period (1890-1941), rehabilitation period (1950-1965), and the five-year development plan period (1969 to present).

The objectives of exploration of coal in the prewar period were to gather data for the development of the coal mines and their future expansion. During 1950 to 1965 these activities were influenced by a possible development of an iron and steel project.

Since 1969 coal exploration was conducted within the framework of the five-year development plan of the government. Studies were being made to utilize the coal from two major mines in Sumatra as fuel in electric power plants and in industry.

The pattern of the Indonesian coal market in the prewar period was for export and the use as fuel in industries, railroad, and shipping. Since 1950 these markets have been gradually declining because petroleum was considered to be more suitable as fuel than coal. The decline of these markets affects seriously the coal industry in Indonesia.

At present the coal industry will be revived due to the government policy to utilize coal as effectively as possible in any uses previously fueled by petroleum, mainly electric-generating power plants.

SOLOVGEV, V. V.

RING MEGA-STRUCTURES OF PACIFIC

No abstract available.

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METALLIC MINERALS IN CANADIAN CORDILLERA

The Canadian cordillera, consisting principally of British Columbia and Yukon, is rich in minable deposits of copper, zinc, lead, and molybdenum, and has nickel, tungsten, gold, silver, mercury, and iron deposits.

The cordillera shows a pronounced regional zoning of metals in background abundances in rocks and an associated zoning in class of deposits and contained metals. Sequential changes occur across the strike of the five subparallel tectonic belts.

The mineral industry has expanded rapidly in the last decade. The total value of metal production in 1973 was $839 million in contrast to $189 million in 1963. Production of major metals for the whole terrane in 1973 was copper, 730 million lb; zinc, 553 million lb; lead, 431.5 million lb; and molybdenum, 25 million lb.

For copper, the 1973 production represented about 8% in international trade. Production and reserves have greatly increased in this decade. For British Columbia geologic reserves at present rates of extraction are estimated to be sufficient for copper and molybdenum for 100 years, for zinc about 60 years, and lead about 35 years.

Mode of discovery has changed radically. Classical prospecting is still the most important method although it shares with more technical methods the revelation of actual significance. Of some 60 major mines and prospects discovered in the last 15 years, the primary discovery credit may be attributed as follows: classical prospecting, 50%; geologic deduction, 21%; geochemistry, 20%; geophysics, 9%.

Factors other than discovery, development, and markets are becoming increasingly important. The industry currently is based significantly on low-grade porphyry deposits most of which have no enriched zones. The profitability of such mines is marginal during periods of low metal prices. To survive, operations have had to become highly efficient. The task becomes more difficult in the face of new legislation in British Columbia and proposed legislation in Yukon. More stringent reclamation and environmental regulations and royalties and increased taxes are being applied. There is a hiatus in mine development awaiting clarification of the impact of the new laws, but exploration and discovery continue at a high level.

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No abstract available.

THIGPEN, J.

EXPLORATION FOR GEOTHERMAL ENERGY IN NICARAGUA

No abstract available.

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HYPOTHESIS FOR PETROLEUM GENERATION AT CONVERGENT PLATE BOUNDARIES

Plate tectonics, the hypothesis of multiple crustal plates floating on a viscous layer called the asthenosphere, provides rationale for viewing the earth's outer shell as a system of shifting continents and growing ocean basins. The idea of diverging plates (or sea-floor spreading) implies that plates converge elsewhere at compatible rates. Estimated convergence rates range up to 4 in. per year, or 140 mi in the 2 m.y. since the beginning of Pleistocene time.

Convergence between oceanic crust and continental crust may result in thermal generation of oil and gas in sediments as young as Pleistocene age because of rapid deep burial associated with subduction. Mountainous source areas for sediment and steep continental slopes favor rapid burial of organic material with turbidites. Rapid subduction of oceanic crust under continental margins may carry sediments to depths which provide requisite thermal environments for generation of oil and gas from organic matter disseminated in the sediment. Continued subduction of oceanic crust under continental slopes may cause reverse faulting such that oil and gas accumulations are uplifted toward the ocean bottom.

Core samples obtained adjacent to the Aleutian Trench in the western Gulf of Alaska apparently show effects of subduction and reverse-fault uplift on a section of Pleistocene sediment. Although this Pleistocene sediment is only a few hundred feet below the ocean bottom, organic matter carbonization suggests previous burial of at least 8,500 ft and late pregeneration stage of organic carbonization. In contrast, noncommercial oil production from uplifted deep-water sediment of early Tertiary age at Katalla, Alaska, suggests formerly significant accumulations have been dissipated by faulting, uplift, and erosion. Late Tertiary rocks beneath outer continental shelves and/or upper continental slopes at convergent margins may be in the

optimum stage of current petroleum expulsion but still buried deeply enough for entrapment of giant oil accumulations.

Regions for analogous exploration application of this hypothesis, in addition to the western Gulf of Alaska, include continental or island margins adjacent to other deep oceanic trenches such as the Japan, Mindanao, Java, Solomon Sea, Peru-Chile, and Central American trenches, and the southern end of the Puerto Rico Trench northeast of Trinidad.

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SEDIMENTATION AND TECTONICS OF PACIFIC CONTINENTAL MARGIN OF BRITISH COLUMBIA

A triple junction of three lithospheric plates at the British Columbia continental margin has had considerable influence on structure and sedimentation in marginal basins. South of the triple point, compressional forces from subduction of oceanic plate beneath the continent have resulted in deformation mainly by folding and block faulting, but north of the triple point stresses are relieved by strike-slip movement along transform faults with only broad folding taking place in Tertiary sediments.

Tofino basin, south of the triple junction, has undergone major uplift, linear en echelon folding, and elongate diapirism on the outer shelf. More than 12,000 ft of Tertiary mudstone and siltstone has been drilled adjacent to such structures by Shell Canada Ltd. The fine clastics in these distal facies are not conducive to petroleum accumulation. However, potentially productive reservoir beds may exist in the proximal turbidite sequences nearer shore. Subsequent uplift and erosion of the latter also may have resulted in clean second-cycle wedges west of the uplift boundary. In the Tofino basin, as in other areas of the west coast, hydrocarbon prospects appear to have the highest potential in stratigraphic traps.

North of Brooks Peninsula, structural style is dominated by shelf-edge faulting which, west of Queen Charlotte Islands, is transform movement between the Pacific and North America plates. The Queen Charlotte basin has undergone net subsidence of several thousand feet with late Tertiary nonmarine sediments over Tertiary and Mesozoic volcanic basement and Paleozoic intrusives in the north, and late Tertiary marine sediments over Tertiary volcanic rocks in the south. Sediments reach 15,000 ft in thickness. Permeabilities are reduced by silts and clays, but facies changes between interfingering marine and nonmarine depositional sites should make good stratigraphic traps.

Winona basin at the base of the slope is folded only gently and broadly in the north but more highly deformed into prominent sedimentary ridges in the south. Three to six km of sediment fills the deepest point under the base of the slope. The oldest sediments in the flank of the basin are Pliocene. The present deepwater basin undoubtedly has received a high proportion of second-cycle clastic deposits from the uplifted older Tertiary belt.

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HYDROCARBON POTENTIAL OF COASTAL BASINS OF PERU

Along the coast of Peru, the shelf between the Andes Mountains and the 100-fm isobath is narrow, about 100 km wide in a few places. Between lat. 6 and 14°S nearly all of it is a wide offshore shelf. This shelf has been the site of marine deposition throughout the Tertiary. Basement highs and irregularities define six subbasins. In the north, the mainly offshore Progreso basin extends into Peru from the Gulf of Guayaquil. It is filled with upper Tertiary shales, sands, and conglomerates with a maximum thickness of 6,000 m. The small abandoned Zorritos field was in this basin and some undeveloped oil and gas have been discovered recently. The basin has an estimated potential of 350 million bbl.

The Talara basin, which has produced over 800 million bbl, is both onshore and offshore. Sedimentary rocks consist of Upper Cretaceous and lower Tertiary silicate clastic rocks with a maximum thickness of 8,000 m, but nearly all production comes from Eocene deltaic, fluvial, and turbidite sandstones. Intense block faulting, gravity sliding, and submarine slumping complicate development operations. The onshore part does not have large undiscovered potential, but the offshore is estimated to have a potential of one billion bbl. The Sechura basin is between the Andes and a discontinuous chain of low coastal mountains which separates it from the Talara basin. It is mostly onshore but extends southward onto the offshore. Up to 3,000 m of marine, brackish, and nonmarine sedimentary rocks, including diatomite and phosphatic and tuffaceous elements, fill the basin. Most of the strata are upper Tertiary, but lower Tertiary and Cretaceous beds also are present. In the 1950s, 28 wildcat wells were drilled with the discovery of moderate reserves of gas. A total potential for the basin is estimated to be 100 million bbl.

The Salaverry basin is the largest of the coastal basins. It is 500 km long and up to 100 km wide, is entirely offshore, and extends to within 100 km of Lima. It contains up to 3,000 m of Tertiary marine shales, silts, and calcareous sedimentary rocks with sandstones at the base. Two wells have been drilled in this basin and the estimated potential for the basin is 500 million bbl. The Pisco basin begins about 100 km south of Lima in the offshore, but southward splits into onshore and offshore parts. Up to 2,000 m of lower and upper Tertiary sedimentary rocks are present. The lower Tertiary is composed of conglomerates, sandstones, and calcareous shales. The upper Tertiary consists of sediments similar to those of the upper Tertiary in the Sechura basin. One well has been drilled in the basin. The estimated potential for the basin is 100 million bbl. The Moquegua basin is a narrow onshore basin between the Andes and the coastal chain of mountains. Marine sediments are found only in the northern part and are of insufficient volume to have significant potential. The total potential of the coastal basins is estimated to be about two billion bbl.

VEERABURUS, M.

FLUORITE RESOURCES IN THAILAND

Thailand, now one of the world's leading producers of fluorite, produced 395,070 metric tons in 1972, somewhat less than the record level of 427,498 tons the previous year. More than 155 deposits have been reported throughout the country; the main producing areas are in the northern and central regions.

Fissure veins and fault-fissure fillings of varied geometry are associated with hydrothermal minerali-