hydrocarbons in this province. However, a thorough understanding of facies relations is essential for success in the search for this type of subtle stratigraphic trap.

PACHT, JORY A., ARCO Oil and Gas Co., Dallas, TX

Petrologic History of Late Cretaceous Nanaimo Group in Nanaimo Basin, Western Washington and British Columbia: Implications for Cretaceous Tectonics

The tectonic development of the Late Cretaceous Nanaimo basin is an important factor in determining plate interactions along the northwest Pacific Coast where the basin was formed within an orogenic collage, surrounded by the North Cascades, coastal plutonic belt, insular belt, and San Juan Island terranes. The Nanaimo basin may have been an intramassif fore-arc basin or a pull-apart basin, which developed within a proto-Queen Charlotte transform zone.

Paleocurrent and petrographic data from the Nanaimo basin indicate derivation of plutonic debris from the coastal plutonic belt and intermediate volcanic and low-grade metamorphic rock fragments from the North Cascades. Plutonic debris and silicic to basic volcanic rock fragments were derived from the insular belt. Chert and subordinate intermediate-volcanic and argillaceous rock fragments were contributed by terranes of the San Juan Islands. Nanaimo sandstones contrast greatly with Late Jurassic to middle Cretaceous fore-arc basin sandstones in this region. Contemporaneous volcanic rock fragments are conspiciously absent in Nanaimo rocks and the dominance of plutonic over volcanic debris from the coastal plutonic belt suggests deep dissection of the massif.

Subduction along the continental margin of British Columbia and Washington may have greatly slowed or ceased during the Late Cretaceous. The tectonic setting was probably characterized by a broad zone of right-lateral transcurrent faulting. Cretaceous and early Tertiary structures of southern Vancouver Island are similar to structures observed along the San Andreas transform zone. Additionally, a magmatic gap is noted in the southern coastal plutonic belt during Nanaimo basin development.

PACHT, JORY A., ARCO Oil and Gas Co., Dallas, TX

Submarine-Fan Facies of Late Cretaceous Nanaimo Group in Restricted Nanaimo Basin, Washington and British Columbia

Geometry of submarine fan facies in the Nanaimo basin contrasts greatly with fans developed along unrestricted continental margins. The latter fans are characterized by sediment deposited in distributary channels extending radially outward from a single-point source, forming fining-upward sequences. At the termini of these channels, nonchannelized sandy lobes are developed, forming coarsening-upward sequences. The surrounding basin-plain is characterized by noncyclic shalerich sequences.

A large part of the Nanaimo Group was deposited as coalescing submarine fans, from several areas, in the restricted Nanaimo basin. These strata are dominated by fining-upward sequences, which indicate most sediment was transported by channelized flow. However, channels trend parallel with basin margins, not radially from them. Sediment transport was largely controlled by regional slope of the basin floor and not by the slope of the basin margins. Coarsening-upward sequences in the Nanaimo Group are not always located at the termini of channels. Some coarsening-upward sequences in the Nanaimo Group are developed in proximal regions of particular fans, alongside time-equivalent, conglomerate-rich, fining-upward sequences. These coarsening-upward sequences may be crevasse splays. Noncyclic, shale-rich sequences are present throughout the Nanaimo basin. Some of these sequences are deposited by overflow from nearby conglomerateand sandstone-filled channels in large interchannel areas. Others are distal fan deposits.

Much of the hydrocarbon found in submarine fan facies occurs in restricted basins. The Nanaimo basin may serve as an important analog to predict reservoir location and trapping mechanisms.

PARCHMAN, W. L., JR., and JOHN W. KNOX, Sunoco Energy Development Co., Dallas, TX

Exploration for Geothermal Resources in Dixie Valley, Nevada: Case History

After several years of reconnaissance geology in Nevada, an exploration program to evaluate the geothermal resource potential of Dixie Valley was begun in 1974. Between 1974 and 1978 Sunoco Energy Development Co. conducted two heat-flow drilling programs, a resistivity survey, a seismic emission study, a ground noise survey, two magnetotelluric surveys, a hydrology study, and a surface geology survey. The synthesis of the data resulting from these projects into the regional geologic framework led to the acquisition of geothermal resource leases from fee property owners, through open-file application of federal lands, and by participation in the federal KGRA competitive lease sale of May 1976.

On September 15, 1978, Sunedco began drilling the No. 1 S.W. Lamb which became the discovery well.

PARKS, JAMES M., Lehigh Univ., Bethlehem, PA

Recognition of Sand Body Depositional Environments: Limitations of Fourier Analysis and New Approach to Grain-Shape Analysis

In searching for subtle depositional traps, it would be useful to have a reliable method for determining the depositional environment of sand bodies from internal evidence. Attempts using various grain-size parameters have met with limited success. Recent advances in grain-shape analysis have not lived up to initial hopes. The potential of Fourier analysis is reduced when harmonic amplitudes are used without considering phase angles. Two types of errors can occur: (1) dissimilar shapes can produce similar sets of amplitudes, and (2) similar (but not identical) shapes can produce dissimilar sets of amplitudes. Phase angles can be compared between grains only when the grains are rotated to comparable positions; this can be accomplished by cross-correlation with an empirical asymmetric reference shape. Data reduction is desirable, but paired variables cannot be easily handled by standard multivariate techniques.

After rotation to standard position, raw shape data (sets of radial lengths) are adequate shape descriptors. These can be reduced by factor analysis that can be compared between grains and between large sets of grains more meaningfully than can Fourier descriptors (which provide a poor basis for comparisons between grains).

Results from the two approaches are compared in a preliminary re-study of the river-beach-dune discrimination problem. Gross grain shapes are classified into natural categories by multivariate analysis of rotated radials.