

**TOWARD AN UNDERSTANDING OF THE BULK COMPOSITION OF THICK STILLWATER ANORTHOSITE UNIT AN-II.** Keith D. Pass and Peter A. Salpas, Department of Geology, 210 Petrie Hall, Auburn University, AL 36849-5305.

Petrogenesis of anorthosite is an important question that bears on the formation of the crusts of Earth and the Moon and perhaps other terrestrial planets. The Stillwater Complex is an anorthosite-bearing mafic layered intrusion in south-central Montana. Understanding of the petrogenesis of Stillwater anorthosites is aided by the nearly complete stratigraphic exposure of the complex which potentially provides access to the mafic minerals that cocrystallized with the plagioclase.

Key questions in our attempt to understand the Stillwater anorthosites are the bulk compositions of the two thick layers, AN-I and AN-II, in the Stillwater Middle Banded Series (MBS). We showed previously (e.g., 1,2,3) that a rock's major and trace element composition is roughly correlatable to its pyroxene mode and that, in general, compositional heterogeneities in the anorthosite units often exist over several to tens of square meters of outcrop. We have recently initiated a study which aims to characterize the bulk composition of AN-II by extensive sampling of the top and bottom of the unit. The resultant compositional data can be compared with that of the middle portion of the unit determined by (2). Here we present preliminary compositional data for 27 samples (half of the total collected) from a single large outcrop, 20m X 15m X 6m in size, that lies within 5 meters of the bottom of AN-II. The remaining samples are being processed for analysis.

We randomly selected the samples for this study from a predetermined grid to guard against bias based on pyroxene mode, unlike our previous outcrop study (2) in which we mapped the outcrop for distribution of pyroxene and then collected samples that display the observed range in pyroxene modes. Our goal of a random sampling was aided by abundant lichen which disguised the distribution of pyroxene on the surface of the outcrop. This sampling strategy should produce a good estimate of the average composition of the outcrop but is less likely to refine our estimates in the ranges in composition. Regardless, the compositional data have extended the maximum concentrations of some elements (e.g.,  $\text{TiO}_2$ , FeO, MgO,  $\text{Na}_2\text{O}$ ,  $\text{K}_2\text{O}$ , Cr, Co, Sc) and the minimum concentrations of others (e.g., FeO, CaO,  $\text{Na}_2\text{O}$ , Cr, Br, REE, Hf, Th) with both extended for some.

Figure 1 compares the average concentrations for a number of elements from this study to their averages for the outcrop from the middle of AN-II (2). Those elements from this study with higher average concentrations are, for the most part, those whose maximum concentrations are extended in this study, and those with lower average concentrations tend to have lower minimum concentrations. In general, it can be said that this outcrop from the bottom of AN-II is enriched in ferromagnesian-compatible elements and depleted in incompatible trace elements relative to the middle of AN-II. The exceptions to this observation are  $\text{Na}_2\text{O}$  and  $\text{K}_2\text{O}$ .

Though they display somewhat different compositions, the samples from this study adhere to the compositional trends established by the samples studied by (2). For example, Figures 2 and 3 plot data from both studies and, except for their ranges, show that the data sets are indistinguishable. As noted by (2), many elements display linear correlations with MgO among the pyroxene-rich rocks (>10% pyroxene) but, in the pyroxene-poor rocks, display excess or deficient concentrations, relative to the trends in the pyroxene-

COMPOSITION OF STILLWATER AN-II: Pass, K.D. and Salpas, P.A.

rich, rocks that are uncorrelated with MgO. In the case of La vs. MgO (Fig. 3), for example, our new data indicate that the trends among the compositional data may be curved and include both the pyroxene-rich and pyroxene-poor samples. We interpret the similar compositional behaviors between the two groups of samples to reflect the fact that their major and trace elements were controlled by the operation of similar processes during their formation.

This work was supported by NASA grant NAG-9-330.

Refs: (1) Salpas et al. (1983) Proc. Lunar Planet. Sci. Conf., 14, B27-B39; (2) Salpas and Haskin (1989) Geochim. Cosmochim. Acta, in press; (3) Salpas et al. (1990) Geochim. Cosmochim. Acta, submitted.

