INTERNATIONAL EXPLORATIONISTS GROUP EVENING MEETING—MARCH 19, 1986

GEORGE E. GRANATA—Biographical Sketch

George E. Granata received his B.S. degree from Hamilton College in 1973. He received his M.S. in 1981 from the University of Texas at Austin.

Mr. Granata worked for the U.S. Geological Survey from 1973-74 mapping landforms and tectonic features on the planet Mars. During 1974-79 he was employed by the Texas Bureau of Economic Geology doing subsurface mapping in the Gulf Coast and West Texas. George consulted for a year in the shallow gas play of western Pennsylvania before joining Marathon Oil Company in late 1980. He has been involved with international exploration at Marathon and currently works as a senior geologist within Marathon's East Africa exploration group. Mr. Granata is a member of the American Association of Petroleum Geologists.

This paper is co-authored by Stephen J. Derksen of Marathon. It was originally presented by Mr. Derksen at the AAPG Wallace Pratt Symposium in 1984.

HYDROCARBON POTENTIAL OF INTRACRATONIC RIFT BASINS

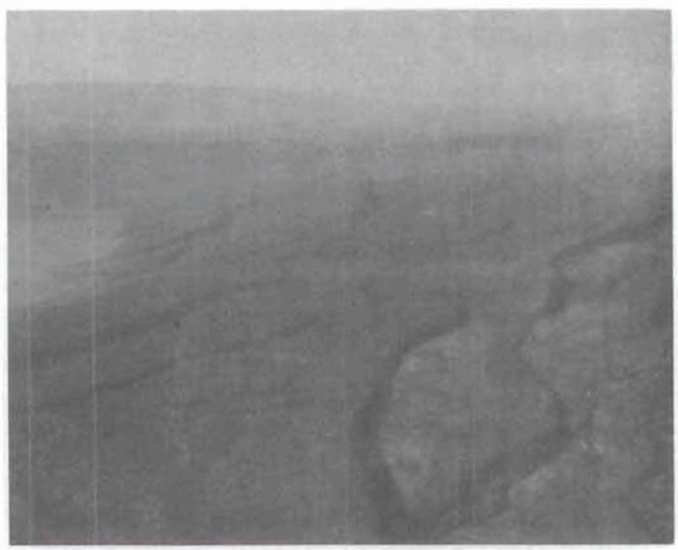
Significant world oil reserves have been added in recent years from rift systems. Examples of petroliferous rift basins may be found on nearly every major continent. As our understanding of the mechanisms of sedimentation and structure in rift basins grows, more oil-productive rifts will be found. With a few notable exceptions, rifts that have been explored in the past are those that formed along continental margins. These contain marine sediments, and the conditions of source rock, sediment type, depositional environment, and structural style are well-known exploration concepts.

Intracratonic rift systems containing continental sediments have received less exploration effort because few have been recognized and because of the problems perceived to accompany continental sedimentation. A good modern analog is the East African rift system. Structurally, the rift system is composed of coalescing half-grabens that commonly alternate in the sense of asymmetry along the strike of the rift. The potential source rock is lacustrine shale with an organic content that can range from 5 to 20%. Organics are preserved by anoxic conditions in thermally or chemically stratified lakes. Heat flow, as in continental-margin rifts, is moderate to high. Combined with a commonly thick section and depth of burial, the sediments can be well within the oil generation window for lacustrine shales. The volume of oil generated may be very large for a basin of limited areal extent. Reservoir quality is highly dependent on the type of sediments deposited, because there is little energy available for sorting or winnowing. There may be sharp facies variations across the rift, and aspect ratios of these facies may approach 1:1. Seals may be either lacustrine shales or evaporites deposited under hypersaline, closed drainage conditions. Structures are genetically similar to those found in continental margin rift valleys. Potential traps are found in series of tilted blocks controlled by commonly listric, down-to-the-basin faults, in drag folds on the downthrown side of growth faults, in basement horsts with a sedimentary cover, and if the basin is asymmetrical, in monoclines developed on the slope. Basin size is typically 20-60 km (12-37 mi) in width and 70-300 km (43-186 mi) in length.

One ancient intracratonic rift of this type is the Central African rift system. This system trends east-west, from the Benue trough in Nigeria to the Lamu embayment in Kenya. It is the result of the propagation of rifting from the triple junction that separated South America from the western margin of Africa, and also from the triple junction on the eastern margin where Madagascar separated from Africa. The rift system was tectonically active during the Cretaceous and Tertiary (Paleogene), and ceased after the initial faulting and coincident igneous activity but before any new crust was formed. The rifting along this trend was superseded in the Miocene by the East African rift system, which is still active.

Several companies have made significant oil discoveries in different components of the Central African rift system. Average daily production in 1982 from the basins associated with the Benue trough was 107,928 BOPD. Conoco has drilled at least eight discovery wells in the Chari basin and Ngaoundere rift components, and zones tested flowed up to 1,900 BOPD. In the Abu Gabra rift component, where Marathon is currently exploring, Chevron has drilled approximately 60 wells. Nineteen of these were discoveries and tested an average rate per well of 3,500 BOPD. The oil in the Chari basin and Abu Gabra rift is found in multiple zones in the Upper Cretaceous and Tertiary continental sands, and is a typical derivative of lacustrine sediments. The Abu Gabra rift may contain up to 10 billion bbl of oil.

Research indicates that this type of rift system is present in other areas of the world. Ongoing worldwide exploration has shown that intracratonic rift basins have the potential to make additional significant contributions to world oil reserves.



Gregory Rift of Kenya

View south from Lake Bogoria (at left) of fault scarps created by recent and continuing extension within the rift. Photo by Stephen J. Derksen, Marathon Oil Co.