referred to as the Fulton and Augusta lobes of the Catskill delta, separated by Grant bay.

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Devonian Shale Gas Production, Photolineaments, and Geology in Central Appalachian Basin of West Virginia

Remote-sensing methods involving photolineament mapping have been used for hydrocarbon prospecting with varying success. Much natural gas in the Appalachian basin is in formations of very low primary permeability; therefore production is from fractures. Natural fracture zones often appear as photolineaments on various types of remote-sensing images. In some parts of the basin, photolineaments have been demonstrated to be loci of improved production of natural gas. Photolineaments are also often indicative of surface and subsurface fractures and stress fields. A test was made of these relations for Devonian shale gas production in the central part of the Appalachian basin. Photolineaments were derived from satellite and aircraft images at a scale of 1:250,000; fracture data were measured on surface outcrops and in one core; and natural gas production data were open flows as given on drillers' logs. Fractures generally parallel nearby photolineaments, but the relation is not simple. Natural open flows tend to be lower on or near photolineaments than between them, whereas open flows of stimulated wells do not appear to be related to photolineaments. Such relations may be due to venting of gas through natural fractures, and the stimulated wells, having new fractures, release previously trapped gas. The disparity between results from this project and those of others may be due to several factors: the allochthonous sedimentary sheets present in the area of some other projects do not extend into the central part of the Appalachian basin; the lithologies differ in significant ways; and the methods used for mapping and the types of photolineaments differ.

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Profitable Shallow Appalachian Gas Reserves—Hard to Find or Easy to Miss?

Recent increases in gas price and subsequent drilling activity have resulted in a second look at old developed gas fields with marginal or submarginal production with the hope of improving the economics of gas development through reservoir analysis, drilling and completion methods, and the development of new or "hidden" reserves.

One of the deterrents to selling this type of prospect is the stigma of certain formation names and geographic areas in the mind of a prospective operator, his investor, or the prospect analyst.

Evaluation of oil and gas potential of development areas is enhanced significantly by a "look at the rocks." These studies of basic rock properties through examination of well samples and cores (porosity, permeability, grain density, pore size and distribution, pore-wall composition, and gas-fluid distribution) along with good electric logs are the dominant ingredients for effective reservoir analysis and completion designs.

With these tools one is equipped to evaluate (1) the significance of the rate of natural flow in air drilling, of drillstem tests in relation to gas or oil in place, (2) in-place reserves from electric logs, (3) economic feasibility for completing or plugging, and (4) completion designs.

Close supervision and planning were required to obtain good samples, test data, and electric logs. Poor electric logs result from rough well-bore conditions. In air-drilled holes "rough hole" and subsequent poor logs commonly are a result of "reducing well cost" by conserving casing through possible water zones. This cost-saving philosophy generally results in lost reserves in areas of low-permeability reservoirs.

Many areas of poor production are the result of cement and perforating problems. These problems can be recognized, avoided, and corrected with safeguard methods.

Development drilling is often complicated by lateral changes in gas-fluid ratios due to structural or stratigraphic separation and fossilized hydrodynamics. These problems are further complicated by inaccurate well elevations and subsequent poor structure maps.

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