GEOPHYSICAL AND Rb-Sr STUDY OF THE ELLIOTT COUNTY, KENTUCKY AND PRAIRIE CREET, ARKANSAS KIMBERLITES

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General:

Rb-Sr systematics, uranium whole-rock analyses, whole-rock and mineral-separate chemical analyses have been determined for two areas of kimberlitic rocks: the Prairie Creek, Arkansas and Elliott County, Kentucky intrusions. In addition, petrologic data and detailed field investigations, completed as part of a joint University of NM-Purdue University study of mid-continental USA kimberlites allow the following interpretation to be made: The Prairie Creek intrusion is characterized by three rock types: micaceous peridotite, clearly distinguishable by magnetic data, and kimberlite breccia and associated tuff, not distinguishable by magnetic data. (1) Detailed mapping and geophysical data suggest the sequence of intrusion to be: kimberlite breccia, characterized by a 'typical' diatreme shape; peridotite, a shallow vertical intrusion of variable thickness; and scattered patches of tuff consisting of reworked breccia and peridotite. (2) Garnet, ilmenite, pyroxene, olivine and phlogopite megacrysts from the two study areas are similar in composition to those of kimberlites described elsewhere in the world.

Twenty Elliott County kimberlites yield $^{87}Sr/^{86}Sr$ ratios ranging from 0.7026 to 0.7102 with an arithmetic mean of 0.7065. Sixty five Prairie Creek analyses range from 0.7058 to 0.7132 with an arithmetic mean of 0.7094. Variability of $^{87}Sr/^{86}Sr$ and total Sr and Rb is attributed to both sample inhomogenity and heterogeneous source regions. The rock are undateable by the Rb-Sr whole rock method.

Discussion:

In Elliott County at least two dikes several hundred feet long and one diatreme about 200 feet in diameter, Permian in age, crop out in poor exposure. The presence of megacrysts of pyrope garnet, magnesian-rich ilmenite, olivine, phlogopite and clinopyroxene in a panidiomorphic groundmass of euhedral olivine, primary carbonate and orthopyroxene indicates these rocks are properly classified as kimberlites, and compared to other U. S. kimberlites, these rocks are relatively fresh. Several xenoliths, including a very interesting metamorphic suite, were examined. These xenoliths suggest that a metamorphic suite of rocks may occur at the base of the crust in Eastern Kentucky.

The Prairie Creek intrusion, covering about 0.5 mi^2 consists of a micaceous peridotite (phenocrysts of subhedral, partially serpentinized olivine-Fo_{92} in a groundmass of phlogopite, serpentine and diopside with minor amounts of perovskite, pyrite, amphibole and magnetite), a kimberlite breccia (serpentinized olivine phenocrysts in a groundmass of serpentinized olivine and phlogopite with minor amounts of spinel, perovskite, secondary biotite, chlorite, and secondary calcite) and associated tuff (containing fragments of breccia, peridotite and country rock). The lack of magnesian ilmenite, enstatite, and chrome diopside and the rarity of garnet suggest the kimberlite breccia may not be a true kimberlite rock in the "strictest sense"; however, the observed mineralogy is not believed to be representative of the original composition because of the extreme alteration of the breccia.

The sequence of intrusion, based on geophysical evidence is believed to be breccia, peridotite, then tuff. Analyses of magnetic and gravity data suggest qualitatively, that the peridotite intrusion is a shallow almost vertical intrusion of variable thickness which dips slightly to the south. The boundary of the kimberlite breccia was not clearly defined by geophysical data.

Garnet, ilmenite, pyroxene, olivine and phlogopite megacryst data from this study compare favorably with foreign and other U. S. analyses. Two suites of garnets occur, one high in Cr_2O_3 (0.5-4.0 wt. %), characteristic of kimberlites, and one low in Cr_2O_3 (less than 0.2 wt. %), characteristic of some other source (probably metamorphic). Compared to South African kimberlite data, Elliott County pyroxenes are equivalent in Al_2O_3 content but possess lower Ca/ Ca+Mg ratios. Most of the megacrysts in this study appear to be xenocrysts, as evidenced by petrographic data and composition similar to corresponding minerals in garnet lherzolites and garnet peridotites.

A Rb-Sr systematic study revealed extreme variations in $^{87}Sr/^{86}Sr$, total Sr and total Rb for both study areas. This variability is attributed predominantly to sample inhomogeneity, heteogeneous source regions and interactions with ground water. Extreme care in selecting "fresh" samples and tedious handpicking to remove xenoliths and megacrysts may (or may not) help to eliminate this scatter, consequently the data were not amenable to isochron treatment. An extensive leach program using dilute HCl was undertaken but did not resolve this problem. A histogram-frequency plot for Prairie Creek rocks is given in Figure 1.

An isochron plot of three Prairie Creek Montmorillonite rich samples yields preliminary data that is encouraging in that the age of intrusion may be successfully determined from clay isochrons in the near future.

References:

Bolivar, S. L., 1977, Geochemistry of the Prairie Creek, Arkansas and Elliott County, Kentucky intrusions, Ph.D. dissertation, Dept. of Geology, University of New Mexico, Albuquerque, New Mexico.

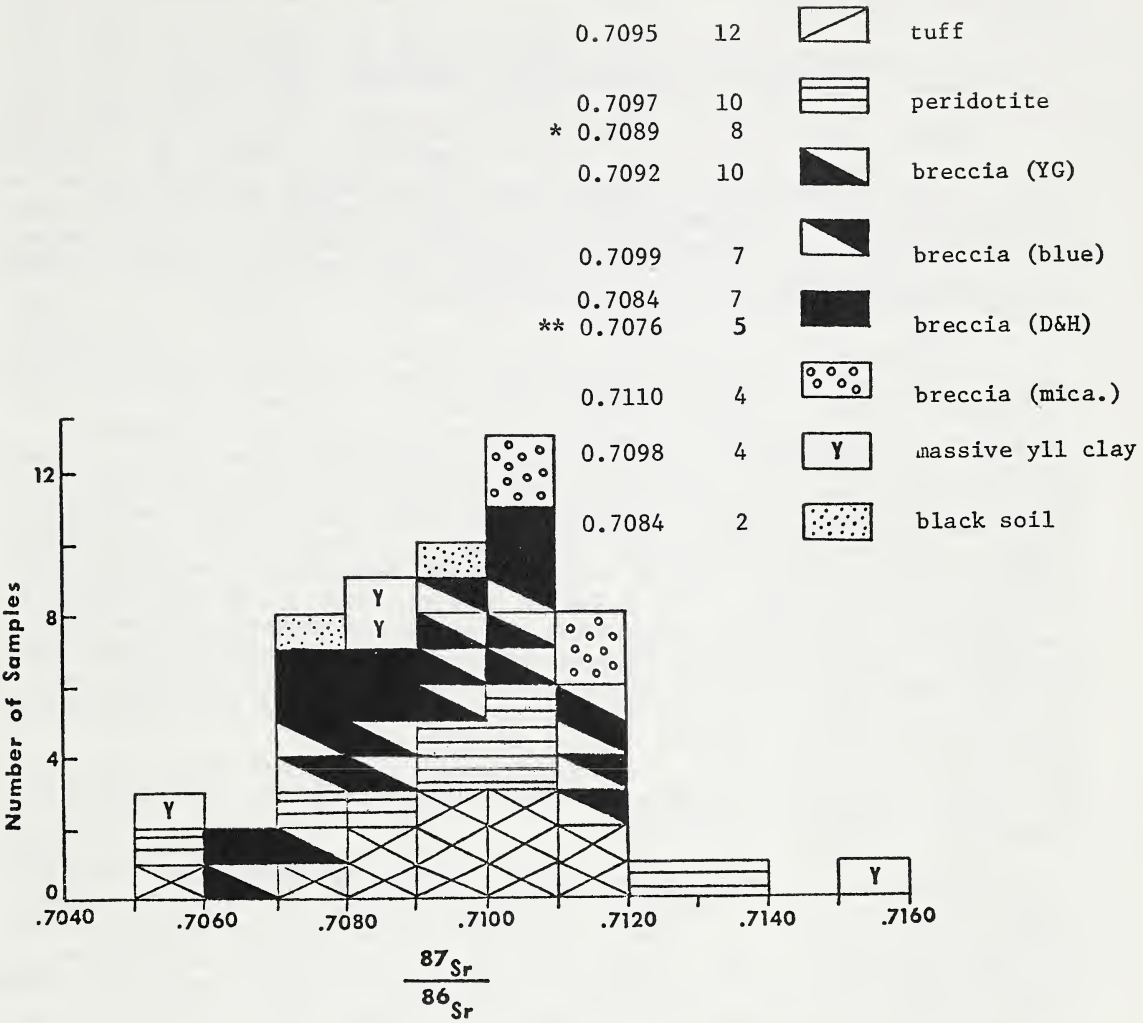

Figure 1. Histogram-frequency plot of $^{87}Sr/^{86}Sr$, from Prairie Creek rocks. The peridotite total for eight samples (*) does not include two weathered samples with 0.7120 and 0.7132 ratios. The D+H breccia total for five samples (**) does not include two weathered samples with 0.7102 and 0.7104 ratios. Weathered samples were not included in averages because of the presence of secondary minerals. Average for 52 samples (not including * and **) is 0.7094.