PS Use of National Uranium Resource Evaluation (NURE) Stream Sediment Data to Determine the Provenance of Triassic Clastic Sediment in the Raleigh-Durham Area, North Carolina*

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Abstract

The National Uranium Resource Evaluation (NURE) program was initiated by the Atomic Energy Commission (AEC) in 1973 with a primary goal of identifying uranium resources in the United States. The program ended in 1983. Two major phases of the program included sampling and analysis of stream sediment and groundwater in many areas of the United States. This study utilizes stream sediment data. There were 397,609 stream sediment samples collected and analyzed for the United States (Smith, 1997).

Elements of interest in minus 100-mesh stream sediment include Th, REE, K, Fe, and Ti. The Durham sub-basin and the Rolesville batholith are enriched in Th, REE, and K, and depleted in Fe and Ti compared to the rocks of the Carolina, Falls Lake, Raleigh and Crabtree terranes that lies between these units. Monazite has been identified in the Rolesville batholith, and the La/Th ratios are consistent with that of monazite in both the Rolesville batholith and the Durham sub-basin. The La/Th ratio in rocks surrounding the basin is much higher, and out of the normal range of monazite. Consequently, La and Th likely reside in different minerals in these rock units.

A geologic model that explains these relationships involves uplift of the Rolesville batholith resulting in erosion and formation of a clastic wedge on a pediment surface that extended to the west. During the early history of the Durham sub-basin, the clastic wedge probably extended over the entire basin, and was captured by the basin during periods of subsidence along the Jonesboro fault. So long as the clastic wedge extended over the entire basin, rock units surrounding the basin were covered and did not contribute sediment. The northern portion of the Durham sub-basin is interpreted as a principal depocenter. From here, sediment was re-transported to southern portions of the sub-basin along basin axial flow.

Implications of these findings on the depositional, erosional, and tectonic history of the area complements recent studies on the natural gas resource potential of the Deep River basin (Reid and Milici, 2008; Reid and others 2011).

USE OF NURE STREAM SEDIMENT DATA TO DETERMINE THE PROVENANCE OF TRIASSIC CLASTIC SEDIMENT IN THE RALEIGH – DURHAM AREA, NORTH CAROLINA

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ABSTRACT

The National Uranium Resource Evaluation (NURE) program was initiated by the Atomic Energy Commission (AEC) in 1973 with a primary goal of identifying uranium resources in the United States. The program ended in1983. Two major phases of the program included sampling and analysis of stream sediment and groundwater in many areas of the United States. This study utilizes stream sediment data. There were 397,609 stream sediment samples collected and analyzed for the United States (Smith, 1997).

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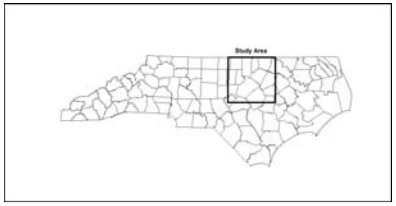
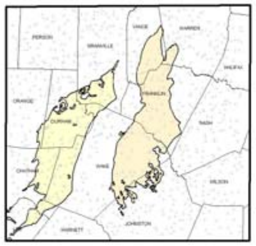
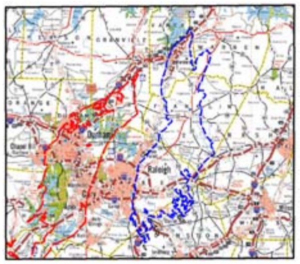
Implications of these findings on the depositional, erosional, and tectonic history of the area complements recent studies on the natural gas resource potential of the Deep River basin (Reid and Milici, 2008; Reid and others 2011).



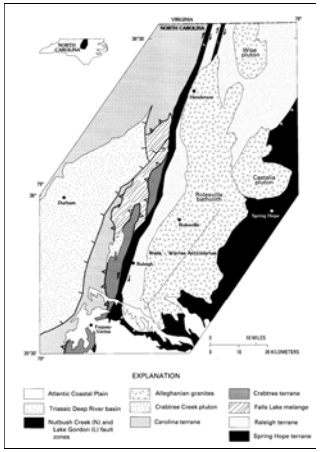
Study area location map – Raleigh-Durham area, North Carolina.



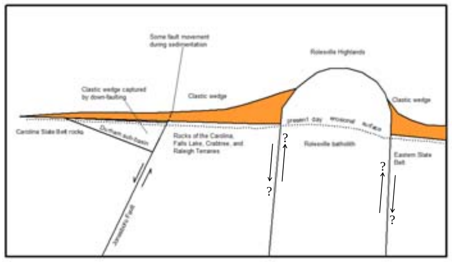
Study area map – Map shows NURE sampling sites (light gray crosses), county boundaries, and the outlines of the Rolesville granite batholith (tan) and the Durham sub-basin (yellow). Data from Smith, 1997. Geochemical maps for Fe, Ti, Th, and K are presented to the right in this poster for the sampling sites.



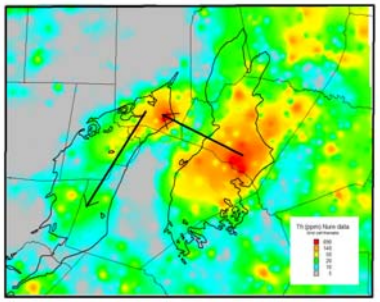
Outline of Durham sub-basin (red) and Rolesville batholith (blue) on 2011 North Carolina highway map.



Geologic terrane map of the Raleigh-Durham area modified from Horton et. al. (1994).



Hypothetical model showing relationships during the Triassic compared to the present day erosional surface. The Rolesville batholith is uplifted by folding (Wake-Warren anticlinorium) and/or faulting to form a highland area.



Grid cell thematic map for thorium. Arrows on map Illustrate transport of sediment from Rolesville batholith to northern portion of Durham sub-basin, and more southerly transport southwest of this area. This is consistent with paleocurrent data determined the N.C. Geological Survey's 1:24,000-scale geologic mapping, and other studies cited by Olsen and others (1991). Potassium shows enrichment in the southern portion of the basin as well as the northern portion. Monazite, being a heavy mineral, was more resistant to southerly transport.

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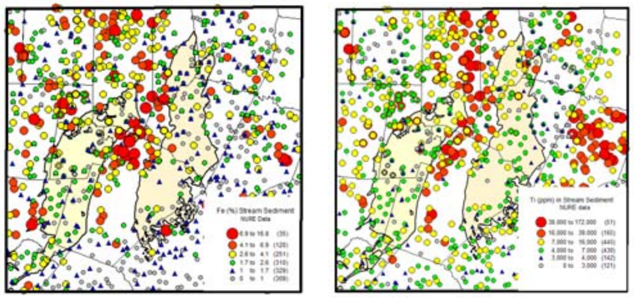
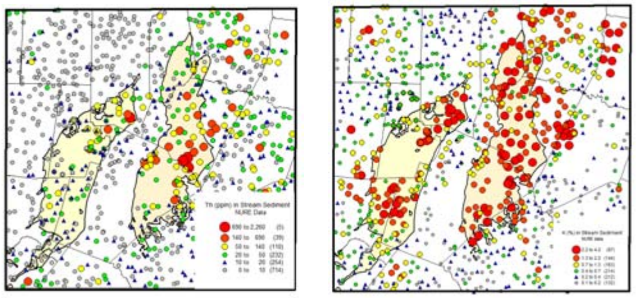
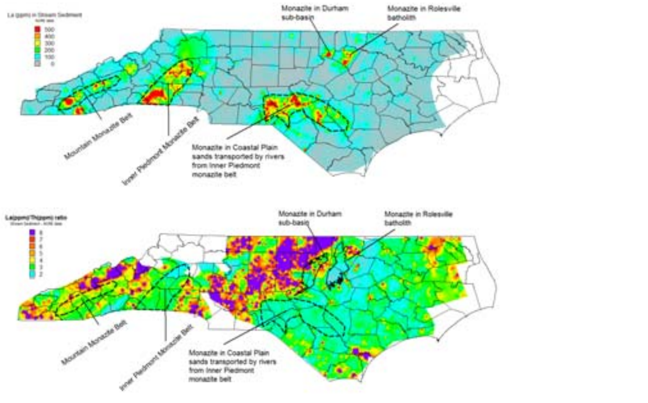


Fe and Ti concentrations in stream sediment. Fe and Ti concentrations in stream sediment minerals are much higher in streams draining the geologic terranes located between the Durham sub-basin and the Rolesville batholith.



Th and K concentrations in stream sediment. Th and K concentrations in stream sediment minerals are much higher in the Rolesville batholith and the Durham sub-basin than in the intervening geologic terranes.



These maps show relationships for Th and REE in North Carolina and the Raleigh-Durham area. La, one of the light rare earths, is shown above, but Ce and Nd show similar relationships. Highest concentrations of Th and REE occur in the mineral monazite (light REE-Th-U-phosphate) at highest grades of metamorphism in the Blue Ridge and Inner Piedmont . The USGS has studied belts of monazite occurrence throughout the southeastern U.S. In the Inner Piedmont province, reserves of Th and REE have been determined in detailed heavy mineral surveys. The USGS has also documented monazite occurrences in Cretaceous sediments and the Rolesville batholith in North Carolina.

Values for La/Th ratio for areas of monazite occurrence are typically between 1 and 3, and Th concentrations range from 3.5 to 9 percent ThO_2 (Mertie, 1975). The same range in La/Th ratio is typical for stream sediment minerals collected from the Durham sub-basin and the Rolesville batholith. This strongly suggests that monazite is the principal mineral containing Th and REE in these geologic units. In geologic units in which sediment contain high La/Th ratios, it is probable that Th and REE occur in minerals other than monazite. This is probably the case for some of the units in the Carolina, Falls Lake, Raleigh, and Crabtree terranes.

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