

# Thermal Effects of Meteorite Impact Structures over Geologic Time

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**Abstract**

**Introduction**

**Heat Flow Data Integrations and Terrestrial Crater Analogues:**

- **Chicxulub Crater, Mexico**
- **Manson Crater, Iowa**
- **Decaturville Crater, Missouri**
- **Red Creek Impact, Utah**
- **Araguainha Dome, Brazil**
- **Riachao Ring, Brazil**
- **Bombay High, India**
- **South China Sea, Southeast Asia**

**Thermal Catastrophism and Subsidence**

**Thermal shock and rock fusion**

**Thermal Melting**

**Curie Point**

**Post-Impact Processes: High-Temperature Hydrothermal Systems**

**Discussion**

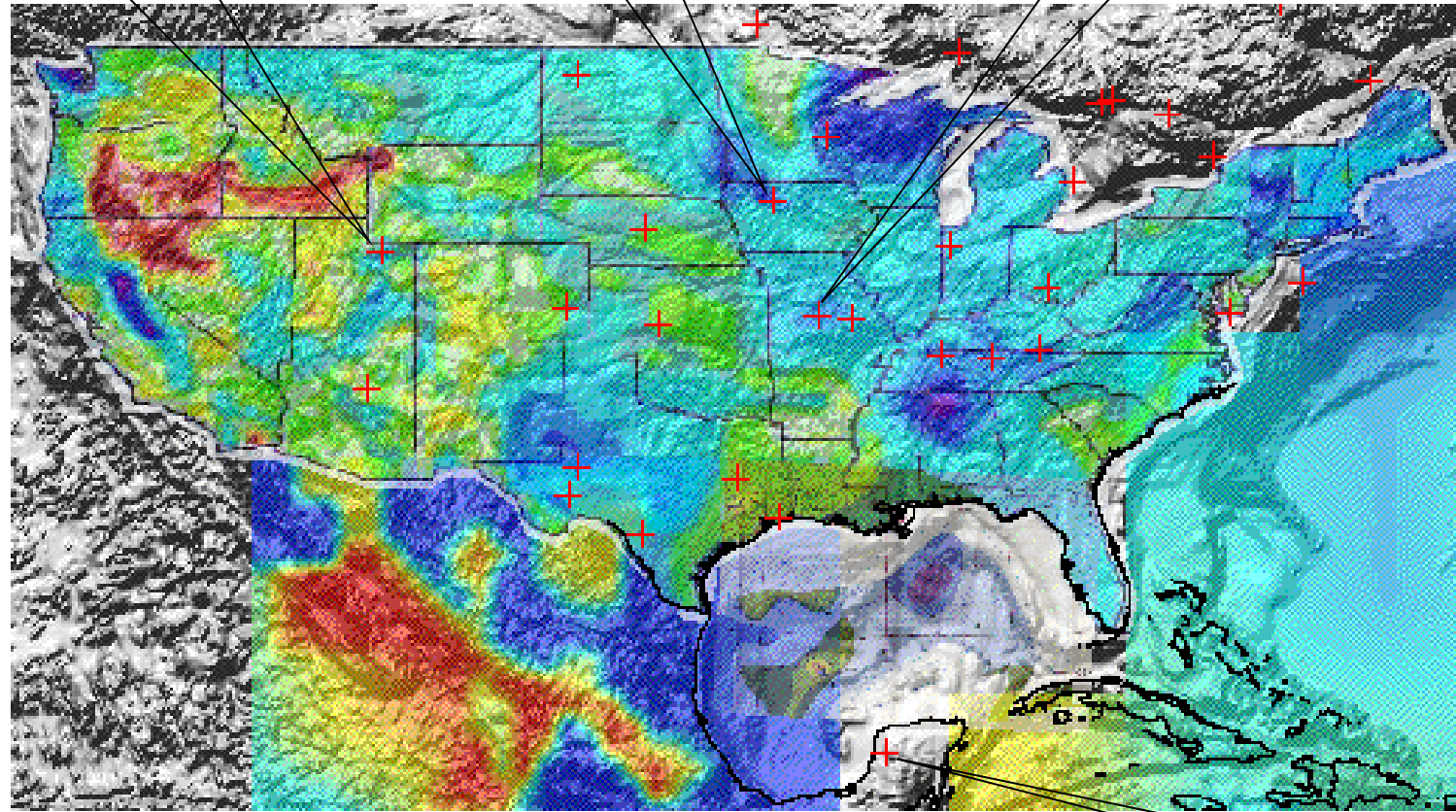
**Conclusions**

**References Cited**

Red Creek Impact, NE Utah,  
25 km diameter, 1550 Ma,  
complex crater (Rtizma, 1995).

Manson Crater, Iowa  
32 km diameter, 70 Ma,  
complex crater.

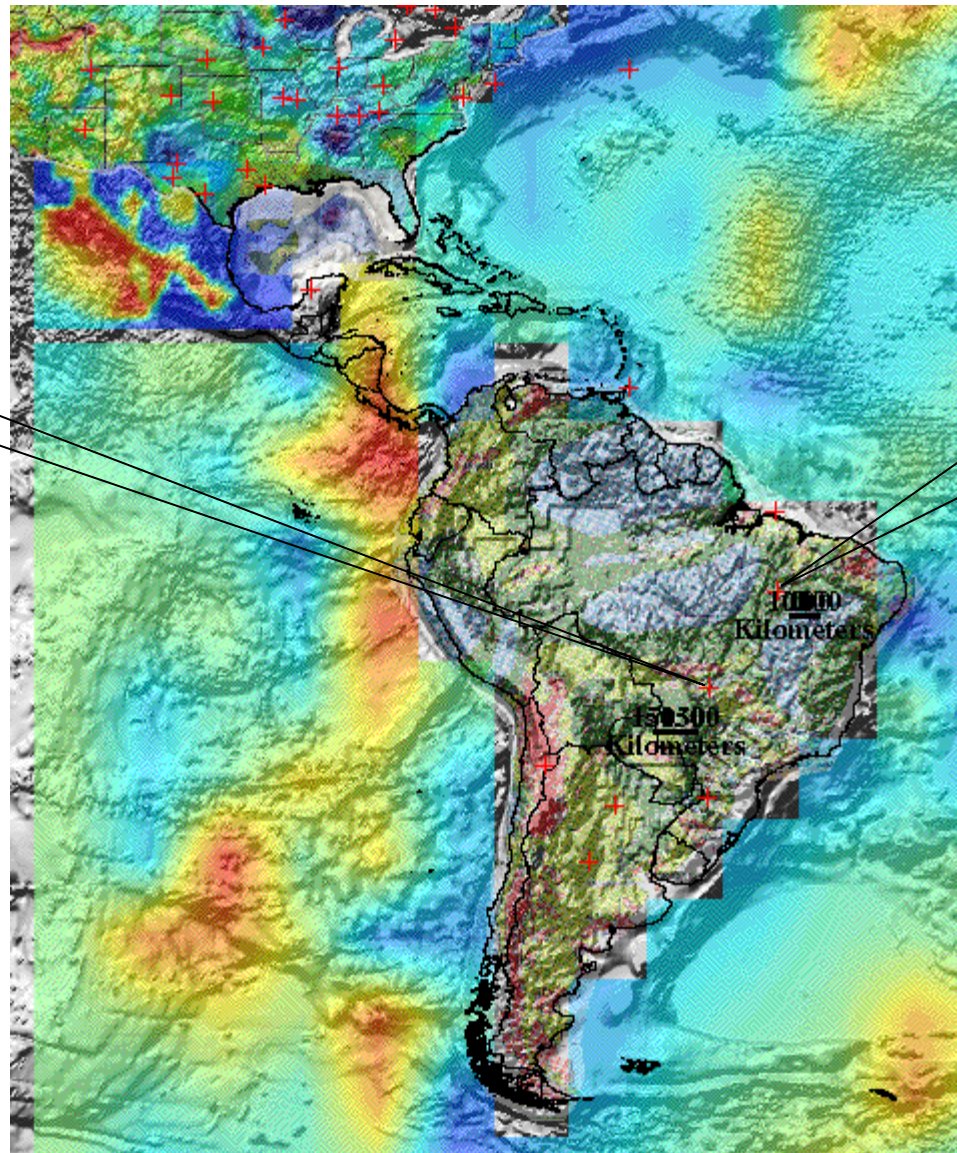
Decaturville Crater, Missouri  
6 km diameter, 300 Ma.



Chicxulub Crater  
300 km diameter, 65 Ma

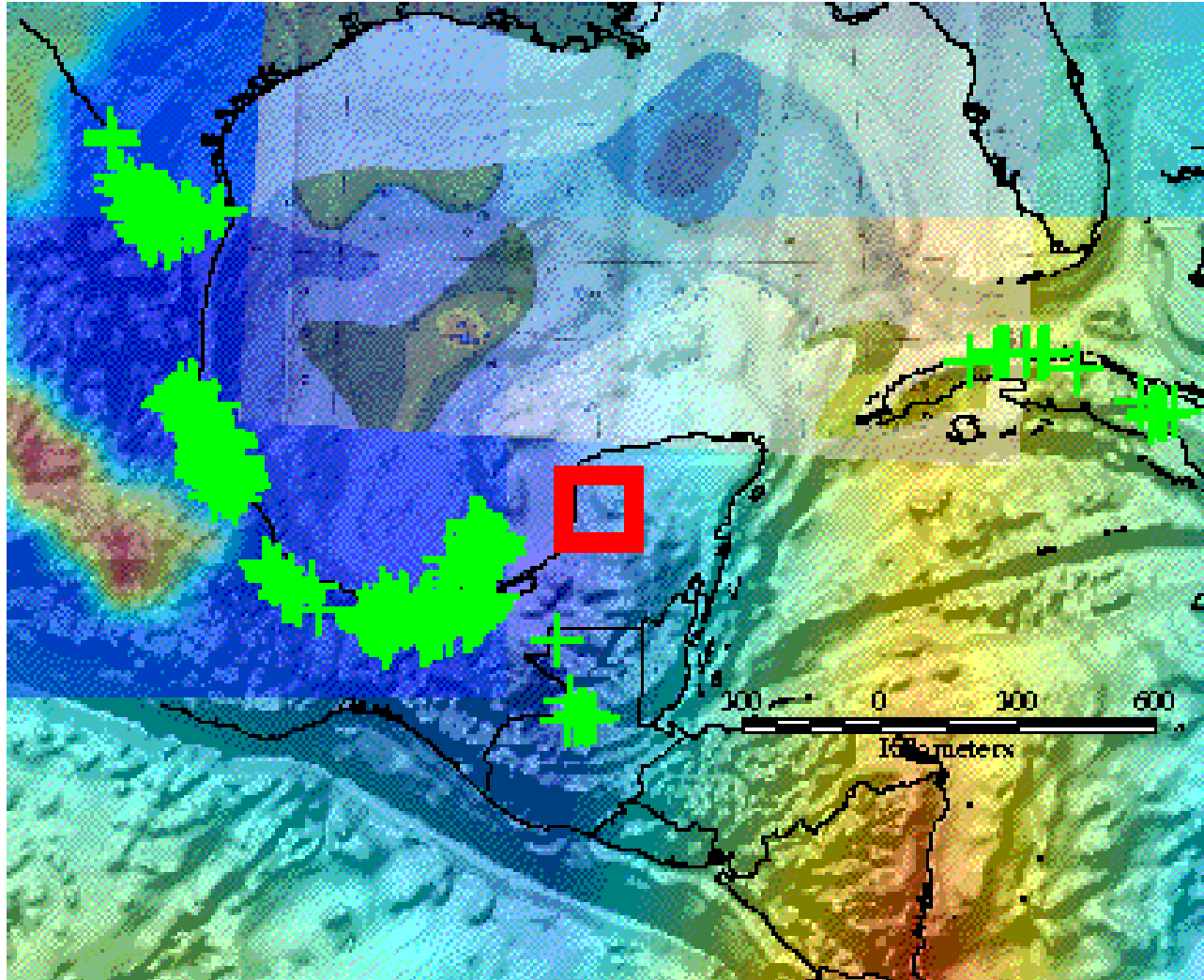
Mean thermal gradient, United States, obtained by heat flow divided by conductivity (source: [www.smu.edu/geothermal/heatflow/heatflow.htm](http://www.smu.edu/geothermal/heatflow/heatflow.htm), 1999). Red crosses are selected impact craters.

Araguainha Dome, Brazil.



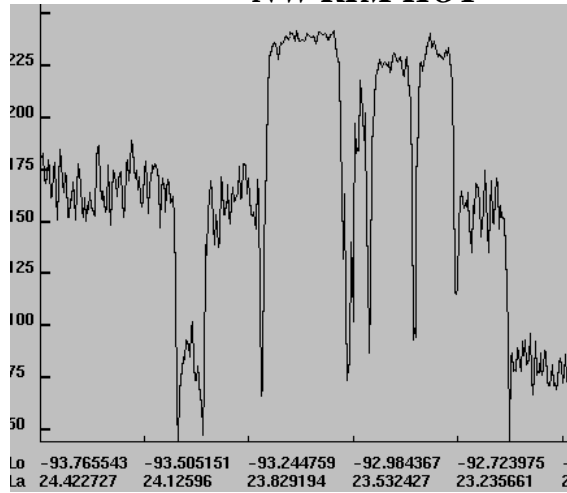
Riachao Ring and surrounding hot.

**Index Map. Geothermal gradients, selected impact craters, on shaded relief bathymetry / topography.**

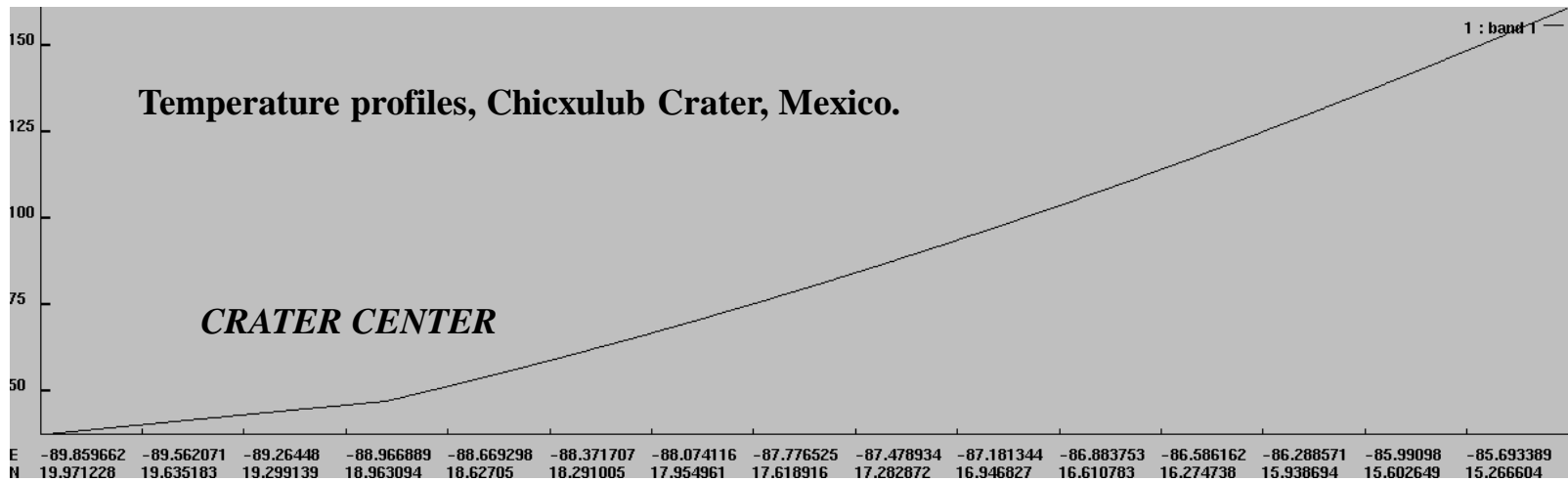


**Gridded and imported heat flow maps (color) on shaded relief bathymetry / topography, with oil and gas fields in Mexico (green crosses) and Chicxulub Impact Crater (red box). Data from DNAG and NGDC.**

***NW RIM HOT***



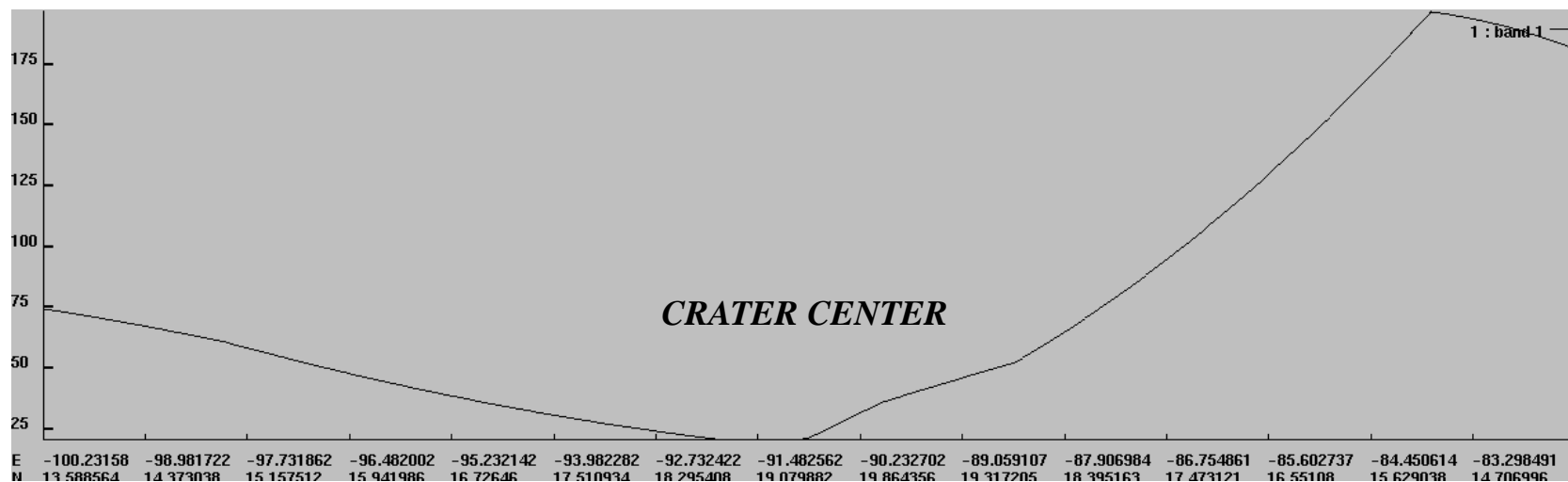
***SE RIM HOT***



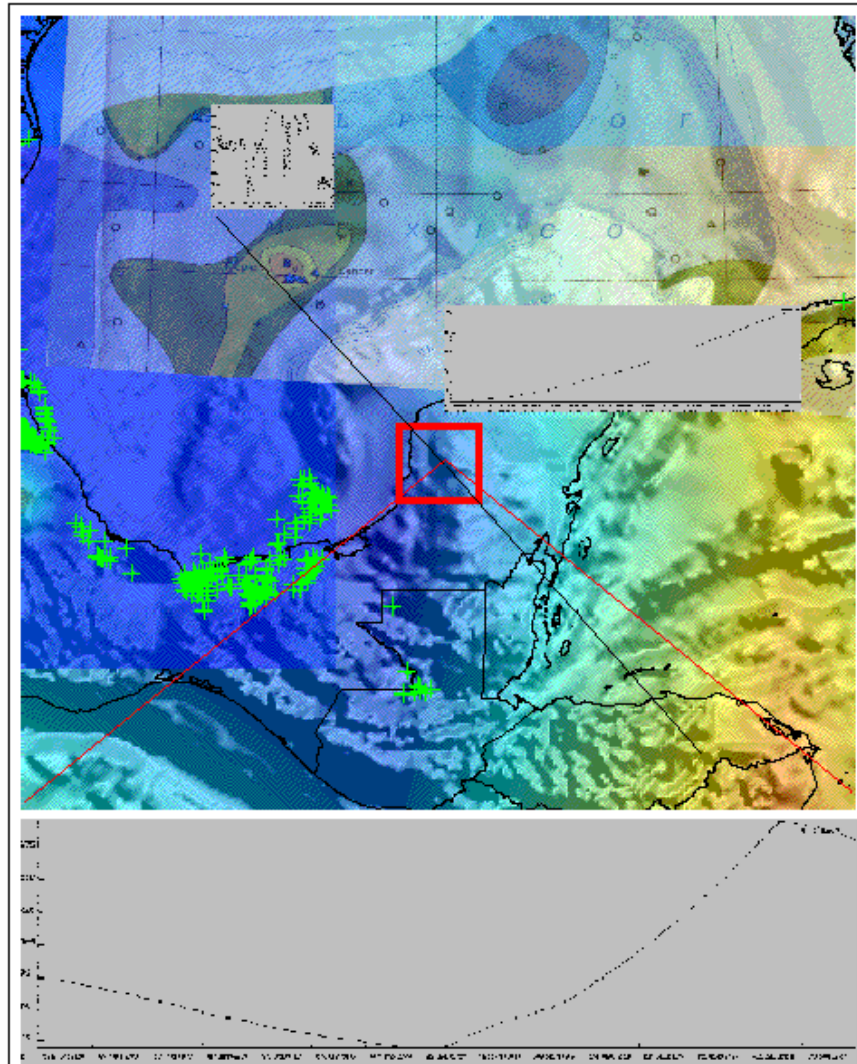
**Temperature profiles, Chicxulub Crater, Mexico. Data sources:  
DNAG (top), NGDC (bottom).**

NW

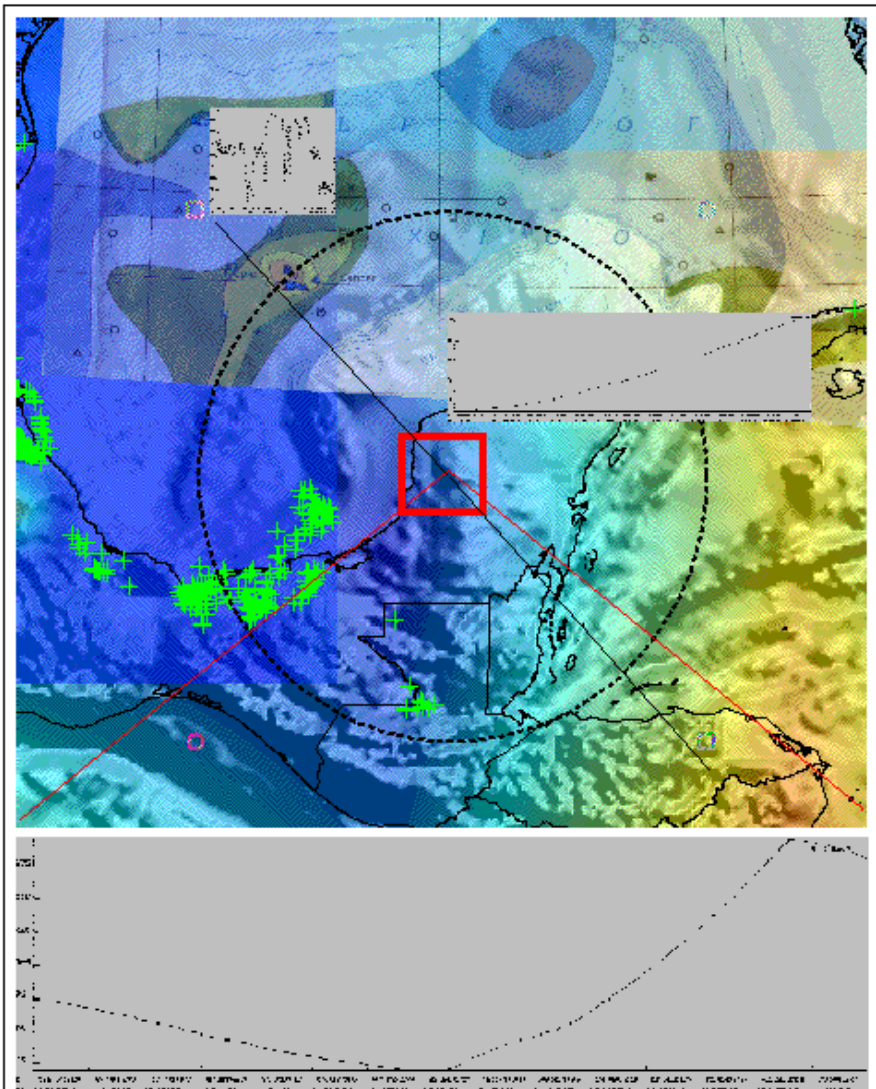
SE



**Geothermal gradient profile, Chicxulub Crater, Mexico. Data source: NGDC (bottom).**

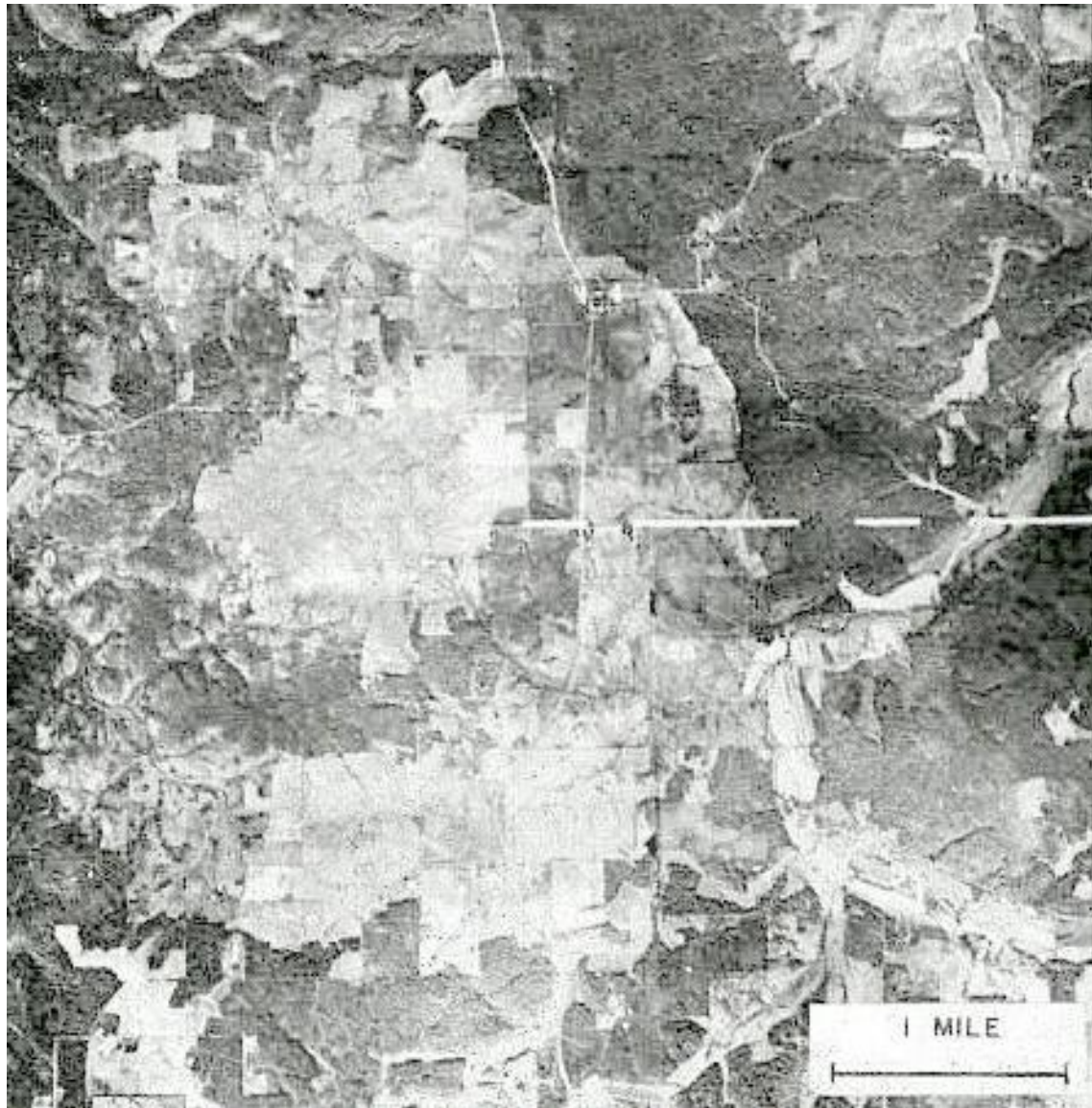


**HEAT FLOW / GEOTHERMAL GRADIENT DATA INTEGRATIONS ON SHADED RELIEF BATHYMETRY / TOPOGRAPHY, GULF OF MEXICO.**

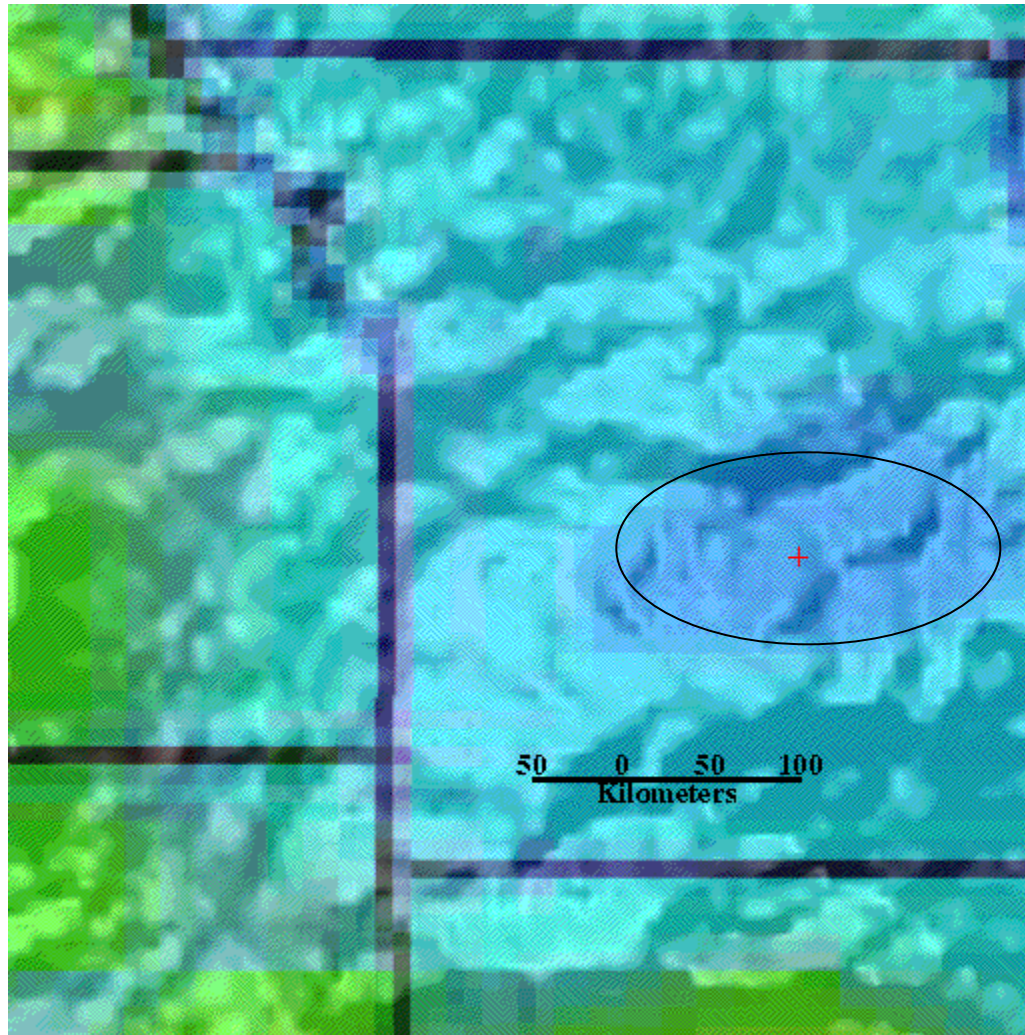


**HEAT FLOW / GEOTHERMAL GRADIENT DATA INTEGRATIONS ON SHADED RELIEF BATHYMETRY / TOPOGRAPHY, GULF OF MEXICO.**

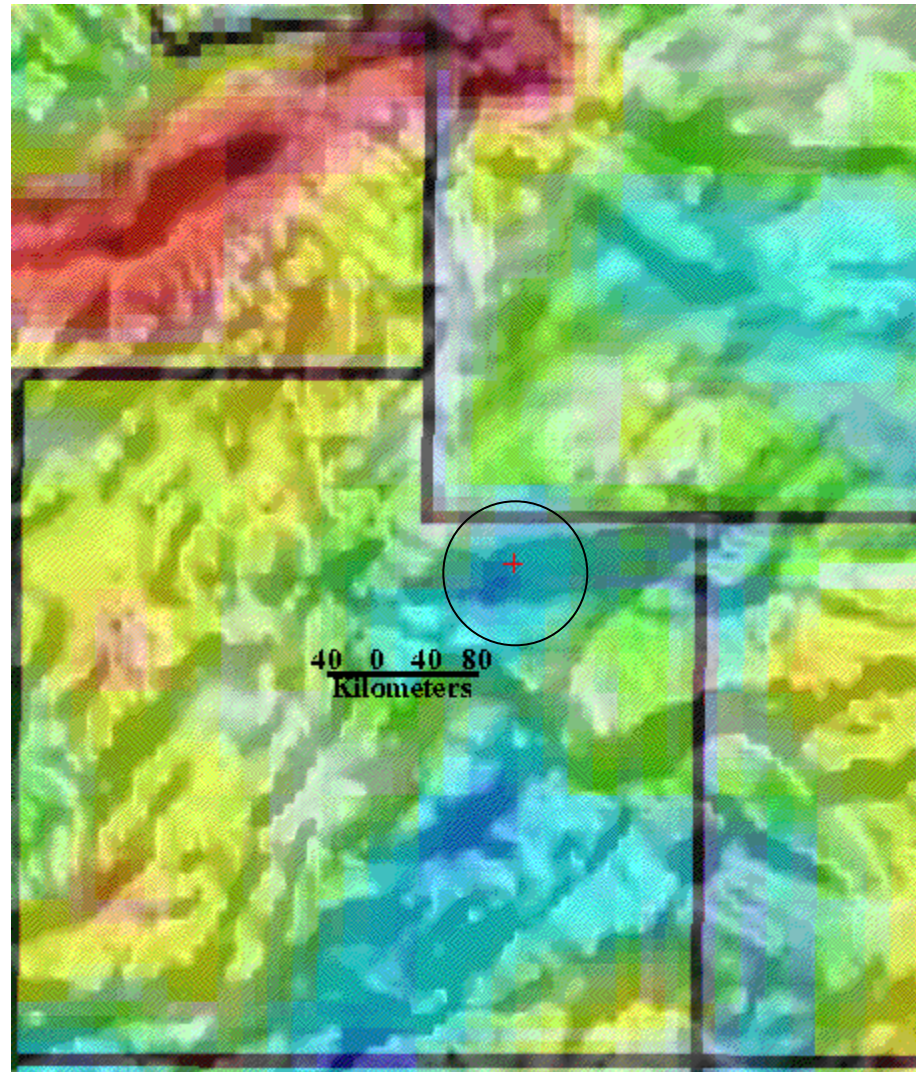




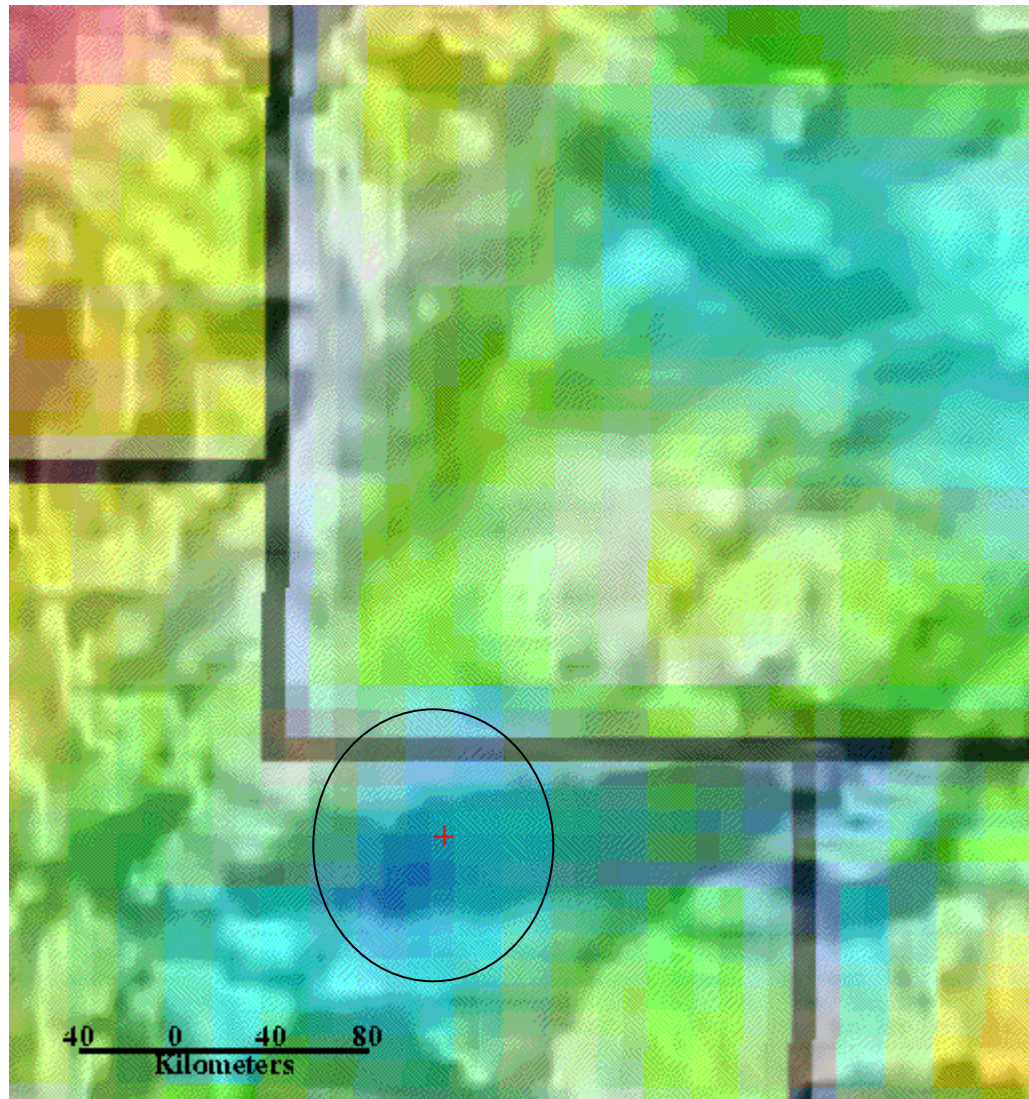
**Decaturville Crater, Missouri, aerial photograph.**



**Decaturville Crater, Missouri, 6 mile diameter complex crater approximately 300 Ma old. Note coincidence of low geothermal gradient and impact crater, suggesting the temperatures have long dissipated.**



**Northeast Utah, USA. Mean thermal gradient on shaded relief topography. Red cross is Red Creek Impact Structure, 25 km diameter, 1550 Ma years old. Note the coincidence of the cooler blues and the point of impact.**

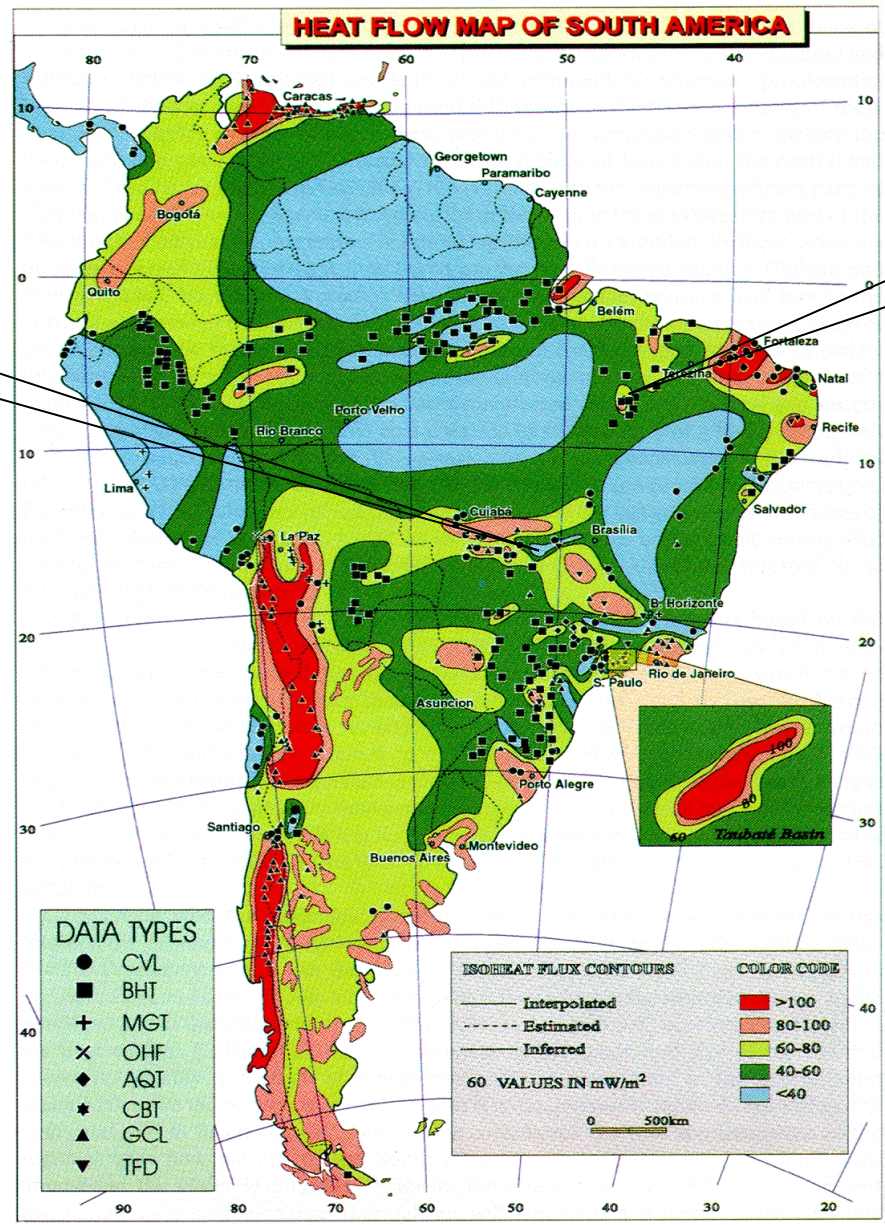


**Northeast Utah, USA. Mean thermal gradient on shaded relief topography. Red cross is Red Creek Impact Structure, 25 km diameter, 1550 Ma years old. Note the coincidence of the cooler blues and the point of impact.**

## HEAT FLOW MAP OF SOUTH AMERICA

Araguainha Dome, Brazil.  
Diminished heat flow surrounded  
by spokes of elevated heat flow.

Riachao Ring exhibiting elevated  
heat flow surrounded by  
diminished heat flow.



**DATA TYPES**

●	CVL
■	BHT
+	MGT
×	OHF
◆	AQT
★	CBT
▲	GCL
▼	TFD

**ISOHEAT FLUX CONTOURS**

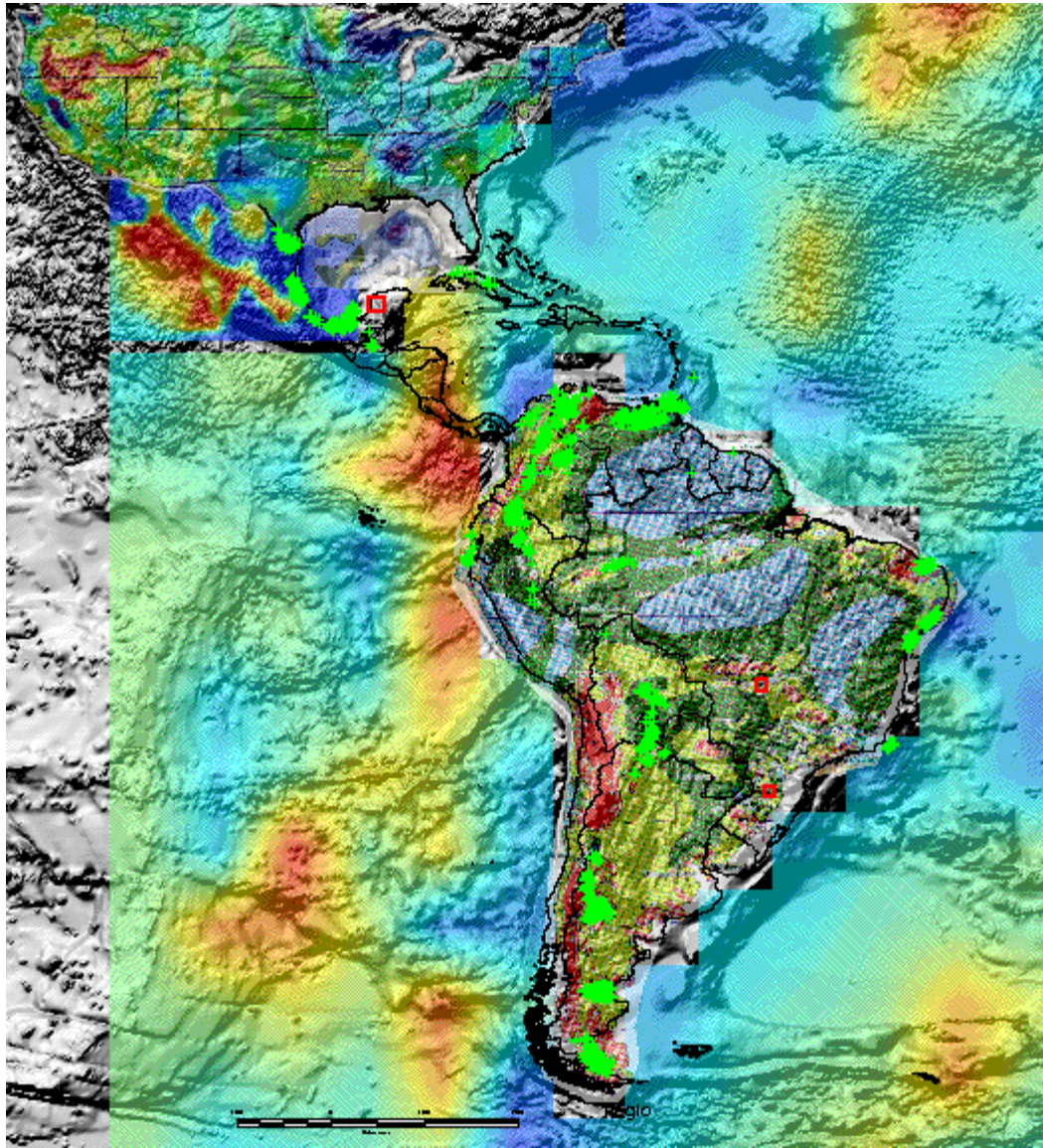
—	Interpolated
- - -	Estimated
—	Inferred

60 VALUES IN  $mW/m^2$

0 500km

<span style="display: inline-block; width: 15px; height: 15px; background-color: red; border: 1px solid black;"></span>	>100
<span style="display: inline-block; width: 15px; height: 15px; background-color: orange; border: 1px solid black;"></span>	80-100
<span style="display: inline-block; width: 15px; height: 15px; background-color: yellow; border: 1px solid black;"></span>	60-80
<span style="display: inline-block; width: 15px; height: 15px; background-color: green; border: 1px solid black;"></span>	40-60
<span style="display: inline-block; width: 15px; height: 15px; background-color: lightblue; border: 1px solid black;"></span>	<40

**Heat flow map of South America with locations of selected impact craters.**

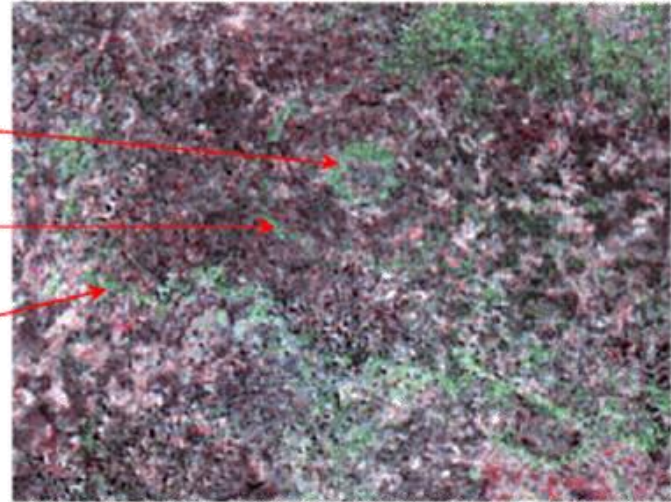


**Temperature Gradient, Degrees C / Km, Oil and Gas Fields, Selected Impact Craters. Index Map.**

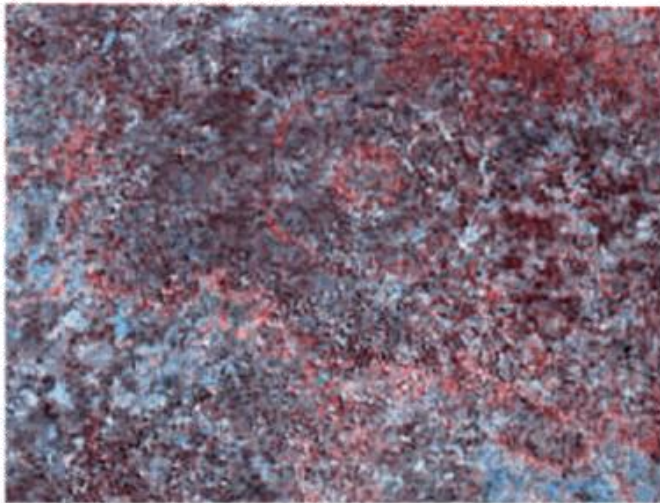
**Inner ring Ponta Grossa Formation**

**Outer ring Passa Dois Formation**

**Limits of Ejecta Blanket**



**Araguinha Dome Impact Crater, Brazil. Complex, 40 km diameter crater, dated at 250 Ma. Landsat TM acquired 4/3/86. Bands 3, 4, 5.**

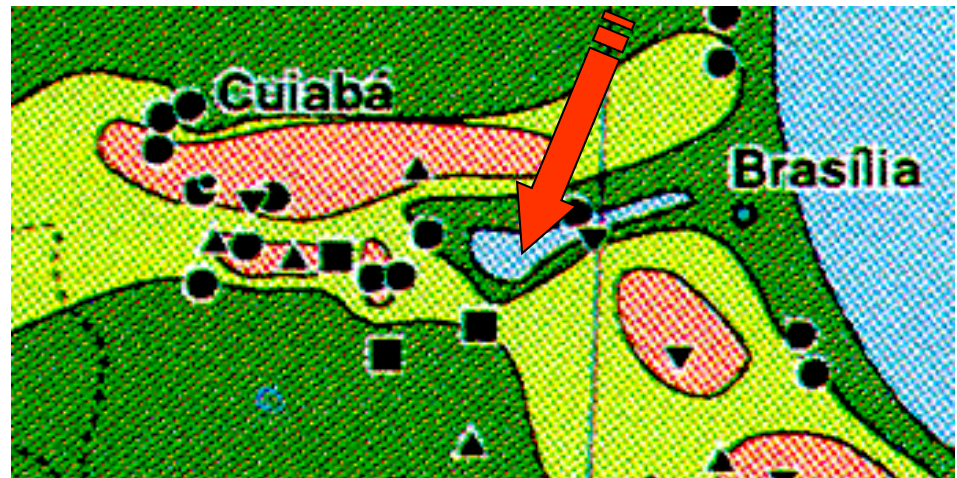


**Landsat TM data acquired 4/3/86.**

**Araguinha Crater, Brazil, Landsat TM data.**



Riachao Ring exhibiting elevated heat flow surrounded by diminished heat flow.



Araguainha Dome, Brazil. Diminished heat flow surrounded by spokes of elevated heat flow.

ISOHEAT FLUX CONTOURS	COLOR CODE
———— Interpolated	<span style="color: red;">■</span> >100
- - - - - Estimated	<span style="color: orange;">■</span> 80-100
———— Inferred	<span style="color: yellow;">■</span> 60-80
60 VALUES IN $mW/m^2$	<span style="color: green;">■</span> 40-60
	<span style="color: lightblue;">■</span> <40

### Heat Flow, Brazil.

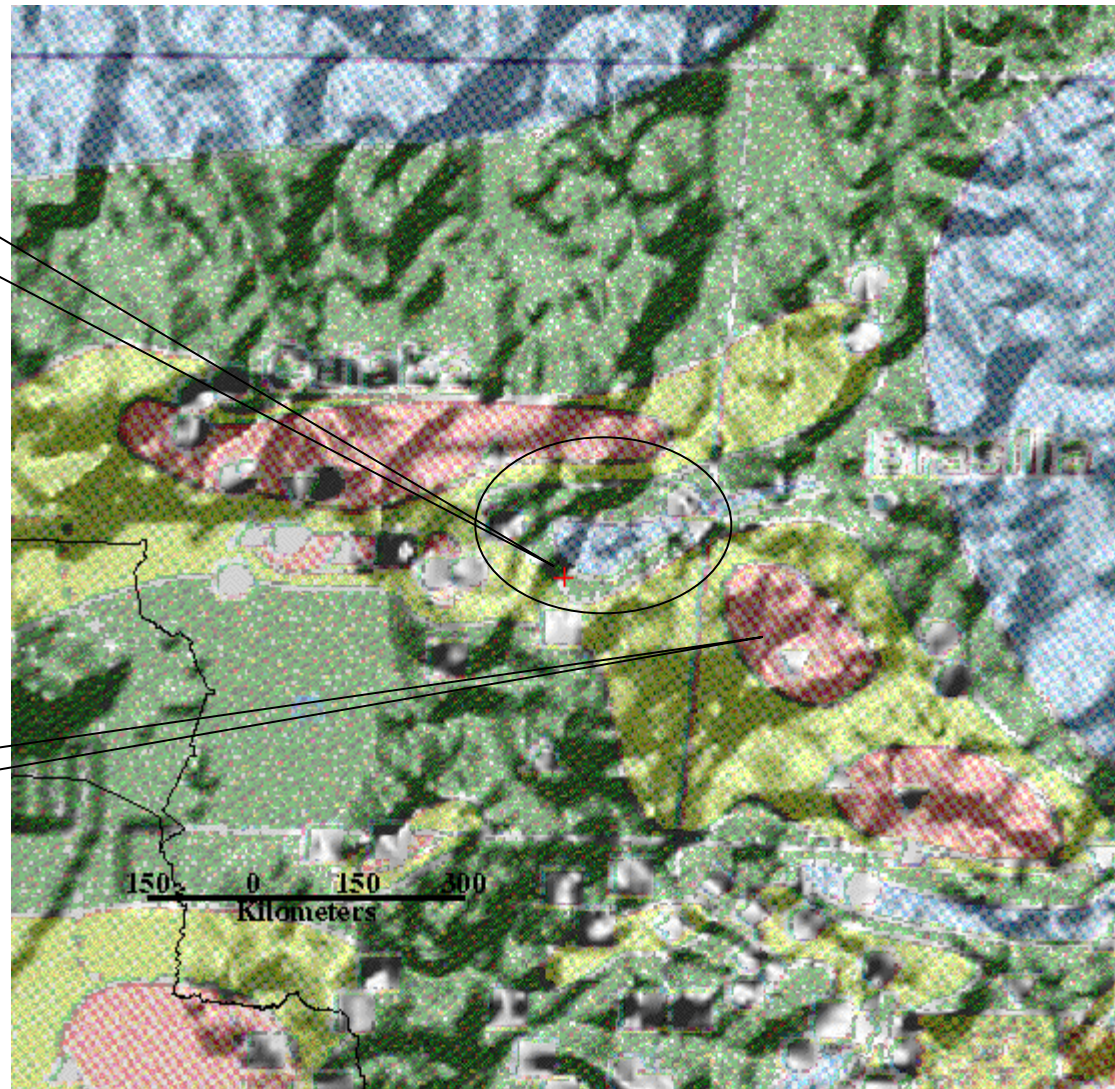


Riachao Ring with elevated heat flow.



**Riachao Ring Crater, 4.5 km diameter, 200 Ma. Note: crater coincides with basin that is geothermally hotter than the surrounding terrain.**

**Araguainha Dome, Brazil.**



**Geothermally hot "spokes" emanating from crater.**

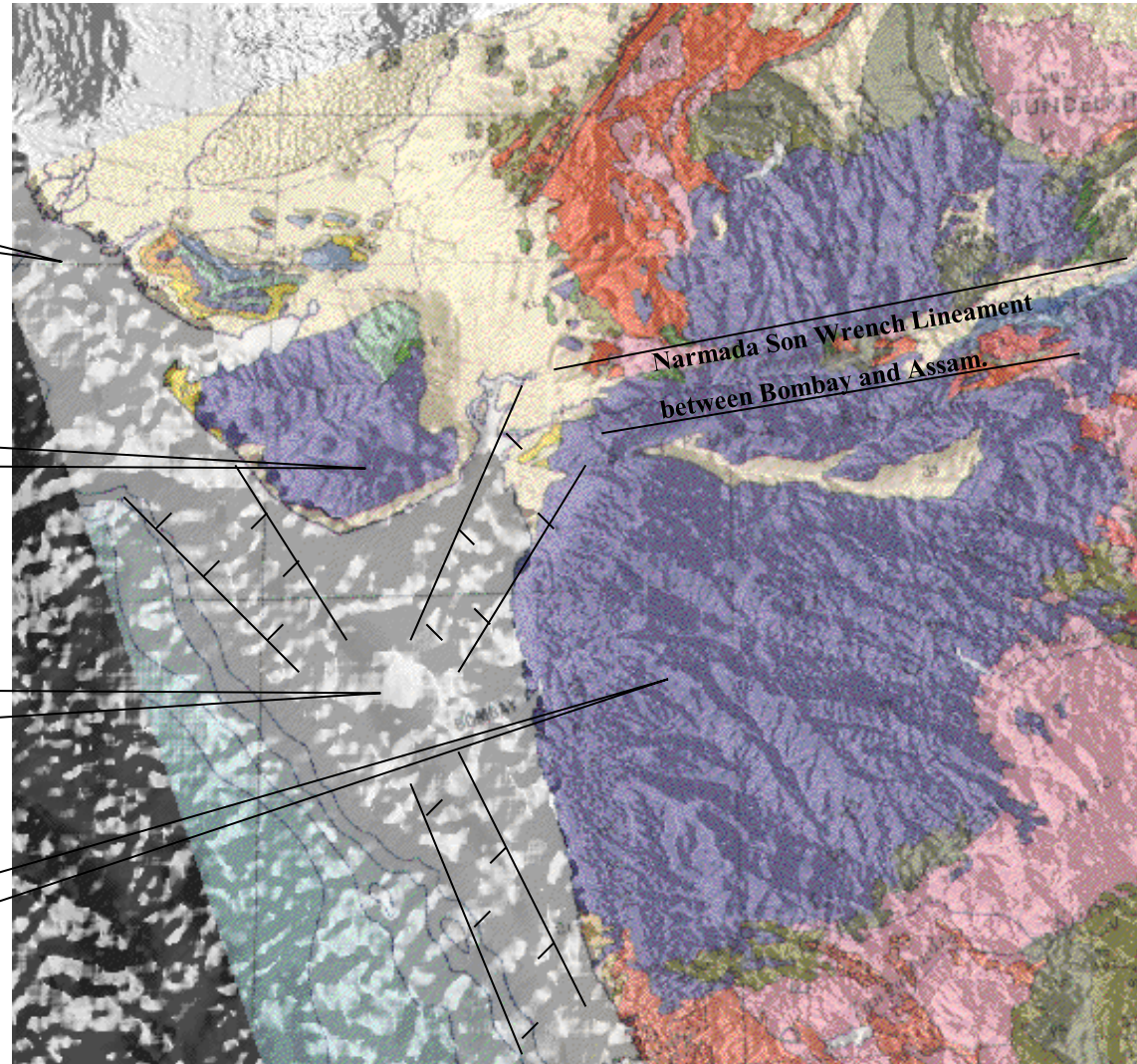
**Araguainha Dome, Brazil. 40 km diameter, 250 Ma. Note cool basin with hotter spokes emanating from the center, similar to Bombay, India.**

**Kutch Gas, high nitrogen content possibly due to cracking from nearby volcanic sills.**

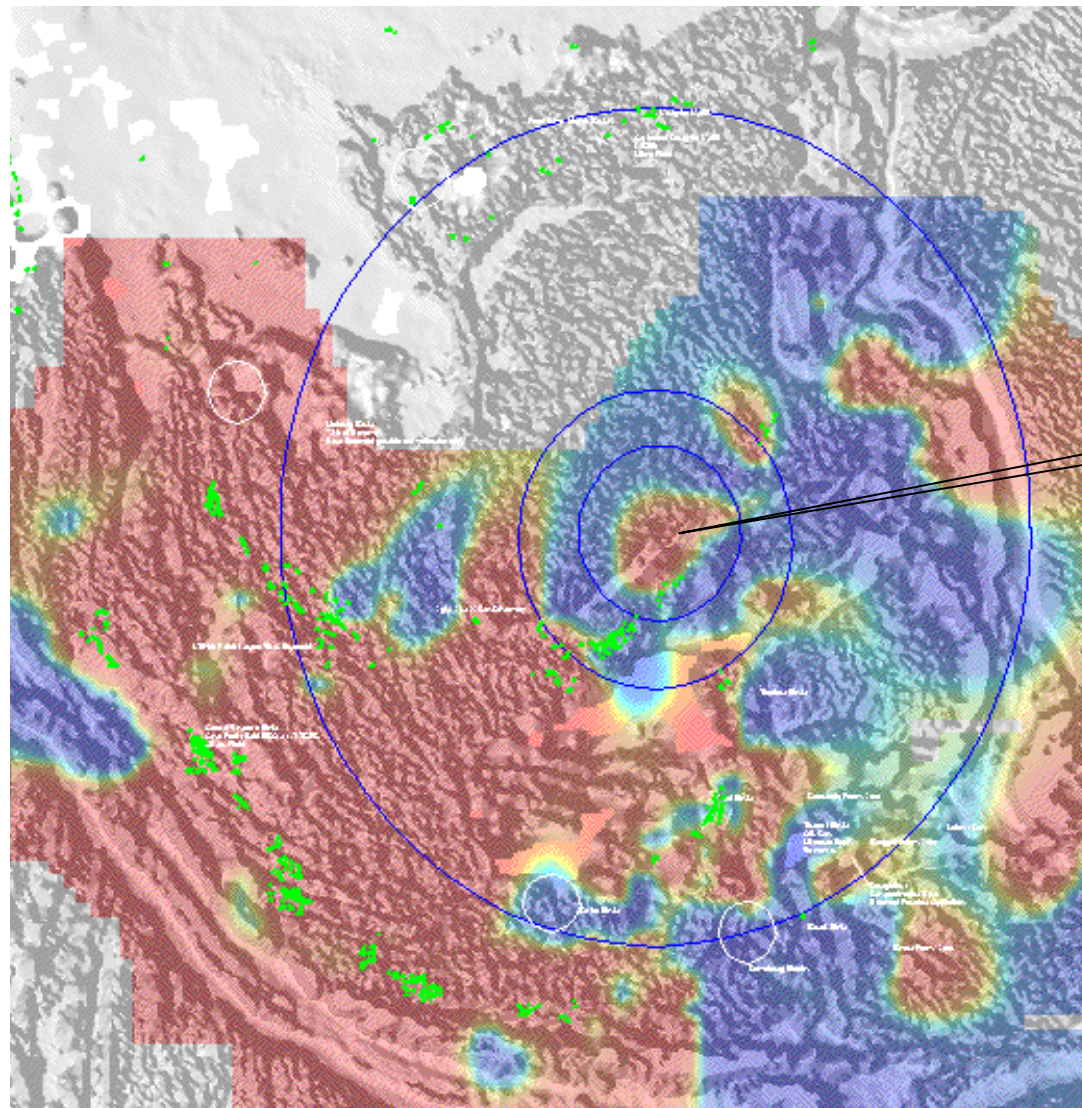
**Deccan Traps exhibiting 3 degrees C per 100 meters heat gradient.**

**Gneissic core underlying Bombay Fields, with 7 degrees C / 100 meters heat gradient.**

**Deccan Traps exhibiting 3 degrees C per 100 meters heat gradient.**

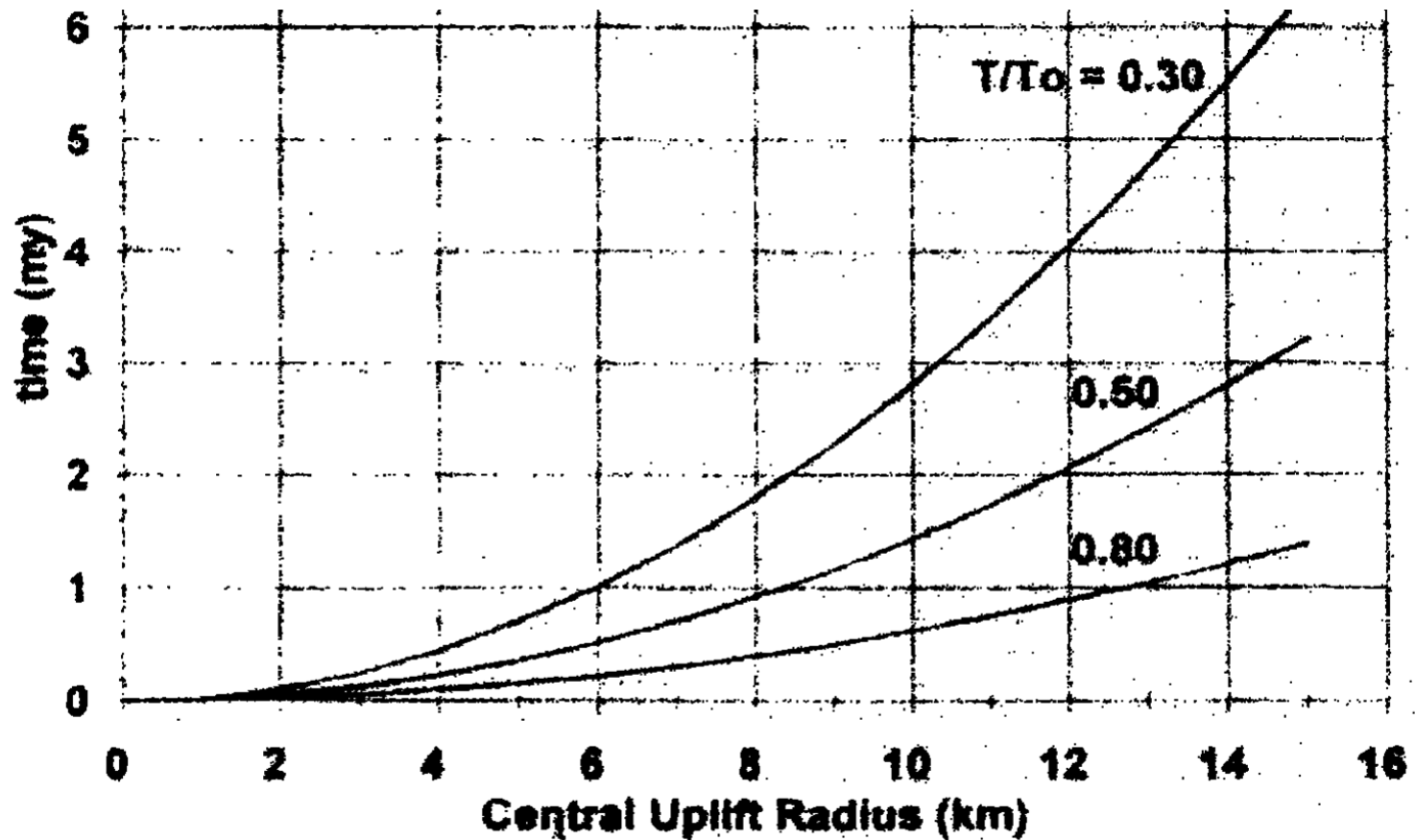


**Geologic Map, Bombay Region, India, on shaded relief satellite gravity offshore and shaded relief topography onshore. The purplish Deccan Traps have long been compared with the impact-generated mare basalts on the moon. Note the potential impact center offshore--a circular gravity minima which has focused the majority of the oil and gas production in the area, including the 1.4 BBOE Bombay Field.**



South China Sea Anomaly

**Geothermal gradient, Southeast Asia, superimposed over shaded relief bathymetry / topography, with oil and gas fields in green. Note high heat flow anomaly in the South China Sea (reds), as well as encircling, low (blues) and high heat flow areas towards onshore Java, Sumatra, Gulf of Thailand, and the Philippines (Buthman, 1999).**



Conductive model, from Crossey, et al, 1998. Shows time required for various degrees of cooling as a function of central uplift radius.  $T/T_0$  is temperature  $T$  relative to initial temperature  $T_0$ .

