SUBSIDENCE AND DEEP STRUCTURE OF PARNAÍBA CRATONIC BASIN

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RESUMO: Cratonic sedimentary basins form within stable continental interiors and constitute some of the largest sedimentary basins on Earth. They are often underlain by thick (i.e. 200 km) lithosphere and they are characterised by slow, punctuated subsidence that lasts for up to several hundreds of millions of years. Their stratigraphic records primarily consist of sequences of intercalated continental and shallow marine sedimentary rocks, commonly bounded by erosional unconformities. The origin and evolution of cratonic basins remain enigmatic due to a paucity of well-constrained geological and geophysical datasets. In order to address the evolution of these basins, the participants of the BP sponsored PABIP project carried out a multidisciplinary investigation of the Parnaíba cratonic basin. Here, we analyse a combination of the 1400 km long deep seismic reflection profile that crosses the entire basin, teleseismic earthquakes recorded by ~ 9 broadband, three component seismometers, 25 ancillary seismic reflection profiles, and 46 wells distributed throughout the basin. Our principal aim is to constrain subsidence histories in the context of crustal structure and sedimentary basin architecture. A combined interpretation of the deep seismic reflection profile and of one-dimensional velocity models calculated by joint inversion of receiver functions and surface wave dispersion curves is carried out. Our results suggest that the Moho occurs at approximately 39 km beneath the city of Teresina located on the eastern region of the basin, and at approximately 37 km beneath Precambrian basement just east of the basin. Beneath Teresina, the crustal velocity model shows an increase in shear wave velocity at approximately 30 km within the lower crust. This velocity increase coincides with mid-crustal reflections observed on the deep seismic reflection profile. The feature is interpreted as the top of a high-velocity body within the crust. The ancillary seismic reflection profiles show that basin stratigraphy is divided into packages of undisturbed reflections separated by bright, rugged reflections that resemble ancient, buried topographic surfaces. Correlation of seismic profiles with well-log information demonstrates that these surfaces correspond to basin-wide erosional unconformities which were observed in the field. Backstripped and water-loaded subsidence curves derived from 46 wells show an overall exponential decrease in subsidence over the last 400 Ma. This background subsidence is punctuated by departures from the long-term trend at times when erosional unconformities occur. These unconformities are interpreted as expressions of mild regional uplift events that affect the entire basin. Our analyses help to shed light on the origin of cratonic basins. Thanks to large volumes of newly obtained datasets, the Parnaíba basin constitutes an excellent natural laboratory for investigating the fundamental driving mechanisms.

PALAVRAS-CHAVE: RECEIVER FUNCTIONS; SUBSIDENCE ANALYSIS; SEISMIC REFLECTION