LATAM GEOTHERMAL CONGRESS

Geothermal power – A giant energy source still to be tapped in Brazil

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Introduction:
Since the early 70s, because of the first oil crisis, Brazilian researchers have been looking for alternative sources of energy and accessing the geothermal potential. A good abstract of such information is updated in 2022, allowing selecting locations with geothermal gradients above 58o.C/Km. This cut-off parameter was chosen, considering an average surface temperature of 25o.C. so it may be possible to reach a minimum temperature of 150o.C, medium enthalpy resource, down to 3Km deep, and use a binary cycle system for power generation. Table 1 shows these locations and related information.

Table 1. Locations of highest Geothermal Gradients in [1]-[4]

BRAZIL REGION	LOCATION	GEOTHERMAL GRADIENT (o.C/Km)	HEAT FLOW (mW/m2)	DETERMINATION METHOD (*)
NORTH	N-1	90,62	203,25	CBT
NORTH	N-2	97,19	213,83	CBT
NORTH-EAST	NE-1	67.40		
NORTH-EAST	NE-2	76.23		
NORTH-EAST	NE-3	99.94		
NORTH-EAST	NE-4	86.28		
NORTH-EAST	NE-5	99.84		
NORTH-EAST	NE-6	79.10		
NORTH-EAST	NE-7	82.74		
NORTH-EAST	NE-8	-------	370	–?--
NORTH-EAST	NE-9	58,31	128,28	CBT
NORTH-EAST	NE-10	72,6	159,72	CBT
NORTH-EAST	NE-11	58,65	129,03	CBT
NORTH-EAST	NE-12	62,3	158,22	CBT
NORTH-EAST	NE-13	60,32	143,67	CBT
NORTH-EAST	NE-14	115.14		
NORTH-EAST	NE-15	141.68		

NORTH-EAST	NE-16	155.76		
WEST-CENTER	WC-1	59,54	139,94	AQT
WEST-CENTER	WC-2	81	240	--?--
WEST-CENTER	WC-3	63,33	146,23	AQT
WEST-CENTER	WC-4	71,33	164,71	AQT
WEST-CENTER	WC-5	63,33	161,29	AQT
WEST-CENTER	WC-6	71,33	181,67	AQT
WEST-CENTER	WC-7	63,33	124,68	AQT
WEST-CENTER	WC-8	62,33	122,72	AQT
WEST-CENTER	WC-9	70	198,93	AQT
WEST-CENTER	WC-10	63,33	179,97	AQT
WEST-CENTER	WC-11	71,67	203,67	AQT
WEST-CENTER	WC-12	59	146,91	CVL
WEST-CENTER	WC-13	59,46	123,07	CBT
SOUTH-EAST	SE-1	62 +1,68,	167	CVL
SOUTH-EAST	SE-2	69+3,6	186	Na-K-Ca
SOUTH-EAST	SE-3	64+3,4	189	Na-K-Ca
SOUTH	S-1	60,33	85,07	CGL/AS
(*) AQT – aquifer ;CBT- stable bottom hole temperature; CVL – conventional; CGL/AS- Groundwater geochemicals				

Cardoso, Hamza and Alfaro [4], identified more than 20 crustal blocks in South America with resources in the range of 10^{13} to 10^{14} Joules (between 1 to 10 Gwh) to the accessible depth limit of 3 km. High temperature resources are in the well known sector of magmatic activity in the Altiplano region in Bolivia, that may explain the high geothermal gradients in the Northern portion of Brazil. They also point to occurrence of medium temperature geothermal resources at depths of 3 to 5 km in some sectors of the eastern parts of the continent, mainly in the northeastern and central parts of Brazil. The West-central geothermal gradients are related to this central source. Their article also points to basal temperatures (of hard sediments) in excess of 300°C in the northeastern coastal region of Brazil and also along an east west trending belt between the northern part of the state of Mato Grosso and northern parts of the state of Rio de Janeiro in the central part and northwestern portion of the country". All these data indicate that the installation of conventional geothermal power projects is possible with boreholes no more than 3km deep.

Geological Framework:

In order to access the geology of potential areas, a general understanding of the Brazil geotectonics must be known. Figure 1 gives a general synoptic view of Brazil´s geotectonics.

Figure 1. Schematic tectonic framework of Brazil with the main discontinuities, cratonic blocks and orogenic belts of the basement (translated from Portuguese) [5].

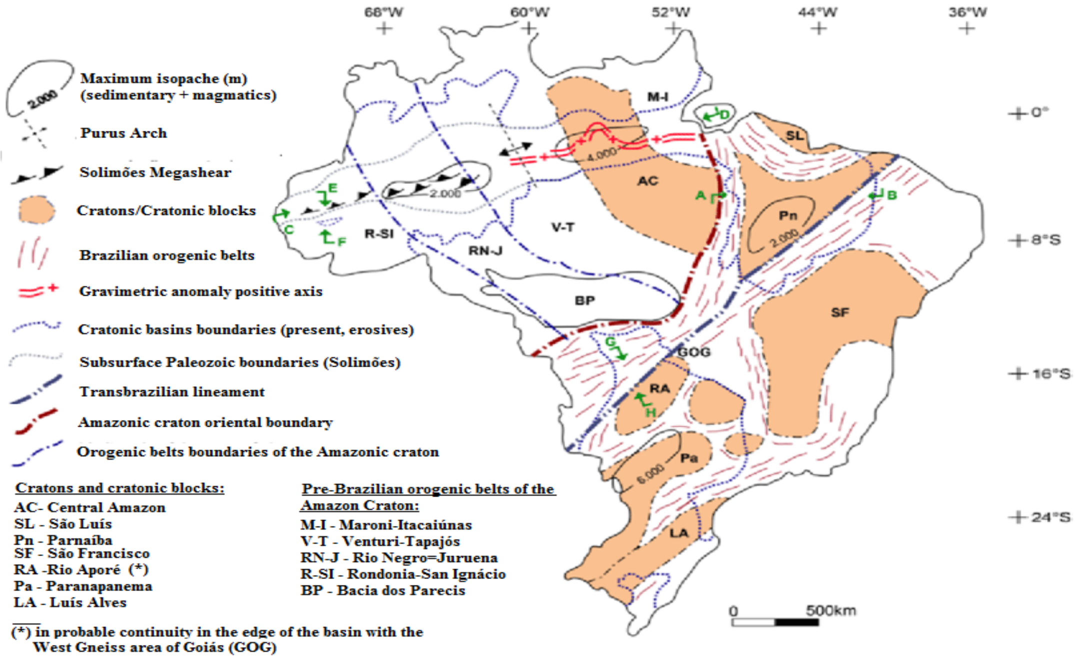


Figure 1 depicts the structural elements that underpin all the Paleozoic sedimentary basins, with their boundaries delineated. The basins are more clearly delineated in Figure 2.

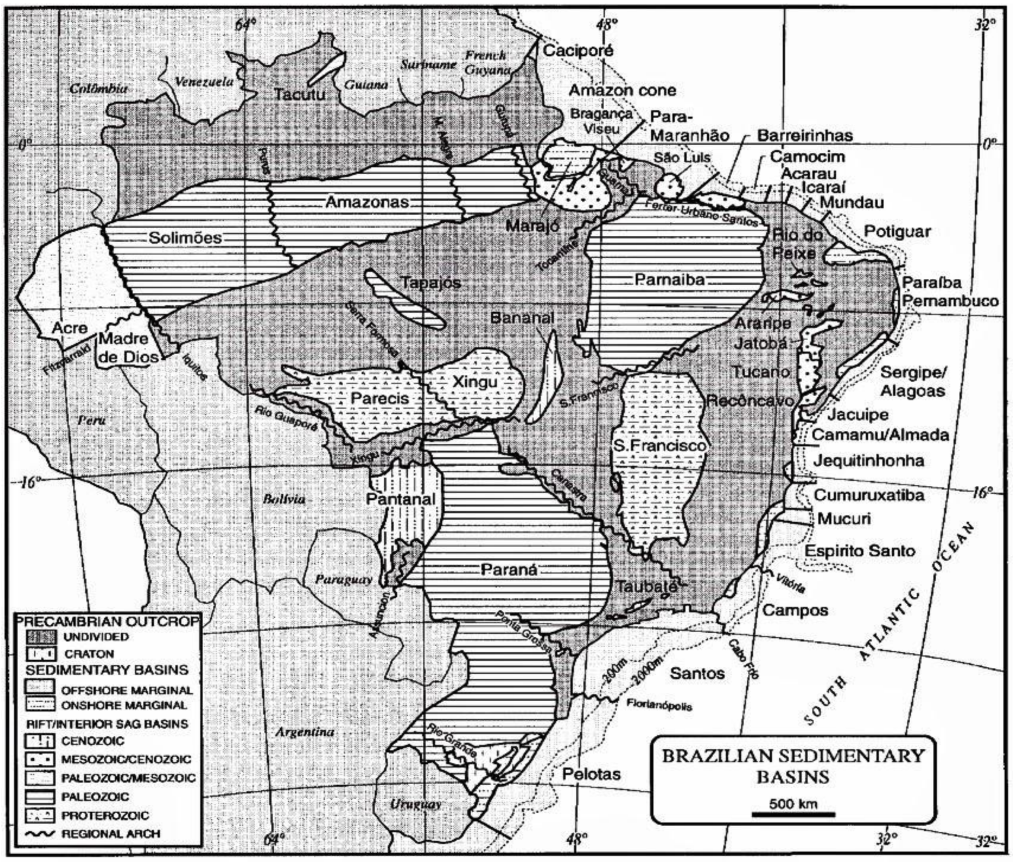
Geothermal areas of interest for power generation are located in the northeastern part of the map and between the Parecis and Pantanal basins, in the central western part of the map. These are likely to have high enthalpy geothermal reservoirs located in highly fractured mobile basement belts surrounding some granitic bodies. In the northeastern part, some faults still show some activity and the area also has some occurrences of recent volcanic rocks. In addition, the northeastern region is also affected by continental fractures related to the mesoceanic opening, of E-W trend, developing from the Fernando de Noronha archipelago.The medium to high enthalpy geothermal reservoirs of West-central region are located in the triangle formed by the São Franciso and Canastra arcs with the western boundary of the São Francisco craton, on an undivided Precambrian basement.

It is important to note that although not related to actual volcanism or active continental tectonic margins, the low tectonic activity present may be the cause of the higher geothermal gradient in the northeast region.

Conclusion

The text shows that, although there aren't any traditional, readily identified geothermal fields in Brazil, there is evidence of the possibility of exploiting existing resources using traditional injection and purging wells, as well as new technologies, including binary cycle systems. These resources are present in all Brazilian regions and await further investment for exploitation.

Figure 2. Simplified map of the onshore and offshore Brazilian sedimentary basins and intervening regional arches[6]



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