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THE USE OF NURE REGIONAL GEOCHEMICAL DATA IN GEOLOGIC MAPPING

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INTRODUCTION

The objective of this paper is to point out the copious regional geochemical data available through the U.S. Department of Energy (DOE) National Uranium Resource Evaluation (NURE) Program and to demonstrate the potential of such data as a tool for geologic mapping in the southeastern piedmont. For some years geologists have been limited to high altitude imagery and regional geophysical maps to aid in the extrapolation and regional interpretation of limited geologic field data. Geochemistry has been restricted to characterizing mapped rock units (such as a specific plutons) or to pinpointing ore deposits in areas which were pre-selected because of geologic criteria. The NURE program provides a massive data bank to assist geologists to prepare more meaningful and accurate geologic maps.

DISCUSSION

Sample Collection and Processing

In the southeastern piedmont, -40 mesh stream sediment composite samples were taken from small streams every 5 square miles. Ground water was sampled at a 10 square mile spacing. At each stream and ground water site, measurements were made of alkalinity, pH, and conductivity of the water. Sediments were sieved to -100 mesh in the laboratory and analyzed for a number of elements which can be clues to petrogenetic processes.

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Data Interpretation

Throughout the following discussion, the reader is cautioned to recall that any interpretation of the data should include possible grain size variations because the analysis is of -100 mesh material. For example, if crystallization conditions caused ilmenite in one gabbro to be coarser than -100 mesh, our titanium distribution map might not show that gabbro.

Water Quality

Figure 1 is a map of the areal distribution of titrable alkalinity in small streams of the Spartanburg, Charlotte, and Winston-Salem quadrangles. Several regional features such as Valley and Ridge carbonates, upper Coastal Plain sands, and Charlotte Belt mafics are obvious. For example, the Churchland Pluton (80° 20'W, 34° 55'N) stands out as a low-alkalinity area within the Charlotte Belt. Water quality data for small streams show strong geologic control and, through multivariate techniques such as cluster and discriminant analysis, can be used as a mapping aid even in detailed geologic studies.¹

Uranium and Thorium in Sediments

Figure 2 is an outline geologic map of the Charlotte 1° by 2° quadrangle as compiled for the Savannah River Laboratory by J. R. Butler.² Figure 3 shows the distribution of uranium in 1249 stream sediment samples from the Charlotte quadrangle. Figure 4 shows the thorium distribution for the same area. Stream sediments from the monazite belt are high in uranium and thorium. Use of perspective views quickly reveals some regional patterns. For example, the high-rank metamorphic zones of the Inner Piedmont yield high values for uranium and thorium in stream sediments; whereas Slate Belt and Charlotte Belt areas yield low values for uranium and thorium in sediments, except in areas intruded by plutons such as the Churchland pluton. Finer structure is evident in the data, but extended discussion is beyond the scope of this paper.

Distribution of Hafnium

Hafnium distribution is shown in Figure 5. The Gold Hill-Silver Hill fault is sharply defined as the boundary between the hafnium-rich Charlotte Belt and the low hafnium Carolina Slate Belt. The Carolina Slate Belt and Kings Mountain Belt are distinctly low in hafnium values — even lower than values reported in the Wadesboro Triassic Basin.

Value of Elemental Ratio Maps

In addition to simple elemental maps, certain elemental ratio maps are extremely useful for geological interpretation. For example, Figure 6 shows the ratio $U/(Th + Hf)$. This ratio tends to accentuate the presence of uranium in minerals other than monazite and zircon or to accentuate areas where zircon or monazite might be particularly high in uranium. The outcrop area of the Cherryville Quartz Monzonite is seen to yield high values for this ratio.

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2. J. D. Heffner and R. B. Ferguson. *Savannah River Laboratory Hydrogeochemical and Stream Sediment Reconnaissance. Preliminary Raw Data Release Charlotte 1° x 2° NTMS Area: North Carolina and South Carolina*. USDOE Document No. GJBX-40(78). Available for \$6.00 from Bendix Field Engineering Corp., Technical Library, P.O. Box 1569, Grand Junction, CO 81501.

FIGURE 1. Areal Distribution of Stream Water Alkalinity Values for the Winston-Salem, Charlotte, and Spartanburg NTMS Quadrangle

FIGURE 2. Geologic Map of the Charlotte NTMS Quadrangle

FIGURE 3. Distribution of Uranium in Stream Sediments
in the Charlotte NTMS Quadrangle

FIGURE 4. Distribution of Thorium in Stream Sediments
in the Charlotte NTMS Quadrangle

FIGURE 5. Distribution of Hafnium in Stream Sediments in the Charlotte NTMS Quadrangle

FIGURE 6. Plot of the Ratio $U/(Th + Hf)$ for the Charlotte NTMS Quadrangle