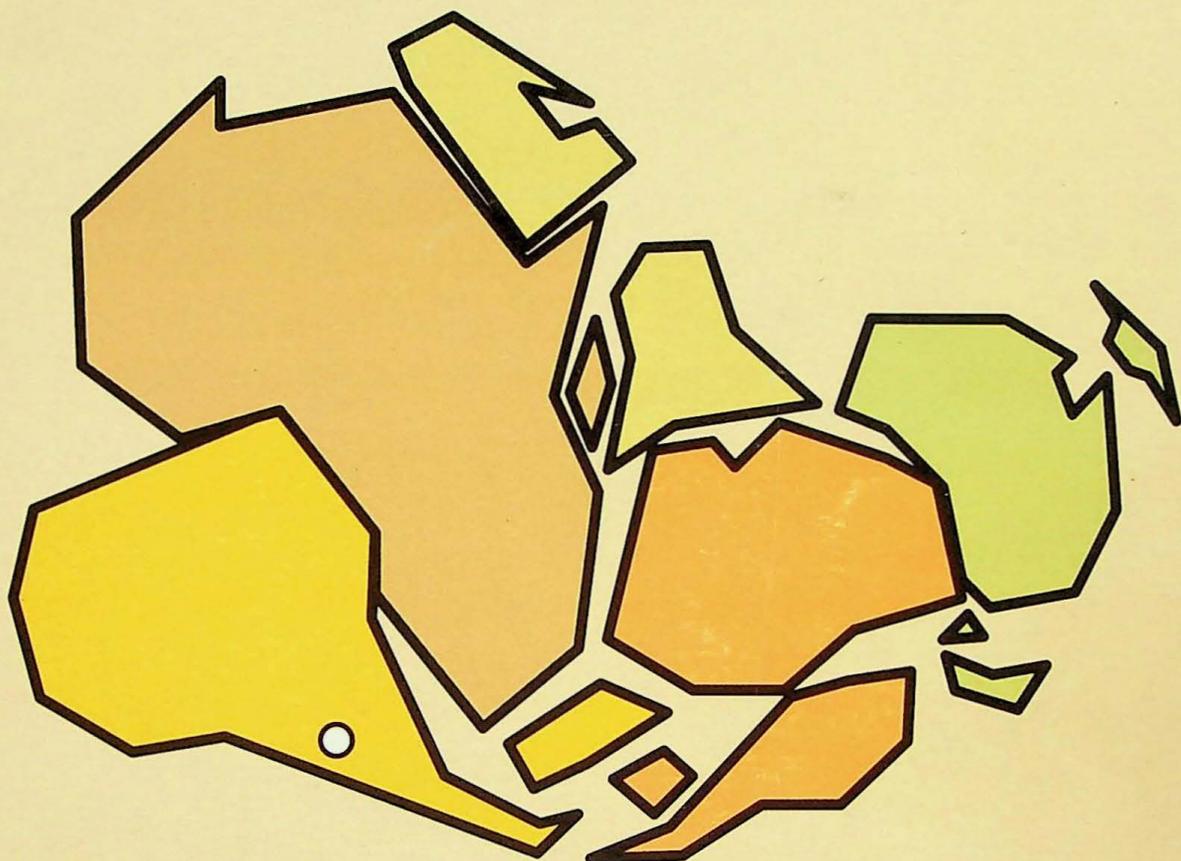




ACADEMIA NACIONAL DE CIENCIAS

Gondwana 12

“Geological and Biological Heritage of Gondwana”



November 6-11, 2005 - Mendoza, Argentina

ABSTRACTS

Edited by

Robert J. Pankhurst and Gonzalo D. Veiga

The effect of long-term asthenosphere physical properties on the lithosphere mechanical behaviour of Africa and South America

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Earlier studies have shown that the amplitude difference of the M2 tidal gravity component (TGA) between the measured and calculated response for a visco-elastic Earth is significantly correlated with the effective elastic thickness (T_e) of the lithosphere. Using a regression equation obtained from a global distribution, TGA data were integrated with those obtained by other methods (gravity-topography coherence and thermo-mechanical analysis) providing a spatial coverage sufficient to establish regional T_e patterns for South America and Africa. The combination of T_e estimates derived from tidal gravity anomalies and from isostatic response modelling was successfully applied to construct a continental scale T_e map for the South American plate. This method is here applied to the continental part of the African plate. The resultant T_e patterns for both plates are then compared, and the similarities related to the elastic parameter of the main tectonic units of each continent are analyzed in the light of the break-up process of Western Gondwana.

The periodic gravity variation with tides, driven by mass redistribution, is a characteristic of the dynamic response of the Earth to an external stimulation. The attraction of the Moon and Sun causes most of the Earth's observed external tide potential, a superposition of various frequency components of the oscillation modes. The high linear correlation ($r = -0.88$) between the tidal gravity anomalies and T_e estimates by the isostatic response method available at 36 locations worldwide allowed the establishment of a linear regression model. Regression analysis was based on worldwide selected data, both from the point of view of tidal quality data and reliability of the corresponding coherence. This equation was applied to 50 tidal gravity stations available on the South American plate, and to 34 available for the African plate. A comparison between the "rigidity" measured for different structures of the South American and African lithosphere, shows a clear contrast between the two continents. The T_e map of the African plate presents a remarkable dichotomy of Neoproterozoic rocks and reworked older rocks, while low T_e values in South America are observed only where extensive tectonics with intense volcanism have acted. While the Pan-African domains have persistently low T_e values (< 60 km and even < 20 km), the correlated Brasiliano domains show T_e values of 50 to 70 km.

Although Africa and South America have previously shared the same continent (Western Gondwana), it is possible to discriminate very different behaviour after continental drift and, to a lesser extent, some earlier different tectonic-magmatic characteristics as well. Both platform domains present similar tectonic frameworks, with pre-Neoproterozoic cratonic nuclei that were amalgamated by the branching system of Brasiliano-Pan African collage during 400 Ma year of plate interactions (from 880 to 480 Ma). Looking at the maps of lithosphere effective elastic thickness of South America, it is easy to discriminate the cratonic pre-Brasiliano (blue areas) and the Brasiliano orogenic domains (yellow and reddish areas). This is not so well-defined in the African T_e map, because the low values of the elastic thickness are dominant, being extended over classical cratonic (pre-Pan African) domains like those of West Africa (northern part) and Kalahari.

Intra-plate activity was a particular characteristic of the African territory in Palaeozoic times (ca. 95 active igneous zones), but especially later on, in Mesozoic times (over 250 active zones). Such activity has been most intense in the Pan-African domains. Additionally, continental rifting has been notably well developed in the African territory. Thus, thermal age provinces are very different in the two continents. Part of this younger tectono-magmatic endogenous activation could be attributed to the relatively slow motion of the African plate, which is an obstacle to the dissipation of the heat generated by the asthenospheric processes.