

generated noise from the S-wave vibrators. Time-depth data available from the S- and P-wave VSPs were used to convert the time sections to depth, and hence provide the best visual tie of common reflecting horizons. The accuracy of the ties is mainly limited by the poor signal-to-noise ratio and narrow bandwidth of the S-wave data.

Finally, energy decay measurements from first breaks on VSP data show that S waves have a higher loss than P waves in the near surface. However, below 3,000 ft (915 m), the slopes of the energy decay curves are similar, thus implying S-wave data quality will not deteriorate faster than P-wave data quality at greater depths.

CORDIVIOLA, STEVEN, Kentucky Geol. Survey, Lexington, KY

#### Improved Data Distribution at Kentucky Geological Survey Through Computer Usage

Computerization of geologic data held by federal, state, and local governmental agencies is becoming more prevalent, and is providing faster and more flexible service to companies and individuals who need this information. In some cases these agencies maintain the only comprehensive source of geologic and hydrogeologic data, and computer storage and retrieval of this information provides welcome relief from the tedious sorting of paper files. Such is the case at the Kentucky Geological Survey (KGS) where for years the more than 150,000 oil and gas, coal, and other geologic records have been stored in file cabinets. In spring 1983, a new interactive computer system was brought online to help manage, sort, and store these records and to provide the information to industry, government, and the general public in a more efficient manner.

Data obtained from various sources, including research projects, industry, and other governmental agencies are stored in computer files that are linked by geographic locations. Users can request information by various combinations of subject (i.e., oil and gas, coal, water, etc), location (latitude, longitude, UTM, county, or other areas of interest), value (greater than, equal to, etc), and other parameters which are stored with each record. Output of the data may also be provided in various formats, such as sorted lists, location maps, and computerized open-file reports. These outputs save users many hours of tedious hand copying and plotting of information from the paper files.

Along with the advantages of computerized data handling have come some problems. One involves verification that data reported and collected by KGS are accurate and reliable, and making users aware of data which may be suspect. Also there are problems related to compatibility between different computers and system security. KGS is presently attempting to find solutions to these and other problems in order to provide users data they need in a format which is most useful to them.

Some potential future applications and services being considered by KGS are allowing users to have telephone access from remote sites, providing graphic display of maps on terminals, and enabling communication between staff geologists via the computer.

COURMES, F., Elf Aquitaine, Pau, France, and V. KOLLA, Superior Oil Co., Houston, TX

#### Channel Migration in Upper Indus Fan in Relation to Geologic History of Region

Multichannel seismic data suggest that the Indus Canyon off the Indus River and at least 3 other canyons that existed in the past on the Pakistan-India shelf fed sediments to several channel-levee systems on the adjacent upper Indus fan since Oligocene-Miocene uplift of the Himalayas. The canyons on the shelf, when they were active, were primarily erosional. However, the channels were erosional-depositional on the continental slope and primarily depositional on the upper fan. The channels of the upper fan are as much as 10 km (6 mi) wide, and may be V- or U-shaped in cross section. The channels in the upper fan as well as the feeder canyons on the shelf migrated extensively in space and time. On one multichannel seismic line parallel to depositional strike, 15 events of channel activity on the upper fan have been observed. There were 2 types of channel migration. In one type, the channels were abandoned, and new ones were opened at entirely different locations. In another type, the channels gradually moved as the banks on one side receded owing to erosion, and the banks on the other side advanced in the same direction because of sediment deposition. The uplift of the Murray Ridge, tectonics in the Indus

River drainage basin, changes in sediment-input rates and sea level changes, and complete plugging of channels by slumped sediment masses probably caused the first type of migration. Coriolis force and channel meander, among other things, might have caused the gradual migration.

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#### Biostratigraphic Restudy Documents Triassic/Jurassic Section in Georges Bank COST G-2 Well

In 1977, the COST G-2 well was drilled in Georges Bank, 132 mi (212 km) east of Nantucket Island to a total depth of 21,874 ft (6,667 m). Biostratigraphic studies of 363 sidewall and conventional cores and 695 cutting samples resulted in a detailed zonation from the Late Jurassic to the present. Restudy of the original samples, as well as new preparations from previously unstudied core material, resulted in revision of the zonation of the Late Jurassic and older section.

On the basis of our study of pollen and spores, dinoflagellates, nanofossils, and foraminifers, we revised the age sequence as follows: 5,856 ft (1,785 m) Late Jurassic (Tithonian); 6,000 ft (1,829 m) Kimmeridgian; 6,420 ft (1,957 m) Oxfordian; 6,818 ft (2,078 m) Callovian; 8,200 ft (2,499 m) Bathonian; 9,677 ft (2,950 m) Bajocian; 14,567 ft (4,440 m) Norian (Late Triassic). Norian dinoflagellate cysts and *Tasmanites* sp. indicate that intermittent normal marine sedimentation was taking place on Georges Bank as early as Norian time, although most of the Triassic section (+14,500 ft or 4,420 m to T.D.) is composed of barren anhydrite, dolomite, and halite (at T.D.) interpreted as having been deposited under evaporitic sabkha-like conditions. The Norian dinoflagellates (*Noricysta*, *Heibergella*, *Hebecysta*, *Suessia*, *Dapcodinium*, and *Rhombodella*) include species common to both Arctic Canada and the Tethyan region, indicating a possible Late Triassic marine connection.

CRABAUGH, JEFF P., and JOHN G. MCPHERSON, Univ. Texas at Arlington, Arlington, TX

#### Transitions in a Fluvial System—Abo Formation, Southeastern Naciminto Mountains, New Mexico

The Abo Formation (Wolfcampian) in the southeastern Naciminto Mountains, New Mexico, is an alluvial plain red-bed sequence which records the evolution of a fluvial system within the distal reaches of a large clastic wedge. Sediment was derived from the southern Uncompahgre uplift, with a paleoflow to the southwest. The Abo Formation consists of mudstone, feldspathic sandstone, and intraformational conglomerate. Three major lithofacies associations, representing distinct fluvial depositional settings, may be distinguished.

The lowermost division (Unit A) (100+ m, or 330+ ft, thick) is mudstone dominant with isolated sandstone bodies showing cutbanks and lateral accretion surfaces. Ridge-and-swale features were noted on an exhumed point bar surface. The sandstones commonly show a progressive upward decrease in the scale of internal bedforms with a lower scour surface containing intraformational conglomerate. Trough cross-bedding is the dominant bedform in the sandstones with common planar-tabular and flat-bedded interbeds. The uppermost sandstones, characteristic of levee and crevasse-splay sands, are ripple cross-bedded with abundant bioturbation and some plant roots. The overbank mudstones contain numerous pedogenic horizons characterized by calcrete nodules (representative of all stages of evolution), vein networks, pseudo-anticlinal structures, slickensides, color mottling, and bioturbation. Vertebrate remains are found in the mudstones.

The middle division (Unit B) (approximately 70 m, or 230 ft, thick) is characterized by thick multilateral channel sandstones and thinner mudstones. The sandstones are coarse grained and contain common intraformational conglomerate. Large-scale trough cross-stratification is the dominant bedform. Pedogenic horizons are present but less common than in unit A.

The uppermost division (Unit C) (approximately 30 m, or 100 ft, thick) is entirely composed of reddish-orange, very fine-grained sandstone. Flat bedding is the dominant bedform. High aggradation is indicated by abundant dish structures in the sandstones and aggradational ripple cross-bedding. Mudstone is rare and preserved as thin laminae.

The fluvial sequence from Unit A to Unit B is thought to represent the transition from a fine-grained to a coarse-grained meander-belt system. The transition to Unit C reflects a change to flash-flood, ephemeral-stream controlled sedimentation. Allocyclic phenomena are suggested as probably cause of these fluvial transitions.

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#### Geology of Point Arguello Discovery

Chevron (as operator for its partners, Phillips, Champlin, and Impkemix) discovered the Point Arguello oil field in 1981. The discovery well, the Chevron et al 1 P-0316, was drilled in federal waters 7.3 mi (11.8 km) south of Point Arguello, California. Delineation drilling on adjoining leases P-0315 (Texaco group), P-0316 (Chevron, Phillips, Champlin, and Impkemix), and P-0450 (Chevron and Phillips) confirmed the presence of a giant oil field with estimated recoverable reserves in excess of 300 million bbl.

The oil field is in a small subbasin at the southern edge of the offshore Santa Maria basin. This local depocenter developed in response to regional strike-slip tectonics and contains more than 15,000 ft (4,570 m) of Neogene sediments.

The Point Arguello structure is a large north-northwest trending anticlinal complex composed of 2 major highs separated by a faulted saddle. Reverse faults may cut the southwest flank and northern plunge of the Point Arguello structure.

The main reservoir is the middle and late Miocene Monterey Formation, composed of highly fractured cherts, porcellanites, and dolostones. Producibility is dependent on fracturing, as matrix permeabilities are low. Matrix porosities average about 13.5% and fracture porosities 1.5% of the reservoir volume. Analyses of pressure buildups indicate in-situ permeabilities up to 782 md.

Crestal wells have indicated productivities, after acid, of approximately 6,000 bbl/day. Platform Hermosa is scheduled to be installed on the P-0316 lease in May 1985, with oil production expected by January 1986.

CRANE, DAVID C., D. C. Crane, Inc., Dallas, TX

#### Microcomputers in Exploration—Perspective and Forecast

General purpose microcomputers have become so inexpensive that powerful systems now are within the budget of a one-person company. The uninitiated have visions of a desktop machine that can do budget reports, royalty accounting, lease control, interactive modeling of the subsurface, contour maps, decision making, dart throwing, and much more. Old hands in major oil companies can see the opposite side: horror stories about expensive programming projects, machines that are overloaded and slow, and enormous staffs required to interface the working geologist with the machine.

The truth about microcomputers is somewhere in between. An intelligent search for software packages will turn up a few that pay for themselves and the computer(s) they require. But buying a machine and attempting to make it fit a "grand vision" can lead to disaster.

This paper presents a perspective on microcomputer capabilities, both software and hardware, now and for the next few years, and suggests a method and a schedule for small-company geologists to become involved with computers.

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#### Seismic Reflection Profiles from Offshore Central California: Evidence for Post-Miocene Imbricate Thrust Faulting

High-resolution, 36-fold seismic reflection data with penetration to 3 sec have been collected recently in the northeastern offshore Santa Maria

basin, the northern Santa Barbara Channel, and off Point Conception, California. These profiles reveal major east-over-west thrust faults in areas previously interpreted as being characterized by strike-slip faults and/or high-angle normal or reverse faults. Like those in well known foreland thrust belts, these faults typically form an imbricate system in which they curve asymptotically downward to a common basal sole thrust. "Solving out" generally occurs at depths of 1.5-3 km (5,000-10,000 ft).

Detailed mapping of faults and folds associated with these thrust systems coupled with fault-plane solutions suggest that (1) these thrusts formed within the last 5 m.y., (2) many have modern activity, and (3) compressive forces causing them are normal to the strike of the San Andreas fault. These observations agree with present-day plate motion studies which require that Pacific-North American relative plate motion include a component of compression orthogonal to the San Andreas fault.

These overthrust regions are all sites of recent major petroleum discoveries. However, these discoveries have all been made on obvious anticlinal structures that generally are attributed to wrench tectonics. Recognition of thrust faulting in these areas may lead to additional discoveries from more subtle geologic traps associated with overthrusting.

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#### Regional Post-Late Miocene Thrust Faulting in Offshore Central California—Implications for Wrench-Style Tectonics

High-resolution, deep-penetration seismic reflection data have recently been collected in the offshore Santa Maria basin, northern Santa Barbara Channel, and off Point Conception, California. These data reveal major post-late Miocene east-over-west thrust faulting in offshore central California. Recognizable on both dip and strike lines, the thrust faults are generally imbricate and curve downward to a basal sole thrust at depths of 1.5-3 km (4,900-9,800 ft).

The offshore Santa Maria basin is generally regarded as a wrench-style basin. However, the Hosgri and other northwest-trending faults within the basin appear to be predominantly thrusts rather than strike-slip faults. Also, detailed mapping within the basin indicates that the overall structural pattern does not fit accepted models of wrench tectonics; for example, folds have a preferred asymmetry and their axes closely parallel faults rather than lie en echelon to them. We conclude that the folds and faults as well as the present morphology of the offshore Santa Maria basin are largely due to post-late Miocene northeast-southwest compression. Similar conclusions can be drawn from the onshore Santa Maria basin on the basis of field relations and well data.

These data, and the conclusions drawn from them, raise questions as to the validity of the generally accepted notion that all California Neogene basins are products of wrench-style tectonics.

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#### Upward-Shoaling Origin of an Eastern Gulf Coast Barrier Island

North Bunces Key is a narrow barrier island which has formed on the northern portion of the ebb-tidal platform of Egmont Channel which services Tampa Bay. The island first became supratidal in 1960. Since that time, it has grown to a length of 2 km (1.2 mi) with widespread vegetation and dunes which rise about 2 m (6 ft) above mean sea level.

Most investigators discount upward shoaling as a mechanism for barrier formation in favor of drowned beach ridges. A closely spaced sequence of aerial photos documents the origin of North Bunces Key from a subtidal shoal area without benefit of significant storm activity. Requirements for formation of the barrier appear to be (1) abundant sediment, (2) shallow, very gently sloping platform, and (3) low wave energy.

Vibracores taken from several traverses across the barrier show a general stratigraphic sequence of nearshore sediments successively overlain by foreshore, backbeach, and dune sediments. Cores immediately landward of the barrier contain muddy lagoonal sands containing fining-upward washover deposits. Absence of typical nearshore sediments landward of the barrier may result from low energy conditions which permitted mud to accumulate even prior to emergence of the shoal or reworking and addition of mud as pellets by benthic organisms.