Peter C. van de Kamp: Diagenesis in Palaeogene sandstones, California

Abstrak (Abstract)

The stratigraphic and lateral distributions of authigenic minerals in feldspar-rich Palaeogene sandstones of the Santa Ynez Mountains, California, are important in determining their reservoir quality. The sandstones were deposited in an east-west elongate basin during two regressive epidosdes. Deep-water turbidites were overlain by shallow-wter traction deposits and eventually by continental fluvial deposits as the basin was pregressively filled from the east. Modal analyses document a common provenance for all the Palaeogene sandstones consisting primarily of acidic to intermediate plutonic rocks, with minor volcanic, metamorphic, and sedimentary components. The average detrital mode of 27 sandstones is $Q_{37}F_{54}L_9$, *and the average partial mode including only the monocrystalline mineral grains is* $Qm_{39}P_{40}K_{21}$.

Textural relationships and the stratigraphic distribution of diagenetic minerals delineate the paragenetic sequence: (1) syndepositional to very early pyrite; (2) early concretionary calcite cement; (3) incipient dissolution of detrital heavy minerals and feldspars; (4) clay pore linings and pore fillings; (5) formation of sphene and anatase; (6) incipient albitization of detrital plagioclase; (7) quartz, plagioclase, and K-feldspar overgrowths; (8) dissolution of feldspar creating secondary porosity; (9) local precipitation of pore-filling kaolinite; (10) laumontite cementation and replacement of plagioclase; (11) barite cementation and replacement of detrital grains; and (12) late-stage calcite replacement of detrital grains and earlier cements.

Organic metamorphism, as expressed by vitrinite reflectance (R_0), *provides a means to correlate mineral diagenesis in the sandstones with the thermal history of the Santa Ynez basin. In the eastern end of the basin (Wheeler Gorge) incipient albitization is first recognized at 0.5%* R_0 *corresponding to a paleotemperature of* 110^oC *(4572 m burial depth), with complete albitization first occurring at a reflectance of 0.90%* R_0 *corresponding to a paleotemperature of* 165^oC *(5425 m burial depth). The first occurrence of laumontite is in the turbidite beds of the basal Matilija Formation (5669 m bural depth) at approximately 1.0%* R_0 *reflectance* (173^oC)*. Further to the west, at Point Conception (Gerber No. 1 well), the first occurrence of laumontite is at an estimated burial depth of only 2515 m, corresponding to approximately 0.5%* R_0 *an a paleotemperature of* 110^oC*. In this well, incipient albitization begins at 0.35%* R_0 (77^oC)*, with complete albitization occurring at roughly the same burial depth (2515 m) and reflectance (0.5%* R_0 *as the first occurrence of laumontite.*

The top of the laumontite zone occurs at greater burial depths and paleotemperatures in the eastern portion of the Santa Ynez basin than in the west. Laumontite distribution appears to be controlled by pore-fluid chemistry and post-compaction permeability variations, which are responsible for creating differences in fluid pressure between petrologically similar sandstones. 'Dynamic' overpressuring may have occurred in the turbidite facies of the Juncal and lower Matilija Formations, whereby pore fluids enriched in Na^+ *from the dewatering of smectite-rich shales permeated into the turbidite sandstones at a faster rate than they were expelled. Under these conditions, a continuous supply of* Na^1 *would have been delivered to the sandstones to allow albitization of calcium-bearing plagioclase which in turn supplied* Ca^{+2} *necessary for the formation of laumontite.*

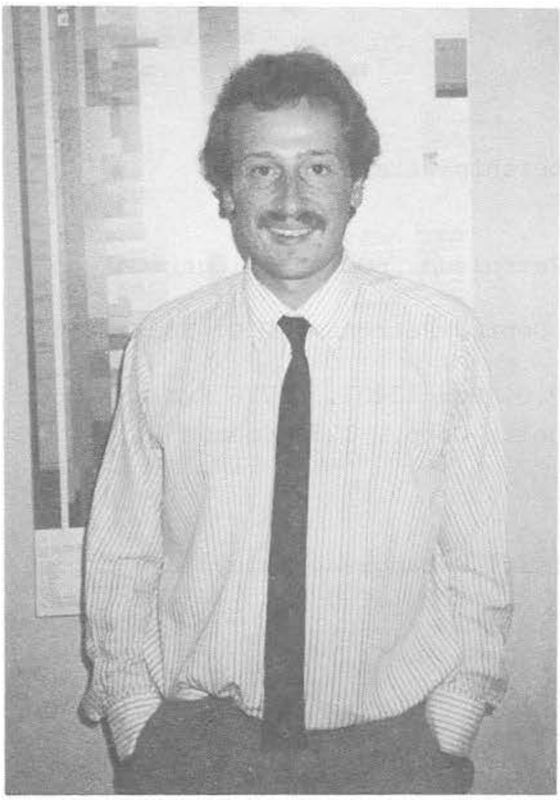
The authigenic minerals in the lower Palaeogene sandstones of the Santa Ynez Mountains render them ineffective as reservoirs. Better reservoir prospects occur in the upper Palaeogene and Neogene sandstones, particularly in the western part of the basin where they have not been subjected to deep burial, and secondary porosity is well developed.

Laporan (Report)

The above talk given by Dr. Peter C. van de Kamp attracted a large crowd of 55 at the Department of Geology, University of Malaya, on Tuesday, 9 September 1986. Dr. van de Kamp, who worked with Shell Oil Co. (USA) from 1967-1973 is presently a Petroleum Exploration consultant with GeoResources Associates, Napa, California. He also conducts research on sandstone petrology, geochemistry and diagenesis.

The paper which forms the basis of his talk is in AAPG Memoir 37, p. 239-276 (1984).

G.H. Teh



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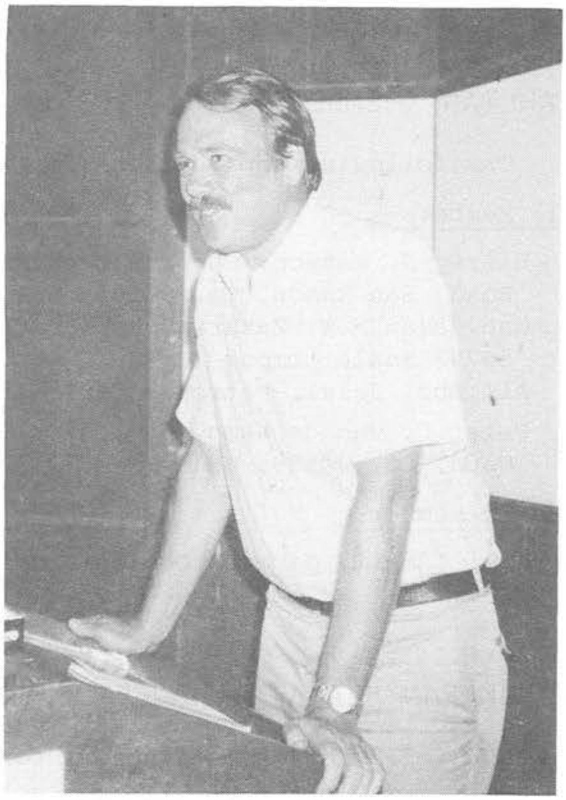

Peter C. van de Kamp

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