 5cm in their longest direction. Pods are normally ellipsoid in shape, but often times irregular. They are filled with SAPD type pegmatites, and some times lack a definite boundary with the host gabbro.
LAICPMS: Laser ablation inductively coupled plasma mass spectrometry is a technique used for the in place analysis of trace elements in solid samples.
EDS: Energy Dispersive Spectroscopy technique on a SEM

Acknowledgements

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