Africa's Vast Petroleum Reserves

Macgregor and Cameron (2000) showed that 98% of Africa's petroleum reserves could be assigned to one or the other of seven groups defined by source rock, age, facies and tectonic setting (Fig. 1). I here summarize the tectonic history of Africa over the past 600 My because it provides a dynamic framework for the appreciation of the roles of the seven groups (Burke, 2000).

Assembly of Gondwana and Collapse of the Mountains

Africa's geological history began with the final assembly of the great continent of Gondwana about 600 million years ago. What is now Africa formed most of the newly aggregated western part of the giant 80 M square km. continent. In western Gondwana continental and island arc collisions at the end of Precambrian time built up a mountainous area five to ten times more extensive than that presently occupying central Asia. The collapse of a part of this huge mountainous region from elevations comparable to those of today's Himalaya and Tibet extended an area of 5 M square km in North Africa and Arabia to 10 M square km in an episode of tectonic escape. Widespread rifts halved the thickness of the continental lithosphere as it extended. Thermal subsidence over the rifted and extended continent led to the formation of a composite long-horn shaped basin that accommodated the deposition of Afro-Arabia's oldest great reservoir rocks: the North African and Arabian Cambro-Ordovician quartz-rich sandstones (the NAACOQRS) of Algeria, Tunisia, Libya and the Arabian peninsula. These reservoir form parts of that appears to have been the largest body of sandstone ever deposited on continental crust (Burke, 1999). Source rocks of Silurian age (Fig. 1) generated fluid hydrocarbons that have charged parts of the Cambro-Ordovician reservoirs at various times during the past 400 My.

Continuing thermal subsidence over North Africa and Arabia until about 300-250 Ma accommodated an average total thickness of 5 km of almost carbonate-free Paleozoic sedimentary rocks (Boote et al. 1998 figs. 3-8). Nowhere else in the world is an unbroken post sedimentary rock cover so thick on an exponential scale. The gradual and declining thermal subsidence that permitted this exceptional thickness of continental cover rocks to accumulate was suddenly interrupted at about 300 Ma by the beginning of 100 million years of intercontinental tectonic unrest following the collision of Gondwana with Laurasia.

Assembly of Pangaea

The collision that assembled Pangaea contrasted with both the collision that had assembled Gondwana and the presently active collision of India with Asia. The contrast lies mainly in the extremely widespread distribution of intra-Pangean deformation associated with the collision. In North America we recognize the effects of the Pangea-forming collision in intra-continental tectonic phenomena such as the inversion of the Southern Oklahoma rift. Contemporary events on the global scale include the inception of rifting in the North Sea, the establishment of the Gondwana rifts of India and the beginning of rifting off the northwestern corner of Australia and in the Perth basin. If we add Permo-Triassic rifting under the West Siberian basin and in Antarctica we can see that 60% of the area of the world's continents (100 M square km out of 160 M square km) remote from the immediate vicinity of collisional mountain-belts was affected. Africa was no exception to these effects. The tar sands of Madagascar represent an organic rich accumulation in a rift formed during this time. The collapse of the mountains formed in the Pangean collision was achieved by rifting in the familiar Newark rift system and in North Africa rifts. A composite long basin was present over those rifts in Tunisia and Algeria is occupied by carbonates.