© TGS, 2006 - Tulsa Geological Society Digest, Volume 29, 1961

up to 20,000 feet in thickness and is bounded near the edge of the shelf by a basement ridge which rises to within 5,000 feet of the surface in places. The outer trough, under the continental slope and rise, contains a greater thickness of sediment, up to 30,000 feet off the Grand Banks of Newfoundland. The sedimentary column decreases in thickness towards the ocean basin, reaching an average thickness of about 3,000 feet.

Beneath the sedimentary rocks are two crustal layers; the basement rocks under the continent, and an oceanic crustal layer under the ocean. Both are found in the vicinity of the continental margin but the basement rocks pinch out as the ocean basin is approached. Both layers may continue under the continent but the boundary between them may be gradational rather than sharp. The boundary between the crust and the mantle becomes obscure in the margin area and the Mohorovicic Discontinuity may not be a sharp interface in this region. Gravity measurements indicate that the change from continental to oceanic crustal properties takes place in a narrow region near the edge of the shelf.

The configuration of the depositional system off northeastern North America compares very favorably with that of the Appalachian system as reconstructed prior to the Taconic Revolution. The shelf is similar to the early Paleozoic Appalachian miogeosyncline with sediments of shallow water origin derived from the continent and an abundance of fauna. The basement ridge resembles the Pre-Cambrian ridge (Green Mountains, Reading Prong, etc.) which separates the two depositional troughs of the Appalachians. The sediments of the outer trough are similar to the eugeosynclinal sediments of the Appalachian and other alpine-type mountain systems and resemble the graywackes of Pettijohn's classification. They are marked by an absence of shallow water features and a dearth of fauna. Bucher has interpreted the scarcity of fauna in eugeosynclinal sediments as due to original scarcity rather than to destruction during metamorphism, an hypothesis which supports a deep water origin for these sediments.

Comparison of the continental margin of northeastern North America with others reveals similarities in some instances and differences in others. Among the other areas studied are the southeastern and Gulf coasts of the United States, some parts of Africa, and South America, especially the Argentine coast between Buenos Aires and Tierra del Fuego.

RENEWED ACTIVITY OF ANAK KRAKATAU

DR. ROBERT W. DECKER

On June 8, 1959, the Indonesian Airforce (A.U.R.I.) kindly supplied the Institute Technology Bandung a Dakota aircraft piloted by Captain Soekardi. The purpose of the flight was to acquaint the Geology students with several of the volcanoes in West Java. Reconnaissance was made of Papandajan, Gede and Krakatau and the many inactive volcanoes along the same route.

We were surprised to find Anak Krakatau in a phase of moderate eruption, for there had been no reports of activitiy since September 20-23, 1953, when "violent eruptive activity took place" (Neve, G.A. de, 1956).

The aircraft arrived at Krakatau at 10:20 a.m. and made several circles of the island group during the next thirty minutes. Four cycles of Vulcanian type eruption took place during this interval, each nearly identical in nature. All the activity came from a small cinder cone approximately 200 meters in diameter and 25 meters high which is located in the center of the older and larger (700 meters diameter) crater of Anak Krakatau.

Phase 1: Black ash and cinder jets 30 to 100 meters into the air, sometimes directed as much as 45° degrees from the vertical. Duration: 1 minute.

Phase 2: Ash and gas in turbulent, gray, cauliflower-like clouds rapidly rising to 500 meters. Duration: 1.5 minutes.

Phase 3: Ejecta ceases while ash and gas cloud slowly rises and dissipates at 1,000 to 1,500 meters. Duration: 2 minutes.

Phase 4: Clear & quiet. Duration: 2 to 3 minutes.

This cycle was then repeated by the sudden renewal of the black ash and cinder jets.

Anak Krakatau first appeared in 1927 from the floor of the submerged caldera formed during the catastrophic eruption of 1883. Its history of activity was well documented until 1941 (Newmann van Padang, 1951). The starting date of this latest activity is not known. The small cinder cone in the center of the crater has not been seen before and is inferred to be a construction of this latest eruption. However, the vegetation on the east tip of the island, although only a few meters high, seems to be flourishing despite the new eruption. This suggests that the new ash and cinder deposits have been largely localized within the older, larger crater, and that the activity reported above represents a near maximum of the renewed activity up to June 8, 1959. It is interesting to note that the vegetation was entirely destroyed on Anak Krakatau by eruptions on October 10-11, 1952, when an ash-layer of nearly 3 meters was deposited on the island (Neve, G. A. de, 1956).

The new cinder cone in the center of the older crater has partially displaced the large crater lake formed in 1952-1953. Two remnants of this lake occur between the new cinder cone and the south rim of the larger crater. The south-southeast lake is crescent shaped and about 400 meters long and 200 meters wide. The other lake on the southwest side of the crater is much smaller. Both lakes are red-brown in color and their surfaces are above sea level.

The asymmetry of Anak Krakatau Island is probably due to several factors. First, the waves from the Indian Ocean enter the 1883 Krakatau caldera from the southwest, aligned with the Sunda Straits and not hindered by the remnant islands Rakata, Rakata Ketjil (Lang), and Sertung (Verlaten). Erosion from these waves is therefore concentrated on the southwest side of the loose ejecta forming Anak Krakatau. For most of its history the crater of Anak Krakatau has been a breached crescentic bay. Tilting has probably also contributed to the southwest asymmetry. In William's map (1941, p. 254, after Escher, Stehn, and Berbeek), the maximum subsea depths of the caldera formed in the great eruption of 1883 occur 2 to 4 kilometers south and southwest of Anak Krakatau. These depths have actually increased 60 to 100 meters during the 40 year period after the caldera formation, and Newmann Van Padang (1933) ascribes this to vertical sagging. Vertical sagging southwest of Anak Krakatau would cause rotational tilting of the island in the direction. Other factors which contribute to the shape of Anak Krakatau include the direction of the seasonal winds which distribute the intermittent eruption products, the refraction of waves by the group of islands surrounding the Krakatau caldera, gravitational phenomena such as cinder avalanches, and of course the erosion gullies formed in the ash and cinders by rainfall and runoff.

The renewed activity of Anak Krakatau again points to the importance of establishing a permanent observation post on one of the islands surrounding the

Krakatau caldera. Krakatau has a history of at least 2 major episodes of caldera collapse, the second, in 1883, caused tidal waves killing over 36,000 persons. The first collapse occurred in prehistoric times, but may have been even more destructive in its physical violence on fortunately uninhabited coasts. The present volume of material forming Anak Krakatau is a very small fraction of the pre-1883 bulk of Krakatau, but its occasional violent eruptions suggest the energy source which has constructed and destroyed Krakatau twice already is not exhausted. Little or no catastrophic danger exists at Krakatau at this time or even in the near foreseeable future, but the scientific value of closely documenting and analysing the symptoms of such an important patient as Krakatau should more than justify the small costs of an observation post.

If continuous observation is not possible, then scientific expeditions to the island should be conducted at regular intervals. Such an expedition is now long overdue*, especially in view of the renewed activity of Anak Krakatau.

NATURAL GASES OF NORTH AMERICA

B. W. Beebe

In 1935, the American Association of Petroleum Geologists published a symposium, "Geology of Natural Gas." Since that time, huge gas transmission systems have been constructed to all heavily populated areas in the country. Consumers have recognized natural gas as a premium source of energy, not only because of its cleanliness and ease of handling, but because natural gas is grossly underpriced. More than six times as much natural gas will be furnished consumers in 1960 than was furnished in 1935. Natural gas marketed currently is equivalent in energy to approximately 5,750,000 barrels of oil daily. Current oil production in the United States is approximately 6,500,000 barrels daily. The impact of this growth on the market for crude oil needs no comment.

Recognizing the rapidly increasing importance of natural gas as a source of energy, the Executive Committee of AAPG has authorized a new two-volume symposium, "Natural Gases of North America," now in preparation. It will be by far the most comprehensive study of this type to be available to those interested in natural gas.

In the immediate future, as in the past, Tertiary rocks of the Gulf Coast Embayment of Texas, Louisiana and Mississippi will continue to be major sources of gas. With depletion of reserves in the Permian Basin of West Texas and the Hugoton-Panhandle field of Kansas, Oklahoma and Texas, importance of the Paleozoic rocks in the Mid-Continent and Permian Basin will probably diminish, to be replaced by gas discoveries from Tertiary and Cretaceous rocks in the huge intermountain basins of the Rocky Mountain region. These two provinces, then, probably will be the major sources of new gas reserves within the United States excluding Alaska, importance of which as a gas productive area cannot be predicted at this time. Vast untapped reserves of natural gases no doubt exist in Canada and Mexico, but demands for energy in both are expanding rapidly, and only a small fraction of these will be available to consumers in this country.

We must therefore depend on discoveries of gas in our own country for the near future to satiate the ever increasing demand. The geologist exploring for natural gas faces a unique and unprecedented challenge. Not only must he deal with problems and risks inherent in all exploration, but he is beset by unique economic con-

*) Last volcanological expedition to Krakatau was in October 1953.