Soeder and Randolph, 1987 Data Set 60

Reference: Soeder, D.J., and P.L. Randolph, 1987, Porosity, permeability, and pore structure of the tight Mesaverde Sandstone, Piceance Basin, Colorado: Society of Petroleum Engineers Formation Evaluation, p. 129-136.

Author's affiliation: Institute of Gas Technology

Reference: Pitman, J.K., C.W. Spencer, and R.M. Pollastro, 1989, Petrography, mineralogy, and reservoir characteristics of the Upper Cretaceous Mesaverde Group in the East-Central Piceance Basin, Colorado: USGS Bulletin, 1787-G, 31 p.

Age: Cretaceous

Formation: Iles and Williams Fork Formations of Mesaverde Group

Location: Rulison Field, Piceance Basin, Garfield County, Colorado

Well: U.S. Department of Energy Multiwell Experiment wells 1, 2, 3

Depth range: 5000-8000 feet.

Depositional environments: From bottom to top: marine, paludal, coastal, and fluvial environments, reflecting a regressive sequence.

Petrography, Pitman et al.: Inspection of five triangular compositional diagrams of five facies shows that quartz typically comprises 50 to 75% of total grains except in the shoreline marine zone where quartz comprises 75 to 90% of total grains. From bottom to top: (1) shoreline-marine zone (lowermost zone), subarkoses and sublitharenites; (2) paludal zone, feldspathic litharenites; (3) coastal zone: litharenites and feldspathic litharenites; (4) fluvial zone: lithic arkoses and feldspathic litharenites, overgrowths on framework quartz grains typically are rare because of the large amounts of pseudomatrix that fill pores. (5) mixed marine-nonmarine zone (uppermost zone, not sampled by Soeder and Randolph): litharenites and feldspathic litharenites, 17-20 weight percent total clay. No grain size data are given in this publication.

Alteration and pore geometry, Soeder and Randolph: "Virtually all the samples contain a pore geometry consisting of secondary pores that are separated from one another by several layers of quartz grains covered by extensive syntaxial quartz overgrowths that produce planar grain contacts. This pore morphology is the result of diagenesis after deposition in which the primary porosity was filled in by quartz precipitating from solution. ...The rock pore volume is divided unequally between the relatively large secondary solution pores and the narrow remnant openings at the planar grain contacts (i.e., slots). As a result, porosity is a function primarily of solution pore volume, although permeability of the rock is controlled by flow through the narrow slots." ... "In many cases, the slot pores are partially filled or lined with authigenic minerals."

Solution pores, Soeder and Randolph: "The quantity and distribution of solution pores are similar for all four depositional environments, as they are from a common source and therefore have similar fractions of the less stable grains, such as feldspar and volcanic rock fragments. ... The type and quantity of secondary minerals present in these solution pores, however, varies with depositional environment."

Slot-like pores: "one of the most striking results of our core analysis is the narrow range of permeability values centered around one microdarcy. … Based just on average grain-size distribution throughout the formation, one would expect permeabilities to vary by at least several orders of magnitude from the finer marine sands to the coarser fluvial deposits. The reason for the narrow permeability range ... all core samples have characteristic slot widths in the range of 0.04 to 0.18 micrometers. ... One is tempted to hypothesize that some natural phenomenon dictates a preferred slot width of about 0.1 micrometer."

Production: none, although gas is present.

Sample selection: Plugs were cut from the sandstone intervals determined by well logs to be gas-bearing, and the samples selected were from the portion of each gas-bearing interval that exhibited the lowest gamma ray response."

Core measurement conditions: Horizontal plug samples 1 inch in diameter and 2 inches long were dried at 45% relative humidity at a temperature of 140 degrees F in a relative-humidity oven to baseline water saturation. Porosity to gas was measured at reservoir net confining stress.

Data entry: manual entry from Figure 8 of Soeder and Randolph, 1987. 42 samples.