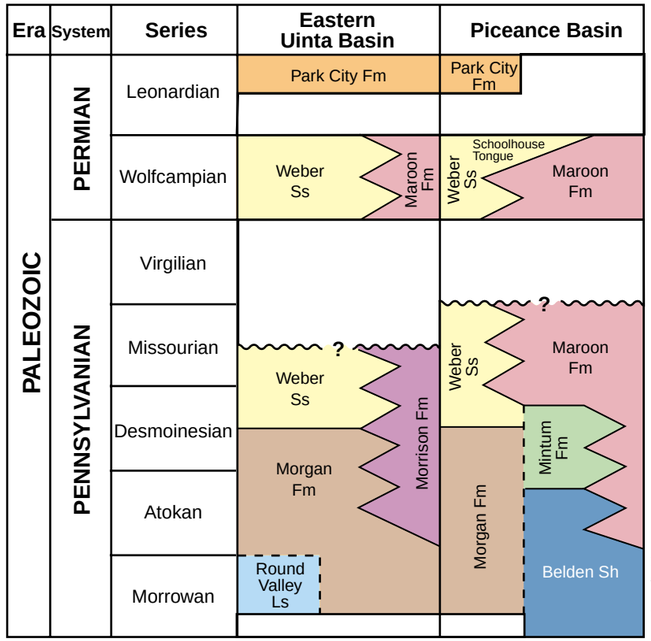


Figure UO-33. Nomenclature and correlation for the Weber Sandstone in the East Uinta and Piceance Basins. Unconformities indicated by white patches (modified after Hemborg, 1993).

PLAY TYPE 5
BASIN MARGIN SUBTHRUSTS PLAY (HYPOTHETICAL)

This play is primarily for closures beneath high- to low-angle thrusts. Figure UO-3 shows some of the flanking thrusts present along the northern to eastern part of the province. The play is hypothetical, and both oil and gas should be present. The only nearby analog is the Tepee Flats Field in the eastern Wind River Basin-Casper Arch area. Here, thick, unfractured Cretaceous marine shale provides a seal for an oil and gas accumulation in the Upper Cretaceous Frontier Formation.

Reservoirs: The reservoirs for this play range in age from Paleozoic to Tertiary. Reservoir quality may be poor, especially for prospects deeper than 12,000 feet. The Mississippian carbonates are expected to be porous in most parts of the play.

Source rocks: The source rocks are within the subthrust section. Possible source rocks containing more than 1 percent total organic carbon (TOC) are found in the Lower Tertiary, Upper Cretaceous, and Pennsylvanian Belden Shale (FIGURE UO-33). The Jurassic Curtis Formation may be a local source bed.

Timing and migration: The timing is uncertain, but most of the thrusting took place during the Laramide Orogeny.

Traps: Traps are most likely structural and structural-stratigraphic (FIGURES UO-34 and UO-35). Play depths should range from 5,000 feet to as much as 25,000 feet.

Exploration status and resource potential: The play is almost unexplored by drilling and only moderately explored by seismic mapping. Based on the abundant fields near the thrusts in the Uinta Basin, a median field size of 2 MMBO and 15 BCF of non-associated gas, and a maximum field size of approximately 50 MMBO and 150 BCFG are estimated for this play.

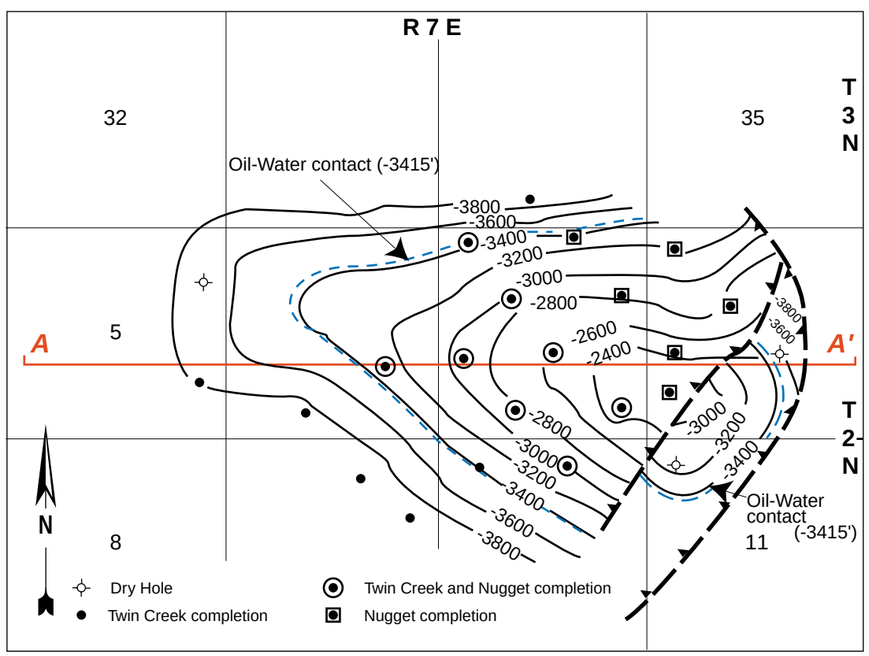


Figure UO-34. Typical geometry of a shallow east-trending structure, Pineview Nugget Reservoir, Summit County, Utah (not on reservation). Gas is trapped in an asymmetrical thrusted anticline in the hanging wall of the Absaroka Thrust system. Structure contour map of the top of the Nugget Sandstone (modified after Hjellming, 1993).

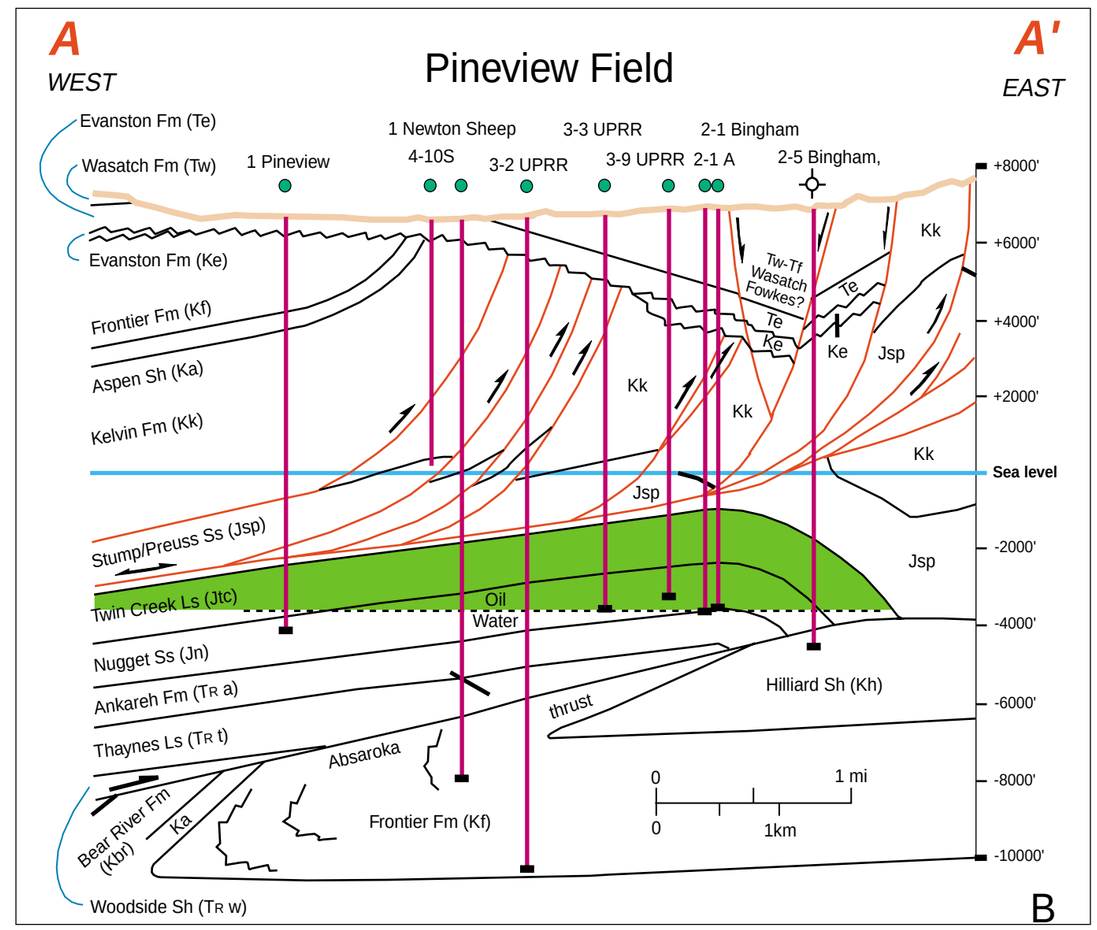


Figure UO-35. Cross section through the reservoir. Line of section shown in Figure UO-34 (modified after Hjellming, 1993).

DEFINITION: Unconventional Plays

Unconventional Play- A broad class of hydrocarbon deposits of a type (such as gas in "tight" sandstones, gas shales, and coal-bed gas) that historically has not been produced using traditional development practices. Such accumulations include most continuous-type deposits.

Cretaceous Self-Sourced Fractured Shales Play (Hypothetical)

Oil is produced from fractured Upper Cretaceous Mancos Shale and its equivalents. The best fracturing occurs in brittle siltstones, carbonates, and calcareous shales.

The play outline is based by the U.S.G.S. on the known occurrence of production and the tectonic features associated with known and suspected potential. In the play, the best open fractures occur at the maximum flexure on anticlines or monoclines. Fractures also produce well where shear zones or faults occur. The play boundary is fairly easy to define except in the area between Rangely and the Axial Uplift, where proprietary seismic data indicate the presence of several subsurface thrusts, including thrusts associated with the White River Field structure.

Reservoirs: The reservoirs are open fractures in brittle siltstones, carbonates, and calcareous and siliceous shales. The producing intervals vary from 10 feet to more than 50 feet thick. The fracturing is highly variable, and one well in the play has produced over 1 MMBO.

Source rocks: The enclosing marine shales are the source rocks. The richness varies from about one percent to more than four percent TOC, based on unpublished information.

Timing and migration: The oil was probably generated in the Late Tertiary during maximum burial.

Traps: The traps are formed by the enclosing unfractured, more plastic shale, which contains less silt and carbonate than the brittle facies. The largest accumulation in the play is found in Rangely Field (EUR 14 MMBO). The highest concentration of oil wells producing from the Mancos Shale at Rangely is along the south flank of the structure at the point of maximum flexure.

Exploration Status and Resource Potential: The play is moderately well explored by vertical wells but nearly unexplored by slant- and horizontal-hole drilling. The U.S.G.S. assumed a low success ratio for the overall play area. Although this play is classified as a continuous-type play (e.g., tight gas), production should be localized by individual fractured structures and fracture trends.

EUR estimates per well are extremely variable and, although the play is treated as a continuous-type occurrence, the U.S.G.S also simulated individual undiscovered fields or "sweet spots" within it to assist in assessment. On this basis, the success ratio in well-mapped structural flexures is considered quite high, perhaps more than 50 percent; also, there is high potential for finding many areas of small production, and perhaps as many as 10 larger fields (Table 1).

Analog Example: Greater Douglas Creek

FIGURES UO-13, UO-14

Location:	Rio Blanco County, Colorado west of Reservation
Producing formations:	Mancos, Mancos (B) Shale
Other significant shows:	Morapos Formation
Lithology:	Sandstone
Type of drive:	Pressure depletion and water drive
Net pay thickness:	30-250 feet
Porosity:	2-20%
Permeability:	0.01-100 mD

TIGHT GAS UINTA TERTIARY EAST PLAY

This play is based on well-established gas production from the Uteland Butte, Chapita, and Buck Canyon zones of the Tertiary Wasatch Formation. Updip to the south and east, the play limit is based on an increase in reservoir quality and a change to mostly conventional reservoirs that have gas-water contacts, which are included in the Uinta Tertiary Oil and Gas Play. Downdip to the north, the play boundary is defined as the point where it becomes predominantly an oil play and is included in Play Type 1. The western limit is along the Green River drainage, where the play becomes higher risk and has been assessed separately by the U.S.G.S. as Tight Gas Uinta Tertiary West Play (Play Type 8). The overall Wasatch tight gas plays (7 and 8) are based on vitrinite reflectance (Ro) levels in the underlying Cretaceous Mesaverde Group. Rice and others (1992) and Fouch and others (1992) showed that Wasatch gas has migrated upward from the Mesaverde Group and that the play occurs between the basal Mesaverde Ro limits at 1.1-1.5 percent.

Reservoirs: Reservoir rocks are generally medium- to fine-grained feldspathic litharenites and litharenites deposited primarily in fluvial environments. They are interbedded with mudstones, siltstones, shales, and some coal. Porosity ranges from less than 5 percent to more than 9 percent. The reservoirs range in depth from about 3,000 feet to about 10,500 feet, having a median depth of 6,400 feet.

Source rocks: The predominant source of the gas is in the underlying Mesaverde Group (Fouch and others, 1992; Nuccio and others, 1992; Rice and others, 1992).

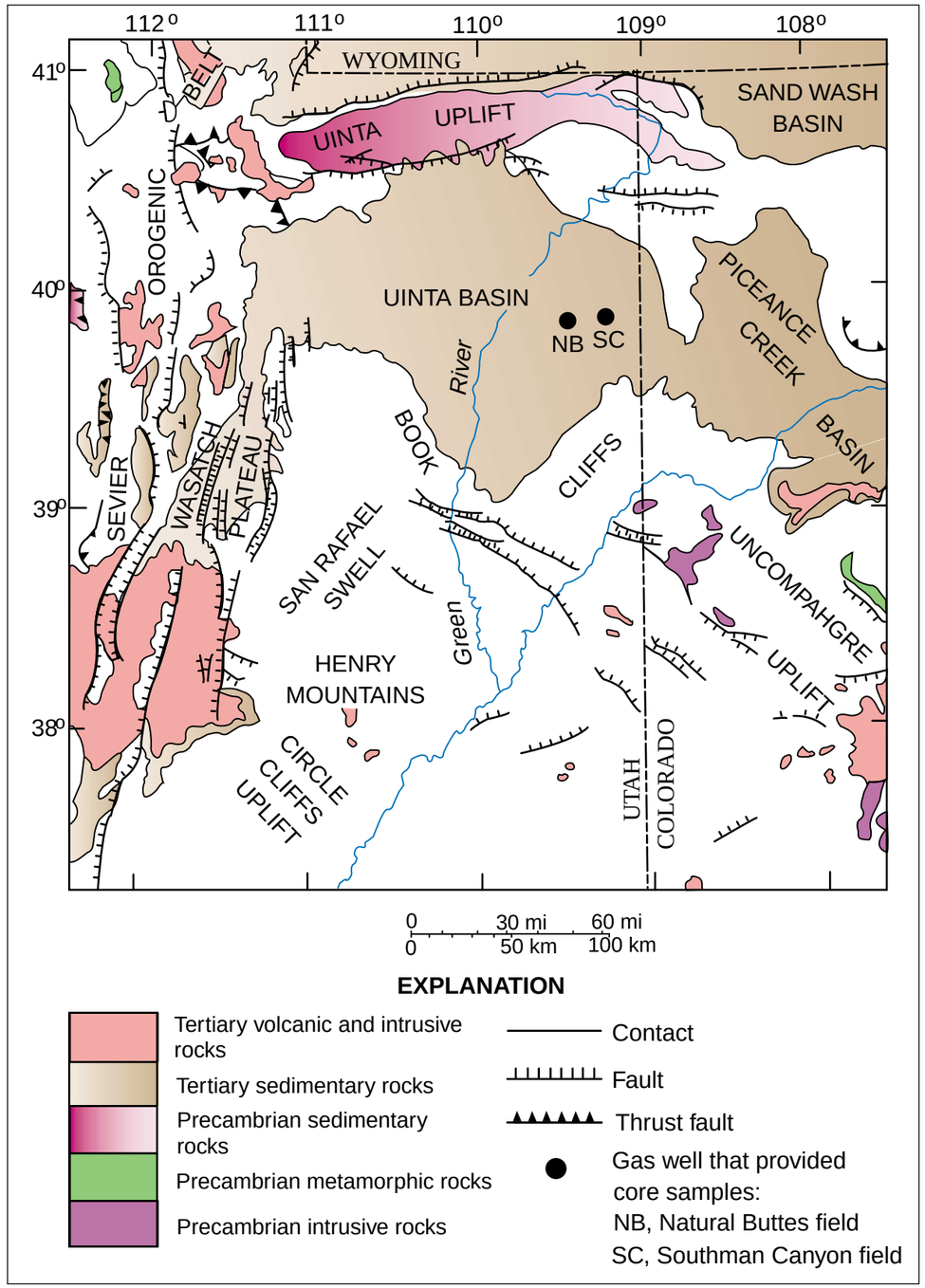


Figure UO-36. Generalized geologic map of the Uinta Basin Province showing location of cored wells (modified after Pitman et al., 1986)

Play 8: TIGHT GAS UINTA TERTIARY WEST PLAY
(HYPOTHETICAL)

This play is the western extension of Tight Gas Uinta Tertiary East Play (Play Type 7) and is separated from Play 7 along the Green River drainage. Although the river is a surface feature, it more or less coincides with a westward decrease in drilling activity and reservoir quality. It is higher risk than Play 7 and, on this basis, it was decided by the U.S.G.S to use separate assessment parameters.

Reservoirs: This play draws on the same reservoirs as Play 7, yet porosities are somewhat lower here, ranging from less than 4 percent to about 8 percent in reservoir sandstones. The play depths range from about 4,500 feet to 11,000 feet, with a median depth of 7,500 feet.

Source rocks: The underlying Mesaverde Group is the gas source. The play limits approximately coincide with maturation levels of R_O 1.1-1.5 percent in gas-prone source beds in the basal part of the Mesaverde Group.

Timing and migration: Gas generation began in the Late Tertiary and may be continuing presently in the Mesaverde in the deeper parts of the basin; however, it is possible that vertical gas migration from the Mesaverde may not be as effective as it is in Play 7.

Traps: Traps are both stratigraphic and diagenetic.

Exploration status: There is considerably less drilling activity in this play relative to Play 7. The play is only sparsely to moderately explored by drilling.

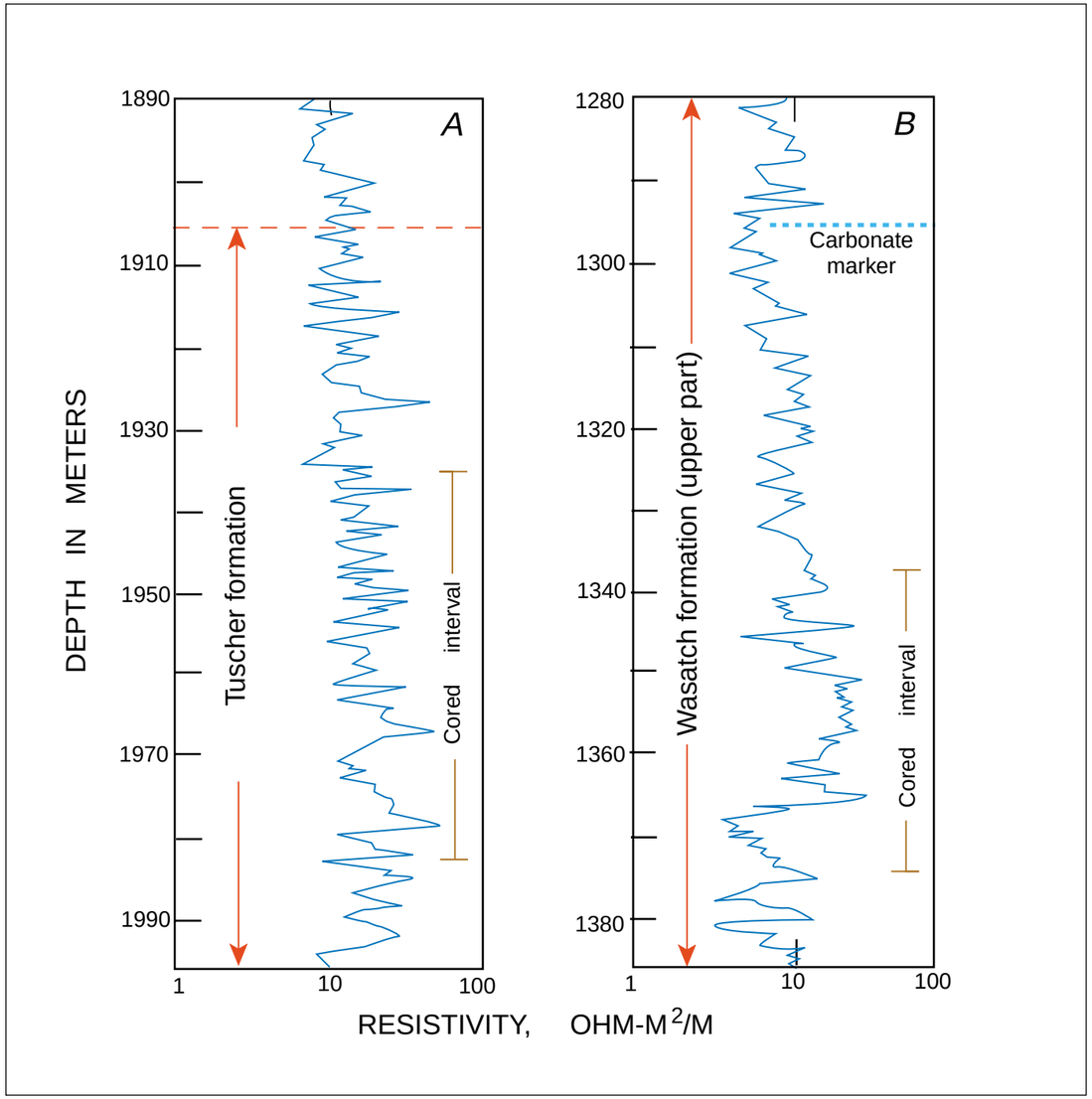


Figure UO-37. Electric log profile of cored wells (modified after Pitman et al., 1986).

Play 9: BASIN FLANK UINTA MESAVERDE PLAY
(HYPOTHETICAL)

This play is based on the widespread occurrence of tight, gas-saturated continental and marginal marine sandstone. The south, east, and west limits of the play are based on thermal maturation levels in the basal part of the Mesaverde Group. The reservoirs grade updip into more conventional Mesaverde reservoirs having gas-water contacts (see Upper Cretaceous Conventional Play Type 2). Mesaverde burial depths greater than 15,000 feet designate the downdip (north) play boundary (Fouch and others, 1994).

Reservoirs: The reservoirs are fine- to medium-grained litharenites to feldspathic litharenites, becoming coarser to the west. Most reservoir permeabilities are <0.1 md. Porosities range from <4 percent to >12 percent, averaging about 8 percent (FIGURES UO-11 and UO-12) (Nuccio and others, 1992). Play depth varies from 8,000 feet to 15,000 feet, having a median of 9,500 feet.

Source rocks: Source rocks are gas-prone, thermally mature coals, carbonaceous shales, and mudstones of the Mesaverde Group (FIGURES UO-11 and UO-12).

Timing and migration: Gas generation began in the Tertiary and may be continuing to the present in the deeper parts of the play. The basal Mesaverde has a thermal maturity greater than R_O 1.1 percent.

Traps: Traps are both stratigraphic and diagenetic.

Exploration status: The play is essentially unexplored due to depth, economics, poor reservoir quality, and the fact that it is mostly overlain by oil- and gas-producing rocks of the Tertiary Green River Formation.

DEEP SYNCLINAL UINTA MESAVERDE PLAY (HYPOTHETICAL)

This play is based on the expected occurrence of gas-saturated, tight Mesaverde sandstones at depths greater than 15,000 feet. The limits of the play are based on depth and reservoir quality. This play borders Play 9 and involves the same suite of rocks.

Reservoirs: Reservoir rocks are sandstones interbedded with mudstones, siltstones, shales, and some coals. Porosity is generally lower than in Play 9, and although there is almost no drilling, the U.S.G.S. expects porosity to be <8 percent to about 3 percent, having a median of 5-6 percent (Table 1). Reservoir depths are >15,000 feet, as deep as 25,000 ft, and have a median of 20,000 feet (FIGURES UO-42 through UO-44).

Source rocks: Gas-prone organic material interbedded with sandstone has generated large volumes of gas.

Timing and migration: Gas generation commenced in the Tertiary, and may be continuing at the present time. The thermal maturity of the Mesaverde is in excess of Ro 1.5 percent, and the deeper rocks exhibit >Ro 2.0 percent.

Traps: Traps are both stratigraphic and diagenetic.

Exploration status: The play is not well explored, due to the fact that primary interest in the area is in the overlying Tertiary reservoirs.

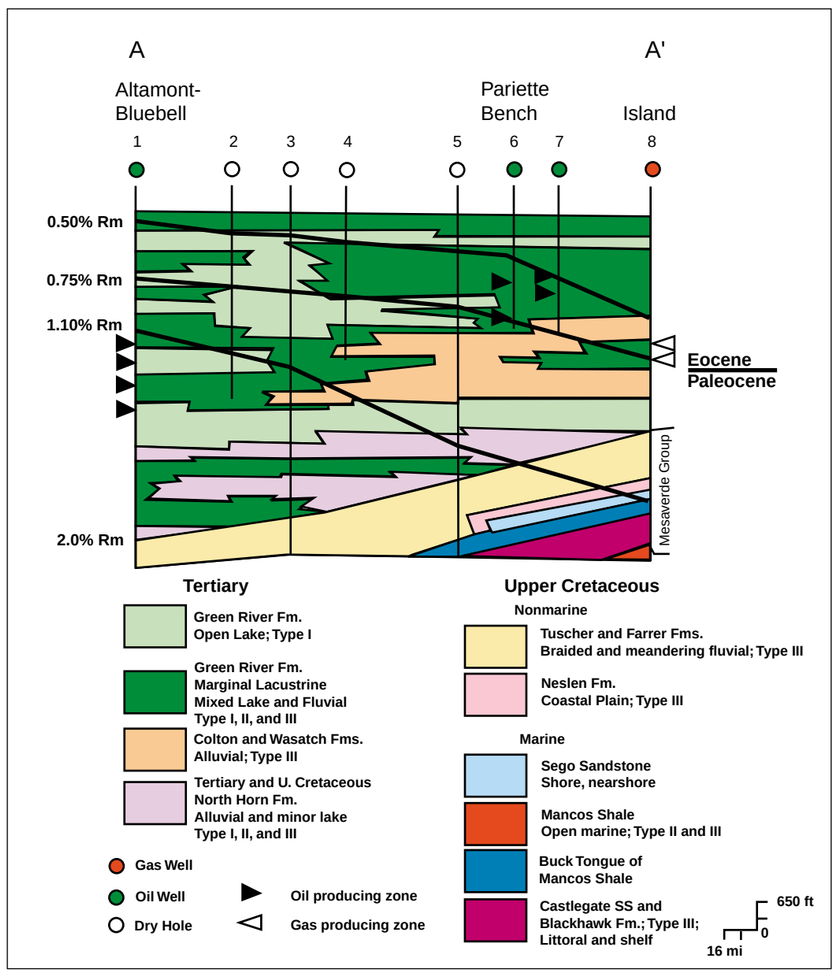


Figure UO-39. Cross section A-A' through the Uinta Basin, Utah, showing types of kerogen found at various stratigraphic intervals, levels of thermal maturity (Rm lines), and associated hydrocarbon producing zones. See Figure UO-42 for line of section (modified after Nuccio et al., 1992).

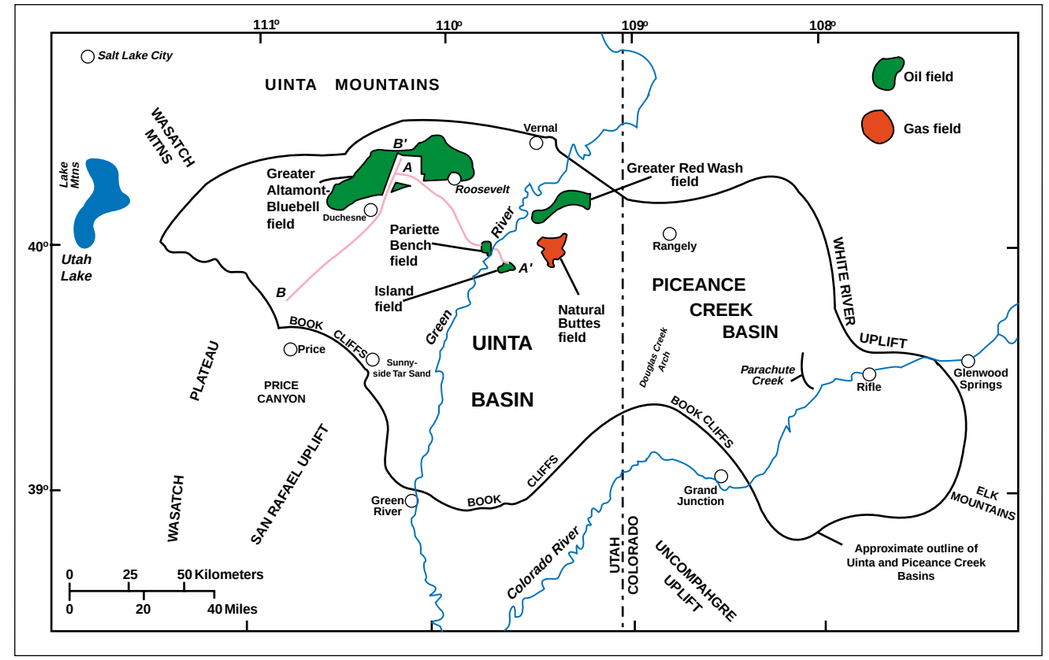
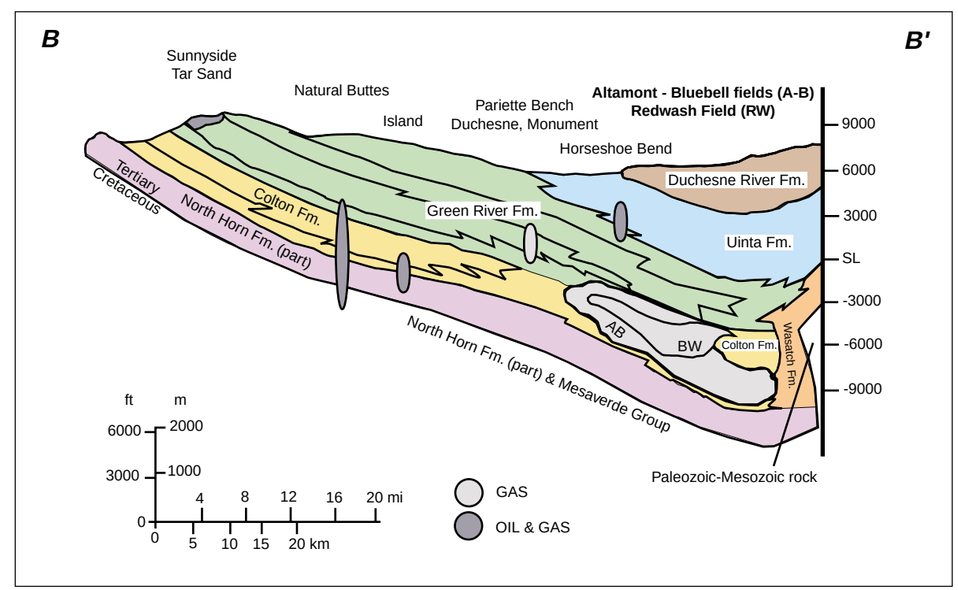


Figure UO-38. Index map of the Uinta and Piceance Creek Basins area showing location of cross-sections ***A-A'*** (Figure UO-43) and ***B-B'*** (Figure UO-44) (modified after Nuccio et al., 1992).

Figure UO-40. Cross section ***B-B'***, which extends from outcrops on the southwest flank of the Uinta Basin through the Altamont-Bluebell Field. Producing intervals for some of the basin's fields are projected into the line of section. See Figure UO-42 for line of section (modified after Nuccio et al., 1992).



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