



## New insights into Geothermal Gradient of the Campos Basin, Brazil

Beatriz Lessa de Jesus,<sup>1,2</sup> Suze Nei Pereira Guimarães,<sup>1</sup> Fábio Pinto Vieira,<sup>1</sup> Sergio Luiz Fontes,<sup>1</sup>

<sup>1</sup>National Observatory, Rio de Janeiro, Brazil.

<sup>2</sup>Fluminense Federal University, Niterói, Brazil.

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### Abstract

The Campos Basin for many years was the most oil producing Basin in Brazil and its interest is now shifting to its pre-salt sediments. Geothermal studies play a crucial role in understanding the evolution of the Campos Basin and in better exploiting the exploratory potential for oil and gas in the region. The correlation between thermal history and the basin's tectonic evolution allows the identification of moments of major warming or cooling, subsidence events and the movement of geological layers. This information is essential to guide exploration and production activities of natural resources, contributing to a more efficient and sustainable exploration of oil and gas resources in the country.

In this study, the mapping of the geothermal gradient involves obtaining additional well data to complement and update the existing information. This acquisition of new well data is important to improve the accuracy and resolution of geothermal models and allow a more detailed characterization of the thermal conditions in a given region, such as the Campos Basin. The geothermal gradient is calculated from bottom hole temperature (BHT) data. The BHTs are plotted in a temperature versus depth profile and then a line or curve is fitted that best fits the data. This line or curve represents the geothermal gradient. Generally, BHT measurements are made while drilling the well, just after the mud circulation has stopped, thus suffering from thermal disturbances from drilling activities. The temperature measurements, therefore, need corrections. An empirical procedure for correcting these data, developed by the American Association of Petroleum Geologists, known as the AAPG method, was adopted. Analysis of seawater temperature and bathymetry data obtained from the National Oceanographic Data Bank of the Directorate of Hydrography and Navigation (BNDO/DHN) of the Brazilian Navy, allowed the mapping of the seafloor temperature in the study area, which was used as boundary conditions for the calculation of the geothermal gradient. The main characteristics of this ocean floor temperature distribution are the vertical and lateral variations in seawater temperature. Following the normal pattern observed in oceanographic research the seawater temperature in the study area decreases systematically with depth.

In the offshore region of the Campos basin, the collection of the Geothermal Laboratory of the National Observatory (LabGeot/ON) contained 72 BHT geothermal data. A total of 90 BHT data were included from ANP wells, randomly distributed throughout the basin. The incorporation of this new data allowed, in this first moment, the refinement of the information about the geothermal gradient of the basin. It can be seen that the highest values are in deeper water regions, with a greater directional trend towards the NE region towards the Espírito Santo basin. It can also be observed with this refinement, that two regions where it pointed out higher values of the geothermal gradient obtained greater detail in the distribution, a region near the north coast of the state of Rio de Janeiro (onshore portion of the basin) and another region more to the center of the basin, over the reservoir region of the Brazilian Pre-salt. The geothermal gradient of the Campos basin shows a variation between 20 and 45 °C/km, in agreement with what is expected from passive continental margins.