Regional Heat Flow Variations in the Eastern Parts of the Niger Delta

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A new heat flow map has been constructed for the Eastern parts of the Niger Delta using reservoir temperatures and corrected bottom-hole temperature data from about Seventy-one wells. Average geothermal gradients vary between 12- 30 oC/Km for the Eastern parts of the Niger Delta. A significant regional eastward increase in geothermal gradients occurs in the Coastal Swamp depobelt. Geothermal gradients also increase from the Coastal Swamp to the Central Swamp and to the Shallow Offshore depobelts. Thermal conductivity values in the Niger Delta range from 1.66 to 2.30 W/mK with an average of about 1.98 W/mK. Heat flow variations in the Eastern Niger Delta range from 30 -55 mW/m2 with an average value of 42.5 mW/m2. These suggest a large imprint of highly variable heat generation in the upper crust. The highest heat flow values (> 45 mW/m2) occur in the eastern parts of the Coastal Swamp , the Central Swamp and the western part of the Central Swamp depobelts. Higher than average heat generation of basement rocks, radiogenic heat contribution from shales and advection of fluids through faults likely accounts for the high heat flow in these areas. The lower heat flow values (< 35 mW/m2) were observed in the western part of the Coastal Swamp and the Shallow Offshore depobelts and the central part of the Central Swamp depobelt. The lower heat flow values in the western parts of the Coastal Swamp and the Shallow Offshore depobelts is attributed to Pliocene- Pleistocene high sedimentation rates resulting in the deposition of Recent cold sediments. The lower heat flow in the central parts of the Central Swamp depobelt is attributed to higher cumulative sedimentation rates in the area in contrast to other parts of the depobelt and little advection of fluids due to fewer prospect faults. In a nutshell, the variability of heat flow in the Eastern Niger Delta results from variations in; the thermal conductivity of the sediments, heat generation of the crystalline basement / mantle heat flow, sedimentation rates and fluid redistribution by migration of formation fluids.