HEAT FLOW, HEAT GENERATION AND CRUSTAL THERMAL STRUCTURE OF THE NORTHERN BLOCK OF THE SOUTH INDIAN CRATON

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Heat flow values (Gupta et al. 1982, 1986, 1987 plus some new data) and heat generation data calculated from the concentration of heat producing radioactive elements, U, Th and K in surface rocks (Atal et al.1978; Allen et al. 1985; Condie and Allen, 1984., Gupta et al. 1986., Janardhan et al. 1983., Narayana et al., 1983., Naqvi, 1981., Rao et al., 1976., Reddy et al. 1983. of the Northern block of the South Indian Craton (SIC) have been analysed. The SIC, according to Drury et al., (1984), can be divided into various blocks, separated by late Proterozoic shear belts. The northern block comprises Eastern and Western Dharwar Cratons of Rogers (1986), Naqvi and Rogers (1987) and a part of the South Indian granulite terrane up to a shear system occuping the Palghat - Cauvery low lands.

We obtain:

that the heat flow in granite-greenstone belts is low (mean heat flow $Q=33$ mWm^{-2}, number of determinations n=7), and is normal ($Q=40$ mWm^{-2}, n=6 - more or less equal to the mean heat flow for the Precambrian Shields) in the vast granitic-gneissic terrane.

that the heat flow data in Proterozoic Cuddapah Basin show a large variation - values from 27 mWm^{-2} to 75 mWm^{-2}. The low value is from an area near its south-western margin where the whole crust has become more or less basic due to intrusions and the high values (50 to 75 mWm^{-2}) are near its north-eastern margin close to an exposed large sized granitic dome.

that a wide scatter occurs in heat production in almost all near surface rocks (Table 1). However, the charnockites and the greenstone rocks are associated by low values of radio-active heat generation.

Reliable heat flow (Q) and heat generation (Ao) pairs for SIC yield values of reduced heat flow (Qr) and the thickness (D) of the top radioactive layer as 23 mWm^{-2} and 11.6 km respectively. However, keeping in mind the existence of great geological heterogenity both in lateral and vertical direction in SIC and similar such terranes, observation of a linear relationship between Q and Ao may be a mere coinsidence. Consequently its use in estimating lower crustal and mantle heat flow (Qr) and the lower crustal temperatures would result in wrong estimates. Alternate suitable method to overcome this difficulty will be presented along with crustal temperature profiles.

It has been generally recognised that the northern block of the SIC, in litho-logical terms, is similar to Archaean terranes in North America, Africa and Australia (Drury et al. 1984). A comparison of its geothermal parameters with those of the Western Australian Shield (WAS), (Sass et al. 1976) has been attempted.

We obtain:

that the heat flow in granite greenstone belt of WAS is also low (mean heat Q=35 mWm^{-2}, n=13), and is normal in its granite-gneiss terrane (Q=44 mWm^{-2}, n=3).

Further the radioactive heat production in near surface and crustal rocks of WASin no way appears to be lower than in the rocks of the northern block of the SIC (Table 1). In fact the data reveal that the heat generations in greenstones, granites and gneisses of the SIC and WAS from granite-greenstone terranes have more or less similar values. The same appears to be the case for granite-gneiss terranes. Other geophysical parameters support existence of more or less similar lower crustal conditions both under SIC and WAS.

The geothermal data clearly demonstrate that the present thermal characteristics of the above two Archaean terranes of the Indian and Australian Shields are quite similar. Their crustal thermal structures are likely to be similar also.

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TABLE 1: RADIOACTIVE HEAT GENERATION (Ao, μWm^{-3}) IN SURFACE ROCKS, NORTHERN BLOCK, SOUTH INDIAN CRATON AND WEST AUSTRALIAN SHIELD

Rock Type/Area	N	Ao μWm^{-3}	Rock Type/Area	N	Ao μWm^{-3}
GRANITE			GREENSTONE BELTS		
Hyderabad	29	5.57	Kolar belt		
Arsikere	9	3.08	a) Hornblende schist	15	0.26
Chikmagalur	6	1.28	b) Amphibolite	5	0.26
Closepet	5	1.81	c) Granites and		
Chamundi	2	3.40	gneisses	5	3.12
GRANITIC PEBBLES			JAVANHALLI BELT		
Kaldurga	9	1.06	a) Na-rich (gn)	-	2.17
Aimangala	7	1.51	b) K-rich (gn)	-	1.91
			c) Para-amphibolite	-	0.18
GNEISSES (gn)					
Champion (gn)			HOLENARASIPUR BELT		
around Kolar	29	1.51	a) Granite/gneisses	5	1.38
Grey (gn)	5	1.98	b) Anorthosite	1	0.10
Tonalite/trondh-			c) Amphibolite	6	0.23
jemite	2	0.53	d) Metapelite	6	1.08
Peninsular (gn)			e) Fuchsite quartzite	4	0.05
Bangalore Dist.	9	1.80			
CHARNOCKITES			CHITRADURGA BELT		
a) low grade	5	0.37	a) Metavolcanic	3	0.15
b) medium grade	4	0.32	b) Graywacke	2	0.62
c) high grade	9	0.23	c) Phyllite	1	0.92
			d) Pebbles (granitic)	7	1.51
GNEISS-CHARNOCKITE			e) Pebbles (diorite)	-	0.15
PAIRS: (PROGRADE)					
Gn	2	2.38			
Ch	2	1.68			
			WEST AUSTRALIAN SHIELD		
GRANITE			GRANODIORITE		
Mount Magnet	7	6.80	Yakab-mount Goode	6	1.88
Kambalda	13	1.29	Gneissic granite	5	1.17
Widd-Wanaway	4	1.15	PYROXENE GRANULITE		
Woolgangie	54	3.18	Kalgoorlie	60	0.54
GRANITIC GNEISS			GREENSTONE BELT	57	0.29
Doodlakine	36	8.90	West Australian	large	2.42
Northam	84	2.13	Shield		