Meulaboh and Mentawai troughs to the north and the south, respectively.

The Banyak Islands cross-structure is a linear zone of deformation that transects the fore arc obliquely. The continental shelf is narrow and an abrupt change in depth to basement and sediment thickness occurs across a near-vertical fault. The trace of this fault continues onshore in good alignment with a major strand of the right-lateral Sumatra fault system. Offshore, the fault transects the Banyak shelf and appears to intersect the late Pliocene flexure on Nias which is thought to represent the rear edge of subduction-related deformation. Here, it occupies a wider zone of deformation characterized by high-angle reverse faults that probably involve basement. Monoclinal folds and secondary faults have developed in the overlying sedimentary section, and large growth faults with normal separation have developed along the crest of the trench-slope break north of Nias.

Stratigraphic relationships and well data indicate that faulting and folding occurred during Pliocene time. The variation in structural style along strike is indicative of varying crustal structure. The shelf, characterized by rigid crystalline basement with a thin sedimentary cover, exhibits a brittle crustal response, whereas the thick prism of fore-arc basin strata overlies more ductile crust which affords greater crustal mobility.

The wide central Sumatra shelf southeast of Nias does not appear to be related to strike-slip faulting. Seismic profiles show that flat sediments of Miocene and Pliocene age onlap an eroded crustal block of continental character lacking diagnostic structures and obvious trend associations. We believe that this feature existed as a broad, paleobathymetric high that separated the basins early in the history of the fore arc. Buried normal faults, which step down to the trench, offset the basement reflector along the paleoshelf edge. The relatively shallow shelf has persisted as a positive structural element exhibiting a reduced rate of subsidence throughout the Neogene.

BEBEL, DENNIS J., Amoco Production Co. (USA), Houston, TX

Depositional Environments of Lower Portion of Pottsville Group (Pennsylvanian) in Southern Ohio

Seven sedimentary facies are recognized within the lower members of the Pottsville Group (Pennsylvanian) in southern Ohio which define an overall onlap-offlap sequence. The facies succession, as defined by stratigraphic lithofacies analysis, begins with coarse clastic braided and meandering stream deposits suggesting an aggrading coastal plain depositional environment. The braided-stream facies comprises medium to coarse-grained quartzarenite and pebble to cobble conglomerate and disconformably overlies Lower Mississippian formations. Contained large-scale planar and some trough cross-bedding yield strongly unimodal (west) paleocurrent directions. The overlying meandering stream facies consists of multistoried fining-upward sequences of sandstone, minor conglomerate, siltstone, shale, and coal. Lacustrine and interdistributary bay facies are interpreted to represent a transitional environment from a low-lying coastal plain to a northward transgressing marine embayment. Varvelike laminae of mudstone and claystone of the lacustrine facies grade upward to marine-fossil bearing interdistributary bay and fine delta front facies. Subsequent southerly progradation of a delta system is indicated by interdistributary bay, delta front, crevasse splay, and distributary channel facies.

Fossil plant assemblages suggest that the lower Pottsville Group, in southern Ohio, is entirely Morrowan (Namurian C–Westphalian A) New River Formation age-equivalent.

BEHRENS, E. W., R. S. SCALAN, and P. L. PARKER*, Univ. Texas at Austin, Port Aransas, TX

Chemical Characterization of Petroleum from a Seep on Slope of Northern Gulf of Mexico

During an extensive coring and geophysical survey of the outer slope of the northwest Gulf of Mexico, a 4-m (13-ft) core recovered from 538 m (1,765 ft) water depth had visible petroleum deposits. The petroleum was extracted and chemically and isotopically characterized. The percent of petroleum soluble in benzene ranged from 4.0 near the surface to 4.5 at 100 cm (39 in.) to 0.1 at 410 cm (161 in.). API gravities ranged between 10.7 and 17.6. GC analysis of the silica gel fractions showed that both the saturated and aromatic hydrocarbon components are highly biodegraded, with the degree of degradation increasing upward in the core. The $\delta^{13}C$ values for the whole oil and the fractions were between -26.2 and $-26.7‰$ on the PDB scale and showed very little variation among compound classes. Carbonate nodules contained in the oil-rich core had carbon isotopic compositions depleted in ^{13}C, indicating oxidized organic matter is the source of the inorganic carbon. The core is located in an area with large-scale normal faulting which also shows evidence of gas migration. Based on this and the distribution of oil in the core, it is supposed that the oil has migrated upward.

BELFIELD, WILLIAM C., JAMES HELWIG, and PAUL R. LA POINTE, ARCO Oil and Gas Co., Dallas, TX, and W. K. DAHLEEN, ARCO Oil and Gas Co., Bakersfield, CA

Monterey Fractured Reservoir, Santa Barbara Channel, California

The South Elwood field in the Santa Barbara Channel is a faulted anticline with cumulative production of 14.5 million bbl from the Monterey Formation as of September 1, 1982. The distributions of pressure, flow rates, and oil-water contacts and the low average matrix permeability of 0.2 md require a fractured reservoir. Within the field, the relation of oil productivity with respect to typical geological parameters of structure or gross lithology is random. However, the present study reveals that the best production is obtained from the wells that penetrate the complete Monterey section, are extensively perforated, and are deviated strongly along structural strike. Observed variations in production as a function of borehole geometry can be quantitatively related to the geometry of fracturing and brecciation.

Core and outcrop studies show a dominant fracture set characterized by vertical, lithologically controlled fractures oriented across strike, and breccias controlled by lithology and structure. Generally, the fracture intensity is unaffected by structural position or bed curvature but is controlled by lithology and bed thickness. Chert, porcelanite, and carbonate rocks are the most intensely fractured lithologies, but the widest fracture openings occur in carbonates. Other varieties of fracturing in the Monterey are related to a protracted history of diagenesis, deformation, and fluid injection.

Three types of tar-bearing breccias occur in the Monterey Formation: stratigraphic breccia, coalescent-fracture breccia, and fault-related breccia. Stratigraphic breccias in porcelanite and chert are attributed to volume decrease owing to silica diagenesis. Coalescent-fracture breccias occur where tar intrudes fractures that lie at high angles to bedding, disaggregating rock adjacent to the fracture. Fault-related breccias commonly are found in conjunction with large-displacement normal faults and rotational strike-slip faults. Formation of breccias probably involves high