Thermal Maturation of Lower Paleozoic Shales in Northern Appalachian Nappe Structures Around Quebec City, Canada

Progressive changes in organic matter maturation and clay mineral diagenesis have been studied in transverse and longitudinal profiles in the external domain of the Quebec Appalachians. Reflectance measurements (90 samples) on dispersed organic matter, probably asphaltic pyrobitumen, and illite crystallinity values reveal an increasing degree of diagenesis from northwest to southeast.

In the northwest, reflectance in oil ranges from 1.70 to 2.30 in the Cambrian Chaudiere nappe, from 1.53 to 1.90 in Cambrian to Ordovician Bacchus nappe, from 1.08 to 1.27 in Lower Ordovician Pointe de Levy nappe, and from 0.99 to 1.21 in Middle Ordovician Quebec Promontory nappe. Illite crystallinity ranges from 4 to 8 mm (0.53 to 1.05° 2θ). In individual nappes, reflectance increases with stratigraphic depth but may not have been affected significantly by tectonic burial resulting from the superposition of nappes. Predeformational burial diagenesis is therefore suggested as the principal agent of thermal maturation.

In the southeast, the Middle Ordovician St. Henedine nappe, representing the anchimetamorphic zone, has reflectance values from 2.82 to 3.79% R_o and illite crystallinity ($<$3mm = 0.40°2θ) lower than in the northwest. In this region, high reflectance in conjunction with low illite crystallinity may be related to elevated temperatures resulting from syndeformational or postdeformational regional metamorphism.

For hydrocarbon exploration in the Quebec Appalachians it appears significant that the trend of decreasing thermal maturation with increasing tectonic "burial" depth may continue into the little deformed platform sequence of the St. Lawrence Lowlands underlying the nappes of the external domain.

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Sulfur and Oxygen Isotope Geochemistry of Abu Dhabi Sabkha

Sulfur and oxygen isotope data vary in a laterally systematic manner across the sabkha at Abu Dhabi. At least three different mechanisms are required to explain the variation of $\delta^{34}S$ and $\delta^{18}O$ of sulfate in evaporite minerals and interstitial brine. Gypsum is precipitating in the seaward zone, and extensive postcrystallization exchange maintains isotopic equilibrium between bulk gypsum and dissolved sulfate. Anhydrite is the dominant sulfate mineral in the central zone where bacterial sulfate reduction results in heavier $\delta^{34}S$ and $\delta^{18}O$ values. In the landward zone both minerals and brine reflect mixing with the isotopically distinct sulfate of continental brines. Laterally systematic isotopic variation supports Patterson's chemical discrimination between seaward, mixed and landward hydrologic regimes, and is consistent with vertical variation of $\delta^{34}S$ demonstrated by Butler et al for this regressive sedimentary sequence. Gypsum-anhydrite transitions do not have significant effects on the isotopic composition of sulfate. Some ancient marine evaporite formations consisting mainly of dolomite and anhydrite may have formed in environments similar to the seaward and central zones of the Abu Dhabi sabkha; considerable isotopic variation would probably accompany subaerial deposition of laterally extensive marine evaporites.

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Oligocene Transgressive Sediments of New Jersey Continental Margin

Sediments deposited by a middle-late Oligocene transgression are present as a thickening downdip wedge in the subsurface of the New Jersey coastal plain. Glauconitic sands and silts, designated as the Jobs Point formation, were deposited under inner mid-shelf depths (15 to 80 m). Middle-upper Oligocene glauconitic silts in the COST B-2 well which were deposited in outer shelf–upper slope depths (180 to 225 m) are a facies of the Jobs Point formation. The Oligocene transgression followed a major regressive event which occurred at the close of Eocene time. A regional hiatus resulted from this event.

Benthic forams in cores from the type wells of the Jobs Point cluster into three assemblages which represent biofacies of distinct depths ($<$30 to 35 m; $<$50 to 60 m; 45 to 80 m). The distribution of these biofacies in the Jobs Point shows an initial rapid transgression and a more gradual regression toward the top of the Oligocene sequence. The presence of the planktonic foraminiferal *Globigerina ampliapertura* Zone in the basal part of Oligocene sediments indicates that the transgression began about 32 m.y.B.P.

Structural-contour and isopach maps of the Jobs Point show that tectonic movements of the Salisbury Embayment and the South Jersey high influenced deposition of the Oligocene sediments.

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Availability of Remotely Sensed Data

A large amount of remotely sensed data has been acquired over many areas of the world, but it is difficult for an individual to identify sources of existing data and to determine coverage, imagery characteristics, availability, and costs. Many federal and state agencies do not distribute descriptions of remotely sensed data holdings to the public. A comprehensive survey conducted by J. R. May in 1978 identifies many sources of these data in federal and state organizations.

The U.S. Geological Survey's EROS Data Center (EDC) is the national distribution facility for LANDSAT and other remotely sensed data products. Data stored at EDC at the end of 1978 included over 1,200,000 frames of LANDSAT imagery; over 56,000 images from Skylab, Apollo, and Gemini; over 1,400,000 images from the NASA research aircraft programs; and over 3,300,000 aerial mapping photographs from the U.S. Department of the Interior, U.S. Department of Commerce, and other federal agencies. Availability and

characteristics of data stored at EDC can be determined by requesting a geographic computer search using latitude and longitude of the area of interest.

A new all-digital system for handling and processing LANDSAT data is in operation at EDC. The data are radiometrically corrected for detector gain and offset and geometrically corrected to a Space Oblique Mercator (SOM) map projection, using cubic convolution resampling techniques. Upon request, the user can obtain data which are corrected to the Universal Transverse Mercator (UTM) or Polar Stereographic (above 65° lat.) map projections with the nearest neighbor resampling technique. The user may also request geometrically uncorrected high-density digital tapes. When placing an order for LANDSAT image products, the user may select or omit contrast and edge enhancements. Film and digital tape products from the LANDSAT multispectral scanner system (MSS) and return beam vidicon (RBV) camera are available in a variety of formats and scales.

LANDSAT data over areas outside the United States are available at EDC; these data are acquired by receiving stations in Canada, Brazil, Italy, and Iran and are also available from these countries. Scale, format, and prices of LANDSAT products from foreign receiving stations are similar to those distributed by EDC.

Other federal and state agencies duplicate aerial photographs for users on request. Scale, area coverage, and film type vary. The most common aerial photography is panchromatic at a scale of about 1:20,000 and in a 9 × 9-in. format. Some color and color infrared photographs also may be available.

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Characteristics of Remotely Sensed Data Acquired from Aircraft

Remote sensing technology has advanced rapidly during the past 2 decades, to the point where sensor systems are capable of acquiring data in wavelength bands from the ultraviolet through the visible and infrared to the microwave. Imaging sensor systems used in aircraft can be grouped into three general catagories: camera, optical-mechanical scanner, and sidelooking radar.

The aerial camera records radiation reflected from features on the earth's surface on black-and-white, normal color, and false-color infrared films. Black-and-white films are used frequently for mapping purposes; however, usage of color films is increasing. Normal color films have advantages in ease of interpretation because surface features are displayed in colors similar to those observed by the human eye. However, atmospheric scattering of incident solar radiation can have a significant deleterious effect upon the processed color photograph. False-color infrared films record reflected radiation in the near-infrared, red and green portions of the electromagnetic spectrum. The false-color photograph displays healthy vegetation as red, water as dark blue to black and red rocks or soil as a hue of yellow. Advantages of false-color infrared photography include less sensitivity to atmospheric scatter; greater contrast between vegetated and nonvegetated areas, moist and dry soils, clear and turbid water, and fresh and old snow; and, in some situations, an enhanced depiction of variations in vegetation owing to stress or species differences.

Optical-mechanical scanners employ photo-electric sensors to record radiation reflected from the earth's surface. The instantaneous-field-of-view (IFOV), normally expressed in milli-stereradians, and the altitude of the aircraft determine the ground resolution (size of the area on the ground that is sampled at any instant of time). Multispectral scanners record reflected and emitted energy in a number of wavelength intervals within the ultraviolet, visible (0.4 to 0.7μm) and infrared (0.7 to 14μm) portions of the electromagnetic spectrum. The infrared (IR) region generally is subdivided into two parts: the reflected IR (0.7 to 3.0μm) and the thermal IR (3.0 to 14.0μm). Thermal IR scanners record emitted radiation in two atmospheric windows (generally 3 to 5μm and 8 to 14μm). The apparent temperature of earth materials is a function of their emissivity and their absolute temperature. Conventional thermal infrared images display variations in apparent surface radiant temperatures in shades of gray with light tones representing warm temperatures and dark tones representing cool temperatures.

Side-looking airborne radar (SLAR) is an active imaging system because if transmits electromagnetic energy that illuminates the terrain. Radar systems operate in the 0.8 cm to 1 m wavelength range of the spectrum. They can be used during day or night and under most weather conditions. Direction and angle of illumination can be controlled to enhance topographic expression of geologic features. The interaction between terrain materials and the transmitted pulse of electromagnetic energy is complex and depends on orientation, surface roughness, and electrical properties of terrain features. Conventional SLAR images display the intensity of the energy returned to the radar received in tones of gray: light tones represent high intensity returns (such as buildings and slopes facing the antenna) and dark tones indicate low intensity returns (such as smooth water, dry lake beds, and roads). Radar has several advantages for regional analysis of geologic structure and terrain analysis: control of illumination direction, day and night and all-weather capability, suppression of surface detail, and continuous image strips.

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Origin and Characteristics of Pennsylvanian-Age Multistory Fluvial Sandstones of Illinois Basin

Continuing studies of Illinois basin Pennsylvanian stratigraphy have revealed a fluvial sandstone body of Desmoinesian age in the central and southern part of the Illinois basin. The sand body is a series of multistory or "stacked" sandstones that aggregate more than 300 ft (100 m) thick, as much as 2 mi (3.2 km) wide, and more than 100 mi (160 km) long, making part of a series of interrelated sandstones that constitute the Highland fluvial complex. The sand complex includes as many as