



Magnetometric and seismic characterization of the Nova Colinas impact structure, Parnaíba basin: Implication for hydrocarbon accumulation.

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Abstract

Impact craters are unique geological features, and their study is fundamental for understanding the origin and evolution of the solar system and its planetary bodies. Meteorite impacts involve an enormous amount of energy, which is transferred to Earth in the form of shock waves and thermal energy. These structures can have a high economic potential in terms of mineral resources, including oil and gas. Geological processes associated with crater formation, including brecciation and excavation, followed by erosion and deposition, can favor the accumulation of oil/gas deposits. Known impact structures such as Ames and Avak, both in Canada and Chicxulub, in Mexico, are examples of such impact-related hydrocarbon accumulations. Geophysics has contributed both to the recognition and to the subsurface understanding of these structures. In Brazil there are 9 confirmed impact structures, the most recent being Nova Colinas (NC). Located in the southwestern regions of Maranhão state, it is a moderately eroded circular structure approximately 7 km in diameter, and is centered at 07°09'33" S / 46°06'30" W. It is a complex type structure, presenting a possible structural uplift in the central portion. Its age was estimated between 200-250 Ma, based on the local stratigraphy. In this work, we used magnetometric and seismic methods to study NC. The aeromagnetometric data, carried out by the National Petroleum Agency (ANP), was acquired with 500 m spacing of the flight lines in the N-S direction, 4 km between the control lines and flight height of 100 m. They show a conspicuous positive annular signal on the analytical signal map, spatially coincident with the apparent outer edge of the structure. There are two distinct magnetic domains surrounding the structure: (i) the northern region, characterized by short-wavelength magnetic anomalies, related to basaltic flows of the Mosquito Formation; and (ii) the southern region, constituted by sedimentary rocks of the Sambaíba Formation. The latter did not show significant magnetic anomalies, which is typical of undeformed sedimentary strata. The depth of the magnetic sources at the edge of the structure is estimated at ~250 m. The seismic data was kindly provided by Eneva S.A., making it possible to identify 2 layers of diabase sills and their fracture pattern, an elevated central region (uplift) and discontinuities of the reflectors associated with high porosity due to fracturing and brecciation. The magmatic activities in the Parnaíba Basin play a fundamental role in the petroleum system, adding the thermal component in the generation and maturation of hydrocarbons, and serving as traps for reservoir formation. All of Brazil's currently known impact structures are found in the Paraná and Parnaíba sedimentary basins, which points out the need for future studies regarding impact-related hydrocarbon reservoirs. In the Parnaíba Basin, in addition to Nova Colinas, there are four impact structure, whereas in the Paraná basin there are four other structures.