Trace Fossil Assemblages of Upper Cretaceous Sand Units, Delaware and New Jersey

Siliciclastic formations of Upper Cretaceous age on the Delaware-New Jersey coastal plain contain diverse trace fossil assemblages. When used with physical sedimentary structures and textural data, the assemblages can differentiate intertidal and shallow subtidal depositional environments. Most close modern analogs can be recognized for the Cretaceous trace makers.

The Englishtown Formation (Campanian) crops out along the C & D Canal in Delaware. The basal part of the unit is characterized by mottling due to dense concentrations of gently meandering, essentially horizontal *Planolites* burrows outlined by rims of dark organic-rich material. Other zones are mottled primarily by small-diameter branched shafts of *Chondrites*. Clumps of quartz sand-lined tubes of *Terebellina* are dispersed throughout. These tubes have gently curved shafts which form tunnels with distinctive feeding-probe structures at their distal ends. At the top of the unit, the assemblage is dominated by stacked *Ophiomorpha nodosa* systems with basal mazes. Also present are several types of *Chondrites*, which commonly surround and/or infest the walls of *Ophiomorpha* shafts, and delicate *Skolithos* shafts.

In New Jersey, the Wenonah Formation, Mt. Laurel Formation, and Shrewsbury Member of the Red Bank Formation (all Maestrichtian) each contain a distinctive trace fossil assemblage. The Wenonah Formation is characterized by *Cylindrichnus*, large concentrically laminated, subvertical, and tapering clay tubes. The Mt. Laurel Formation exhibits two facies, one characterized by small-diameter *Ophiomorpha* shafts and associated *Chondrites* forms and the other containing an *Ophiomorpha, Chondrites, Skolithos,* and *Cylindrichnus* assemblage. Large-diameter *Ophiomorpha nodosa* systems and associated *Chondrites* characterize sands of the Shrewsbury Member of the Red Bank Formation.

The trace fossil assemblages and primary sedimentary characteristics suggest the following depositonal environments: Englishtown Formation, shallow subtidal shoals transitional to lower foreshore; Wenonah Formation, subtidal, inner shelf; Mt. Laurel Formation, shoreface and transition zones to shallow shoal complex; and Shrewsbury Member of Red Bank Formation, offshore bar complex.

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Advances in Radon Exploration Techniques for Uranium

In an effort to evaluate several radon measurement methods, Bendix Field Engineering Corp., as part of the Department of Energy's National Uranium Resource Evaluation (NURE) program, has performed radon measurements using a variety of new techniques at a uranium occurrence located in the Red Desert area of south-central Wyoming. The site had 100 sampling locations over a 1.5-sq km area.

The radon techniques used were: a prototype microprocessor-controlled emanometer; alpha-track detectors with two types of detector material, with and without membranes for thoron separation; radon adsorption on activated charcoal with the measurement of the gamma-emitting radon decay products; thermoluminescence detectors; partial extraction of lead-210 from soil samples; and an established emanometer. The radon measurements obtained by these techniques at the sample locations are compared for their sensitivity, variability, signal enhancement, and the correlation between the radon techniques. The radon techniques were also correlated to the equivalent uranium in the soil samples.

The prototype emanometer was found to exhibit less variability than the established emanometer. One alpha-track material was 15 times more sensitive than the other material. The thoron membranes decreased the number of alpha tracks by 47% in the more sensitive material and increased the number of alpha tracks in the less sensitive material by 27%. Signal enhancement obtained for all the radon techniques was similar for this research site and ranged from 2.5 to 3.5. Correlation coefficients between the techniques ranged from 0.32 to 0.70 and from 0.3 to 0.9 with equivalent uranium.

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Application of Regional Geochemical Data to Uranium Exploration

Hydrogeochemical and stream-sediment reconnaissance data generated by the U.S. Department of Energy's National Uranium Resource Evaluation program can be used to identify geologic environments favorable for uranium or base metal deposits.

Open-filed analytical data for 1 × 2° NTMS quadrangles are obtained on magnetic tape from Oak Ridge National Laboratory and transferred to disk for interactive computer use. Data may then be organized into subsets according to sample type, geologic, or physiographic units; smoothed using block or nearest-neighbor averaging techniques; and power transformed to normalize frequency distributions. Multivariate statistical techniques, including principal component, discriminant, and multiple regression analyses, aid in interpretation. A contrast filter may be used to identify areas that are significantly different from their local background.

Machine-generated color or black and white maps are produced from raw elemental analyses, elemental ratios, and statistical parameters such as factor scores and multiple regression residuals. The data may be represented at any scale, using a variety of symbol or color schemes designed to cartographically enhance the appearance of anomalous areas.

Results of the geochemical interpretation are used to select target areas several tens of square kilometers in size. Examples from the Colorado Plateau and other areas illustrate how the interpretive techniques are used.

Both the data and data analysis techniques have wide application in mineral exploration. Because of the extensive suite of elements represented, the data can be